BUILDING CODE
of the

CITY AND COUNTY OF DENVER
BUILDING CODE

OF THE CITY AND COUNTY OF

DENVER, AS AMENDED

Ordinance No. 690 of the Series of 1976
Amended Ordinance No. 322 of the Series of 1978
Amended Ordinance No. 100 of the Series of 1979
and as Amended by Ordinances Indicated in the Text, 1979-1982
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ADMINISTRATIVE AND BOARD OF APPEALS

SECTION 100. TITLE. The title of this Ordinance shall be, and this Ordinance shall be cited and referred to as, THE BUILDING CODE or the BUILDING CODE OF THE CITY AND COUNTY OF DENVER.

SECTION 101. PURPOSE OF THE BUILDING CODE. The purpose of this Building Code is to provide minimum standards to maintain and promote the public health, safety and welfare by regulating and controlling the design, use, occupancy, construction, quality of materials, location, and maintenance of all buildings and structures within the City and County of Denver, and certain equipment specifically regulated herein.

SECTION 102. SCOPE OF THE BUILDING CODE. This Building Code shall extend to and govern the followi:

(a) New Buildings, Structures and Utilities. Construction, addition, alteration, repair, demolition, removal, moving, occupancy, use and maintenance of any building, structure, or utility hereafter erected within the City.

(b) Existing Buildings, Structures, or Utilities. Alteration, addition, repair, demolition, removal, moving, change of occupancy, and maintenance of any existing building, structure, or utility heretofore erected within the City.

(c) Most Restrictive. Wherever in any specific case the requirements of different Sections of this Building Code vary, the most restrictive shall govern.

SECTION 103. ORGANIZATION OF THE BUILDING INSPECTION DIVISION.

(a) General. There shall be and hereby is established, as an Agency under the Manager of Public Works, a Building Inspection Division. Within this Building Code, this Agency shall be referred to as the Department. See Chapter 4 for definition.

(b) Director. The Department shall be administered by a Director. The Director shall be a professional engineer registered by the State of Colorado with five years of management experience in a building inspection department or a consulting engineering firm, architec-
tural firm, or construction firm specializing in building design or construction, or an architect licensed by the State of Colorado with five years of management experience in a building inspection depart-
ment or a consulting engineering firm or construction firm special-
izing in building design or construction. (Rev. 585, ORD. 241)

(c) Employees. The Director shall authorize or appoint various indi-
viduals to carry out duties and exercise powers delegated to him by
this Building Code.

(d) Authorization and Identification. Each employee of the Depart-
ment shall be provided with an identification card bearing informa-
tion required by the Director. This card shall be carried upon the
person identified, and shall be displayed when necessary to identify
the person properly to perform official duties.

SECTION 104. GENERAL POWERS AND DUTIES OF THE BUILD-
ING DEPARTMENT.

(a) Powers and Duties. This Department, administered by the Direc-
tor, shall administer and enforce this Building Code and all other
Ordinances which are or may hereafter be assigned to the Depart-
ment for enforcement and administration. There is hereby vested
in the Department the duties of enforcing and administering this
Building Code, and the power necessary for such enforcement.

(b) Authority to Inspect. The Department shall have the authority
to inspect, or cause to be inspected, for compliance to this Building
Code, all buildings, structures or utilities.

(c) Investigations and Surveys. Incidental to any of these duties and
powers, but without limitation of the same, the Department shall
conduct investigations or surveys to determine compliance or non-
compliance with the provisions of this Building Code; and further
shall investigate or cause to be investigated all accidents pertaining
to buildings, structures, or utilities. All investigations or surveys
shall be conducted to establish whether the requirements of this
Building Code have been met or violated.

(d) Right of Entry. Incidental to such inspections, investigations and
surveys, an authorized representative of the Department may enter
into and upon, and cause any land, building, structure, or utility to
be inspected and examined. A failure or refusal to permit the entry
and inspection, after issuance by the Department of an order there-
fore, shall constitute a violation of this Building Code. Additionally,
the right to entry and inspection may be enforced by application to,
and proper orders from a court of proper jurisdiction.

(e) Orders. Whenever work is being performed or has been performed
contrary to the provisions of this Building Code, or any of the several
codes or ordinances enforced or administered by this Department, the Department or any of the employees of the Department who are charged with the enforcement of this Building Code or other codes or ordinances may:

1. Order the work stopped by issuing an order or notice in writing.
2. Order the work being performed or which has been performed be done or redone so that the resulting work is in accordance with the requirements of this Building Code or other codes or ordinances enforced or administered by the Department.
3. Order work to be done to correct a condition which is in violation of the requirements of this Building Code or ordinances enforced or administered by the Department. The order or notice shall be issued in writing and served on the owner of the property upon which work was or is being performed or where the condition exists, or any person engaged in the work, causing the work to be performed or the person having a permit to perform the work. (Revised 11/80 Ord. No. 582)

(f) Rules and Regulations. The Director shall have the full power to adopt in reference to this Building Code, any rules, restrictions or measures that may, by said Director, be advisable.

(g) Unlawful. It shall be unlawful to disobey any written lawful order or notice issued by Department.

SECTION 105. SERVICE AND NOTICE. Service of any notice may be by personal service, as defined in the Colorado Rules of Civil Procedure, or may be made by registered or certified mail, return receipt requested, and service shall be deemed complete upon delivery. In the event the address of a person to be notified is unknown, or the receipt of a notice which has been mailed is returned unsigned, the notice may be served by posting the same in a conspicuous place on the premises upon which the violation of this Building Code is alleged. Service shall be deemed complete as of the moment of posting.

SECTION 106. APPLICATION TO EXISTING BUILDINGS.

(a) General. Existing buildings, structures, or utilities to which additions, alterations, or repairs are made or required to be made pursuant to Sections 107, 108, and 109 of this Building Code, shall be made to comply with all requirements for new buildings, structures, or utilities, unless otherwise specifically provided for in this Building Code.

(b) Additions, Alterations, or Repairs. Additions, alterations or repairs may be made to any building or structure without requiring the existing building or structure to comply with all the require-
ments of this code provided the addition, alteration or repair conforms to that required for a new building or structure, except as otherwise provided for in this code. Additions, alterations or repairs shall not cause an existing building or structure to become unsafe or overloaded. Any building so altered, which involves a change in use or occupancy, shall not exceed the height, number of stories or area permitted for new buildings. Any building plus new additions shall not exceed the height, number of stories and area specified for new buildings. Alterations or repairs to an existing building or structure which are nonstructural and do not adversely affect any structural member or any part of the building or structure having required fire resistance may be made with the same materials of which the building or structure is constructed. (Revised 3/81 Ordinance No. 172)

EXCEPTION: The installation or replacement of glass shall be as required for new installations.

(c) Existing Occupancy.

1. Buildings in existence at the time of the passage of this Building Code may have their existing use or occupancy continued, if such use or occupancy was legal at the time of the passage of this Building Code, provided such continued use is not dangerous to life.

2. Any change in the use of occupancy of any existing building or structure shall comply with the provisions of Chapters 3 and 5 of this Building Code.

(d) Maintenance. All buildings, structures, or utilities, existing or new, and all parts thereof, shall be maintained in a safe condition. All devices, utilities, or safeguards which are required by this Building Code, or which were required to have been erected or installed pursuant to any previous Code or Ordinance, relating to use, construction, or quality of materials, shall be maintained in good working condition. The owner or his designated agent shall be responsible for the maintenance of such buildings, structures, or utilities.

SECTION 107. UNSAFE BUILDINGS OR STRUCTURES.

(a) General. An unsafe building or structure is one which constitutes a fire hazard or hazard to life, health, property, or public welfare by reason of use, construction, disaster damage, vandalism, quality of materials, inadequate maintenance, dilapidation, or abandonment. However, without limitation of the foregoing, any building or structure in which any one or more of the following conditions exists shall be deemed conclusively to be an unsafe building or structure.
(b) **Plumb.** Those buildings or structures in which a wall or other vertical structural members lists, leans, or buckles to such an extent that a plumb line passing through the center of gravity falls outside of the middle third of the base.

(c) **Structural.** Those buildings or structures which show damage or deterioration to any structural or load bearing member or members to the extent that the members do not have sufficient strength to resist all applicable loads specified in Chapter 23. Also, those which show damage or deterioration of non-bearing exterior walls or enclosures to such an extent that they will not resist the wind pressure or lateral forces in accordance with the requirements of Chapter 23, or show damage or deterioration to any exposed exterior member or members to the extent that the member or members provide inadequate protection from the elements to the occupants of the building or structure.

(d) **Overloads.** Those buildings or structures in which the loads upon the floors or roofs exceed the maximum design limits specified in Chapter 23.

(e) **Egress.** Those buildings or structures having inadequate facilities for egress in case of fire or those having insufficient stairways, elevators, fire escapes or other means of communication.

(f) **Attachments.** Those building or structures which have parts attached in such a manner that they may fall and cause injury to the public or property.

(g) **Incomplete Buildings.** Uncompleted buildings or structures when the permit has been cancelled.

(h) **Open Excavations.** Open pits, open wells and open excavations of all types when such are determined to be hazardous by the Department.

(i) **Trenches or Ditches.** Trenches or ditches not properly shored or cribbed. See Chapters 29 and 50.

(j) **Vacant Buildings.** Vacant buildings which are not secure and to which entry may be made through opened or unlocked doors, windows or other openings.

**SECTION 108. UNSAFE UTILITY.**

(a) **General.** An unsafe utility is one which constitutes a fire hazard or a hazard to life, health, property, or public welfare by reason of use, construction, installation, obsolescence, disaster damage, deterioration, quality of materials, abandonment, or inadequate maintenance. However, without limitation of the foregoing, any utility in which any one or more of the following conditions exists shall be determined to be hazardous by the Department.
(b) **Fuel-Fired Equipment.** Gas-fired, oil-fired, or solid fuel-fired appliances, devices or apparatus which have any of the following defects:

1. Broken or cracked heat exchangers.
2. Defective or deteriorated vents, venting, or flues which permit leakage of flue products.
3. Defective or improperly installed fuel supply piping.
4. Insufficient air supply for the combustion of fuel.
5. Inadequate ventilation of the heating equipment room.
6. Defective, improperly installed, or maladjusted controls and appurtenances.
7. Defective or improperly installed heating equipment.
8. Equipment locations which constitute a fire or explosion hazard.
9. When a negative air pressure condition exists in a heating equipment room or area.
10. Excessive corrosion of combustion chambers where the original thickness of the metal is reduced 50 percent or more.
11. Warped or distorted combustion chambers or furnace boiler firing doors which permit leakage of combustion products.
12. Field alteration or modification of a listed appliance or appurtenance.
13. Excessive scaling, corrosion, cracks in seams, tube, or shell of boilers.
14. Defective valves, gauges or cocks of boilers.
15. Grooving or pitting of boilers.
16. Improperly installed or maladjusted controls and appurtenances of boilers.
17. Any unlisted appliance or appurtenance installed without approval of the Department.
18. Appliances not provided with required safety controls.

(c) **Elevators, Escalators, Dumbwaiters, and Moving Walks.**

Elevators, escalators, dumbwaiters, moving walks, or similar conveyances or apparatus which have any of the following defects:

1. Hoisting, counterweight, or governor ropes of cables with frayed or broken strands.
2. Operation in a hoistway used to store material other than elevator equipment. This shall also apply to elevator machine room, machinery spaces and pits when and where materials other than elevator equipment are maintained or stored.

(Revised 3/81 Ordinance No. 172)

3. Operation in a hoistway that is in danger as a result of dust or other highly combustible material on the mechanism or in
the hoistway, penthouse, or pit.
4. Brake mechanism not functioning, or not functioning properly or safely.
5. Those not safety tested in accordance with the requirements of this Building Code, or where required safety devices have been disconnected or discontinued.
6. Those safety or operational devices provided in the elevator cab which are not functioning, or not functioning properly or safely.
7. Where hoistway entrance protection does not meet the requirements of this Building Code.

(d) **Electrical.** Electrical systems, appliances, devices, or apparatus which have any of the following defects:
   1. Bare wiring.
   2. Poor electrical connections.
   3. Overloaded circuits, feeders, or services.
   4. Equipment not properly grounded.
   5. Disconnecting means not provided at the appliance.
   6. Over-fused circuits.
   7. Misuse of cord wiring.
   8. Wiring not properly supported.
   9. Non-approved wiring exposed to extreme heat, moisture, gases, or other harmful vapors or liquids.

(e) **Refrigeration.** Refrigeration systems which have any of the following defects:
   1. Inadequate ventilation.
   2. Inadequate venting of pressure relief valves.
   3. Unauthorized fuel-fired equipment located in the same room designated for the refrigeration equipment.
   4. Improperly installed cooling towers by reason of location, type, fan, water condition, controls, roof or floor overload.
   5. Faulty controls.

(f) **Plumbing.** Plumbing systems or devices which have any of the following defects:
   1. When the supply water does not meet the standards of potability as required by the Colorado State Department of Public Health and the City Department of Health and Hospitals.
   2. Those water systems subjected to the hazards of back-flow or back-siphonage which might create a pollution to the potable water supply.
   3. Where inadequate piping does not supply sufficient water to the various appliances.
4. Clogged sewers or drains
5. Where a trap seal is not provided or is inadequate.
6. Inadequate venting.
7. Leaking water, sewage, or sewer gas within a building or structure.
8. Trenches or ditches not properly shored or cribbed.

SECTION 109. ABATEMENT AND NOTICE OF UNSAFE BUILDINGS, STRUCTURES, OR UTILITIES.
(a) General. If after inspection by the Department the building, structure, or utility is determined to be unsafe, the building, structure or utility shall be declared a nuisance. This nuisance shall be abated by repair, replacement, removal, or demolition upon notice by the Department to the persons having a record interest therein.

(b) Unsafe Building or Structure. In the case of an unsafe building or structure, the Department may order such building or structure, or any buildings or structures placed in jeopardy by the unsafe building or structure, vacated immediately; and the unsafe buildings or structures shall be posted in accordance with other provisions of this Section. See Section 109 (g).

(c) Unsafe Utility.
1. In the case of an unsafe utility, the Department shall attach or affix an approved warning tag on the unit declared to be unsafe. Where a utility is declared to be unsafe, the Department shall order the utility disconnected or its use discontinued until the nuisance created thereby is abated. In addition, the Department may order any building, structure, or utility which is placed in jeopardy by the unsafe utility to be vacated and/or disconnected, and these shall not be reoccupied or reconnected until declared safe by the Department.
2. It shall be unlawful for any person, firm or corporation to mark any unsafe utility, as herein defined, with any type markings or tags declaring them to be unsafe, except as authorized by the Department.

(d) Demolition or Securing by the City. If the owner of an unsafe building, structure, or utility fails to carry out the repairs, rehabilitation, securing, or removal required to be carried out in a notice or order within the time specified in the notice or order or any extension of time to comply with said notice or order, the City may, as set forth in subsection (h), cause the demolition or securing of said unsafe building or structure. (Rev. 7/86 Ord. No. 415)

(e) Emergency Demolition or Securing. In the event an emergency should occur wherein the continued use or existence of a building, structure, or utility could constitute an immediate hazard to life,
health, property or public welfare, the Department may order and/or cause the building, structure, or utility to be demolished, removed, disconnected, or secured at once by any means available to the Department. Recovery of cost and expense of demolition and/or removal or securing, if borne by the City shall be made as provided for in Section 109 (h) of this Building Code.

(f) Emergency Barricades. If any building, structure or utility is declared a hazard to life or safety or persons using a public walk or public way, the public walk or way shall be provided with barricades to prevent public use. The barricades shall be erected on order from the Department. Recovery of cost and expense, if borne by the City, shall be made as provided for in the Building Code.

(g) Posting of Signs. When necessary to protect life, health and public welfare, the Department may post signs which shall prohibit entry into an unsafe building or structure; provided, however, that with permission of the Department, it shall be lawful to enter the unsafe building or structure for purpose of effecting any required repairs, rehabilitation, or demolition; or by members of the Fire Department. The signs shall be provided and attached to the building or structure by the Department and shall read, in addition to other information, “DANGER KEEP OUT”. See Section 112 for Prohibitions and Violations.

(h) Procedure for Demolition or Securing by City. Upon the failure of the owner of a building or structure to make any building or structure safe after the issuing of notice or order, the Department;

1. Shall obtain competitive bids for the securing or demolition of the building or structure.

2. May upon receipt of the bids, issue a notice of intent to raise or secure the building or structure which shall include the estimated cost of demolition or securing plus a fee not to exceed 25% of the cost of demolition or securing to cover administrative and other costs. Such notice shall be served personally or by registered or certified mail return receipt requested upon owner(s) of the property and the owners of all recorded interests in the property at least 10 days prior to the demolition or securing.

3. If service cannot be obtained upon any or all parties with record interests as provided in 2 above, may post the notice upon the property for 10 days and mail notices to the last known address of each party having a record interest.

4. Upon completion of service under 2 or 3 above, may, ten days after completion of service, proceed with demolition or securing.
5. Upon completion of the demolition or securing, shall mail a notice of the final cost of demolition or securing and of the intent to file a lien against the property to owners of a recorded interest in the property. (Rev. 7/86 Ord. No. 415)

(i) City’s Lien. In the event the owner or owners fail to pay the costs as set forth in the notice sent under Section 109(h)5., the amount shall constitute a lien against the real property upon which the building or structure was or is situated. The Department shall there- after pay the cost and expense of demolition, removal, securing, barricading, from any appropriation made available for that purpose, and shall certify a statement thereof to the Manager of Revenue, who shall assess and charge the same against the property involved and collect the same due, together with interest at the rate of interest established by law for delinquent real property taxes.

1. The lien created thereby shall be superior and prior to other liens, regardless of date, except liens for general and specific taxes.

2. For purposes of this Building Code, cost and expense shall include the demolition, removal, securing, barricading, and all administrative costs incurred therewith. (Rev. 7/86 Ord. No. 415)

SECTION 110. USED MATERIALS. Used materials may be permitted in the construction of any building, structure, or utility subject to approval of the Department.

SECTION 111. ALTERNATE MATERIALS AND METHODS OF CONSTRUCTION AND EQUIPMENT.

(a) General. The provisions of this Building code shall not prevent the use of alternate methods, materials, or equipment which meet the standards of strength, safety, sanitation, and fire resistance required to be met in any building, structure, or utility to which this Building Code applies, provided the alternate has been approved by the Department.

(b) Application and Fee. An application for approval of an alternate material, method, or equipment shall be filed with the Department upon a form furnished by the Department. Information shall be that required by the Department and this Building Code. The application shall be accompanied by a fee of $200.00, payable to the Manager of Revenue, City and County of Denver, and shall be paid in the office of the Department.

(c) Annual Review and Renewal. Each approved method or equipment shall be subject to an annual review and the approval shall be renewed yearly. The fee for review and renewal shall be $25.00
per year.

(d) Department Approval. The Department shall give approval, in writing, for any such alternate methods, materials, or equipment, provided the proposed design is satisfactory and that the alternate is, for the purpose intended, at least the equivalent of that prescribed in this Building Code. The applicant may appeal the decision as outlined in the procedures of this Building Code.

(e) Requirements and Tests.

1. When a construction material, assembly, fixture, device, utility, or other article different from that provided for in this Building Code is proposed for use, plans, specifications, details, test data, samples and literature shall be furnished to the Department for examination.

2. In order that claims for alternate materials, methods, or equipment may be substantiated, the Department may require tests to be made at the expense of the applicant by an approved laboratory or agency. Test methods shall be as set forth by the Standards which are part of this Building Code, or by a test method established for a particular product by a nationally recognized agency. If there are no appropriate test methods or Standards set forth in this Building Code, the Department may determine acceptable test procedures.

(f) Approved Testing Laboratories. At the discretion of the Department, new methods and materials may be acceptable if tested by a recognized testing laboratory or agency. The testing laboratory or agency must be one approved by the Department and it shall provide listing, labeling and follow-up inspection services. A copy of the agency approval report or the test report shall be submitted to the Department for approval. (Rev. 5/87 Ord. No. 96)

SECTION 112. PROHIBITIONS - VIOLATIONS - PENALTIES - REMEDIES.

(a) Prohibitions. It shall be unlawful for any person, firm or corporation to do or cause to be done, or to perform or cause to be performed, any act contrary to or in violation of the provisions of this Building Code, any other Code, Ordinance, Rule, or Regulation promulgated thereunder which is enforced and administered by the Department, and without limitation to the foregoing:

1. Alternate Methods, Materials, or Equipment. It shall be unlawful for any person, firm or corporation to use any method,
material, or equipment as an alternate to the methods, materials, or equipment permitted by this Building Code without first obtaining approval in the manner herein provided.

2. **Licensing, Certificate and Registration.** It shall be unlawful for any person, to perform any work on any building or utility without first obtaining a license, certificate or registration in accordance with the requirements of Chapter 2 of this Building Code, except that the owner of a building, authorized under Chapter 3 of this Code, who obtains a permit for the work being performed, need not be licensed, certified or registered.

3. **Licensing, Certificate and Registration Holder Responsibility.** It shall be unlawful for any licensed, certificate or registration holder to commit any violation of the responsibilities enumerated in this Building code. See Chapter 2.

4. **Drawings and Specifications.** It shall be unlawful to make application for a permit without first having submitted drawings and specifications as required by Chapter 3 of this Building Code.

5. **Permits.** It shall be unlawful for any person to perform any work on any building structure or utility without first obtaining a permit for such work from the Department in accordance with Chapter 3 of this Building Code. (Revised 5/82 Ordinance No. 245)

6. **Certificate of Occupancy.** It shall be unlawful for any person firm, or corporation to occupy a new building or structure without first having obtained a Certificate of Occupancy from the Department as required by the provisions of this Building Code. A Certificate of Occupancy will not be required for remodeling or additions, unless there is a change of occupancy. See Chapters 3 and 5.

7. **Unsafe Building, Structure, or Utility.** It shall be unlawful for any person to maintain or permit to be maintained any building, structure or utility which is unsafe as defined in this Building Code. It shall also be unlawful to remove or deface any City red tag attached to a utility. These provisions shall apply to buildings, structures, or utilities which are new, existing, under construction, altered or demolished.

8. **Enter, Occupy, or Inhabit an Unsafe Building or Structure.** It shall be unlawful to enter, occupy, or inhabit any unsafe building or structure posted in accordance with the provisions of this Building Code. See Section 109(g).

9. **Removal of Danger Sign(s).** It shall be unlawful to remove or deface a sign required by Section 109 (g), without specific
approval from the Department.

10. **False Information.** It shall be unlawful to furnish the Department any false information in any application for a License, Certificate or Permit required by this Building Code.

11. **Vacant and Inadequately Maintained or Boarded Up Buildings or Structures.** It shall be unlawful for any person, firm or corporation to maintain or permit to be maintained for a period longer than six months any building or structure in any residential zoned district which is vacant and inadequately maintained or which is boarded up, and which does not show evidence of current construction or remodeling activity.

11.5 **Vacant and Inadequately Maintained Buildings or Structures Located within 1,000 feet of a Residential Zoned District.** It shall be unlawful for any person to maintain or permit to be maintained for a period longer than six months any building or structure which is vacant and inadequately maintained, and which does not show evidence of current construction or remodeling activity, and which is:

1. Within 1,000 feet of a residential zoned district and is located in an I-O zoned district.

2. Within 1,000 feet of a residential zoned district and is located in a business zoned district.

**EXCEPTION:** B-5, B-7, and B-8 zoned districts. (Revised 7/84 Ordinance No. 365)

12. **Operate or Maintain Unsafe Utility.** It shall be unlawful for any person to operate or maintain an unsafe utility or reconnect the power or fuel supply to any utility declared by the Department as being unsafe, and to which a City “warning” or City “danger” tag has been attached as provided for in Section 109(c) 1 of this Building Code.

13. **Removal of City Warning or City Danger Tag.** It shall be unlawful for any person to remove a City warning or City danger tag attached to any utility as provided for in Section 109 (c) 1 of this Building Code. The owner and occupant of any building or structure containing an unsafe utility to which a City warning or City danger tag has been attached as provided for in Section 109 (c) 1, who has notice that the said utility has been declared unsafe and so tagged by the Department, shall not permit said utility to be operated and shall take whatever steps are necessary to insure that said utility is not operated.

**EXCEPTION:** A properly Licensed Contractor with a permit may remove a City red tag for purposes of repair of the equipment. However, in the case of Elevators, is shall be unlawful
to allow any person to occupy the elevator except a licensed contractor and his employees during said repairs. Permission shall be obtained from the Department prior to removal of the City red tag.

(b) Violation. Wherever, by the provisions of this Building Code, the performance of any act is prohibited, or wherever any regulation, dimension, or limitation is imposed on the erection, alteration, maintenance, or occupancy of any building, structure, or utility, each failure to comply with provisions of this Building Code shall constitute a violation. Each day on which a violation exists shall constitute a separate offense and a separate violation.

(c) Penalties. Whenever, in any Section of this Building Code, or any Section of a Rule or Regulation promulgated hereunder, the performance of any act is required, prohibited, or declared to be unlawful, and no definite fine or penalty is provided for a violation thereof, any person, firm, or corporation convicted of a violation of any Section shall, for each offense, be fined a sum of not more than $300.00, or imprisoned not to exceed 90 days, or both so fined and imprisoned. The suspension or revocation of any license, certificate, permit, or other privileges conferred by the City shall not be regarded as a penalty for the purpose of this Building Code.

(d) Remedies. In the event any building, structure, or utility is erected, constructed, reconstructed, altered, repaired, converted, demolished, moved, or maintained; or any building, structure, or utility is used in violation of this Building Code, the City or any proper person may institute an appropriate action or proceedings to prevent the unlawful erection, construction, reconstruction, alteration, repair, conversion, maintenance, or occupancy, and to restrain, correct, or abate such violation, or to prevent the occupancy of said building, structure, or land. The imposition of any penalty hereunder shall not preclude the City or any proper person from instituting any appropriate action or proceeding to require compliance with the provisions of this Building Code, and with administrative orders and determination made hereunder.

SECTIONS 113 THROUGH 119 HAVE BEEN PURPOSELY OMITTED.
SECTION 120. BOARD OF APPEALS.

(a) **Creation.** There shall be and is hereby created a Board of Appeals, hereinafter referred to as the "Board", which shall consist of 5 members and 2 alternates. The 5 members and 2 alternates of the Board shall be appointed by the Mayor and shall be constituted of the following persons:

1. One person and an alternate who are professional Engineers registered in the State of Colorado.
2. One person and an alternate who are licensed Architects in the State of Colorado.
3. One person who is the holder of a City Building Contractor Class A, B, or C license.
4. Two citizen members who are not associated with the building industry.

In the absence of any member of the board, the respective alternates shall be authorized to fill the vacancy so created, with the full power and compensation accorded the regular member.

(b) **Secretary.** There shall be a Secretary of the Board, furnished by the Department, and the Secretary shall be without voting power. The Secretary shall be the custodian of the records, shall conduct correspondence and be responsible for clerical work of the Board. The Secretary shall be present at all meetings, and shall present all relevant information regarding appeals to the Board. The Secretary shall notify all interested parties regarding matters to come before the Board prior to the meeting of such Board.

(c) **Fire Department Representative.** The Chief of the Fire Prevention Bureau, or his authorized representative, shall be an ex-officio member to the Board, but shall have no voting power. Terms of office and remuneration shall not be applicable to this member.

(d) **Terms.** Each member of the Board shall serve a term of 3 calendar years, and may be removed only for cause upon written charges. The members of the Board serving on the effective date of this Ordinance, under a Building Code effective prior hereto, shall be and constitute the first Board hereunder, and each member thereof shall serve the balance of the term to which he was appointed. Any vacancy which occurs in the Board shall be filled by the Mayor for the unexpired term of any member whose term became vacant. No member of the Board shall serve more than 3 consecutive full terms or a total of more than 9 consecutive calendar years. (Revised 5/82 Ordinance No. 245)
(e) **Meetings-Quorum.**

1. **Regular Meetings.** Regular meetings shall be held once each month, or as often as may be required by the Department. At the first regular meeting of each calendar year, one of the members of the Board shall be elected as Chairman and one Vice-Chairman. The Chairman of the Board shall require that all members of the Board be polled during voting at the meeting, and shall instruct the Secretary to record each vote of aye, nay, or abstain. Three members of the Board shall constitute a quorum.

2. **Special Meeting.** Special meetings may be held at the call of the Chairman and at such times as the Board shall determine. The Department may exercise the same prerogatives. Any special meeting held at the request of an appellant shall be paid for by the appellant in the amount of $125.00. Three members of the Board shall constitute a quorum at special meetings.

(f) **Powers and Duties of the Board.**

1. **Procedures and Regulations.** The Board shall be authorized to make rules of procedure and adopt regulations essential for the transaction of business consistent with this Building Code.

2. **Appeals.** To hear and decide appeals of any order, decision, or determination made by the Department in the enforcement of this Building Code.

3. **Variances.** To hear and decide appeals for variances to Building Code requirements where there are practical difficulties or unnecessary hardships caused by conformance to the strict letter of this Building Code. The intent of this Building Code shall be observed to the end that public welfare is preserved, and substantial justice performed in the granting of any variance.

4. **Oath Subpoena.** For the purpose of exercising the powers herein enumerated, the Chairman, or in his absence, the Vice-Chairman, may administer oaths, accept affirmations and compel the attendance of witnesses. A failure or refusal to appear in response to the subpoena issued by the Board shall constitute a violation of this Ordinance.

(g) **Decision of the Board.** The Board may, in exercising its powers and duties, reverse or affirm, wholly or in part, or may modify the order, requirements, decision, or determination made by the Department, and shall render its order, requirements, decision or determination. A concurring vote of 3 members of the Board shall be necessary to reverse any order, requirement, decision, or determination of any administrative official, or to decide in favor of the appellant.
or any matter upon which the Board is required to pass under this Building Code.

(h) **Compensation.** Each member of the Board shall receive $25.00 per regular or special meeting attended.

**SECTION 121. APPEALS.**

(a) **Method of Application Fee.** Prior to an action by the Board an application shall be filed in the office of the Department, on a form providing the necessary information required by the Board. An appeal shall not be considered unless filed with the Department at least 10 days prior to the meeting. Upon filing the application, a fee of $15.00 shall be paid the City. All checks shall be made payable to the Manager of Revenue, and shall be paid in the office of the Department. This fee is not refundable. (Revised 3/81 Ordinance No. 172)

(b) **Hardship or Error.** Any person, firm, or corporation aggrieved by a decision of the Department in the enforcement of this Building Code; or any person, firm or corporation who feels that there are practical difficulties or unnecessary hardships involved in carrying out the strict letter of this Building Code; or where it is alleged there is error in any order, requirement, decision, or determination made by the Department, may, within 30 days after being notified of such decision or order, appeal the decision or order of the Department by filing an application with the Board.

(c) **Unsafe Condition.** Whenever the owner of an alleged unsafe building, structure, or utility, or other condition does not agree with the order from the Department in the enforcement of this Building Code as to the correction to be made, he shall have the right to appeal to the Board within 30 days from the date of said order. In his appeal, he shall state how he proposes to make the building, structure, utility, or other condition safe; and if required by the Board, he shall submit detailed engineering analysis or recommendations, accompanied by plans and specifications prepared by a Colorado Licensed Architect or Colorado registered Professional Engineer, as prescribed in this Building Code. The Board may require substantiating data concerning the removal or other remedial steps to be taken to render the building, structure, utility, or other condition safe.

(d) Upon the filing of an Appeal, a notice of the Appeal shall be served by the applicant upon the the person whose notice, order or decision is being appealed and from the time of service all action by the Department relating to the notice, order or decision appealed shall be stayed pending the decision of the Board except that any action of the Department under Section 109(e) or (g) shall not be stayed.

(Rev. 7/86 Ord. No. 416)
(e) In any matter in which an order or notice relating to an unsafe building or structure is appealed, the Department may certify to the Board that the building or structure could become an imminent hazard in which case the Board shall schedule a meeting within three work days prior to hear said appeal. (Rev. 7/86 Ord. No. 416)

SECTION 122. APPEALS FROM DECISIONS OF THE BOARD.
(a) Procedure. Any person aggrieved, the City or any officer, department, or division of the City may have a decision of the Board reviewed in the manner provided by the rules relating to civil proceedings. A review shall not be granted unless a petition therefore, duly verified, setting forth that such decision is illegal in whole or in part, and specifying the grounds of the illegality, is presented to the court of record within 30 days after the filing of the decision in the office of the Board. The Board shall not be required to return the original papers acted upon by it, but shall return copies thereof. The returned copies shall concisely set forth other facts pertinent and material to the decision appealed from, and shall be verified.
(b) Effect of Appeal. The issuance of a writ on a petition hereunder shall not stay proceedings upon the decision appealed from; but the court, on application after notice to the Board and on due cause shown, may grant a restraining order.
(c) Transcript Costs. Whenever a transcript is demanded by the person taking the appeal, or when a transcript is furnished by the Board pursuant to court order, the cost of preparing the transcript of proceedings shall be borne by the appellant, in the amount of at least $200.00.

SECTION 123. VALIDITY OF BUILDING CODE. If any section, subsection, sentence, clause, or phrase of this Building Code is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this Building Code.

SECTION 124. LIABILITY. The Director, or his authorized representative charged with the enforcement of this code, acting in good faith and without malice in the discharge of his duties, shall not thereby render himself personally liable for any damage that may accrue to persons or property as a result of any act or by reason of any act or omission in the discharge of his duties. Any suit brought against the Director or employee because of such act or omission performed by him in the enforcement of any provision of this code shall be defended by The City Attorney until final termination of such proceedings.
This code shall not be construed to relieve from or lessen the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall the Department or City be held as assuming any such liability by reason of the inspections authorized by this code or any certificates of inspection or occupancy issued under this code. (Revised 7/83 Ordinance No. 389)
CHAPTER 2

LICENSING, CERTIFICATION, REGISTRATION, BOARDS OF STANDARDS

SECTION 200. GENERAL. This Chapter provides for the licensing of all persons, the Certification of supervisory personnel, registration, other types of Certifications, and Boards of Standards.

SECTION 201. AUTHORITY.
(a) Licenses. The Department is vested with the authority to establish licensing procedures, to qualify applicants for licenses and to issue, revoke, renew, and suspend licenses.
(b) Certificates. The Department is vested with the authority to establish certification procedures, prequalify applicants, and to issue, revoke, renew, and suspend certificates.

SECTION 202. LICENSES OR REGISTRATION.
(a) Defined. A license is authority granted to the person, agency or political entity to whom it is issued to perform the work authorized by the license. A Registration is Authority granted an Electrical Contractor by the State of Colorado to perform the work authorized by said Licensee in the City.
(b) Licenses or Registration Required. Licenses shall be required for all types of work described in this Chapter. Plumbing contractors shall be licensed by the Department and shall have a master plumber licensed by the State of Colorado as the licensee or in the full time employ of the contractor. Electrical contractors shall register with the Department and need only be licensed by the State of Colorado. Electrical registrants are required to comply with all the requirements of this code except section 209 through and including section 219. (Revised 7/83 Ordinance No. 389

EXCEPTIONS:
1. Public Utility Companies will not be required to obtain licenses when engaged in the installation, operation and maintenance of their equipment used for the production, generation, or distribution of the utility, product or service through the facilities owned or operated by the utility company to the point of customer service.
2. Work performed by owners of Group H-3, I and J Occupancies under a permit authorized by Chapter 3.

(c) Application and Fee. Every applicant for a License shall fill out a form provided by the Department, and shall pay an application fee of $15.00 at the time of filing. This fee shall not be refundable and shall not apply to the License fee. The name of the Certified Supervisor shall appear on the License application. A final review and appropriate action shall be taken on the License application by the Department, and
the applicant shall be notified accordingly. If the License is approved, the applicant shall procure this License within 90 days after notification. Thereafter, upon failure of the applicant to procure the License, a new application with fee shall be filed. If the application for License is disapproved by the Department, the applicant may appeal to the Board of Appeals in the manner provided for in the manner provided for in this Building Code.

(d) Supervisor Required. Every Licensee shall be required to have in his employ a Supervisor who holds a Supervisor Certificate of Qualification for that particular license. A Plumbing Contractor, Class A or B, shall be required to have in his employ a holder of a State of Colorado Master Plumbers License as the required supervisor. The license shall be valid only as long as the named Supervisor shall remain in the employ of the Licensee in an active, full-time capacity. If the Supervisor should leave the employ of the Licensee, the Licensee shall notify the Department within 3 working days after the Supervisor terminates. Failure of the Licensee to notify the Department within 3 working days that the Supervisor is no longer in his employ shall be cause for suspension or revocation of the License. The Licensee shall be required to obtain a certified Supervisor within 30 days after the date the Supervisor leaves the employ of the Licensee. If a Supervisor is not obtained within the 30 day period, the License shall be deemed suspended until the Supervisor is obtained and the Department notified accordingly. (Revised 7/83 Ordinance No.389)

1. Individual. If the Licensee is an individual, he also may qualify as the Supervisor for that license, after examination.

2. Not Required. The following Licenses and Electrical registration shall not require a certified Supervisor:
   A. Electrical Registration.
   B. Building Contractor Class E.
   C. Sign Contractor Class B.
   D. Lawn Sprinkler Contractor.

SECTION 203. CLASSIFICATION OF LICENSES AND REGISTRATION.

(a) General. There shall be various classes of Licenses and an Electrical Registration and the holder thereof shall be authorized to perform the following:

1. Building Contractor Class A. To erect, add to, alter or repair any building or structure. The demolition of a building or structure is permitted when the Licensee establishes that he will erect a new building or addition on the same site. All work shall be performed under the supervision of the holder of a Class A Construction Supervisor Certificate.

2. Building Contractor Class B. To erect, add to, alter or repair any building or structure except that buildings of Type I or II construction shall not exceed the height and area which is permitted
for a Type III building. The demolition of any I Occupancy or one story building or structure is permitted when the Licensee establishes that he will erect a new building or addition on the same site. All work shall be performed under the supervision of the holder of a Class A or B Building Construction Certificate.

3. Building Contractor Class C. To erect, add to, alter or repair any Group I or J Occupancy building. The Contractor may perform work on any type building or structure provided the character of the work is not structural. The demolition of any one story Group I or J occupancy building or structure is permitted when the Licensee establishes that he will erect a new building or addition on the same site. All work shall be performed under the supervision of the holder of a Class A, B or C Construction Supervisor Certificate.

4. Building Contractor Class D. To perform work listed under any one of the crafts listed below. All work enumerated in this Section shall be performed under the supervision of the holder of a Class A, B, or C or the particular Class D Construction Supervisor Certificate.

D-1 Lathing, Plastering and Dry Wall. Installation of all lathing, plastering and dry wall, including the installation of non-bearing partitions and stucco.
D-2 Roof Covering and Waterproofing. Installation of roof coverings including valleys, gutters and downspouts, waterproofing and damproofing.
D-3 Masonry. Laying and forming all types of masonry.
D-4 Sand Blasting and Cleaning. Sand blasting, cleaning, or texturing of the exterior of buildings or structures.
D-5 Well Drilling, Excavating, Concrete Foundations and Caissons. Well drilling, all types of excavating work, and installation of concrete foundations and caissons.
D-6 Wood Framing. The fabrication and erection of wood framing for all types of buildings.
D-7 Swimming Pools. Installation of swimming pools including utilities as indicated in Chapter 57.
D-8 Structural Metals. The fabrication and erection of structural metal for all types of buildings or structures excluding the complete construction of a Type IV building.
D-9 Pre-Cast Concrete Building Units. The erection of precast concrete structural units for all types of buildings and structures.
D-10 Dry Wall. Installation of all dry wall including the installation of non-bearing partitions.
5. **Building Contractor Class E.** To perform the work involving the installation, altering or repair of any or all of the following:
   - Accoustical treatment.
   - Gutters and Downspouts.
   - Fences.
   - Glass and Glazing.
   - Prefabricated Metal Patios, Carports, and Awnings.
   - Scaffold Erection.
   - Siding.
   - Building Insulation.
   - Tile and Marble.

   A certified supervisor shall not be required for this License.

6. **Construction Management Firm.** To administer and coordinate those trades and contracts directly engaged in the construction of buildings, structures and utilities. The holder of this License shall conform to all the provisions of this Building Code and Chapter except that this licensee shall not be permitted to obtain Permits in accordance with Chapter 3. This License shall require a Construction Certificate holder who shall be certified in the Class of Construction being performed and be in the employ of the Construction Management Firm. See Table 2-B.

7. **Demolition Contractor Class A.** To demolish any building, structure, utility, or portion thereof. All work shall be performed under the supervision of the holder of a Class A Demolition Supervisor Certificate.

8. **Demolition Contractor Class B.** To demolish any building not more than 2 stories in height. All work shall be performed under the supervision of the holder of a Class A or B Demolition Supervisor Certificate.

9. **Moving Contractor.** Moving of all types of buildings or structures. All work shall be performed under the supervision of the holder of a Moving Supervisor Certificate.

10. **Plumbing Contractor Class A.** To install, add to, alter or repair sanitary plumbing, potable water supply piping and appliances connected thereto; storm sewer; gas piping; water heaters; gas ranges; domestic gas incinerators; swimming pool and spa piping and solar plumbing utilized for potable water. All work shall be performed under the supervision of the holder of a State of Colorado Master Plumbers License. (Revised 7/83 Ordinance No. 389)

11. **Plumbing Contractor Class B.** To install, add to, alter, or repair sanitary plumbing; potable water supply piping and appliances connected thereto; storm sewer; gas piping; water heaters not exceeding 100 Mbtu input; gas ranges; domestic gas incinerators and gas dryers; swimming pool and spa piping.
All work listed in this category is for Group I and J Occupancies only. All work shall be performed under the supervision of the holder of a State of Colorado Master Plumbers License. (Revised 7/83 Ordinance No. 389)

12. Steam and Hot Water Contractor. To install, add to, alter or repair steam and hot water heating systems, solar, water heating; process piping and related appurtenances; piping used for the transmission of chemicals, gases, air and other products; all items regulated by Chapter 58 of this Building Code; low static gas fired unit heaters; industrial ovens; burners; controls; piping and controls utilizing gas, liquid or solid fuel; water heaters; pipe insulation and low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. All work shall be performed under the supervision of the holder of a Steam and Hot Water Supervisor Certificate.

13. Hot Water Contractor. To install, add to, alter or repair hot water heating systems and their appurtenances; solar water heating; water heaters; gas piping and controls, pipe insulation and low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. All work permitted by this License shall be restricted to a Group I or J Occupancy only. All work shall be performed under the supervision of the holder of a Steam and Hot Water or Hot Water Supervisor Certificate.

14. Heating and Ventilating Contractor Class A. To install, add to, alter or repair warm air heating; venting; ventilation; evaporative cooling; exhaust systems and their appurtenances; ductwork; dust collection systems; domestic and commercial range hoods; water heaters not exceeding 100 Mbtu input; gas piping; burners, controls, and venting; trash and laundry chutes; exterior sheet metal; duct insulation; low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway; maximum of 10 tons of refrigeration when it is utilized for comfort cooling and the refrigerating system is self-contained. This refrigeration shall not include systems with precharged lines or separate air-cooled condenser or chilled water systems. All work shall be performed under the supervision of the holder of a Class A Heating and Ventilating Supervisor Certificate.

15. Heating and Ventilating Contractor Class B. To install, add to, alter or repair, in Group I and J Occupancies only, warm air heating systems and their appurtenances; ductwork; ventilation; evaporative cooling; duct insulation; exterior sheet metal; gas piping; burners; venting and controls; water heaters not exceeding
100 Mbtu input; low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. All work shall be performed under the supervision of the holder of a Class A or B Heating and Ventilating Supervisor Certificate. (Revised 5/80 Ord. No. 240)

16. Gas Service Contractor. To install, add to, alter or repair the following equipment which utilizes gas or liquid fuel;
A. Gas and liquid fuel piping.
B. Gas and liquid fuel controls.
C. Commercial cooking equipment.
D. After burners.
E. Ranges.
F. Dryers.
G. Conversion burners.
H. Venting of Domestic water heaters, Dryers and Incinerators.
I. Water heaters not exceeding 100 Mbtu input.
J. Low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. (Rev. 7/86 Ord. No. 417)

17. Refrigeration Contractor Class A. To install, add to, alter or repair refrigeration systems and appurtenant cooling towers; pipe insulation; and low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. A permit or license is not required for the installation of window type air conditioners. All work shall be performed under the supervision of a Class A Refrigeration Supervisor Certificate.

18. Refrigeration Contractor Class B. To install, add to, alter or repair refrigeration systems consisting of self-contained refrigeration systems of 5 tons or less; the installation of precharged systems utilizing Group 1 Refrigerants and gas fired absorption chillers. All work permitted by this license shall be restricted to Group I Occupancy only. All work shall be performed under the supervision of the holder of a Class A or B Refrigeration Supervisor Certificate.

19. Sign Contractor Class A. To fabricate, install, erect, or maintain all types of signs. All work shall be performed under the supervision of the holder of a Class A sign Supervisor Certificate.

20. Sign Contractor Class B. To install, erect or maintain the following types of non-illuminated signs:
1. Cloth signs painted directly on a wall.
2. Wall signs not exceeding 200 square feet in area.
3. Ground signs not exceeding 150 square feet in area.
4. Arcaded signs not exceeding 25 square feet in area per side. A certified supervisor shall not be required for this license.
21. Elevator Contractor. To install, add to, alter or repair elevators, escalators, moving sidewalks, moving ramps, dumbwaiters, stage lifts, manlifts and amusement devices which employ ropes, cables, pulleys or platforms. In addition, this license shall include electrical work from the controls to the equipment. All work shall be performed under the supervision of the holder of an elevator Supervisor Certificate.

22. Fire Protection Contractor Class A. To install, add to, alter or repair fire extinguishing systems of all types. All work shall be performed under the supervision of the holder of a Class A Fire Protection Supervisor Certificate.

23. Fire Protection Contractor Class B. To install, add to, alter or repair automatic fire sprinkler and standpipe systems of all types. All work shall be performed under the supervision of the holder of a Class A or B Fire protection Supervisor Certificate.

24. Fire Protection Contractor Class C. To install, add to, alter or repair approved non-water, factory engineered extinguishing systems. All work shall be performed under the supervision of the holder of a Class A or C Fire Protection Supervisor Certificate.

25. Lawn Sprinkler Contractor. To install, add to, alter or repair underground lawn sprinkler systems except for the connection to the water service line. A certified supervisor shall not be required for this license.

26. Electrical Signal Contractor. To install, add to, alter or repair electrical wiring and equipment for fire alarm, fire detection, emergency voice communication systems, electrical signalling and control wiring. Voltages shall not exceed 48 volts, or the system shall be power limited as defined by the National Electrical Code. Complete conduit or raceway systems shall not be installed by the holder of this license. All work shall be performed under the supervision of the holder of an Electrical Signal Supervisor Certificate. (Revised 5/80 Ord. No. 240)

27. Domestic Appliance Contractor. To install, repair and replace Domestic Appliances as defined in Chapter 41 of this Building Code. All work shall be performed under the supervision of the holder of a Domestic Appliance Supervisor or Class A or B Plumbing Supervisor Certificate.
28. Boilermaker Contractor. To install, assemble, or repair steam and hot water boilers; all pressure and non-pressure vessels; precipitators; breeching; metal stacks; plates and casings. All work shall be performed under the supervision of the holder of a Boilermaker Supervisor Certificate.

29. Water Service Contractor. To install the initial water service from the main tap through the stop box and meter pit and continuing to and through the wall of the building and capped at that point. This License shall not permit the installation of the water meter. All work shall be performed by or under the supervision of the holder of a Water Service Supervisor Certificate or a State of Colorado Master Plumbers License. (Revised 7/83 Ordinance No. 389)

30. Electrical Registration. Performs all work authorized by the License issued by the State of Colorado.

SECTION 204. LICENSE FEES.
(a) Annual Fees Required. The annual license fee applicable to those enumerated shall be paid to the Department in accordance with Table 2-A.
(b) License Fee Refund. License fees shall not be refundable.

SECTION 205. LICENSE RENEWAL. All Licenses shall be renewed annually. Any work performed 30 days after expiration of a license shall constitute a violation of this Building Code.

SECTION 206. REISSUANCE OF A LICENSE. The Department shall have the authority to reissue a license without the filing of a new application provided the reissuance is accomplished within 1 year after the license has expired. If the license is not reissued within 1 year, a new application and fee shall be required.

SECTION 207. LICENSE RESPONSIBILITY.
a) General. All licensees shall be responsible for performing the work under the provisions of this Building Code, including, but not limited to the following items:
1. To report in writing to the Department within 3 working days, any accident occurring on any construction which results in damage to the building, structure or utilities, and any accident occurring during demolition. Accidents involving elevators shall be reported per Section 5501(d). (Revised 5/84 Ordinance No. 253)
2. To provide minimum safety measures and equipment to protect workmen and the public.
3. To present the license card when requested by the Department.
4. To employ a qualified supervisor certified in accordance with the requirements of this Building Code.
5. To employ qualified journeymen certified in accordance with the requirements of this Building Code.
6. To obtain a permit when required.
7. To faithfully construct, without substantial departure from drawings and specifications filed and approved by the Department and permit issued for same, unless changes are approved by the Department.
8. To complete all work authorized by the permit issued under the authority of this Building Code, unless acceptable cause is indicated to the Department.
9. To obtain inspection services where required by this Building Code.
10. To pay any fee assessed under authority of this Building Code.
11. To obey any order or notice issued under the authority of this Building Code.
12. To provide all vehicles used in the operation of his business with identification of the business in a manner prescribed by the Department.
13. To provide toilet facilities prior to construction or demolition.
14. To maintain with the Department a current mailing address and to accept at the address maintained at the Department any Order, Notice, Summons and Complaint or other Departmental Communication whether delivered by personal service or by certified, registered or first class mail. (Revised 3/86 Ordinance No. 129)

SECTION 208. LICENSE CHANGES.
(a) Change of Name. A change of name or address of a licensee shall be reported to the Department within 15 days after making the change. A new license shall not be required for the change.
(b) New Licenses Required. The creation of a new legal entity, even through one or more of the members, officers or directors have a license, shall require that a new license be obtained within 30 days after the change is made.
(c) Dissolution. The dissolution of a corporation or partnership which has been licensed terminates the license, and no person may operate under that license.
SECTION 209. SUSPENSION OR REVOCATION OF LICENSE.
(a) Authority. The Department may suspend or revoke a license when the
licensee commits one or more of the following acts or omissions:
1. Fails to comply with any of the licensee responsibilities as outlined
   in this Building Code.
2. Knowingly conspires with a person to permit a license to be used
   by another person.
3. Acts as agent, partner, associate, or acts in any capacity with per-
   sons to evade the provisions of this Building Code.
4. Violates any of the provisions of this Building Code.
(b) Procedure. When any of the acts or omissions enumerated herein are
committed by a license holder and the Department deems that the
license shall be suspended or revoked, the action shall be as follows:
1. The Department shall notify the licensee in writing by certified
   mail or personal service at least 7 days prior to suspension or
   revocation.
2. Upon receipt of the notice, the licensee may request a hearing.
   This request shall be in writing to the Department within 7 days
   after receipt of the notice.
3. If a hearing is requested by the licensee, the Department shall set
   a time, date and place, and so notify the licensee. Suspension or
   revocation of the license shall be deferred until after the hearing
   or appeal.
4. When a hearing is conducted, the licensee and other interested
   parties may be in attendance. Upon completion of the hearing, the
   Department shall take all evidence admitted under advisement,
   and shall notify the licensee of the findings and ruling. The find-
   ings and ruling shall be rendered in writing by certified mail or
   personal service.
5. If the decision rendered by the Department is adverse to the
   licensee, the licensee may appeal to the Board of Appeals as set
   forth in Chapter 1 of this Building Code within 30 days after notice
   of ruling.
(c) Emergency Suspension. If the Department finds that cause does ex-
ist for suspension or revocation of a license, it may enter an order for
the immediate suspension of the license, pending further investigation.
The licensee may, upon notice of the suspension, request an immediate
hearing before the Department. The hearing shall be conducted in the
manner prescribed by other Sections of this Chapter.
(d) Delegation of Authority. In the event of a hearing, the Director may
appoint a qualified member of the Department to sit in his stead as
Hearing Commissioner to conduct the hearing. Final decision shall be
rendered by the Director.

SECTION 210. CERTIFICATES.
(a) Definition. A Certificate of Qualification is authority to perform cer-
tain skills, and is issued by the Department on the successful comple-
tion of an examination. This certificate is not transferrable. Where the term Certificate is used, this means Certificate of Qualification.

(b) Temporary Certificate. The Department may issue a temporary certificate when the applicant has previously exhibited his skills to the satisfaction of the Department and the applicant’s qualifications are acceptable. The Department shall determine the period of validity of the temporary certificate.

(c) Certificate Application. Every applicant for a certificate shall be required to complete a form provided by the Department and to pay an application fee of $15.00 at the time of the filing. The fee shall not be refundable and shall not apply to the certificate fee. The payment of the fee shall entitle the applicant to one examination only; and if the applicant is re-examined for any reason whatsoever, a new application and fee shall be required. If an applicant does not appear for examination and indicates a valid reason for not appearing, one excused absence shall be permitted without a new application and fee.

(d) Successful Applicants. After an applicant has successfully passed the examination given by the Department and fails to procure this certificate within 90 days after notification, this certificate shall be declared to be null and void and a new application and fee shall be filed.

(e) Failure to Pass Examination. When an applicant has failed to pass the examination, he shall be notified in writing by the Department.

(f) Right to Appeal. All decisions of the Department may be appealed as prescribed in Chapter 1.

(g) Supervisors.

1. Every supervisor required for a particular license shall be examined by the Department, and if qualified shall be issued a Supervisor Certificate of Qualification. The certificate holder shall be entitled to perform and supervise the work in the particular skill for which he is qualified and certified. This certificate is an individual certificate and shall not be construed to be a license.

2. The certificate holder shall maintain an active part in the supervision of the workmen under his direction.

SECTION 211. CLASSIFICATION OF SUPERVISOR CERTIFICATE OF QUALIFICATION. All licenses issued by the Department shall require a Supervisor Certificate for the particular work to be performed, in accordance with Table 2-B. The Supervisor Certificate shall permit the holder thereof to be a Supervisor under the licenses enumerated herein.

SECTION 212. CLASSIFICATION OF JOURNEYMAN AND OPERATOR CERTIFICATE OF QUALIFICATION.

(a) General. Unless otherwise provided for in this Section or in this Building Code, all journeymen and operators required to be certified shall perform that work permitted under the provisions of licenses for a particular type of work. The work permitted by the certification shall be performed in the employ of the licensee as hereinafter set forth.
(b) Journeyman Certificate of Qualification. A Journeyman Certificate of Qualification shall be required in the following trades and shall entitle the individual to work in the trade for which he is certified and classified. This Certificate shall permit the individual to work only under a certified supervisor.


2. Journeyman Steam Fitter Certificate. Permit the installation of steam and hot water heating systems; solar water heating; process and industrial piping and related appurtenances; piping used for the transmission of chemicals, gases, air, milk, and other products transmitted through piping; and all items regulated by Chapter 58 of this Building Code: low static gas fired unit heaters; industrial ovens; burners, piping and controls utilizing gas, low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway; commercial cooking equipment; commercial incinerators; after burners. The holder of this certificate may perform this work only in the employ of a Steam and Hot Water Contractor or a Hot Water Contractor.

3. Journeyman Water Service Certificate. Permits the installation of the initial water service from the main tap through the stop box and meter pit and continuing to and through the wall of the building and capped at that point. This certificate shall not permit the installation of the water meter. The holder of this Certificate may perform this work only in the employ of a Water Service Contractor or a Plumbing Contractor Class A or B.

4. Journeyman Gas Service Certificate. Permits the installation of the following equipment utilizing gas or liquid fuel:
   A. Gas and liquid fuel piping.
   B. Gas and liquid fuel controls.
   C. Commercial cooking equipment.
   D. After burners.
   E. Ranges.
   F. Dryers.
   G. Conversion burners.
   H. Venting of Domestic water heaters, Dryers and Incinerators.
   I. Water heaters not exceeding 100,000 Btu input.
   J. Low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. The low voltage wiring permitted by this Certificate shall apply to gas or liquid fuel-fired appliances only. The holder of this Certificate may perform this work only when in the employ of a Gas Service Contractor or a Heating and Ventilating Contractor Class A or B. (Rev. 7/86 Ord. No. 418)
5. Journeyman Heating and Ventilating Certificate. Permits the installation of warm air heating, ductwork, ventilation and evaporative cooling; exterior sheet metal; water heaters not exceeding 100 Mbtu input; gas piping, burners, venting and controls; exhaust systems and appurtenances thereof; low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. The holder of this Certificate may perform this work only in the employ of a Heating and Ventilating Contractor Class A or B.

6. Journeyman Refrigeration Certificate. Permits the installation of refrigeration systems and appurtenant cooling towers; pipe insulation; low voltage wiring which does not exceed 48 volts and is not enclosed in a conduit or raceway. The holder of this Certificate may perform this work only in the employ of a Refrigeration Contractor Class A or B.

7. Journeyman Domestic Appliance Certificate. Permits the installation of Domestic Appliances as defined in Chapter 41 of this Building Code. The holder of this Certificate may perform this work only in the employ of a Domestic Appliance Contractor or a Plumbing Contractor Class A or B.

8. Journeyman Boilermaker Certificate. Permits the installation and erection of steam and hot water boilers; pressure vessels; precipitators; incinerators; breeching; chimneys; plate and casings. The holder of this Certificate may perform this work only in the employ of a Boilermaker Contractor.

9. Journeyman Electrical Signal Certificate. Permits the installation of electrical wiring and equipment for fire alarm, fire detection, emergency voice communication system, burglar alarm, and electrical signalling and control wiring. Voltages shall not exceed 48 volts or the system shall be power limited as defined in the National Electric Code. Complete conduit or raceway systems shall not be installed by the holder of this Certificate. The holder of this Certificate shall perform this work only in the employ of an Electrical Signal Contractor.

10. Journeyman Drainlayer Certificate. Permits the installation of sanitary, storm sewer, and sewer connections. This work shall commence at the pipe located 5 feet outside the buildings and hence to the main sewer and shall include digging and backfilling of ditches. The holder of this Certificate may perform this work only in the employ of a Plumbing Contractor Class A or B.

(c) Stationary Engineer and Operator Certificates. It shall be unlawful to operate any of the following equipment without the personal attendance of a properly Certified Stationary Engineer or a properly Certified Operator.
1. Any steam boiler and appurtenances thereto; steam pumps; steam turbines; and steam engines where the steam pressure is in excess of 15 psi working pressure and where the equipment produces a total of 10 boiler horsepower or more at Denver altitude.

2. Water heating systems when the water temperature exceeds 250 degrees F. in the system.

3. Composite grouping of refrigeration machines where machines are 25 tons in capacity and parallel to a common refrigerant piping system. The total charge in the entire system shall determine the capacity of the system.

4. Refrigeration systems utilizing Group 2 or 3 refrigerants as defined in Chapter 49 of this Building Code and which contains a charge of 200 lbs. or more.

5. Refrigeration systems having manual or semi-automatic control with charges of 1500 lbs. or more of Group 1 refrigerants as outlined in Chapter 49.

6. Refrigeration systems with fully automatic controls with charges of 1500 lbs. or more of Group 1 refrigerants.

(d) **Stationary Engineer.** Permits the holder to take charge of and operate all steam boilers and appurtenances thereto; steam pumps; steam turbines; steam engines and mechanical refrigeration systems.

(e) **Boiler Operator Certificate, Class A.** Permits the holder to take charge of and operate all steam boilers and appurtenances; steam pumps; steam turbines; and steam engines.

(f) **Boiler Operator Certificate, Class B.** Permits the holder to take charge of and operate all steam boilers and appurtenances; steam pumps; steam turbines; and steam engines containing a steam pressure between 15 and 100 psi and where the equipment produces a total of between 10 and 100 horsepower at Denver altitude.

(g) **Refrigeration Operator Certificate.** Permits the holder to take charge of, operate, and make needed adjustments and maintenance repairs for refrigeration systems of all sizes and types.

(h) **Semi-Automatic Defined.** As used in this Section, semi-automatic shall mean plants or systems which are provided with automatic safety controls by manual load proportioning controls requiring other than seasonal adjustments.

(i) **Hoist Operator Certificate.** It shall be unlawful to operate a construction hoist powered by steam, electricity, or other power when such hoist serves buildings or structures under construction or demolition exceeding 25 feet in height unless said hoist is operated by a properly Certified Hoist Operator. This Section shall not be construed to include elevators regulated as defined in Chapter 55 of this Building Code. **EXCEPTION:** Single drum material hoists not more than 25 feet in height and not carrying personnel need not require a Hoist Operator Certificate Holder.
SECTION 213. APPRENTICES AND TRAINEES.
(a) General. This Section shall govern the requirements for apprentices and trainees and shall be limited to the crafts listed in this Chapter where a Journeyman Certificate holder is required.
(b) Requirements. Apprentices and trainees shall not be required to possess a Certificate, but shall be permitted to work as prescribed in other Sections of this Chapter.
(c) Definition.
   1. An apprentice shall mean any person who has entered into an apprentice agreement which provides for participation in a program of training through employment and education in related and supplementary subjects.
   2. A Trainee shall mean any person working at the trade under the direct supervision of a Certified Journeyman or Supervisor.
(d) Work. An apprentice or trainee may perform any work which is distinctive to a specific craft, but only under the direction and supervision of a Certified Supervisor or Journeyman of the craft. during working hours. Persons working on tasks not distinctive to any specific craft shall not be classed as an apprentice.
(e) Employment of Apprentices. Contractors may employ apprentices or trainees for the licensed crafts or trades. The ratio of apprentices and trainees to Journeyman employed shall not exceed one apprentice or trainee to one Journeyman.
(f) Employer. All apprentices or trainees shall be in the employ of the Licensed crafts where Journeymen Certificate holders are required.

SECTION 214. CERTIFICATE FEES.
(a) Annual Fees. Annual Certificates of Qualification fees shall be paid the Department in accordance with the provisions of this Section.
   Supervisor Certificate ........................................... $25.00
   Journeyman Certificate .......................................... $10.00
   Engineer Certificate ........................................... $10.00
   Operator Certificate ........................................... $10.00
   EXCEPTION: The certificate fee for employees of the City shall be waived when performing work for the City or when employed by the Department.
(b) Certificate Fee Refund. Certificate fees shall not be refundable.

SECTION 215. CERTIFICATE RENEWAL. Certificates shall be renewed annually. Any work performed 30 days after expiration of the Certificate and prior to obtaining a renewal of the certificate shall be a violation of this Building Code.
SECTION 216. REISSUANCE.
(a) General. The Department shall have the authority to renew a Certificate provided the renewal is accomplished within the limits set forth herein:
   1. The Certificate may be reissued without a new application provided such reissuance shall be accomplished within one year after the certificate has expired. If such certificate is not reissued within said one year period, a new application shall be required.
   2. If the certificate holder reapplies within 3 years of the date of expiration, re-examination shall not be required.
   3. If the certificate holder applies more than 3 years but less than 5 years after expiration, re-examination shall be required, unless he can substantiate that a Department issued Certificate has been in force within the past 5 years.
   4. If neither the Department nor the individual can substantiate Certification within the past 5 years, the individual shall reapply in the manner provided for new applicants.

SECTION 217. CERTIFICATE HOLDER RESPONSIBILITY
(a) General. All certificate holders shall be responsible for the work they assume in accordance with the requirements of this Building Code, without limitation, and to the following items:
   1. To have in possession at all times, a Certificate of Qualification.
   2. To present a certificate when requested by any member of the Department.
   3. To faithfully construct, without departure from or disregard of approved drawings and specifications.
   4. To obey any order issued under authority of this Building Code.
   5. To pay any fee assessed under the authority of this Building Code.
   6. To observe the safety requirements of this Building Code.

SECTION 218. SUSPENSION OR REVOCATION OF CERTIFICATE.
(a) Authority. The Department may suspend or revoke a Certificate issued under the provisions of this Building Code for any one or more of the following acts of omission:
   1. Incompetence.
   2. Misuse of the certificate.
   3. Violation of any of the provisions of this Building Code.
   4. Failure to comply with any of the certificate holder responsibilities outlined in Section 217.
(b) Procedures. When any acts or omissions enumerated are committed by a certificate holder and the Department deems that the certificate shall be suspended or revoked, the action shall be as follows:
1. **Notification.** The Department shall notify the certificate holder, in writing, by certified mail or by personal service, at least 7 days prior to suspension or revocation.

2. **Request Hearing.** Upon receipt of the notice, the certificate holder may request a hearing. This request shall be in writing to the Department within 7 days after receipt of the notice.

3. **Time of Hearing.** If a hearing is requested by the certificate holder, the Department shall set a time, date, and place, and so notify the certificate holder. Suspension or revocation of the certificate shall be deferred until after the hearing or appeal.

4. **Attendance.** When a hearing is conducted, the certificate holder and other interested parties may be in attendance. Upon completion of the hearing, the Department shall take all evidence admitted under advisement, and shall notify the certificate holder of the finding and ruling, in writing, by certified mail or personal service.

5. **Adverse Decision.** If the decision rendered by the Department is adverse to the certificate holder, the certificate holder may appeal this decision to the Board of Appeals, within 30 days after notice of ruling. The finding and ruling shall be rendered in writing and the certificate holder shall be notified by certified mail or personal service.

   (c) **Emergency Suspension or Revocation.** If the Department finds that cause does exist for suspension or revocation of a certificate, it may enter an order for immediate suspension or revocation of the certificate, pending further investigation. The certificate holder may, upon notice of the suspension or revocation, request an immediate hearing before the Department. The hearing shall be conducted in the manner prescribed herein.

   (d) **Delegation of Authority.** In the event of a hearing, the Director may appoint a qualified member of the Department to sit in his stead as the Hearing Commissioner to conduct the hearing. Final decision shall be rendered by the Director.

**SECTION 219. BOARDS OF STANDARDS.**

(a) **Creation of Boards of Standards.** There is hereby created and established Boards of Standards which shall have the duties, powers, and functions prescribed by this Section.

(b) **Members.** The members of the Boards shall be appointed by Mayor to serve a period of 2 calendar years and may be re-appointed for an additional 2 years; but no member shall serve more than 4 consecutive years.

(c) **Procedures and Bylaws.** The Board of Standards are authorized to make rules of procedure and adopt bylaws necessary for the transaction of business consistent with this Building Code. Each Board shall
elect its own Chairman at the first meeting of each calendar year and that person shall be Chairman for the entire year. A simple majority shall constitute a quorum. Each member shall receive $25.00 for attendance per meeting.

(d) Examination Standards. The Board of Standards shall develop standards for the examination of applicants for certificates and shall submit the standards to the Department for approval. The standards shall be consistent with the purpose of this Building Code, which is the protection of the public health, safety, and welfare of the people of the City to the extent that those persons recommended to be certified under this Building Code are qualified in terms of their skills, knowledge, practical experience and knowledge of pertinent law to perform the work for which they may be certified.

1. The Examination Section of the Department shall examine applicants in the following areas:
   A. Applicable portions of the Building Code.
   B. Technical knowledge.
   C. Skills.

2. The Boards shall furnish the Examination Section of the Department with suggested test material which reflects the examination standards established.

3. The Department shall establish minimum standards for education and experience of applicants.

(e) Annual Review. The standards shall be reviewed annually, or more frequently if necessary, to maintain the standards current with changes in the Building Code and building practices.

(f) Members. The qualifications for members of the respective Boards shall be as follows:

1. Building Board.
   Construction Class A Certificate Holder.
   Construction Class B Certificate Holder.
   Construction Class C Certificate Holder.
   Professional Engineer registered in the State of Colorado.
   Architect licensed in the State of Colorado.
   Sign Class A Certificate Holder.
   Demolition Class A Certificate Holder.

   A. This Board shall develop standards for the examination of applicants for the following certificates:
      Construction Class A,B,C,D and Moving.
      Demolition Class A and B.
      Sign Class A.
2. **Heating, Ventilating and Gas Service Board.**  
Heating and Ventilating Class A Certificate Holder.  
Gas Service Certificate Holder.  
Professional Engineer registered in the State of Colorado.  
Journeyman Heating and Ventilating Certificate Holder.  
A. This Board shall develop standards for the examination of applicants for the following certificates:  
   Heating and Ventilating Class A, B.  
   Gas Service.  
   Journeyman Gas Service.  
   Journeyman Heating and Ventilating.  

3. **Mechanical Board.**  
Steam and Hot Water Certificate Holder.  
Journeyman Steamfitter Certificate Holder.  
Stationary Engineer Class A Certificate Holder.  
Professional Engineer registered in the State of Colorado.  
Refrigeration Class A Certificate Holder.  
Fire Protection Class A Certificate Holder.  
Boilermaker Certificate Holder.  
Journeyman Boilermaker Certificate Holder.  
Journeyman Refrigeration Certificate Holder.  
Water Service Certificate Holder  
Domestic Appliance Certificate Holder  
Journeyman Drainlayer Certificate Holder.  
A. This Board shall develop standards for the examination of applicants for the following certificates:  
   Refrigeration Class A, B.  
   Stationary Engineer  
   Boiler Operator Class A, B.  
   Refrigeration Operator.  
   Steam and Hot Water.  
   Hot Water.  
   Fire Protection Class A, B, C.  
   Boilermaker.  
   Water Service  
   Journeyman Steamfitter.  
   Journeyman Refrigeration.  
   Journeyman Water Service.  
   Journeyman Boilermaker.  
   Journeyman Drainlayer  
   Domestic Appliance  

4. **Electrical Board.**  
Hoist Operator.  
Professional Engineer registered in State of Colorado.  
Electrical Signal Certificate Holder.  
Elevator Certificate Holder.  
A. This Board shall develop standards for the examination of applicants for the following certificates:
Hoist Operator.
Elevator.
Electrical Signal.
Journeyman Electrical Signal.

SECTION 220. TRANSITIONAL PROVISIONS. Except as otherwise expressly provided herein, this Building Code shall not be construed to require the duplication of reissuance of any license or certificate within the same calendar year, the duplication of any examination, nor the duplication of any payment of any license or certificate fee for a particular grade of license or certificate within the same calendar year. All persons in the building and construction industries presently licensed under former codes and ordinances shall be deemed to be appropriately licensed hereunder. Any licensee under a former code or ordinance who fails to reapply for a license at the conclusion of the calendar year shall surrender his license and the same shall be deemed to be null and void.

SECTION 221. TABLES AND FEES.
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<tr>
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<tr>
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<tr>
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### TABLE 2-B
CLASSIFICATION OF SUPERVISOR

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<thead>
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<th>Contractor License:</th>
<th>Supervisor Certificate Required:</th>
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<tr>
<td>Building Class A</td>
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<td>Electrical Signaling</td>
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<td>Hot Water or Steam and Hot Water</td>
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<td>Hot Water</td>
<td>Moving</td>
</tr>
<tr>
<td>Lawn Sprinkler</td>
<td>State of Colorado Master Plumber's License</td>
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<td>Refrigeration Class B</td>
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<td>Sign Class A</td>
<td>NOT REQUIRED</td>
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<td>Sign Class B</td>
<td>Steam and Hot Water</td>
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<td>Water Service or State of Colorado Master Plumber's License</td>
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<tr>
<td>Water Service</td>
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</tbody>
</table>
CHAPTER 3
PERMITS-DRAWINGS-INSPECTIONS-CERTIFICATE
OF OCCUPANCY

SECTION 300. PERMITS REQUIRED.
(a) General. No person, the City and County of Denver, the Denver Housing Authority, or School District No. 1 in the City and County of Denver, shall erect, construct, enlarge, remodel, alter, repair, move, improve, remove, convert, demolish, or change the type of Occupancy of any building, structure, or utility, or perform any other work regulated by this Building Code, or cause the same to be performed, without first having obtained a Permit from the Department for the specific work to be performed. This Permit shall be displayed or available on the job site at all times. Although a Permit is not required from the United States Government or the State of Colorado, the other requirements of this Building Code shall apply.

EXCEPTIONS:
1. Group J Occupancy buildings of less than 100 square feet not more than 7 feet in height and used as a playhouse and for storage or the housing of animals; however, Permits shall be required for utilities, if installed. (Revised 4/79 Ordinance No.158)
2. A Permit shall not be required of a Public Utility duly franchised or authorized as such in the City for the repair and maintenance of their equipment and facilities used in the distribution of their utility.
3. Permits shall not be required of the State and Federal Governments, their agencies or subdivisions or contractors constructing improvements for said State and Federal Governments, their agencies or subdivisions, when constructing improvements to be used for and maintained strictly for the operation of said Governments.

(b) Prohibition. Permits shall not be transferable and the fee shall not be refundable.

(c) Validity. The issuance of a permit or the approval of drawings and specifications shall not be construed to be a permit for, nor an approval of, any violation or deviation from the provisions of this Build-
ing Code or other ordinances, laws, rules or regulations. The Department shall notify and take action it deems necessary to require that all work performed meets all requirements of this Building Code.

SECTION 301. ISSUANCE OF PERMITS.
(a) General. The Department shall, upon application, issue permits to perform work as shown on the submitted documents and as specified on the permit:

1. After all phases of the project conform to the requirements of this Building Code, Department of Public Works, Zoning Administration, Department of Health and Hospitals, and Fire Department; and,

2. When the applicant is a person Licensed under this Building Code to do work authorized by the permit; or

3. When the applicant is a Natural person who owns an I or J Occupancy building, or, who owns and occupies a unit in a Group H-3 Occupancy Building, or, who owns property and wishes to construct an I or J Occupancy building, for his own occupancy; all under the following conditions:
   A. All construction or demolition shall be performed under the personal supervision of the owner or occupant.
   B. Any person other than the owner who is employed and paid to perform any work shall hold an appropriate license to perform such work.
   C. The applicant for a permit to perform electrical, heating, cooling, plumbing or roofing work shall hold an appropriate Certificate of Qualification or shall pass an examination appropriate to the work to be performed and shall personally perform the work.

EXCEPTION: A permit shall not be issued to the owner-occupant of an H-3 Occupancy for structural or utility work. Only one permit to construct a Group I Occupancy building shall be issued to any person under Section 301 (a) 3 in any 12 month period.

D. A permit for minor work involving the volunteer services of persons working through a recognized volunteer organization, or of other qualified individuals, may be issued to the owner-occupant of a Group I or J Occupancy. Request for permit shall be in writing and shall be issued only when approved by the Director. (Revised 7/79 Ordinance No.318)
(b) Application.

1. The application for a permit shall be on forms furnished by the Department and shall contain the information the Department deems necessary. The applicant should exercise care in completing information, especially addresses, as permits are non-transferable unless the address change is approved by the address section of the Design Engineering Division.

EXCEPTION:

The Department retains the right to correct minor errors in the address when a change can be made on all copies of the permit and initialed by the inspector. (Revised 7/83 Ordinance No. 389)

2. The owner may apply for a permit under Section 301 (a) 3.

3. Every application for a permit shall be signed by:
   A. The license holder, or
   B. An authorized representative of the license holder, or
   C. The owner may apply for a permit under Section 301 (a) 3.

(c) Suspension-Cancellation-New Permits.

1. A permit may be cancelled by the Department when:
   A. The work is not commenced within 60 days from the date of issue unless this time is extended by the Department.
   B. The work is suspended or abandoned for a period of 60 days after work is commenced unless this time is extended by the Department.
   C. No request for inspection has been made for a period of 60 days unless this time is extended by the Department.

2. A demolition or moving permit may be cancelled by the Department when:
   A. The work is not commenced within 30 days after the date of issue, or
   B. The work is suspended or abandoned for a period of 10 days after work is commenced unless otherwise approved by the Department.

3. A new permit may be issued to replace an expired permit, provided no changes have been made in the original drawings and specifications for the work, when:
   A. The holder of a cancelled permit demonstrates that the suspension or abandonment of work was occasioned by circumstances beyond his control and that it would be an injustice to require a new fee; or,
B. Payment for a fee equal to 1/2 the current permit fee, provided the application is made within one year after cancellation.

(d) Suspension or Cancellation of Permits. The Department may suspend or cancel any permit, or may stop the work for any of the following reasons:

1. Whenever there is a violation of any provisions of this Building Code or any City ordinance which the Department is empowered to enforce.

2. Upon written notice by the Department or Division affected when the owner or permit holder has failed to comply with the requirements of the Department of Public Works, Zoning Administration, Department of Health and Hospitals, and the Fire Department.

3. Whenever the continuance of any work becomes dangerous to life or property.

(e) Notice. The suspension or cancellation notice for reasons stated in Section (d), shall be in writing and shall be served upon the holder of the permit, the owner, or the person in charge of the work. After the notice is served, it shall be unlawful to proceed with any work.

SECTION 302. PERMIT FEES.

(a) Fees Required. A fee for each permit shall be paid to the Department as set forth in Table 3-A.

An application fee as set forth in Table 3-A shall be paid to the Department at the time of plan submittal. This fee shall provide for clerical processing and storage of the plan. (Rev. 6/86 Ord.No.333)

(b) Valuation. See Chapter 4.

(c) Reinspection Fee. Permit fees provide for customary inspections only. When inspection cannot be completed due to circumstances generated by the permit holder, a fee of $10.00 shall be charged for each reinspection. This fee shall be paid to the Department by the holder of the permit.

(d) Late Fees. When work for which a permit is required by this Building Code is begun without obtaining a permit, the fees stated in Table 3-A shall be doubled. The payment of this double fee shall not relieve any person from fully complying with the requirements of this Building Code in the execution of the work nor from other penalties for performing work without a permit.

EXCEPTION:

For items of work, performed on an emergency basis, as determined by the Department, to maintain an existing service or utility when the maintenance is necessary to protect health, life, or safety, the
penalties stated herein shall not apply if application for a permit is made within 3 normal working days after commencement of the emergency work.

(e) **Fees Not Required.** The City and County of Denver, Denver Housing Authority and School District No. 1 and all agencies and departments thereof, shall be exempt from the payment of fees for work performed on buildings, structures and utilities owned wholly by such agencies or departments devoted exclusively to governmental use.

(f) **Additional Fees.** A supplementary permit shall be obtained for any additional valuation not included in the original permit. The fee shall be the difference between the fee paid and the current fee which would have been required had the original permit included the entire valuation.

(g) **Additional Permit Fees for Rejected Drawings.** When drawings are rejected by the Department an additional fee equal to 10 percent of the permit fee, but not less than $25.00, shall be charged for each rejection.

(h) **Modified Drawings.** When an approved set of drawings is modified or substantially changed so as to require rechecking by the Department, an additional fee equal to 25 percent of the original permit fee, but not less than $25.00, shall be charged. If changes or modifications require additional field inspection of construction, an additional permit fee equal to 10 percent of the original permit fee, but not less than $10.00 shall be charged for each additional inspection.

(i) **Refunds.** No refund will be granted for any permit fee paid to the Department.

**EXCEPTION:** Fees for duplicate permits and out of city permits may be refunded. A processing fee of $25.00 per permit will be charged to the permit holder and that amount will be deducted from the refund. Application for refund must be made within 60 days of the date of the permit. (Revised 7/83 Ordinance No. 389)

**SECTION 303. DRAWINGS AND SPECIFICATIONS.**

(a) **General.** Drawings and specifications shall be required for review and approval by the Department prior to the issuance of a permit.

(b) **New Construction, Additions, Alterations, Repairs.** Application for a permit shall be accompanied by the following:

1. Two complete sets of drawings which shall include architectural, structural, mechanical, electrical and general elevator arrangements. (Revised 5/82 Ordinance No. 245)
2. Two plot plans, except for interior alterations and repairs. (Revised 5/82 Ordinance No. 245)
3. One complete set of specifications.
4. One copy of the land survey. See Section 306.
5. Copies of an engineering report containing studies and test results concerning the hazards present on the building, demolition or moving site when such site is within an area designated as a Special Construction Zone under Article 647 of the Revised Municipal Code. Each report shall contain adequate information as a result of tests to allow identification of the hazards present and recommendations as to methods of minimizing the hazards during construction and methods for controlling the identified hazards likely to be present after construction. The Department of Health and Hospitals and the Fire Department shall approve all reports required by this subsection before any permit is issued. (Revised 3/80 Ord. No. 114)
6. When required by the Department, additional drawings shall be submitted for approval. (Revised 3/80 Ord. No. 114)

   (c) Approval. Drawings and specifications complying with the provisions of this Building Code and approved by the Department shall bear the Department stamp of approval on the first page thereof. When corrections are required to be made, the Department may require that the drawings and specifications be revised and resubmitted for approval prior to the issuance of a permit.

   (d) Distribution. One set of approved drawings shall be returned to the applicant. This set shall be maintained at the job site. One set of approved drawings and specifications shall remain in the office of the Department. (Revised 5/82 Ordinance No. 245)

   (e) Disposal. Upon completion of the work, and when final inspections have been made by the Department, the Department's copy of the approved drawings and specifications may be disposed of at any time after 2 years have elapsed from the date of issuance of the permit. If no permit is issued, plans and specifications may be disposed of after 90 days from the date of application for the permit, or when requested by the permit holder or applicant for a shorter time.

   (f) Not Required. Drawings, specifications and an engineering report need not be submitted for the construction, demolition or moving of minor buildings, additions, structures, or utilities; nor for minor alterations and minor repairs to existing buildings, structures or utilities when the Department is satisfied that the strength, safety, sanitation, and fire resistance are adequately described on the permit.
application, and it is satisfied that such construction, alterations, repair, demolition or moving will not substantially increase the hazard present in a Special Construction Zone. (Revised 3/80 Ord. No. 114)

(g) Utility Companies. With the approval of the Department, the design of buildings, structures or utilities for the franchised or authorized public utility companies may vary from these Building Code requirements.

SECTION 304. PREPARATION OF DRAWINGS AND SPECIFICATIONS. Any person may submit drawings and specifications in connection with an application for a permit, in accordance with the following limitations:

(a) Architect and Engineer Required. Drawings and specifications for the following buildings or structures shall bear the seal and signature of the architect and engineer responsible for the design phases of the building or structure:
1. Buildings or structures 3 or more stories in height.
2. Buildings or structures housing the following Occupancies:
   Group A, B-1, B-2, B-3, C-1, C-2, D-1, D-2, F-1, and F-2 Occupancies except as listed under paragraph (b) of this Section.

(b) Architect or Engineer Required. Drawings and specifications for the following buildings or structures shall bear the seal and signature of an architect or an engineer responsible for the design phases of the building or structure:
Group B-4, E-1, E-2, E-3, E-4, E-5, G-1, G-2, G-3, H-1, H-2, H-3 Occupancy and F-2 Occupancies as approved by the Department.

(c) Architect or Engineer Not Required. Drawings and specifications for the following buildings, structures, additions, alterations, or repairs need not bear the seal of an architect or engineer:
1. Group I and J Occupancies.
2. H-2 and H-3 Occupancies when the floor area of the building does not exceed 5,000 square feet, and the building is not more than one story in height, and is without basement or cellar.
3. Garages, industrial buildings, warehouses, stores, mercantile buildings, or office buildings where the floor area of the building does not exceed 5,000 square feet and the building is not more than one story, without a basement, cellar or excavated sub-floor area.
4. Nonstructural alterations to any building or structure, provided the alterations do not affect the stability of the building or the health and safety of the occupants.
5. If after review of the drawings and specifications, the Department is unable to determine that the proposed building or structure is adequately designed, the Department may require that the drawings and specifications bear the seal of an architect and engineer who will be responsible for the design phases of the building or structure.

6. Architect and Engineer defined, see Chapter 4.

SECTION 305. INFORMATION REQUIRED FOR PREPARATION OF DRAWINGS AND SPECIFICATIONS. Drawings and specifications shall be complete and of sufficient clarity to indicate the entire work proposed and to show in detail that the building, structure, or utility conforms to the provisions of this Building Code, relevant laws, ordinances, rules and regulations. Each set of drawings and specifications shall contain at least the following:

(a) Architectural, Structural, Mechanical, Electrical, Drawings, Specifications, and Analysis.
   1. The exact address, legal description, and location of the work performed.
   2. The name and address of the owner.
   3. Name and address of the person or firm responsible for the preparation of the drawings and specifications. The seal and signature of the architect and or engineer responsible for the preparation of the drawings and specifications shall be affixed to each drawing when required by Section 304.
   4. A plot plan showing the location of the proposed construction and the location of every adjacent existing building on the property, including roads, walks, utilities, and other site improvements, all property lines, streets, alleys, easements, and other public areas.
   5. The gross area in square feet in which new construction or remodel work is being performed.
   6. The Occupancy Group which applies to the building, the type of construction, and the Fire Zone in which the building is located.
   7. Building drawings showing the number of floors, arrangement of each floor, elevations, sections, and details required to show construction and fire-resistive protection, door and finish schedules.
8. Specifications or notes that clearly describe the type, quality, and finish of materials, and the method of assembly, erection, and installation of equipment to be installed.

9. Foundation, floor, and roof plans; elevations; sections and details showing all structural requirements.

10. Foundation design criteria shall be submitted when requested by the Department for all new construction in accordance with a soils investigation report signed and sealed by an engineer responsible for the preparation of the report.

11. Design criteria indicating all lateral and vertical loads and allowable stresses in all structural materials.

12. A field survey per Section 306 shall be required for all additions and new construction.

13. A complete elevator and dumbwaiter layout, if applicable.

14. Mechanical Drawings, Specifications and Analysis Required.
   A. Single line drawings, including typical isometric, of plumbing, heating, air treatment systems, and gas piping layout shall be submitted.
   B. Btu rating of gas units, method of combustion and ventilation air supply, type and horsepower of refrigeration, and gas meter locations.
   C. Heating, cooling, ventilating, plumbing, fire protection details, and fire or smoke damper locations.

15. Electrical Drawings, Specifications, and Analysis Required.
   A. Complete electrical drawing, including a single-line power distribution diagram showing sizes of service, feeder conductors, and overcurrent protection and panel ratings.
   B. Electrical diagrams for fire protection systems as required in Chapters 38 and 53.
   C. Four complete sets of drawings for fire alarm and fire detection systems, shall be submitted prior to installation. Each drawing shall bear the seal and signature of the engineer responsible for the design of the system.
   D. Drawings of all new or replacement services of 400 amperes or more. Drawings shall indicate all information, including calculated loads. Each drawing shall bear the seal and signature of the engineer responsible for the design of the system, when required by the Department.

16. Specifications which describe the type and quality of materials employed with proper reference to accepted standards.

(b) Additional Information, when Requested.
1. Reports from an independent testing agency which substantiate requirements of this Building Code regarding structural or fire-resistive requirements.
2. Engineering design calculations.
3. Other information deemed necessary to determine compliance with the requirements of this Building Code.

SECTION 306. FIELD SURVEYS.
(a) General. Prior to the issuance of a permit, a field survey shall be conducted by a land surveyor registered by the State of Colorado, establishing the following:
   1. Corner Stakes. Location of property corners and placement of corner stakes or markers.
   2. Lines and Locations. Lines and locations of all existing buildings on the property.
   4. Certificate. Items 1 through 3 shall be shown on a surveyor's certificate and shall be drawn to scale.
(b) Access for Department. The contractor or property owner shall provide unobstructed access for the Department to the required corner stakes or markers.

SECTION 307. INSPECTIONS.
(a) General. All work performed shall be subject to inspection by the Department, and certain work shall be continuously inspected by privately employed qualified inspectors. All inspections except those requiring a special or periodical inspection shall be requested at least 24 hours in advance.
(b) Inspection Required. The Department shall conduct the inspections of buildings, structures, or utilities and shall either approve that portion of the work then completed or notify the permit holder or his agent of any failure to comply with the requirements of this Building Code. Inspection shall constitute those as approved by the Department.

(c) Annual Inspections.
   1. Boilers, Incinerators, Crematories, and Pressure Vessel Annual Inspection. Boilers, pressure vessels, crematories, pool heaters, incinerators of all types, and water heaters located in any Group A through H-2 Occupancy shall be inspected by the Department at least once in each year.
2. Vertical Transportation Semi-Annual Inspection. The units enumerated herein shall be inspected by the Department and City Licensed Elevator Contractors as indicated in this Section: Passenger or passenger service elevators, combination passenger and freight elevators, freight and freight service elevators, escalators, dumbwaiters, sidewalk elevators, stage lifts, orchestra lifts, and manlifts.

A. The owner, agent or lessee shall, at his expense, cause the elevator to be thoroughly checked by an Elevator Contractor licensed by the City. This inspection shall include the requirements of Chapter 55 and the following:

A-1. All hoistway doors or gate locking devices shall be checked so that the elevator will not operate when they are in the open position.

A-2. All hoisting and counterweight ropes or cables shall be checked to determine dangerous wear or breaks.

A-3. All hoisting ropes or cables of a winding type machine shall be reshackled every year for overhead machines and every 2 years for basement and garden level type machines.

A-4. The car safety device shall be tested without load, at the lowest possible speed each year; full load at the rated car speed every 2 years for winding machines; and every 5 years for traction machines. The overspeed governor actuating the safety device shall be checked for calibration every 3 years.

EXCEPTION: Listed storage type direct fired water heaters of less than 200,000 BTU/HR input.
If, after inspection by the Department, the equipment is found to be in safe condition, the Department shall issue a certificate stating that the equipment may be operated. The certificate shall be posted in a conspicuous place in the equipment room and shall be framed with glass or clear plastic cover.

Owner to Provide Facilities. Every person owning or having in his possession or control of the equipment enumerated herein, shall provide, at his expense, proper arrangements and facilities for the required inspections. See Chapter 58.

Annual Inspection Fees. The annual inspection fee for boilers, pressure vessels, incinerators, and crematories shall be as specified in Table 3-B.(Rev. 5/87 Ord. No. 95)
B. **Certificate.** If, after inspection by the Department, the equipment is found to be in safe condition, the Department shall issue a Certificate stating that the equipment is ready for use and indicating the maximum load permitted. Certificates shall be maintained, in the building for which they are issued, by the owner, agent or lessee in a manner easily accessible for checking by the Department or other interested persons. Valid elevator certificates shall be mounted in a tamper proof frame in the elevator for which they were issued or a metal plaque indicating where the certificate is located within the building may be mounted in the car in lieu of the current certificate of inspection.

C. **Tag.** The owner or operating agent shall cause the equipment to be tagged so as to indicate the contractor's name and date when the test and work were performed.

D. **Semi-Annual Inspection Fees.** The semi-annual inspection fee for vertical transportation units shall be as specified in Table 3-C.

(d) **Special Inspection - Inspector.**

1. The Department may require the owner or his agent to employ a qualified inspector during construction for the following types of work:

   A. **Concrete.** Structural reinforced concrete work including forms and placement of reinforcement; and on precast, prestressed and post tensioned concrete.

   B. **Masonry.** Plain masonry when the design is based upon an ultimate design strength of masonry in excess of 1,000 pounds per square inch.

   C. **Structural Steel.** At all times during the erection of structural steel when field bolting, riveting, or structural welding is being performed.

   D. **Special Cases.** Special construction or work involving unusual hazards; or when the Department does not have the capability to perform the required inspection(s).

2. **Special Inspector.** The special inspector shall be a qualified person approved by the Department and shall be an engineer registered in the State of Colorado, an architect licensed in the State of Colorado, or a person in the employ of or subject to direct supervision and control of the named engineer or architect.

   A. **Duties of Special Inspector.** The special inspector shall provide continuous inspection of the construction or work requiring his employment. He shall submit a written report of his inspections to the owner and to the Department.
(e) **Other Inspections.** The Department may make or require other inspections for any work to ascertain compliance with the provisions of this Building Code and other laws enforced by the Department.

(f) **Inspection Record Card.** No work shall be commenced before the permit holder has posted an inspection record card in a conspicuous place. This Card shall include the information required by the Department and shall be maintained until the work has been completed and all final inspections made. Upon completion of the work, and after all required inspections have been made and properly signed by personnel of the Department, the record card shall be returned to the Department by the Construction permit holder. Return of the completed card shall be required prior to the issuance of a Certificate of Occupancy, where the Certificate is required.

(g) **Exposure of Work.** Where work is concealed by additional work without first having been inspected as required, the Department may order, by written notice, that the work be exposed for examination. The work of exposing and recovering shall not entail expense to the City.

**SECTION 308. CERTIFICATE OF COMPLIANCE.** A Certificate of Compliance may be issued by the Department to the General Building Contractor when the inspection card issued by the Department is returned indicating that all final inspections by the Department's inspectors have been made. (Revised 3/86 Ord. No. 130)

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**SECTION 309. CERTIFICATE OF OCCUPANCY.**

(a) **Required.** New buildings or structures in Group A through H and I-2 occupancies and new buildings in a Planned Building Group under Section 59-616 of the Revised Municipal Code shall not be used or occupied until a certificate of occupancy is issued by the Department. No building or portion thereof shall be used or occupied for an occupancy other than the one designated on the certificate until a new certificate of occupancy is issued by the Department. (Revised 5/87 Ord. No. 249)

(b) **Requirements Prior to Issuance.** A certificate of occupancy shall be issued to the owner after the issuance of a certificate of compliance as specified in Section 308, and after approvals by other Departments as follows:

1. Approved by Construction Engineers Division, Wastewater Management and Zoning Administration.
2. Approval by the Department of Health and Hospitals and the Fire Department when specifically requested by both Departments in writing at the time of application.

3. Approval by the Department of Health and Hospitals, Fire Department, and the Department of Public Works showing compliance with all provisions of this Building Code applicable to buildings or structures located in a Special Construction Zone designated pursuant to Article 647 of the Revised Municipal Code. (Revised 3/80 Ord. No. 114)

(c) Issuance of Certificate. When all the conditions of this Chapter have been fulfilled, the Department, in conjunction with the Zoning Administrator, shall issue a Certificate of Occupancy indicating:
1. The use and occupancy for which the certificate is issued.
2. Approval by the Department and Zoning Administrator.

(d) Duplicate Certificate of Occupancy. Upon payment of $5.00 to the Department, a duplicate Certificate of Occupancy may be secured by the owner, architect, engineer, contractor, permit holder or tenant.

(e) Temporary Certificate of Occupancy. The Department may issue a temporary certificate of occupancy to the owner where unusual construction difficulties have delayed the completion of the building. The certificate may be issued upon payment of a fee to the Zoning Administration provided:
1. No substantial hazard will result from the occupancy.
2. Approved by the Department of Zoning Administration.
3. Approved by Construction Engineering Division and Wastewater Management of the Department of Public Works.
4. Approved by the Department of Health and Hospitals and Fire Department when specifically requested by either of said Departments, in writing, at the time of application.
This temporary certificate shall be valid for a period of 6 months. Upon application by the owner the certificate may be extended by the Department for an additional 6 months if reasonable cause can be shown. After the expiration date of the temporary certificate of occupancy, the building or structure shall require a Certificate of Occupancy in accordance with other provisions of this chapter. (Rev. 7/86 Ord.No. 419)

(f) Change of Occupancy. Changes in the character or occupancy of Group A through I Occupancies shall not be made except as specified in Chapters 5 and 31 of this Building Code.
(g) **Cancellation of Certificate of Occupancy.** A Certificate of Occupancy may be cancelled when:
   1. The owner has failed to comply with the requirements of the Department of Public Works.
   2. The continued occupancy of the structure is dangerous to the public health, safety, or welfare.

(h) **Violation.** It shall be a violation of this Building Code to occupy a building or structure prior to obtaining a Certificate of Occupancy when required.

**SECTION 310. ADDRESS.**
(a) **On Job Site.** The construction permit holder shall post, at the front of the premises in a conspicuous place, a sign indicating the following:
   1. The address number and street or avenue, court, parkway or other, as assigned by the office of the City Engineer.
   2. The name of the firm, address, business phone number, and emergency phone number of permit holder.
   3. The Building Permit number.

(b) **Permanent Address.** The owner or occupant of every building shall display the permanent address of each building in a permanent visible location on the building.

**SECTION 311. TEMPORARY BUILDING PERMIT.** A permit for a temporary building may be issued by the Department if the applicant can substantiate that an emergency and a definite need for the temporary building exists. The Permit shall not exceed 6 months duration. However, after the expiration date of the permit, if the applicant can demonstrate that there have been no complaints or hazards as a result of this temporary occupancy, the Department may issue a renewal of the permit for an additional 6 months. The request for a permit shall be in writing, detailing the reason for the request. The basis for approval shall be on the need, extent of time, and the type of unit to be installed.

**EXCEPTION:** Temporary buildings for use by licensed contractors at the construction or demolition sites, shall not require a permit.

**SECTION 312. FOUNDATION PERMITS.**
(a) **General.** A foundation permit for Group A through H Occupancies may be issued to a contractor who holds a license qualifying him as a general contractor for the entire project, prior to the issuance of the Construction Permit for the building, provided:
1. When the total valuation of the project, excluding utilities, exceeds $200,000 or as approved by the Department.

2. Drawings of the proposed superstructure containing sufficient detail relating to the design of the foundation or substructure are submitted to the Department. Complete calculations shall be submitted to validate the design of footings, caissons and all other substructure elements.

3. Approvals required by the appropriate City agencies are obtained prior to issuance of the permit.

4. For purposes of this Section, the term “Project” shall mean one building only with a valuation in conformance with Section 312 (a) 1.

(b) **Fee.** The fee charged at the time of issuance of the foundation permit shall be based on the total valuation of the construction for both the substructure and the superstructure, plus an additional 25 percent. See Table 3-A.

(c) **Deviations.** Any deviation from the approved foundation permit drawings shall be cause for the cancellation of the Permit. However, if changes are substantiated by engineering calculations and revised drawings, the deviations may be approved by the Department.

(d) **Responsibility.** The contractor shall assume full responsibility for the installation of all utilities in the substructure. Any changes in design or construction to meet the requirements of this Building Code for the combined substructure shall be the sole responsibility of the contractor. A Permit issued under this Section shall not be construed as approval for any portion of the structure not covered by the foundation permit.

(e) **Not Applicable.** Foundation Permits are not applicable to Phased Construction.

**SECTION 313. PHASED CONSTRUCTION PERMITS.**

(a) **General.** The Department may issue permits for the construction of a portion or phase of a building, structure, or utility prior to the submission of the complete drawings and specifications, provided:

1. The minimum total valuation of the building, structure, or utility is more than $1,000,000.

2. The approval of appropriate City agencies has been obtained prior to application for the initial permit.

3. The valuation of the portion of the work, including utilities, is stated on each application.

4. Drawings shall show on each sheet the note “Phased Construction” with a brief description of the phase covered by the permit.
(b) **Fees.** Permit fees shall be assessed at twice the amount of those specified in Table 3-A. A permit issued under this Section shall not be construed as approval for any portion of the structure not covered by the permit.

**SECTION 314. TABLES AND FEES.**

(a) **Permit Fees.** A fee, specified in Table 3-A shall be assessed for all permits except as otherwise provided for in this Chapter.

(b) **Other Fees.**

1. Annual and semi-annual fees shall be as specified in Tables 3-B and 3-C.

2. Fees for special inspections requested to be made after 4 p.m. or prior to 8 a.m., or at any time on any Saturday, Sunday or Holiday, shall be $50.00 per man hour with a minimum charge of two man hours. All such requests for inspections shall be made 24 hours prior to such inspection. Any calls for such inspection made less than twenty-four (24) hours in advance shall be accepted only with the approval by the Director. (Rev. 3/86 Ord. No. 141)
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**Building Moving Permits**

| Per Each Address | $100.00 |

(Rev. 8/86 Ord. No. 516)
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Saturday, Sunday and Holiday Inspection Fees shall be double the fees indicated in Table 3-B.

1For purposes of determining fees for electric boilers one boiler horsepower is equivalent to 10 kilowatts.

2For electric water heaters divide kilowatt rating by 0.000293 to obtain BTU/HR equivalent.

(Revised 5/87 Ord. No. 95)
## TABLE NO. 3-C

**PERIODICAL INSPECTION FEES**  
*(VERTICAL TRANSPORTATION)*

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<tbody>
<tr>
<td>Elevators</td>
<td>$37.00 (each unit)</td>
</tr>
<tr>
<td>For each additional landing over 3</td>
<td>1.00</td>
</tr>
<tr>
<td>Escalators *</td>
<td>37.00 (each unit)</td>
</tr>
<tr>
<td>Dumbwaiters</td>
<td>37.00 (each unit)</td>
</tr>
<tr>
<td>Stage Lifts</td>
<td>37.00 (each unit)</td>
</tr>
<tr>
<td>Orchestra Lifts</td>
<td>37.00 (each unit)</td>
</tr>
<tr>
<td>Man Lifts</td>
<td>37.00 (each unit)</td>
</tr>
</tbody>
</table>

*This shall mean each unit, floor to floor, in either direction.

Saturday, Sunday, and Holiday Inspection Fees shall be double the fees indicated in Table 3-C. (Rev. 5/87 Ord. No. 98)
CHAPTER 4

DEFINITIONS AND ABBREVIATIONS

SECTION 401. INTRODUCTION. For purposes of this Building Code, certain words, phrases and terms shall be given the defined meaning. Words, phrases and terms neither defined herein, nor in this Building Code, shall be given their usual and customary meanings. The text of this Building Code shall control captions, titles, maps, figures, and diagrams. The word "shall" is mandatory and not permissive; the word "may" is permissive and not mandatory. Words used in the singular shall include the plural, and words used in the plural shall include the singular. Words used in the present tense shall include the future tense, and words used in the future tense shall include the present tense. Words used in the masculine gender shall include the feminine, and words used in the feminine gender shall include the masculine. Many other terms and abbreviations used only with specialized application are defined in the Chapter in which they are used.

SECTION 402. DEFINITIONS.

ABANDON. The desertion of a building, structure or utility. Abandon shall also apply when the building, structure, or utility is left to the effects of vandalism, dilapidation, and deterioration, thereby creating a fire hazard, unsafe condition, or a public nuisance.

ACCESSORY USE, MINOR. A secondary occupancy or use closely associated with the principal use. See Chapter 5.

ADDITION. Construction which increases the external dimensions of a structure.

ADEQUATE. Determined to be acceptable to the Department.

AGGREGATE. See Chapter 26.

AIR CONDITIONING. See Chapter 52.
AISLE. A free, unobstructed passageway in a building for public ingress and egress to and from seats or other similar use areas leading to a lobby, foyer, corridor, or exit. See Fire Code.

ALLEY. An established passageway for vehicles and pedestrians affording a secondary means of access to properties abutting on a street or highway.

ALTERATION. Any change, re-arrangement, addition, or modification in construction or occupancy.

APARTMENT. A living unit in an apartment building.

APARTMENT BUILDING. Any building, or portion thereof, occupied as the residence of 3 or more families living independently of each other, with separate eating, sleeping, and toilet facilities.

APPLIANCE. See Chapters 41, 51, 53.

APPRENTICE. See Chapter 2.

APPROVED. Methods, materials, equipment, and types of construction accepted officially by the Department as determined from the results of investigation and tests by recognized testing laboratory, national authorities, technical and scientific organizations, and by the standards established in this Building Code. Approved (Approval) shall also mean to be officially acceptable or satisfactorily meeting the basic requirements of this Building Code and Department.

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or furnishing inspection services when the agency has been approved by the Department.

APPROVED FABRICATOR. An established and qualified person, firm, or corporation approved by the Department.

ARCADE. A covered passageway between buildings.

ARCHITECT. An Architect licensed by the State of Colorado.

AREA. See Floor area.
AREAWAY. An excavated space outside the wall of a building used for access, lighting, or ventilation.

ASPHALT. See Chapter 32.

ASSEMBLY BUILDING. A building used in whole, or in part, for the assembly of persons for purposes of deliberation, education, instruction, worship, entertainment, recreation, amusement, dancing, drinking, dining, awaiting transportation, and other similar uses.

ASSEMBLY, FIRE. See Chapter 43.

ATRIUM. A space entirely within a building, covered with a floor or roof, and forming a vertical opening through more than 2 floors. (Revised 10/81 Ord. No. 518)

ATTIC STORY. A story located wholly or partly within a roof structure and used for occupancy or storage.

AWNING. See Chapter 45.

BALCONY. That portion of the seating space of an assembly room in which the lowest part is raised 4 feet or more above the level of the main floor. A balcony is also a projection from a building, designed to be occupied or used.

BALCONY, EXTERIOR EXIT. See Chapter 33.

BALCONY, INTERIOR. See Mezzanine.

BALCONY, PRIVATE. A balcony provided for the exclusive use of one tenant.

BALCONY, PUBLIC. A balcony used by more than one tenant, or as an exterior exit balcony.

BASEMENT. That portion of a building between floor and ceiling which is partly below and partly above grade, located so that the vertical distance from grade to floor below is less than the vertical distance from grade to ceiling. See Story.
BOARD. The Board of Appeals.

BOILER. See Chapter 58.

BOILER or FURNACE ROOM. A boiler or furnace room is any room where central fired heating equipment is located. This equipment may be producing hot water, steam or warm air and the equipment utilizes solid, liquid, liquified petroleum gas, natural or manufactured gas as fuel. For purposes of this Building Code, this definition shall not include floor or dual-wall furnaces, unit heaters, space heaters, wall type heaters, water heaters of less than 100 gallon storage capacity, or any heating equipment in a Group I Occupancy. See Chapters 17 and 51 for enclosures.

BREEZEWAY. See Arcade.

BRICK. See Chapter 24.

BUILDING. A structure, including utilities, enclosed with a roof and within exterior walls built and designed for the housing, shelter, enclosure and support of individuals, animals or property of any kind. See Chapter 3.

BUILDING EXISTING. A building constructed prior to the adoption of this Building Code, or on land annexed to the City.

BUILDING, TEMPORARY. A building not intended for permanent use. See Chapter 3.

BURNER. See Chapter 51.

CANOPY. See Chapter 45.

CARPORT. A covered shelter for automobiles or similar motor vehicle.

CAST STONE. A precast building stone manufactured from portland cement concrete.

CELLAR. That portion of a building between floor and ceiling which is wholly or partly below grade and located so that the vertical distance from grade to the floor below is equal to or greater than the vertical distance from grade to the ceiling.

CEMENT. See Chapters 26 and 47.
CENTRAL STATION. See Chapter 38.

CITY. The City and County of Denver.

CLINIC. A building or portion thereof which contains offices for the diagnosis and treatment of out-patients for health services. This definition does not include buildings which provide facilities for overnight accommodation of patients.

COLUMN. See Chapters 23, 25, 26, and 27.

COMBUSTIBLE MATERIAL. Material which will ignite and burn when subjected to fire.

CONCRETE. See Chapter 26.

CONSTRUCTION. All labor and materials used in the erection, demolition, or removal of a building, structure, utility, appliance or device.

CORRIDOR. See Chapter 33.

CORRIDOR, PRIVATE. See Chapter 33.

CORRIDOR, PUBLIC. See Chapter 33.

COURT. A space open to the sky and bounded on 3 or more sides by walls of a building. An inner court is a court entirely within the exterior walls of a building. See Chapter 33.

CRAWL SPACE. A space located under the first floor of a building which provides a clear height of less than 5 feet.

DEAD LOAD. See Chapter 23.

DECORATION. Shall mean painting, wall papering, installation of cabinets, curtains and drapes and similar items as indicated in this definition.

DEMOLITION. The destruction and removal of a building, structure, or utility.
DEPARTMENT. The Building Inspection Division of the Department of Public Works.

DETERIORATION. Buildings, structures, utilities, equipment, and materials in which corrosion, decay, wear and tear through use or abuse, obsolescence, effects of the elements, fire damage, disaster, flood, earthquake, lack of maintenance, vandalism, or any other cause, including fatigue due to overstressing, disintegration of component parts, and the separation of materials and structural parts occurs.

DIRECTOR. The Officer charged with the administration and enforcement of this Building Code, or his authorized representatives. See Chapter 1.

DOMESTIC APPLIANCE. See Chapter 41.

DOOR, FIRE. See Chapter 43.

DOOR, LEAF. A single door section. When an opening is closed by 2 or more doors, each individual door shall be considered a leaf.

DOOR, SELF-CLOSING. A door which closes automatically after use.

DORMITORY. A building, or portion thereof occupied as a residence by an organized group of unrelated persons sharing common living facilities.

DWELLING. A building occupied as the residence of one or 2 families living independently of each other, with separate eating, sleeping, and toilet facilities.

DWELLING, MULTIPLE. See Chapter 13.

ENGINEER. An Engineer Registered by the State of Colorado.

EXHIBITION HALL. See Chapter 18.

EXISTING BUILDING. See Building, Existing.

EXITS. See Chapter 33.

EXTINGUISHING AGENT. See Chapter 38.
FAMILY. An individual, two or more persons related by blood or marriage, or a group of not more than five persons, excluding servants, who need not be related by blood or marriage, living together in a dwelling.

FIRE ALARM SYSTEM. See Chapter 38.

FIRE ASSEMBLY. See Chapter 43.

FIREBRICK. See Chapter 48.

FIRE CODE. The Fire Code of the City and County of Denver administered by the Fire Department.

FIRE DAMPER. See Chapter 52.

FIRE DEPARTMENT. The Fire Department of the City and County of Denver.

FIRE DETECTION SYSTEM. See Chapter 38.

FIRE DISTRICT ZONING. See Chapter 16.

FIRE DOORS. See Chapter 43.

FIREPLACE. See Chapter 48.

FIRE PROTECTION SYSTEM. See Chapter 38.

FIRE RESISTIVE CONSTRUCTION. See Chapters 5 and 43.

FIRE SPRINKLER SYSTEM. See Chapter 38.

FIRE STANDPIPE SYSTEM. See Chapter 38.

FLAME-SPREAD. The propagation of flame over a surface.

FLAME-SPREAD RATING. See Chapter 42.

FLAMMABLE LIQUID. See Fire Code.

FLOOR-AREA. The area included within the surrounding exterior walls of a building. The floor area of a building without surrounding walls
is the area of the horizontal projection of the roof or floor above.

FOOTING. That portion of the foundation of a building, structure or utility which distributes and transmits loads directly to the bearing surface.

FUELS. See Chapter 51.

FURNACE. See Chapter 52.

FURNACE ROOM. See Boiler or Furnace Room.

GARAGE. A building, or portion thereof, in which vehicles are housed.

GARAGE, OPEN PARKING. See Chapter 12.

GARAGE, PRIVATE. A building, or portion thereof with an area of not more than 1000 square feet, in which motor vehicles used by tenants of the building are stored.

GARAGE, PUBLIC. Any garage other than a private garage.

GARAGE, REPAIR. A building, or portion thereof used for the repair of internal combustion engines; repair of motor vehicle transmission, differentials, frames or bodies; where any part is removed for repairs which would render the vehicle inoperative; repairs requiring welding or brazing; stripping of inoperative motor vehicles; painting, or any other work not permitted in a storage garage.

GARAGE, STORAGE. A building other than a private, repair, or open parking garage used exclusively for the housing of motor vehicles.

GAS. See Chapter 51.

GRADE. The lowest point of elevation of the finished surface of the ground, paving, or sidewalk within the area between the building and the property line; or when the property line is more than 5 feet from the building, between the building and a line 5 feet from the building.

GROUT. See Chapter 24.

GUEST. Any person hiring or occupying a room for living or sleeping purposes.
GUEST ROOM. A room used by a guest for sleeping purposes.

GYPSUM, GYPSUM LATH AND PLASTER. See Chapter 47.

HABITABLE SPACE. Any room used for sleeping, living, cooking, and dining purposes, excluding closets, pantries, bath and toilet rooms, janitors closets, connecting corridors, laundries, unfinished attics, foyers, storage spaces, utility rooms, and other similar spaces.

HANDRAIL. For purposes of this Building Code, the work handrail shall mean a rail serving as a guard or support to be held by the hand as along a stairway, the widest horizontal dimension not to exceed 3 1/2 inches.

HEIGHT OF BUILDING. The vertical distance above grade to the highest point of the coping of a flat roof or to the highest point of a pitched roof. The height of a stepped or terraced building is the maximum height of any portion of the building.

HELIPORT. An area of land, water, or a structural surface used for the landing, take-off, and servicing of helicopters.

HELISTOP. A structural surface used for the landing and take-off of helicopters, with no refueling or repairs.

HIGH RISE BUILDING. Any building having floors used for human occupancy more than 75 feet above the lowest level of Fire Department vehicle access. (Revised 3/87 Ord. No. 119)

HOMES, NURSING. See Nursing Homes.

HOSPITAL. A building, or portion thereof, used for the treatment and housing of ill or injured persons.

HOSPITAL, MENTAL. A building, or portion thereof, used for the treatment and housing of mentally ill persons.

HOTEL. A building, or portion thereof, used for the living accommodation of guests on a short term rental basis, and which does not provide individual kitchen facilities.
INCINERATOR. See Chapter 48.

INCOMBUSTIBLE. See Noncombustible.

LANDING. A continuation of the floor of a building giving access to stairs, ramps, or an escalator, and any level space between runs.

LINTEL. A structural member placed over an opening or recess in a wall for the purpose of supporting construction above.

LISTED, LISTING. Materials or equipment shown in a list published by an approved testing agency qualified and equipped for experimental testing, maintaining a periodic inspection of current productions, and whose listing states that the material or equipment complies with nationally recognized safety standards, and the Standards of this Building Code.

MACHINE ROOM. A room used for the housing of elevator, refrigeration or air handling equipment.

MAINTENANCE. Shall mean the normal upkeep of property or equipment. To keep in an existing state such as minor repairs to equipment to keep such operational. This definition shall not invalidate the requirement for a Permit when so determined by the Department as beyond the scope of maintenance.

MARQUEE. A rigid, roof-like structure attached to the exterior walls of a building.

MASONRY. See Chapter 24.

MEZZANINE. An intermediate floor placed in any story or room. When the total area of the mezzanine exceeds one-third of the total floor area in that room, it shall be considered to be an additional story. The clear height below a mezzanine floor construction shall be at least 7 feet. (Revised 5/82 Ord. No. 245)

MORTAR. See Chapters 24, 47, and 48.

MOTEL. A hotel as defined in this Building Code.

NONCOMBUSTIBLE. Noncombustible as applied to building construction means a material which, in the form it is used, is either one of the following:
1. Material of which no part will ignite and burn when subjected to fire. Any material conforming to ASTM E-136 shall be considered noncombustible within the meaning of this Section.

2. Material having a structural base of noncombustible material as defined in item No. 1 above, with a surfacing material not over 1/8 inch thick which has a flamespread rating of 50 or less. "Noncombustible" does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, kitchen exhaust systems or other sources of high temperatures shall refer to material conforming to item No. 1. No material shall be classed as noncombustible which is subject to increase in combustibility or flame-spread rating, beyond the limits herein established, through the effect of age, moisture or other atmospheric condition. Flame-spread rating as used herein refers to rating obtained according to tests conducted as specified in ASTM E-84. (Revised 5/82 Ord. 245)

NURSING HOME. A facility which is operated in connection with a hospital or in which nursing care and medical services are prescribed by or performed under the general direction of persons licensed to practice medicine or surgery by the State of Colorado; for the accommodation of convalescents or other persons who are not actually ill and not in need of hospital care and related services. The term Nursing Home is restricted to provide those facilities, the purpose of which is those contained in skilled nursing care and related medical services for a period of not less than 24 hours per day.

OCCUPANCY. The purpose for which a building, or portion thereof, is used or intended to be used.

OCCUPANCY, MIXED. The use of a building for more than one occupancy.

OCCUPANT LOAD. See Chapter 33.

OCCUPIED ROOF. The roof of a building or structure used for purposes other than maintenance, repair, or servicing of the building or equipment.

OWNER. A person, firm, corporation, or agent having a legal or equitable interest in a property.

PANIC HARDWARE. See Chapter 33 and 43.

PARTITION. A vertical construction used to divide a building, or portion thereof, into rooms or spaces.
PARTITION, PERMANENT. A partition meeting the requirements of this Building Code for fire-resistance or noncombustibility as determined by the type of construction.

PARTITION, TEMPORARY. A partition which does not meet the requirements of this Building Code for fire-resistance or noncombustibility as determined by the type of construction.

PENTHOUSE. An enclosed structure built on or above the roof of a building, and used for the housing of machinery or equipment, and not used for habitation.

PERMIT. An official document issued by the Department authorizing performance of a specified activity.

PERSON. A natural person, his heirs, executors, administrators, or assigns; also a firm, corporation, or partnership, its successors or assigns; or an agent of any of the aforesaid.

PERSONAL CARE BOARDING HOME. A facility which provides meals and personal care for ambulatory tenants. Personal care shall include the following services: housekeeping, maid service, laundry, social supervision, and other services of a personal nature.

PIER. See Chapters 23, 24, and 29.

PIT. See Chapters 52 and 55.

PLATFORM. An elevated portion of an assembly room which does not meet the requirements for an enclosed platform, stage, or balcony.

PLATFORM, ENCLOSED. A partially enclosed portion of an assembly room, the ceiling of which is not more than 5 feet above the highest point of the proscenium opening, and which is used for the presentation of plays or other entertainment wherein scenery, drops, decorations, or other effects may be used.

PLASTIC. See Chapter 60.

PLUMBING. See Chapter 50.

PORCH. A roofed structure providing shelter at the entrance of a building or an open or enclosed room at the outside of a building.
PREFABRICATED ASSEMBLY. See Chapter 34.

PROSCENIUM. A vertical plane or separation between an assembly area and a stage or enclosed platform.

PUBLIC WAY. See Chapters 33 and 45.

RECOGNIZED VOLUNTEER ORGANIZATION. A non-profit organization, organized for the purpose of aiding the needy and which is recognized by the Internal Revenue Service as a charitable organization or a religious organization. (Revised 7/79 Ordinance No. 318)

REFRIGERANT - REFRIGERATION SYSTEMS. See Chapter 49.

REFUGE AREA. A specified area within a building constructed and ventilated to protect the occupants from fire and/or smoke. (Revised 10/81 Ord. No. 518)

REPAIR. The reconstruction or renewal of any portion of an existing building, structure, or utility.

REHABILITATION CENTER. A center for the rehabilitation of handicapped persons.

RETAIL ESTABLISHMENT. Any occupancy open to the public for the purpose of buying or selling goods or services.

ROOF. See Chapter 32.

ROOF, OCCUPIED. See Occupied Roofs.

ROOF, OPEN FRAME. A roof with all supporting members exposed on the underside and without a ceiling.

ROOF STRUCTURE. A structure above or on the roof of a building including: cooling towers, tanks, heating and cooling equipment, spires and towers or any other projection above the roof, not used for habitation.

SCHOOL, PUBLIC OR PRIVATE. An institution which provides instruction or education at elementary, secondary and high school learning levels.

SCHOOL, VOCATIONAL. An institution which provides instruction
or education for a trade, art, voice, music, modeling, or similar endeavors.

SENIOR HOMES (HOMES FOR THE AGED). A building for the housing of the elderly which does not provide hospital, medical personal care, or detention services.

SERVICE STATION. A building or lot, the primary purpose of which is the sale of motor vehicle fuel. The term may include the replacement of minor parts and minor repairs, but does not include parking of motor vehicles within a building, or repair garage use.

SHAFT. An enclosed vertical opening through a building.

SIGN STRUCTURE. See Chapter 56.

SKYLIGHT. See Chapters 54 and 60.

SMOKE CONTROL SYSTEM. See Chapter 18. (Revised 10/81 Ord. No. 518)

STAGE. A partially enclosed portion of an assembly building or room used for the presentation of plays or other entertainment wherein the scenery, drops, decorations or other effects may be used, where the distance between the top of the proscenium opening and the ceiling above is more than 5 feet, and the stage is equipped with tie and fly galleries.

STAIRS. See Chapter 33.

STAIRWAY. 2 or more risers.

STAIRWAY, EXIT. See Chapter 33.

STAIRWAY, PRIVATE. See Chapter 33.

STORY. That portion of a building included between the upper surface of any floor and the floor next above, except that the topmost story is that portion of a building included between the upper surface of the topmost floor and the ceiling above. If the finished floor level directly above a basement, cellar, or unused under-floor space is more than 6 feet above grade for more than 50 percent of the total perimeter of the building, or is more than 12 feet above grade at any point, the basement, cellar, or unused under-floor space shall be considered as a story. (Revised 5/82 Ord. No. 245)
STREET. A thoroughfare dedicated or deeded to the public for public use. A street may also be a thoroughfare not dedicated or deeded to the public, but on private property and used by the public.

STRUCTURE. An assembly of materials forming a construction for occupancy and including among others, building, stadiums, tents, reviewing stands, platforms, stagings, observation towers, radio and television towers, water tanks, swimming and wading pools, retaining walls, open sheds, coal bins, shelters, fences, display signs. This definition shall not include utilities.

TENANT. A person or persons occupying a building, or portion thereof, and separated from other tenants by walls, floors, and ceilings.

TIER. One of 2 or more rows arranged one above the other.

TREAD. The horizontal portion of a step, including nosing.

UNDERGROUND. The word underground is defined as embedded by completely burying pipe, cable, or etc., in earth.

UNSAFE BUILDING, STRUCTURE, OR UTILITY. See Chapter 1.

USE. The purpose for which a building is occupied.

USEABLE SPACE. Space that may be used. This definition does not apply when a useable or potential useable space is sealed off so that access to the area is not provided.

UTILITIES. For the purpose of this Building Code, utilities shall be defined, without limitation, to include the following:
Refrigeration systems and their appurtenances; electrical systems and all appurtenances, such as motors, etc; heating and ventilating systems and appurtenances; elevators, dumb waiters, escalators, and similar conveyances; fire protection systems and apparatus; air conditioning or air treatment systems, including ductwork; exhaust or ventilating systems, including ductwork; plumbing and sanitary systems and all appurtenances; signal and annunciator systems; gas, oil, and solid fuel fired appliances, piping, controls, burners, and their appurtenances; evaporative cooling, antennae, wells, and equipment; water heaters; gas lights; swimming pool piping; gasoline pumps; L.P.G., liquid fuel, and gasoline tanks and piping.
UTILITY PUBLIC. An authorized or franchised firm which is given the right to perform services necessary to fulfill obligations specified in the authorization or franchise.

VALUE OR VALUATION. The determination of value or valuation for permit purposes shall include labor, profit, overhead, materials, equipment and appliances. In addition, the determination pertaining to the listed items herein and for other uses shall be made or directed to be made by the Department.

VENNEER. See Chapter 30.

VENT. See Chapter 37.

VENTILATION. See Chapter 52.

VERTICAL OPENING. An opening extending vertically through one or more floors of a building.

VERTICAL TRANSPORTATION. See Chapter 55.

WALL. A vertical structural member which encloses, divides, supports, or protects a building or room.
   Bearing. A wall which supports any load other than its own weight.
   Cavity. See Chapter 24.
   Composite. See Chapter 24.
   Faced. See Chapter 24.
   Foundation. A wall extending from the footing to the lowest floor and serving as the support for other parts of the building.
   Hollow. See Chapter 24.
   Interior. A wall entirely within the exterior walls of a building.
   Non-Bearing. A wall which supports no load other than its own weight.
   Panel. See Chapter 24.
   Parapet. That part of a wall entirely above a roof line surface.
   Party. A wall used or adapted for joint service between two buildings.
   Retaining. A wall designed to resist the lateral displacement of earth or other forces.
   Solid. See Chapter 24.
   Spandrel. See Chapter 24.
Veneer. See Chapter 24 and 30.

WEATHER EXPOSED SURFACE. Any building surface exposed to the elements.

WINDOW, BAY. A rectangular, curved or polygonal window.

WORK. Work includes all construction or repair but does not include decoration or maintenance of existing utilities or appliances.

WRECKING. See Demolition.

YARD. An open unoccupied space, other than a court, situated on the same lot with a building.
CHAPTER 5

CLASSIFICATION OF ALL BUILDINGS BY USE OR OCCUPANCY; GENERAL REQUIREMENTS FOR ALL OCCUPANCIES

SECTION 501. OCCUPANCY CLASSIFIED.
   (a) General. Every building shall be classified according to its use or the character of its occupancy as a building of Group A through J, as defined in Table 5-A, and in Chapter 6 through 15, respectively.
   (b) Other Occupancy. Any occupancy not mentioned specifically, or about which there is any question, shall be classified by the Department and included in that Group which it most nearly resembles, based upon the existing or proposed use and fire hazard.

SECTION 502. CHANGE IN OCCUPANCY.
   (a) General. Changes shall not be made in the character of an occupancy or use of any building which would place the building in a different Division of the same Group of occupancy or in a different Group of occupancy unless the building shall be made to comply with requirements of this Building Code for that Division or Group of occupancy.
   EXCEPTION: Historic structures as designated by the Denver Landmark Preservation Commission shall be inspected and reviewed by the Department and shall be made to comply only with those requirements of this Building Code which are deemed necessary for public safety. See Chapter 31.
   (b) Change. The character of the use or occupancy of existing buildings may be changed, subject to the approval of the Department; and the building may be occupied for purposes in other Groups of occupancy without conforming to all the requirements for those groups; provided the new or proposed use or occupancy is less hazardous, based upon use and fire hazard, than the existing use. There shall be no change made in the use of a building which changes the occupancy classification without the issuance of a new Certificate of Occupancy as required in Chapter 3 of this Building Code.

SECTION 503. MIXED OCCUPANCY.
   (a) General. When a building is used for more than one occupancy purpose, each part of the building comprising a distinct “Occupancy”, as described in Chapters 5 through 15, shall be separated from any other occupancy as specified in Section 503 (c) and Table 5-B. When a building houses more than one occupancy, each portion of the building shall
conform to the requirements for the occupancy housed therein. The area of the building shall be such that the sum of the ratio of the actual area divided by the allowable area for each separate occupancy shall not exceed one. When minor accessory uses do not occupy more than 10 percent of the area of any floor of a building nor more than the basic area permitted by Table 5-C for the minor use, the major use of the building shall determine the occupancy classification, provided the uses are separated as specified in Table 5-B.

(b) Type of Separations. Occupancy separations shall be vertical, horizontal or both; or as may be required to afford a complete separation between the various occupancies in the building. Occupancy separations shall be classed as 4-Hour, 3-Hour, 2-Hour, and 1-Hour Fire-Resistive.

(c) Requirements for Separations. Occupancy separation shall be provided between the various Groups and Divisions of occupancies as specified in Table 5-B.

1. A 4-Hour Fire-Resistive occupancy separation shall be at least 4-hour fire-resistive construction. Openings in walls forming the separation shall be protected by a fire assembly which provides a 3-hour fire-resistive rating. The total width of all openings in any story shall not exceed 10 percent of the length of the walls in that story, and no single opening shall exceed 25 square feet. Horizontal openings shall not be permitted.

2. A 3-Hour Fire-Resistive occupancy separation shall be at least 3-hour fire-resistive construction. Openings in walls forming the separation shall be protected by a fire assembly which provides a 3-hour fire-resistive rating. The total width of all openings in any story shall not exceed 25 percent of the length of the walls in that story, and no single opening shall exceed 120 square feet. Openings in floors shall be protected by vertical enclosures extending continuously above and below the openings to the adjacent floors or to the point of termination of the penetrating enclosure. Vertical enclosures shall be at least 2-hour fire resistive construction, and openings therein shall be protected by a fire assembly which provides a 1-1/2 hour fire-resistive rating.

3. A 2-Hour Fire-Resistive occupancy separation shall be at least 2-hour fire-resistive construction. Openings in walls forming the separation shall be protected by a fire assembly which provides a 1-1/2 hour fire resistive rating.

4. A 1-Hour Fire Resistive occupancy separation shall be of at least 1-hour fire resistive construction. Openings in walls forming the separation shall be protected by a fire assembly which provides a 1-hour fire-resistive rating.
SECTION 504. LOCATION WITHIN THE CITY AND LOCATION ON PROPERTY.
(a) General. Buildings shall adjoin or have access to a public space, yard, or street on at least one side. Required yards shall be permanently maintained. See Zoning Regulations and Chapter 16. For the purpose of this Section, the center line of an adjoining street or alley shall be considered an adjacent property line.
(b) Access. For access, see Chapters 6 through 15.
(c) Exterior Walls. Exterior walls shall be provided with fire-resistance and opening protection as specified in this Chapter, Chapters 6 through 15, Chapter 17, and in accordance with the additional requirements specified in Chapters 16 and 43. The set-back distance shall be measured perpendicular to the property line. The provisions of this Section shall not apply to walls perpendicular to the property line.
(d) Method for Wall Opening Protection. For purposes of determining the required wall and opening protection, buildings on the same property and court walls of buildings over one-story in height shall be assumed to have a property line between them.
(e) New Building on Property with Existing Building. When a new building is erected on the same property with an existing building and is considered a separate structure, the distance to the property line shall be the distance to the assumed property line from the existing building for each occupancy as specified in Table 5-A and Chapters 17 through 22. If the distance requirements are not met, 2 or more buildings on the same property may be considered as portions of one building if the aggregate area of both buildings is within the limits specified in Section 505 for a single building. If the distance requirements are not met, and the buildings house different occupancies or are of different types of construction, the allowable area shall be that permitted for the most restrictive occupancy or type of construction.

SECTION 505. ALLOWABLE FLOOR AREAS.
(a) One-Story Buildings. The area of a one-story building shall not exceed the limits specified in Table 5-C nor the limits specified in Chapter 16, except as provided for in Section 506. For buildings located in Fire Zone 3, the basic area may be increased by 33 1/3 percent.
(b) Areas of Buildings Over One Story. The total area of all floors of buildings over one story in height shall not exceed 200 percent of the area permitted for one story buildings. No single floor area shall exceed that permitted for one story buildings. Basements and cellars need not be included in the total allowable area.
(c) Separation Walls. Each portion of a building separated by one or more separation walls may be considered a separate building, provided the separation walls meet the following requirements:
1. Separation walls shall conform to the 4-hour occupancy separation in Types I, II, or III Buildings, and 2-hour occupancy separation in Types IV and V Buildings.

2. Separation walls shall extend from the foundation to the highest point of the building, shall terminate at the underside of the roof sheathing or decking, and shall extend to the exterior walls. Openings or penetrations shall not be permitted except as provided for in Section 503.

3. When a separation wall separates portions of a building having different heights, openings at a point 30 inches or more above the lower roof level shall be permitted, provided the openings are protected by assemblies having a 3/4-hour fire protective rating.

SECTION 506. MAXIMUM HEIGHT OF BUILDINGS AND FLOOR AREA INCREASES.

(a) General. The maximum area, height, and number of stories of every building shall not exceed the limits set forth in Tables 5-C and 5-D, except as provided for in this Section, and as specified in Section 503 for mixed occupancy buildings.

(b) Allowable Area Increases. The allowable floor area requirements specified in Section 505 may be increased by one or more of the of the following:

1. Separation on 2 Sides. Where public space, streets, or yards more than 20 feet in width extend along and adjoin 2 sides of the building, floor areas may be increased at a rate of 1-1/4 percent for each foot by which the minimum width exceeds 20 feet, but the increase shall not exceed 50 percent.

2. Separation on 3 Sides. Where public space, streets, or yards more than 20 feet in width extend along and adjoin 3 sides of the building, the floor area may be increased at a rate of 2-1/2 percent for each foot by which the minimum width exceeds 20 feet, but the increase shall not exceed 100 percent.

3. Separation on All Sides. Where public space, streets, or yards more than 20 feet in width extend on all sides of a building and adjoin the entire perimeter, floor areas may be increased at a rate of 5 percent for each foot by which the minimum width exceeds 20 feet, but the increase shall not exceed 100 percent.

EXCEPTIONS:

A. Aircraft repair hangars may have the floor area increased 300 percent.

B. One-Story aircraft storage hangars may have the floor area increased 500 percent.
(c) **Unlimited Area.** The area of a one story building of Group G occupancy, of Type II, Type III one-hour, or Type IV construction, shall not be limited if the building is entirely surrounded by public space, street, or yards at least 40 feet in width.

(d) **Automatic Fire Sprinkler System Increases.** The area of any one-story building of Group E, Division 5; Group F; and Group G occupancies shall not be limited when the building is provided with an approved automatic fire sprinkler system throughout, and is entirely surrounded by public space, streets, or yards at least 20 feet in width. The allowable area requirements specified in Section 505 may be tripled in one story buildings and doubled in buildings of more than one story if the building is provided with an automatic fire sprinkler system throughout. The increase in area for fire sprinkler systems may be combined with the area increases permitted in Section 506 (b).

(e) **Towers, Spires, and Steeples.** The height of towers, spires, and steeples erected as a part of a building and not used for habitation or storage shall be limited only by structural design if constructed completely of noncombustible material, or may extend not more than 20 feet above the height limit in Table 5-D if constructed of combustible materials.

**SECTION 507. FIRE-RESISTIVE SUBSTITUTION.** Where one-hour fire-resistive construction throughout is required by this Building Code, an approved automatic fire extinguishing system, as specified in Chapter 38, may be substituted, provided this system is not otherwise required.

**EXCEPTIONS:** The substitution shall not waive nor reduce required fire-resistive construction for:

1. Occupancy separations, Section 503 (c), greater than one-hour.
2. Exterior wall protection due to proximity of property lines. See Chapter 5.
3. Area Separations. See Chapter 5.
5. Stair Enclosures. See Chapter 33.
7. Type of construction separation. See Chapter 5.
8. Corridors in High Rise Buildings. See Section 1807. (Revised 10/81 Ordinance No. 518)

**SECTION 508. ARCADES.** Arcades connecting buildings and used exclusively as passageways need not be considered as adjacent buildings for the provisions of this Chapter, provided the walls of the arcade adjoining the building are of the same construction required for the exterior walls of the building, with no communicating openings between the buildings and arcade.
except self-closing Class C fire doors; and provided the arcades are of at least one-hour fire-resistive construction or constructed entirely of noncombustible materials or heavy timber construction with 2 inch nominal sheathing.

**EXCEPTION:** In Group C occupancies, automatic fire doors may be installed in lieu of the self-closing doors required herein.

**SECTION 509. TOILET FACILITIES.**

(a) **General.** Every building shall be provided with toilet room facilities for use by the public and employees as specified in this Section. Types of building occupancy not indicated herein shall be considered individually by the Department.

**EXCEPTION:** When the building or portion thereof is designed and intended for a fixed number of occupants the number of fixtures shall be installed on the basis of actual or intended number of occupants of the building or portion thereof.

1. **Places of Assembly.** The requirements of this Section shall apply to all theaters, lodges, churches, auditoriums, bowling alleys, public libraries, court houses, sports arenas, dance halls, skating rinks, drive-in restaurants, drive-in theaters, and other similar buildings for entertainment, recreation, worship, and dining purposes. Assume 2 persons per vehicle space at drive-in restaurants and theaters.

**EXCEPTIONS:**

A. **Bowling Alleys.** Provide one lavatory and one water closet for each 16 alleys and one urinal for each 10 alleys or any portion thereof for males. Provide one water closet for each 10 alleys and one lavatory for each 16 alleys or any portion thereof for females.

B. **Churches.** Provide a minimum of one water closet and one lavatory for each sex to serve the occupant load of the sanctuary. Plumbing facilities required for adjacent areas of other related uses may be used in lieu of this requirement.

C. **Libraries (Public).** Provide a minimum of one water closet and one lavatory for each sex on every floor to which the public has access.

2. **Taverns, Lounges.** The requirements of this Section shall apply to taverns, lounges and similar establishments whose principal function is dispensing alcoholic beverages for consumption on the premises. This shall include 3.2 beer establishments.

3. **Dormitories.** The requirements of this Section shall apply to all school, labor, institutional or other dormitories.

4. **Hotels, Motels, and Tourist Courts.** Each unit shall be provided with one water closet, one lavatory and one bathtub or shower.
5. **Dwelling Units.** Each unit shall be provided with one water closet, one lavatory, one bathtub or shower, and one kitchen sink with garbage disposal.

   A. In addition, buildings with one or two dwelling units shall provide an accessible capped rough-in for a laundry facility in a space large enough to accept laundry equipment in each unit.

   B. In buildings with 3 or more dwelling units or apartments, provide one laundry tray and one automatic washer for the first 10 units or apartments. In excess of 10 units or apartments, provide one automatic laundry washing machine for each additional 15 units or apartments. This equipment shall be accessible to all units or apartments.

6. **Industrial.**

   **Scope.** The requirements of this Section shall apply to all warehouses, manufacturing workshops, parking structures with attendants, foundries and similar establishments.

   **EXCEPTION:** Warehouses and parking structures with attendants. Provide one water closet and one lavatory for each sex employed. Parking structures without attendants need not have toilet facilities. Separate plumbing facilities for warehouse areas are not required if adjacent office floor area in the building is less than 1000 square feet.

7. **Institutional (Health).** The requirements of this Section shall apply to hospitals, nursing homes, homes for the aged, sanitariums, mental hospitals and similar establishments.

   A. Individual patient room or ward facilities shall be mandatory with centralized water closets, lavatories and bath facilities as optional, except in mental hospitals. Enclosed water closets for individual patient rooms or ward rooms shall be directly connected to not more than 2 patient rooms or ward rooms serving not more than a total of 4 beds. One lavatory per room and one bathtub with shower or shower per 4 beds.

   B. Nursing departments with centralized facilities requires a water closet per 4 patients, one lavatory per 10 patients, one bathtub with shower or shower per 10 patients, one drinking fountain per nursing station and at least one service sink per floor.

   C. Waiting rooms shall be provided with one water closet and one lavatory for each sex.

   D. Bubbler fountains shall not be connected to a water faucet or lavatory.

8. **Institutional (Penal).** The requirements of this Section shall apply to all jails or other places of detention. One water closet and
one lavatory per cell. One bathtub or shower and one drinking fountain per cell block floor. One service sink per floor. One water closet, one urinal and one lavatory per exercise room. One drinking fountain per exercise area.

9. **Institutional (Nurseries)**. The requirements of this Section shall apply to all day nurseries, orphanges and similar occupancies. One water closet per 25 males or 20 females, one lavatory per 10 males or females, one urinal per 50 males, one bathtub or shower for each 10 persons, one drinking fountain for each 50 persons with a minimum of one per floor. One service sink per floor.

10. **Public Buildings**. The requirements of this Section shall apply to all offices, retail establishments, and places of employment not otherwise regulated herein.

**EXCEPTION:** Retail, wholesale and service establishments with occupant load of not more than 20 people may provide only one toilet room (water closet and lavatory) to accommodate both sexes.

11. **Schools and other Places of Instruction.**

**Scope.** The requirements of this Section shall apply to all public, parochial and private schools, universities, colleges, academies, seminaries, libraries, museums and galleries, including all buildings used for the purpose of instruction.

12. **Swimming Pools.** Separate toilet facilities for each sex shall be located adjacent to all swimming pools used by the public except Group H Occupancies of 3 stories or less.

(b) **Other Requirements.**

1. **Separate Facilities.** Separate toilet room facilities shall be provided for males and females unless otherwise excepted in this Section. Toilet room facilities shall be completely enclosed or screened to insure privacy. Toilet rooms, except for I Occupancies and other than public toilet rooms in H Occupancies, shall be identified for each sex and shall be available for use by the public and the employees during normal hours of occupancy of the building. Toilet rooms utilized by both sexes shall be identified as a “rest room.”

2. **Ratio.** In buildings occupied by both sexes, the ratio of male to female facilities shall be established on the basis of 50 percent male and 50 percent female occupants, except when the building or portions thereof, are designed and intended for an unbalanced division of the sexes. In this case, the number of fixtures for each sex shall be installed on the basis of the actual or intended ratio of male to female occupants of the building or portion thereof.

3. **Accessory Use Building Requirements.** Toilet room facilities shall not be required in accessory use buildings when these facilities are available within 300 feet of this building.
4. **Handicapped Persons.** For handicapped requirements see Section 510.

5. **Construction.**

   A. **Floors and Walls.** In occupancies other than family dwelling units, floors and walls of toilet facilities shall be constructed of hard, smooth, non-absorbent surfaces.

   B. **Compartments.** Every toilet room shall have at least 14 square feet of floor area with a minimum width of 3 feet and at least 100 cubic feet of volume for each water closet and each urinal in addition to adequate space required for other plumbing fixtures or equipment installed within the toilet rooms. Compartments for water closets shall be at least 30 inches wide, and shall provide at least 24 inches clearance in front of the water closet.

   C. **Bathing and Shower Facilities.** Enclosures for bathtubs and showers, when provided, shall be constructed of shatter resistant materials. Hinged doors shall open outward. See Chapter 54 for glazing requirements.

   D. **Lavatories.** 18 inches of wash sink or 18 inches of a circular basin, when provided with water outlets at each space, shall be considered equivalent to one lavatory.

   E. **Toilet Room Accessories.** At least one type of hand-drying facility shall be provided in each toilet room facility where lavatories are provided.

   F. **Access.** Access to any portion of the building shall not be through a toilet room facility. Access to toilet rooms shall not be through food preparation areas except for toilet room facilities provided exclusively for the use of employees in the food preparation area.

   G. **Location of Toilet Facilities.** Facilities shall be located convenient to occupied areas being served and in no case more than 200 feet on the same level or more than one floor removed from the occupied area.

   H. **Location of Service Sinks.** Service sinks are required in all Group A through G Occupancies on each floor where toilet facilities are required. Hose bibb and floor drain may be substituted for service sinks in Group G Occupancies. Service sinks shall not be installed in the toilet rooms.

6. **Urinals for Women.** Urinals for women may be installed under the following conditions:

   A. The urinals shall be installed as an auxiliary or supplementary fixture. The fixture shall not be considered as a substitute for water closets; in all cases the required minimum number of water closets shall be provided.
B. The urinal shall be enclosed with a water closet compartment and door to insure privacy in use.

7. Coin-Operated Toilets. When toilet rooms for public use are provided with coin-operated or other external locking devices, these toilet facilities shall be provided in addition to the toilet room facilities required by this Chapter.

8. Temporary Toilet Facilities. Enclosed temporary facilities for working personnel shall be provided when existing permanent toilet facilities are not available or assigned for use in a convenient location near the work area. Fixtures may be conventional water closets and urinals installed in accordance with the requirements of Chapter 50 or may be water closets and urinals of the chemical storage type. Water closets shall be provided with seats and covers.

SECTION 510. REQUIREMENTS FOR HANDICAPPED PERSONS.
(SEE CHAPTER 64.) (Revised 5/83 Ordinance No. 259).

SECTION 511. TABLES.
<table>
<thead>
<tr>
<th>GROUP</th>
<th>DIVISION</th>
<th>DESCRIPTION OF OCCUPANCY</th>
<th>CHAPTER REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>An assembly building with a stage and an occupant load of 1,000 or more.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>An assembly building without a stage and an occupant load of less than 1,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>An assembly building without a stage and an occupant load of 300 or more</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>An assembly building without a stage and an occupant load of less than 300, and which is not classified as a Group F occupancy</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Stadiums, grandstands, bleachers, reviewing stands, and amusement park structures not included within Group A or Group B Division 1, 2, 3 occupancies</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>A building used for educational purposes by 20 or more persons at the twelfth grade level or below, such as nursery schools, kindergartens, preschools, dance schools, day care centers, schools for manual arts, elementary schools, junior high schools, etc</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>A building used for educational purposes by fewer than 20 persons at the 12th grade level or below, such as nursery schools, kindergartens, preschools, dance schools, day care centers, schools for manual arts, elementary schools, junior high schools, high schools, etc</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>Buildings used for mental hospitals, mental sanitariums, jails, prisons, houses of correction, or buildings where personal liberties of the inmates are restrained</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Buildings used for hospitals, sanitariums, homes for the retarded, homes for the handicapped, nursing homes, orphanages, rehabilitation centers, and similar uses, and which accommodate 5 or more patients or residents</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>Buildings storing or handling hazardous materials NFPA classified flammable liquids, highly flammable solids, explosive materials, flammable compressed gases, or similar material, including hazardous chemicals as defined in the Fire Code.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Buildings storing or handling hazardous materials NFPA classified combustible fluids such as diesel fuel, fuel oil, printers' ink, animal fat, combustible dry cleaning fluids, or similar to any listed in this Section</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>A building storing or handling materials for processing or manufacturing, where combustible residue is produced or generated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Repair facilities where gasoline, diesel fuel, gas and similar fueled equipment is housed. Automobile service stations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Aircraft repair hangers and aircraft storage hangers.</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>Drinking and dining establishments, recreational buildings and other assembly buildings without fixed theater type seating, and with an occupant load of less than 150 persons.</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Stores for wholesale or retail sales, office buildings, medical or dental office buildings, and clinics, veterinary clinics and hospitals, police and fire stations, universities, colleges, and adult education facilities in which each classroom has an occupant load of less than 50 persons.</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>Manufacturing plants, factories, or workshops utilizing noncombustible, non-explosive or not highly combustible materials and salesrooms incidental to their operation.</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>A building storing non-explosive materials, noncombustible or not highly combustible materials and salesrooms incidental to their operation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Automobile parking garages.</td>
<td></td>
</tr>
<tr>
<td>GROUP</td>
<td>DIVISION</td>
<td>DESCRIPTION OF OCCUPANCY</td>
<td>CHAPTER</td>
</tr>
<tr>
<td>-------</td>
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<td>----------------------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>N</td>
<td>1</td>
<td>Hotels and motels.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Apartments, garden apartments, dormitories, convents, monasteries, roofing and boarding houses, foster homes, senior citizen homes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Townhouses, cluster homes, row dwellings and connected dwellings housing more than 2 families.</td>
<td>13</td>
</tr>
<tr>
<td>I</td>
<td></td>
<td>One and 2 family dwelling units.</td>
<td>14</td>
</tr>
<tr>
<td>J</td>
<td>1</td>
<td>Private garages, carports, covered patios, storage sheds, agricultural buildings, laundry buildings, and minor recreational buildings not exceeding 1000 square feet in area and an occupant load of 10. See Chapter 1.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Separate structures such as swimming pools, retaining walls, and fences.</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: See Chapters 6 through 15 for specific requirements.
| GROUP | A | B | B | B | C | D | E | E | E | E | E | E | F | F | G | G | G | H | H | H | I | J | J |
| 1 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 2 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 3 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 4 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 5 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 6 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 7 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |

Refer to Occupancy Chapters 6 through 15 for specific requirements.

N = No Separation required.

* Provided that materials as approved for one-hour fire-resistive construction on the garage side and tight-fitting solid wood door at least one and three-eighths (1-3/8) inches in thickness, shall be permitted.

** See Chapter 13 for required separation between units.

NP=Not Permitted

(Rev. 7/86 Ord. No. 420)
## TABLE NO. 5-C

**BASIC ALLOWABLE FLOOR AREA (IN SQ. FT.) FOR BUILDINGS ONE STORY IN HEIGHT IN FIRE ZONES No.1 and No. 2 FOR BUILDINGS LOCATED IN FIRE ZONE No.3, THE BASIC AREA MAY BE INCREASED 33 1/3% PERCENT.**

(Revised 5/60 Ordinance No. 240)

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
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<tr>
<td></td>
<td>1-Hour</td>
<td>NP</td>
<td>NP</td>
<td>1-Hour</td>
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<tr>
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<td>10,200</td>
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<tr>
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<tr>
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<td>E-5</td>
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<td>23,000</td>
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<td>H-2</td>
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<td>24,000</td>
<td>10,200</td>
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<td>H-3</td>
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</tr>
<tr>
<td>- 1</td>
<td>Unlimited</td>
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<tr>
<td>J-1</td>
<td>See Chapter 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>J-2</td>
<td>See Chapter 15</td>
<td></td>
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</table>

**SR - Special requirements - Refer to Occupancy Chapter for special provisions.**

**NP - Not Permitted**

**N - Non Fire-resistive construction**

**NOTE:** See Section 505 and 506 for additional information on allowable floor area and floor area increases.

*For open parking structures see Chapter 12.*
### TABLE NO. 5-D

**MAXIMUM HEIGHT OF BUILDINGS**
(Revised 5/80 Ordinance No. 240)

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Types of Construction</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1-Hour or H.T.</td>
<td>N</td>
<td>1-Hour</td>
<td>N</td>
<td>1-Hour</td>
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<tr>
<td>Unlimited</td>
<td>MAXIMUM HEIGHT IN FEET</td>
<td>75</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>55</td>
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<tr>
<td>A</td>
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<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
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<td>B-1</td>
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<td>4</td>
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<td>2</td>
<td>NP</td>
</tr>
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<td>4</td>
<td>2</td>
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<td>2</td>
<td>NP</td>
</tr>
<tr>
<td>B-3</td>
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<td>4</td>
<td>2</td>
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</tr>
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<td>B-4</td>
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<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>C-1</td>
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<tr>
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<td>D-1</td>
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<td>NP</td>
<td>NP</td>
<td>NP</td>
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<td>3</td>
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<td>1</td>
<td>1</td>
<td>NP</td>
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<tr>
<td>E-1</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E-2</td>
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<td>2</td>
<td>1</td>
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<td>E-3</td>
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<td>2</td>
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<td>2</td>
<td>1</td>
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<td>2</td>
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<td>4</td>
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<td>6</td>
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<tr>
<td>G-1</td>
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<td>6</td>
<td>4</td>
<td>1</td>
<td>4</td>
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</tr>
<tr>
<td>G-2</td>
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<td>4</td>
<td>1</td>
<td>4</td>
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<tr>
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<td>5</td>
<td>1</td>
<td>4</td>
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<tr>
<td>H-1</td>
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<td>4</td>
<td>1</td>
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<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>3</td>
<td>3</td>
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<td>3</td>
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<tr>
<td>J-1</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>J-2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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</tr>
</tbody>
</table>

NP - Not Permitted
NA - Not Applicable
N - Non Fire-resistive Construction

**NOTES**:
Refer to Chapters 6 through 22 for other requirements.

For other restrictions regarding the height of buildings, see Article 640, 645, and 646 of the Revised Municipal Code.

*For maximum height limitations of open parking structures, see Chapter 12.

**Parking structures may be permitted on the first story in this type of construction when built of noncombustible materials. See Chapter 12.
<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>USE</th>
<th>WATER CLOSETS</th>
<th>MALE URINALS (d)</th>
<th>LAVATORIES</th>
<th>Drinking (e) (f) FOUNTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-E-1</td>
<td>Places of Assembly (c)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>1 - 1.100</td>
<td>1 - 1.75</td>
<td>1 - 1.100</td>
<td>1 - 1.250</td>
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<td></td>
<td></td>
<td>2 - 101-600</td>
<td>2 - 76-200</td>
<td>2 - 101-600</td>
<td>2 - 251-600</td>
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<tr>
<td></td>
<td></td>
<td>3 - 601-950</td>
<td>3 - 201-400</td>
<td>3 - 601-950</td>
<td>3 - 601-1100</td>
</tr>
<tr>
<td></td>
<td>Add 1 fixture for each additional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>500 males and 200 females</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-E-2</td>
<td>Industrial, office, retail, &amp;</td>
<td>1 - 1.30</td>
<td>1 - 1.10</td>
<td>1 - 1.30</td>
<td>1 - 1.30</td>
</tr>
<tr>
<td></td>
<td>Public Buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For additional occupants</td>
<td>1 - 1.30</td>
<td>1 - 1.10</td>
<td>1 - 1.30</td>
<td>1 - 1.30</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>2 - 11-10</td>
<td>2 - 31-60</td>
<td>2 - 31-60</td>
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<td></td>
<td></td>
<td>3 - 61-90</td>
<td>3 - 31-60</td>
<td>2 - 61-120</td>
<td>3 - 61-120</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-E-3</td>
<td>Taverns and Lounges</td>
<td>1 - 1.30</td>
<td>1 - 1.30</td>
<td>1 - 1.30</td>
<td>1 - 1.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 - 31-90</td>
<td>2 - 31-60</td>
<td>2 - 31-60</td>
<td>2 - 61-120</td>
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<td></td>
<td></td>
<td>3 - 91-150</td>
<td>3 - 61-90</td>
<td>3 - 61-90</td>
<td>3 - 121-180</td>
</tr>
<tr>
<td></td>
<td>For additional occupants</td>
<td>1 per 60</td>
<td>1 per 30</td>
<td>1 per 60</td>
<td>1 per 40</td>
</tr>
<tr>
<td>5-E-4</td>
<td>Schools (b) Elem. &amp; Jr. High</td>
<td>1 per 100</td>
<td>1 per 45</td>
<td>1 per 30</td>
<td>1 per 100 with 1 per floor minimum</td>
</tr>
<tr>
<td>5-E-4</td>
<td>All others</td>
<td>1 per 100</td>
<td>1 per 45</td>
<td>1 per 30</td>
<td>1 per 100 with 1 per floor minimum</td>
</tr>
<tr>
<td>5-E-5</td>
<td>Dormitories (g) (h)</td>
<td>1 per 10</td>
<td>1 per 8</td>
<td>1 per 25</td>
<td>1 per 75 with 1 per floor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Section 509 (a) and (b) for additional requirements.

a. The plumbing facilities shown are for the number of persons indicated or any fraction thereof.

b. Provide one shower for each 5 pupils of a gym or pool class.

Cont'd.
TABLE NO. 5-E
MINIMUM PLUMBING FACILITIES (a)
(Fixtures per Occupants Except where Noted)

c. Where alcoholic or malt beverages are served, the requirements for urinals for males and water closets for females shall be doubled.
d. Whenever urinals are provided, one water closet less than the number specified may be provided for each urinal installed, except the number of water closets in such cases shall not be reduced to less than one half of the minimum specified.
e. Where food is consumed, water stations may be substituted for drinking fountains.
f. Drinking fountains shall not be installed in toilet rooms.
g. Provide one bathtub or one shower for each 8 persons. For women's dormitories, additional bathtubs shall be installed.
h. Provide one laundry tray for each 50 persons. In excess of 100 persons provide one laundry tray or one automatic laundry washing machine for each additional 50 persons.
i. For service sink requirements, see Section 509 (b) 5H.
<table>
<thead>
<tr>
<th>USE OR OCCUPANCY</th>
<th>SQ. FT. PER PERSON</th>
<th>SEC. 509 (a)</th>
<th>TABLE</th>
</tr>
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<tbody>
<tr>
<td>Arenas or Field Houses (a)</td>
<td>7</td>
<td>1</td>
<td>5-E-1</td>
</tr>
<tr>
<td>Armories</td>
<td>30</td>
<td>1</td>
<td>5-E-1</td>
</tr>
<tr>
<td>Assembly Halls (a)</td>
<td>7</td>
<td>1</td>
<td>5-E-1</td>
</tr>
<tr>
<td>Auditoriums (a)</td>
<td>7</td>
<td>1</td>
<td>5-E-1</td>
</tr>
<tr>
<td>Banquet Rooms</td>
<td>15</td>
<td>1</td>
<td>5-E-1</td>
</tr>
<tr>
<td>Barber Shops</td>
<td>30</td>
<td>10</td>
<td>5-E-2</td>
</tr>
<tr>
<td>Beauty Parlors</td>
<td>30</td>
<td>10</td>
<td>5-E-2</td>
</tr>
<tr>
<td>Billiard Rooms</td>
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<td>5-E-1</td>
</tr>
<tr>
<td>Bowling Alleys</td>
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<tr>
<td>Cafes (b)</td>
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<td>1</td>
<td>5-E-1</td>
</tr>
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<td>Cafeterias (b)</td>
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<td>Day Nurseries</td>
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<td>9</td>
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<td>Dining Rooms</td>
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<td>5-E-1</td>
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<td>3</td>
<td>5-E-5</td>
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<td>5-E-1</td>
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<td>Drive-in Theatres</td>
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<td>Lounges (b)</td>
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<td>5-E-3</td>
</tr>
<tr>
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<td>7</td>
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<td>11</td>
<td>5-E-4</td>
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</tr>
<tr>
<td>with Tablet arm</td>
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<td></td>
</tr>
<tr>
<td>Chairs or seats</td>
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</tr>
<tr>
<td>without desks</td>
<td>10</td>
<td>11</td>
<td>5-E-4</td>
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<td>Shops &amp; Vocational Rooms</td>
<td>300</td>
<td>11</td>
<td>5-E-4</td>
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<td>15</td>
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<td>5-E-3</td>
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<tr>
<td>Theaters</td>
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<td>Tourist Courts</td>
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<td>Warehouses</td>
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<tr>
<td>Workshops</td>
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<td>6</td>
<td>5-E-2</td>
</tr>
</tbody>
</table>

a. Seating area projected horizontally.
b. Use one person for each 200 sq. ft. of preparation area.
c. For Fixed seating, use 1 occupant per seat.
CHAPTER 6

REQUIREMENTS FOR GROUP A OCCUPANCIES

SECTION 601. GROUP A OCCUPANCIES DEFINED. Group A occupancy shall be an assembly building with a stage and an occupant load of 1000 or more.

SECTION 602. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
   (a) General. Buildings or portions of buildings classified in Group A because of the use or character of the occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.
   (b) Special Provisions.
       1. Stages and enclosed platforms shall be constructed in accordance with the requirements of Chapter 39.
       2. The slope of the main floor of the assembly room shall not exceed one foot in eight.
       3. See Chapters 17, 25, and 32 for attic space partitions and draft stops.
   (c) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.

SECTION 603. LOCATION.
   (a) In City. Buildings shall not be limited in location within fire zones.
   (b) On Property. Buildings shall front directly upon or have access to a public street at least 20 feet in width. The access to a public street shall be a 20 foot minimum width right-of-way maintained solely as access to the public street. The main entrance to the building shall be located on the public street or the access. See Chapter 17 and Zoning Regulations for property setbacks.
   (c) Exterior Walls and Opening Protection. See Chapters 17 and 18 for fire resistive protection of exterior walls and openings, as determined by location on the property. See Chapter 5 for regulating adjacent buildings on the same property.

SECTION 604. EXIT FACILITIES. See Chapter 33.

SECTION 605. LIGHT, VENTILATION, TOILET ROOM FACILITIES.
   (a) Light. All portions of the building used by human occupants shall be provided with either natural or artificial light. Lighting in all portions
of the building used by human occupants shall be on a circuit separate from the stage lighting, and shall be controlled from the box office.

(b) Ventilation. See Chapter 52.
(c) Toilet Room Facilities. See Chapter 5.

SECTION 606. ENCLOSURE OF VERTICAL OPENINGS.
(a) Exits. See Chapter 33.
(b) Shafts. See Chapter 17.

SECTION 607. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 608. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapter 37, 51, 52, and 58.
(b) Motion Picture Machine Booths. See Chapter 40.
(c) Heating or Equipment Rooms. See Chapters 17 and 33.
CHAPTER 7

REQUIREMENTS FOR GROUP B OCCUPANCIES

SECTION 701. GROUP B OCCUPANCIES DEFINED. Group B occupancy shall be:

Division 1: An assembly building with a stage and an occupant load of less than 1000.
Division 2: An assembly building without a stage and an occupant load of 300 or more.
Division 3: An assembly building without a stage and an occupant load of less than 300, and which is not classified as a Group F occupancy.
Division 4: Stadiums, grandstands, bleachers, reviewing stands, and amusement park structures not included within Group A or Group B Divisions 1, 2, and 3 occupancies. See Chapter 33 for specific requirements for grandstands, bleachers, and reviewing stands.

SECTION 702. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.

(a) General. Buildings or portions of buildings classified in Group B because of the use or character of the occupancy shall conform to the type of construction, area, and height requirements specified in Chapter 5.

EXCEPTION: Division 4 structures of open frame type shall not be limited in height or area.

(b) Special Provisions.

2. The slope of the main floor of the assembly room shall not exceed one in eight.
3. Divisions 1 and 2 occupancies shall be of at least one-hour fire-resistive construction throughout, except that a fire-resistive ceiling shall not be required in one story Division 1, 2, and 3 occupancy buildings of Type III, IV or V construction having an open frame roof. Division 1 occupancy and Division 2 occupancy with an occupant load of 1000 or more shall be of Type I, II, or III construction.

EXCEPTION: Gymnasiums which have not more than 2 balconies, each with an occupant load not to exceed 300, and which are not located over usable spaces, need not have one-hour fire-resistive protection.

4. Division 3 occupancies located in a basement or above the first story shall be at least one-hour fire-resistive construction.
5. Group B assembly rooms having an occupant load of 1000 or more shall not be located in the basement.
6. Division 3 occupancies with an occupant load of 50 or more which are located over usable space shall be separated from the usable space by at least one-hour fire-resistive construction.

7. See Chapters 17, 25 and 32 for attic space partitions and draft stops.

8. Structures housing Division 4 occupancies, other than those of open frame type. When more than one story in height or 400 square feet in area shall be at least one-hour fire-resistive construction.

9. When the space under a Division 4 occupancy is used for any purpose, it shall be separated from all parts of the Division 4 occupancy, including exits, by walls, floors, and ceilings of noncombustible materials.

EXCEPTIONS:
A. Exits under temporary grandstands need not be separated.
B. The underside of continuous steel deck grandstands, when erected outdoors need not be fireproofed when the enclosed spaces are used for public toilets.

(c) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.

SECTION 703. LOCATION.
(a) In City. See Chapter 16 for restrictions based upon location in Fire Zones.

(b) On Property. Buildings shall front directly upon or have access to a public street at least 20 feet in width. The access to a public street shall be a 20 foot minimum width right-of-way maintained solely as access to the public street. The main entrance to the building shall be located on the public street or the access. See Chapter 17 and Zoning Regulations for property setbacks.

(c) Exterior Wall and Opening Protection. See Chapters 5 and 17 through 22 for fire-resistive protection of exterior walls and openings, as determined by location of property. See Chapter 5 for regulating adjacent building on the same property.

SECTION 704. EXIT FACILITIES. See Chapter 33.

SECTION 705. LIGHT, VENTILATION, TOILET ROOM FACILITIES.
(a) Light. All portions of the building used by human occupants shall be provided with either natural or artificial light.

(b) Ventilation. See Chapter 52.

(c) Toilet Room Facilities. See Chapter 5.
SECTION 706. ENCLOSURE OF VERTICAL OPENINGS.
   (a) Exits. See Chapter 33.
   (b) Shafts. See Chapter 17.

SECTION 707. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 708. SPECIAL REQUIREMENTS.
   (a) Chimneys and Heating Apparatus. See Chapters 37, 51, 52, and 58.
   (b) Motion Picture Machine Booths. See Chapter 40.
   (c) Heating or Equipment Rooms. See Chapters 17 and 33.

SECTION 709. EXCEPTIONS AND DEVIATIONS. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel, or of other surfaces approved by the Department. In gymnasiums and in multi-purpose schoolrooms having an area not greater than 3200 square feet, one-inch nominal tight tongue-and-groove wood or 3/4 inch plywood wall covering may be used as a finish on the inner side of the required fire-resistive walls.
CHAPTER 8
REQUIREMENTS FOR GROUP C OCCUPANCIES

SECTION 801. GROUP C OCCUPANCIES DEFINED.
Division 1. A building used for educational purposes by 20 or more persons at the twelfth grade level or below, such as nurseries, kindergartens, preschools, dance schools, day care centers, schools for manual arts, elementary schools, junior high schools, and high schools.
Division 2. A building used for educational purposes by fewer than 20 persons at the twelfth grade level or below, such as nurseries, kindergartens, preschools, dance schools, day care centers, schools for manual arts, elementary schools, junior high schools, and high schools.

SECTION 802. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in a Group C Occupancy because of the use or character of the occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.
(b) Special Provisions.
1. Rooms having an occupancy load of more than 100 and rooms used for preschool, kindergarten, and first or second-grade shall be located at ground level, except in buildings of Type I construction.
2. Except in one-story buildings in which rooms used for instruction have at least one exit door directly to the outside, buildings shall be at least one-hour fire-resistive construction throughout.
A fire-resistive ceiling shall not be required in a one story building having an open frame roof.
3. Balconies and bleachers over usable space, and janitor closets, shall be protected with at least one-hour fire-resistive construction.
4. See Chapter 42 for the flame-proofing of curtains, drapes, and drops.
5. See Chapter 39 for stages and platforms.
6. See Chapters 17, 25 and 32 for attic space partitions and draft stops.
7. With prior approval of the Department, workshops such as wood working facilities in Group C Occupancies, used for the instruction of students, may be classified as part of the C Occupancy provided an approved dust collection system is installed and is activated during use of any equipment. Interlocking of electrically operated tools with the dust collection system will be required. (Revised 7/83 Ordinance No. 389)
(c) Existing Buildings Converted to a C-2 Occupancy. Existing buildings may be remodeled for a C-2 Occupancy provided the following conditions are met:
1. Students shall not be permitted on other than the ground floor.
2. The ground floor shall provide a minimum of 2 exits. There shall be no dead-end corridors.
3. All openings to corridors and stairways shall be protected by a fire assembly which provides at least a 3/4 hour fire-resistive rating.
4. Gas fired appliances. See Chapters 17, 37, 51, 52 and 58.
5. Existing partitions, walls, and ceilings may be approved if the ex-
   isting surface is of a fire-resistive material consisting of lath and
   plaster or gypsum board of at least 1/2 inch thickness.
6. The basement or second floor shall be separated from the ground
   floor by a minimum of one-hour fire-separation.

(d) Occupancy loads and Separations. See Chapter 33 for occupant
loads. See Chapter 5 for occupancy separation requirements.

SECTION 803. LOCATION.
(a) In City. See Chapter 16 for restriction based on location in Fire Zones.
(b) On Property. Buildings shall front directly upon or have access to a
    public street at least 20 feet in width. The access to a public street shall
    be 20 foot minimum width right-of-way maintained solely as access to
    the public street. At least one required exit shall be located on the
    public street or access way. See Chapter 17 and Zoning Regulations.
(c) Exterior Wall and Opening Protection. See Chapters 5 and 17
    through 22 for fire-resistive protection of exterior walls and openings
    as determined by location on property. See Chapter 5 for regulating ad-
    jacent building on the same property.
    EXCEPTION: Exterior walls or portions of walls of Group C Occupan-
    cies having an occupant load of less than 100 persons, when within 10
    feet of adjacent property lines, may be one-hour fire- resistive construc-
    tion.

SECTION 804. EXIT FACILITIES. See Chapter 33.

SECTION 805. LIGHT, VENTILATION, TOILET ROOM
FACILITIES.
(a) Light. All portions of the building used by human occupants shall be
    provided with either natural or artificial light.
(b) Ventilation. See Chapter 52.
(c) Toilet Room Facilities. See Chapter 5.

SECTION 806. ENCLOSURE OF VERTICAL OPENINGS.
(a) Exits. See Chapter 33.
(b) Shafts. See Chapter 17.

SECTION 807. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 808. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapter 37, 51, 52, and 58.
(b) Motion Picture Machine Booths. See Chapter 40.
(c) Heating or Equipment Rooms. See Chapter 17 and 33.

SECTION 809. EXCEPTIONS AND DEVIATIONS. Gymnasiums and
similar occupancies may have running tracks constructed of wood or
unprotected steel, or of other surfaces approved by the Department. In gym-

nasiums and in multi-purpose schoolrooms having an area not greater than
3200 square feet, one-inch nominal tight tongue-and-grooved wood or 3/4
inch plywood wall covering may be used as a finish on the inner side on the
required fire-resistive walls.
SECTION 809. EXCEPTIONS AND DEVIATIONS. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel, or of other surfaces approved by the Department. In gymnasiums and in multi-purpose schoolrooms having an area not greater than 3200 square feet, one-inch nominal tight tongue-and-grooved wood or 3/4 inch plywood wall covering may be used as a finish on the inner side on the required fire-resistive walls.
CHAPTER 9
REQUIREMENTS FOR GROUP D OCCUPANCIES

SECTION 901. GROUP D OCCUPANCIES DEFINED.
Division 1: Buildings used for mental hospitals, mental sanitariums, jails, prisons, houses of correction, or buildings where personal liberties of inmates are restrained.

Division 2: Buildings for hospitals, sanitariums, homes for the retarded, homes for the handicapped, nursing homes, orphanages, rehabilitation centers and similar uses in which skilled or intermediate medical care is provided, and which accommodate five or more patients or residents. (Rev. 7/86 Ord. No. 421)

SECTION 902. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in Group D Occupancy because of the use or character of occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.

(b) Special Provisions.
1. Division 1 occupancies shall be of Type I or II construction throughout. Occupancies in which the personal liberties of inmates or patients are restrained within the building shall have floors of noncombustible construction.

2. Division 2 occupancies more than one story in height shall be of Type I or II construction; further, all buildings shall be of one-hour fire-resistive construction throughout. Nonbearing partitions between rooms and minor interior partitions shall be constructed of noncombustible materials or covered with a minimum of 1/2 inch plaster or gypsum board.

3. Existing buildings may be remodeled for D-2 occupancy for an occupant load of ten or less patients provided the ceilings and walls are finished with noncombustible materials throughout. All openings to corridors and stairways shall be protected by a fire assembly having a 3/4 hour fire-resistant rating. A minimum of 2 exits shall be provided on the ground floor. Use by patients of other than the ground floor is prohibited.

4. See Chapter 17, 25, and 32 for attic space partitions and draft stops.

(c) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.
SECTION 903. LOCATION.
(a) In City. See Chapter 16 for restrictions based on location in Fire Zones.
(b) On Property. Buildings shall adjoin a yard, public space, or street on at least one side. See Chapter 17 and Zoning Regulations for property setbacks.
(c) Exterior Wall and Opening Protection. See Chapters 5 and 17 through 22 for fire-resistant protection of exterior walls and openings, as determined by location on property. See Chapter 5 for regulating adjacent buildings on the same property.

SECTION 904. EXIT FACILITIES. See Chapter 33.

SECTION 905. LIGHT, VENTILATION, TOILET ROOM FACILITIES
(a) Light. All portions of the building used by human occupants shall be provided with either natural or artificial light.
(b) Ventilation. See Chapter 52.
(c) Toilet Room Facilities. See Chapter 5.

SECTION 906. ENCLOSURE OF VERTICAL OPENING.
(a) Exits. See Chapter 33.
(b) Shafts. See Chapter 17.

SECTION 907. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 908. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapters 37, 51, 52, and 58.
(b) Motion Picture Machine Booths. See Chapter 40.
(c) Heating or Equipment Rooms. See Chapters 17 and 58.
(d) Auxiliary Power Plants. Auxiliary power plants shall be installed in a one-hour enclosure, containing only the generator and its appurtenances, in accordance with N.F.P.A. Pamphlet 37 and Chapter 17 of this Building Code.

SECTION 909. REQUIREMENTS FOR ANESTHESIA ROOMS AND ANESTHETIZING LOCATIONS.
(a) Conductive Flooring. Conductive flooring shall be provided in anesthetizing location to provide accumulation of electrostatic charges. A resistance not exceeding 5 to 10 megohms between the objects or persons shall be considered sufficient to prevent dangerous voltages. The floor limit of one million ohms resistance shall be sufficient to meet this requirement.
(b) Heating and Cooling. Heating and cooling systems and equipment shall conform to the requirements of Chapters 37, 49, 51, 52 and 58.
SECTION 910. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA</td>
<td>Pamphlet No. 56, June 1973, for the Use of Flammable Anesthetics.</td>
</tr>
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<td>Stationary Combustion Engines and Gas Turbines, Pamphlet No. 37, 1975.</td>
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<tr>
<td>NFPA</td>
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<tr>
<td>National Fire Protection Association</td>
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<tr>
<td>Batterymarch Park</td>
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<tr>
<td>Quincy, Mass. 02269</td>
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CHAPTER 10

REQUIREMENTS FOR GROUP E OCCUPANCIES

SECTION 1001. GROUP E OCCUPANCIES DEFINED.
DIVISION 1. Buildings storing or handling hazardous materials; NFPA classed flammable liquids; highly flammable solids; explosive materials; flammable compressed gases, or similar material including hazardous chemicals as defined in the Fire Code.
DIVISION 2. Buildings storing or handling hazardous materials; NFPA classed combustible fluids such as diesel fuel, fuel oil, printers ink, animal fat, combustible dry cleaning fluids or similar to any of the above. Automobile service stations are not included in this occupancy.
DIVISION 3. A building storing or handling materials for processing or manufacturing, where combustible residue is produced or generated.
DIVISION 4. Repair facilities where gasoline, diesel fuel, gas and similar fueled equipment is housed. Automobile servicing stations.
DIVISION 5. Aircraft repair, hangars and aircraft storage hangars.

SECTION 1002. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in Group E Occupancy because of the use or character of the occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.
(b) Special Provisions.
1. Division 5 occupancies shall have exterior walls of a least one-hour fire-resistive construction, or shall be surrounded by public space, streets, or yards at least 60 feet in width.
2. See Chapter 5 for area increases for aircraft repair hangars.
3. In public garages and repair facilities when flammable or explosive liquids are stored or used, floors shall be of noncombustible, nonabsorbent materials.
4. See Chapter 17, 25 and 32 for attic space partitions and draft stops.
5. See Chapter 8 for special provisions for woodworking shops in Group C Occupancies. (Revised 7/83 Ordinance No. 389)
(c) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.

SECTION 1003. LOCATION.
(a) In City. See Chapter 16 for restrictions based upon location in Fire Zones.
(b) On Property. The building shall adjoin a yard, public space, or street on at least one side. See Chapter 17 and Zoning Regulations for property setbacks.
(c) Exterior Wall and Opening Protection. See Chapters 5 and 17 through 22 for fire-resistive protection of exterior walls and openings, as determined by location on property. See Chapter 5 for regulating adjacent buildings on the same property.

SECTION 1004. EXIT FACILITIES. See Chapter 33.

SECTION 1005. LIGHT, VENTILATION, TOILET ROOM FACILITIES.
(a) Light. All portions of the building used by human occupants shall be provided with either natural or artificial light.
(b) Ventilation. See Chapter 52.
(c) Toilet Room Facilities. See Chapter 5.

SECTION 1006. ENCLOSURE OF VERTICAL OPENINGS.
(a) Exits. See Chapter 33.
(b) Shafts. See Chapter 17.
(c) Automobile Ramp Doors. Doors which are part of an automobile ramp enclosure may be kept open normally, but shall be provided with an automatic fire-assembly arranged to be self-closing when released.

SECTION 1007. FIRE PROTECTION SYSTEM. Where a fire sprinkler system is required and where the presence of a fire sprinkler system would create a more dangerous condition, the fire sprinkler may be eliminated from that area and replaced with a smoke detection system, when approved by the Department and Fire Department. This requirement shall supercede the requirements of Chapter 38. For other requirements see Chapter 38.

SECTION 1008. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapter 37, 51, 52 and 58.
(b) Heating or Equipment Rooms. See Chapters 17 and 58.
(c) Explosion Venting. Buildings, because of the explosion characteristics of the materials being processed or stored, shall be designed in accordance with the Standards.
(d) Fire Protection System. See Chapter 38.

SECTION 1009. SERVICE STATIONS WITHIN BUILDINGS. Service stations within buildings are not permitted.

SECTION 1010. ADDITIONAL REGULATIONS FOR DRY CLEANING PLANTS. Dry cleaning plants shall be of Type I construction and shall not exceed one story in height. See Fire Code.
SECTION 1011. ADDITIONAL REQUIREMENTS FOR SPRAY PAINTING, DIPPING ROOMS, AND BOOTHs.

(a) Location. See Chapter 16.
(b) General. In establishments where flammable liquids or solvents are used or applied by means of spraying or dipping, a separate room or booth shall be provided. Spraying or dipping shall be permitted only in this room or booth. These rooms or booths shall not be permitted below grade. For storage, see Fire Code.
(c) Enclosure. Spray painting and dipping rooms shall be at least one-hour fire-resistive construction. Spray booths not exceeding 100 square feet in area and 8 feet in height shall be constructed of metal or one-hour fire-resistive construction.
(d) Electrical Equipment. See Chapter 53.
(e) Heating Equipment. Heating equipment located in a paint spray room or booth shall not constitute a source of ignition.
(f) Exits. In addition to the requirements of Chapter 33, each room in which spray booths or spraying equipment is installed shall be provided with 2 means of exit.
(g) Ventilation. See Chapter 52.
(h) Fire Protection Systems. See Chapter 38.

SECTION 1012. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

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<tr>
<th>ORGANIZATION</th>
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<tr>
<td></td>
<td>Storage and Handling of all Flammable Liquids.</td>
</tr>
<tr>
<td></td>
<td>Pamphlet No. 32, 1974 - Dry Cleaning Plants.</td>
</tr>
<tr>
<td></td>
<td>Pamphlet 33, 1977 - Spray Finishing.</td>
</tr>
<tr>
<td></td>
<td>Pamphlet 61C, 1973 - Flour and Feed Mills.</td>
</tr>
<tr>
<td></td>
<td>Pamphlet No. 63, 1975 - Dust Explosions in Industrial Plants.</td>
</tr>
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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
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<tr>
<td></td>
<td>1916 Race Street</td>
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<td></td>
<td>Philadelphia, Pa. 19103</td>
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<tr>
<td>NFPA</td>
<td>National Fire Protection Assn.</td>
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<td>Batterymarch Park</td>
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<tr>
<td></td>
<td>Quincy, Mass. 02269</td>
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</table>
CHAPTER 11

REQUIREMENTS FOR GROUP F OCCUPANCIES

SECTION 1101. GROUP F OCCUPANCIES DEFINED.
Division 1: Drinking and dining establishments, recreational buildings, and other assembly buildings without fixed theatre type seating and with an occupant load of less than 150 persons.
Division 2: Stores for wholesale or retail sales, office buildings, medical or dental office buildings and clinics, veterinary clinics and hospitals, police and fire stations, universities, colleges, and adult education facilities in which each classroom has an occupant load of less than 50 persons.

SECTION 1102. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in Group F Occupancy because of the use or character of the occupancy shall conform to the types of construction, area and height requirements specified in Chapter 5.
(b) Special Provisions. See Chapters 17, 25 and 32 for attic partitions and draft stops.
(c) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.

SECTION 1103. LOCATIONS.
(a) In City. See Chapter 16 for restrictions based upon location in Fire Zones.
(b) On Property. Buildings shall adjoin a yard, public space, or street on at least one side. See Zoning Regulations for property setbacks.
(c) Exterior Wall and Opening Protection. See Chapters 5 and 17 through 22 for fire-resistive protection of exterior walls and openings, as determined by location on the property. See Chapter 5 for regulating adjacent buildings on the same property.

SECTION 1104. EXIT FACILITIES. See Chapter 33.

SECTION 1105. LIGHT, VENTILATION, TOILET ROOM FACILITIES.
(a) Light. All portions of the building used by human occupants shall be provided with either natural or artificial light.
(b) Ventilation. See Chapter 52.
(c) Toilet Room Facilities. See Chapter 5.

SECTION 1106. ENCLOSURE OF VERTICAL OPENINGS.
(a) Exits. See Chapter 33.
(b) Shafts. See Chapter 17.
SECTION 1107. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 1108. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapters 37, 51, 52 and 58.
(b) Heating or Equipment Rooms. See Chapters 17 and 33.

SECTION 1109. ADDITIONAL REQUIREMENTS FOR DRY CLEANING PLANTS USING NONFLAMMABLE LIQUIDS.
(a) General. This Section shall apply to dry cleaning plants using non-flammable, toxic liquids.
(b) Construction and Occupancy. These plants shall be constructed without basement, cellar, or floor below grade. Dwelling occupancy shall not be permitted in conjunction with this occupancy.
(c) Floor Construction. The entire floor area shall be of non-absorbent, noncombustible construction.
(d) Servicing Area. The dry cleaning equipment shall be constructed to permit servicing from the rear of the equipment. An area shall be provided at the rear of the equipment to permit access and servicing. See Chapter 52 for ventilation of this area.
(e) Heating Equipment and Access. Heating equipment and water heaters shall be enclosed in accordance with the requirements of Chapter 17. Entry to the heating equipment or water heater room shall be provided only from the exterior of the building. Combustion air shall be provided from the outside and in accordance with Chapter 51. The use of duct, wall, or unit heaters is prohibited.

SECTION 1110. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

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<tr>
<th>ORGANIZATION</th>
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<tr>
<td>MCA</td>
<td>Chemical Data Sheet - Perchlorethylene 1948.</td>
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<tr>
<td>MCA</td>
<td>Manufacturing Chemists Association, Inc. 1825 Connecticut Avenue N.W. Washington, D.C. 20009</td>
</tr>
</tbody>
</table>
CHAPTER 12

REQUIREMENTS FOR GROUP G OCCUPANCIES

SECTION 1201. GROUP G OCCUPANCIES DEFINED.
Division 1. Manufacturing plants, factories, or workshops utilizing noncombustible, non-explosive or not highly combustible materials.
Division 2. A building storing non-explosive materials, noncombustible or not highly combustible materials and salesrooms incidental to their operation.
Division 3. Automobile parking garages.

SECTION 1202. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in Group G Occupancy because of the use or character of the occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.
(b) Special Provisions. Storage areas in excess of 1000 square feet in connection with offices incidental to these operations, shall be separated from the public areas by a one-hour fire-resistive occupancy separation as defined in Chapter 5. See Chapters 17, 25 and 32 for attic space partitions and draft stops.
(c) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.

SECTION 1203. LOCATION.
(a) In City. See Chapter 16 for restrictions based upon location in Fire Zones.
(b) On Property. Buildings shall adjoin a yard, public space or street on at least one side. See Zoning Regulations for property setbacks.
(c) Exterior Wall and Opening Protection. See Chapters 5 and 17 through 22 for fire-resistive protection of exterior walls and openings, as determined by location on property. See Chapter 5 for regulating adjacent buildings on the same property.

SECTION 1204. EXIT FACILITIES. See Chapter 33.

SECTION 1205. LIGHT, VENTILATION, TOILET ROOM FACILITIES.
(a) Light. All portions of the building used by human occupants shall be provided with natural or artificial light.
(b) Ventilation. See Chapter 52.
(c) Toilet Room Facilities. See Chapter 5.

SECTION 1206. ENCLOSURE OF VERTICAL OPENINGS.
(a) Exits. See Chapter 33.
(b) Shafts. See Chapter 17.
SECTION 1207. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 1208. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapters 37, 51, 52 and 58.
(b) Heating or Equipment Rooms. See Chapter 17.

SECTION 1209. AUTOMOBILE PARKING GARAGES.
(a) General. Structures housing Group G, Division 3 Occupancies shall conform to the following:
   1. Automobile parking garages of more than one tier in height shall be constructed of noncombustible materials. Automobile parking garages one tier in height shall provide a floor surface constructed of noncombustible materials.
   2. Automobile parking garages may be open or enclosed construction.
   3. Curbs for traffic control shall be provided.
   4. For purposes of this Chapter, a tier, level, or parking surface are synonymous.
   5. Roof-top parking shall be permitted.
   6. Hand-type fire extinguishers shall be as required by the Fire Department, and shall be located as directed.
   7. Mechanical ventilation shall not be required for an automobile parking garage when 2 or more sides are a least 50 percent open.
   8. Vehicle exit ramps may be utilized for pedestrian exit requirements, provided the pedestrian walkway space is clearly defined by a curb or raised walk; that the number of automobiles parked per tier is one hundred or less; and the number of tiers is three or less. See Chapter 33.
   9. Where ramps are used for the transfer of automobiles from one floor to another, the ramps shall comply with Section 1722 at point of exiting from building. (Revised 7/83 Ordinance No. 389)

(b) Open Parking Garages.
   1. Definition. For the purpose of this Section, an open parking garage is a structure of Type I, II, or IV Construction more than one tier in height which is at least 50 percent open on 2 or more sides and is used exclusively for the parking or storage of passenger motor vehicles.
2. **Construction.** Construction shall be of noncombustible materials. Open parking garages shall meet the design requirements of Chapter 23. Curbs and guardrails shall be provided at each opening.

3. **Area and Height.** Area and height of open parking garages in Fire Zones No. 1, No. 2 and No. 3 shall conform to Table 12-A, except for increases permitted by Subsection 1209 (b) 4.

4. **Area and Height Increase.** The area of a parking garage open on three sides may be increased 25 percent and one tier in height. The area of parking garages open on 4 sides may be increased 50 percent and one tier in height.

Open parking garages constructed to heights less than maximums established by Table No. 12-A may have individual tier areas exceeding those otherwise permitted, provided the gross tier area of the structure does not exceed that permitted for the higher structure. At least three sides of each such larger tier shall have continuous horizontal openings not less than 30 inches in clear height extending for at least 80 percent of the length of the sides and no part of such larger tier shall be more than 200 feet horizontally from such an opening. In addition, each such opening shall face a street or yard accessible to a street with a width of at least 30 feet for the full length of the opening. (Revised 10/81 Ordinance No. 519)

5. **Location on Property.** When located adjacent to interior property lines, exterior walls shall conform to the fire resistance requirements set forth in Table 12-B. Walls shall be without opening.

6. **Stairs and Exits.** Stairs and exits shall meet the requirements of Chapter 33 when persons other than parking attendants are permitted. When parking attendants only are permitted, at least 2 stairs, 3 feet wide shall be provided. Lifts may be installed for use of employees only, provided they are completely enclosed with noncombustible materials.

7. **Fire Protection Equipment.** See Chapter 38. If area is increased per 1209 (b) 4 above, standpipes shall be required in each tier. Where any portion of a story or tier is more than 100 feet from required openings, an automatic fire sprinkler system shall be installed. (Revised 10/81 Ordinance No. 519)

8. **Occupancy Separations.** Occupancy separations shall be installed as required in Chapter 5 between open parking garages and other occupancies.

9. **Enclosure of Vertical Openings.** Enclosure shall not be required for vertical openings except as specified in Subsection 1209 (b) 6 for stairs, exits and lifts.
11. Prohibitions. The following uses are prohibited:
   A. Automobile repair work.
   B. Sale of gasoline or oil.
   C. Parking of buses, trucks and similar vehicles.
   D. Partial or complete closing of required openings in exterior
      walls by any means.

SECTION 1210. STANDARDS. Unless provided for in other portions of
this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCA</td>
<td>Chemicals Data Sheet - Perchloroethylene 1948.</td>
</tr>
</tbody>
</table>

LEGEND

<table>
<thead>
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<th>ORGANIZATION</th>
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<tr>
<td>MCA</td>
</tr>
<tr>
<td>Manufacturing Chemists Association, Inc.</td>
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<tr>
<td>1825 Connecticut Avenue</td>
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<tr>
<td>N.W. Washington, D.C. 20009</td>
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SECTION 1211. TABLES.

TABLE NO. 12-A

OPEN PARKING GARAGES
AREA AND HEIGHT

<table>
<thead>
<tr>
<th>TYPE</th>
<th>AREA (Square Feet)</th>
<th>HEIGHT</th>
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<tbody>
<tr>
<td>Type I</td>
<td>Unlimited</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Type II</td>
<td>125,000 per tier</td>
<td>75 feet maximum</td>
</tr>
<tr>
<td>Type IV-one hour</td>
<td>50,000 per tier</td>
<td>75 feet maximum</td>
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<tr>
<td>Type IV-unprotected</td>
<td>30,000 per tier</td>
<td>75 feet maximum</td>
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TABLE NO. 12-B

OPEN PARKING GARAGES
FIRE RESISTANCE OF EXTERIOR WALLS

<table>
<thead>
<tr>
<th>Distance from Property Line To Building</th>
<th>Fire Zone No. 1</th>
<th>Fire Resistance Fire Zone No. 2</th>
<th>Fire Zone No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0'- 10'</td>
<td>2-hour</td>
<td>2-hour</td>
<td>1-hour</td>
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<tr>
<td>10'- 20'</td>
<td>1-hour</td>
<td>1-hour</td>
<td>None</td>
</tr>
</tbody>
</table>

12-4
CHAPTER 13

REQUIREMENTS FOR GROUP H OCCUPANCIES

SECTION 1301. GROUP H OCCUPANCIES DEFINED.
Division 1: Hotels and motels.
Division 2: Apartments, garden apartments, dormitories, convents
 monasteries, rooming and boarding houses, foster homes, senior citizen
 homes.
Division 3. Townhouses, cluster homes, row dwellings, and connected
 dwellings housing more than 2 families.

SECTION 1302. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portion of buildings classified in Group H Occu-
 pancy because of the use or character of the occupancy shall conform to
 the types of construction, area and height requirements specified in
 Chapter 5.
(b) Special Requirements.
1. Group H-1 and H-2 Occupancies more than one story in height
 shall be at least one-hour fire-resistive construction.
2. Group H-3 Occupancies shall meet the following conditions:
   A. Shall consist of 3 or more attached dwelling units, not more
      than 3 stories in height, with each unit having independent
      access to the exterior of the building in the ground story.
   B. Shall be provided with separate sewage, water supply, heating,
      electric and plumbing systems together with all other
      housing utilities and equipment.
   C. Each dwelling unit shall be separated by a 2-hour fire-resis-
      tive wall extending from the foundation to the highest point
      of the building, to the underside of the roof sheathing or
      decking, and to the exterior walls. Voids or openings shall
      not be permitted. Common utilities including plumbing,
      electrical, heating, air conditioning, telephone and etc., shall
      not be permitted in the 2-hour fire-resistive separation wall.
   D. Electrical, heating, plumbing and construction installations
      shall conform to all the requirements of Group I Occupan-
      cies.
   E. For purposes of this Section, if living quarters are located in a
      basement, the basement shall be considered a story.
   F. The second story or basement of any Group H-3 Occupancy
      shall not be utilized to house another family.
   G. Where a conflict exists between this Section and other Sec-
      tions of this Building Code, this Section shall apply.
(c) Occupancy Loads and Separations. See Chapter 33 for occupant
 loads. See Chapter 5 for occupancy separation requirements.
SECTION 1303. LOCATION.
   (a) In City. See Chapter 16 for restrictions based on location in Fire Zones.
   (b) On Property. Buildings shall adjoin a yard, public space, or street on
       at least one side. See Zoning Regulations for property setbacks.
   (c) Exterior Wall and Opening Protection. See Chapters 5 and 17
       through 22 for fire-resistive protection of exterior walls and openings,
       as determined by location on property. See Chapter 5 for regulating ad-
       jacent buildings on the same property.

SECTION 1304. EXIT FACILITIES. See Chapter 33.

SECTION 1305. LIGHT, CEILING HEIGHT, VENTILATION, TOILET
       ROOM FACILITIES.
   (a) Light. All portions of the building used by human occupants shall be
       provided with either natural or artificial light. Required windows shall
       open on a court, yard, or street, either directly or through a porch at
       least 7 feet high and not more than 7 feet deep, with at least 2 sides 50
       percent open. The width of courts or yards shall be at least 3 feet when
       not more than 2 stories high, and shall be increased in width at the rate
       of 6 inches for each additional story. The court shall have a width at
       least 50 percent greater than otherwise required when the court is en-
       tirely surrounded by the building.
   (b) Ceiling Heights. Every habitable room shall have a minimum ceiling
       height of 7 feet over at least 50 percent of its area, and no portion of the
       remaining ceiling shall be less than 5 feet in height.
   (c) Ventilation. See Chapter 52.
   (d) Toilet Room Facilities. See Chapter 5.

SECTION 1306. ENCLOSURE OF VERTICAL OPENINGS.
   (a) Exits. See Chapter 33.
   (b) Shafts. See Chapter 17.

SECTION 1307. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 1308. SPECIAL REQUIREMENTS.
   (a) Chimneys and Heating Apparatus. See Chapters 37, 51, 52 and 58.
   (b) Heating or Equipment Rooms. See Chapter 17.
CHAPTER 14
REQUIREMENTS FOR GROUP I OCCUPANCIES

SECTION 1401. GROUP I OCCUPANCIES DEFINED.
DIVISION 1. One and two family dwelling units constructed as separate buildings.
DIVISION 2. Group homes for not more than eight residents which do not require skilled or intermediate care and are licensed and approved by the State of Colorado or approved by the Denver Department of Health and Hospitals. Not more than two resident managers will be permitted in addition to the eight residents. (Rev. 7/85 Ord. No. 422)

SECTION 1402. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in Group I Occupancy because of the use or character of the occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.
(b) Special Provisions.
A minimum of one-hour fire-resistive construction shall be provided between the dwelling unit and an attached garage. See Table 5-B.
Exception: A carport open on 2 or more sides need not have a fire separation between the carport and the dwelling. Windows between the carport and the dwelling shall not be openable. Doors may be of any type, provided that any sash used in a door shall be fixed.
(c) Occupancy Loads and Separations. See Chapter 33 and the Zoning Code for occupant loads. See Chapter 5 for occupancy separation requirements.
(d) Special Requirements for Division 2 Occupancies. Division 2 occupancies shall comply with the following requirements in addition to other requirements for Division 1, I occupancy.
1. The Group Home shall be provided with approved residential type single station smoke detectors wired to a 115 volt AC unsswitched electric power source. Activation of any one detector shall cause all detectors to alarm. The detectors shall be located in corridors adjacent to sleeping rooms, general living areas and basements as required by the Department. When the group home has non-ambulatory occupants, the system shall be a supervised detection system conforming to the requirements of Chapter 38, and be connected to a central station.
2. All doors separating floors, sleeping rooms and fuel fired equipment rooms, shall be solid core construction and be a minimum of 1-3/8 inch in thickness. All walls and ceilings shall be covered with a minimum of 1/2" plaster or gypsum board. Openings thru floors shall be protected by a 1-3/8" solid core door or as approved by the Department.

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3. Fuel fired equipment rooms shall be enclosed with 5/8" type X gypsum board on the ceiling and on each side of the walls. Fire dampers need not be installed in air ducts passing through the wall, floors or ceilings. Adequate outside combustion and relief air ducts are required from the furnace room.

4. Each habitable floor shall have two approved exits.

5. Handicap access shall be provided in all group homes licensed for non-ambulatory occupants per the Colorado Department of Health regulations.

6. Plans and building permits shall designate whether the group home is for ambulatory or non-ambulatory occupants and the maximum number of occupants permitted.

7. Plans for the renovation of an existing building or the construction of a new building shall bear the seal and signature of the architect and engineer responsible for the design phases of the building.

8. All construction shall be performed by a contractor licensed under the Denver Building Code to perform such work.

(Rev. 7/86 Ord. No. 422)

SECTION 1403. LOCATION.
(a) In City. See Chapter 16 for restrictions based on location in Fire Zones.
(b) On Property. Buildings shall adjoin a yard, public space, or street on at least one side. See Zoning Regulations for property setbacks.
(c) Exterior Wall and Opening Protection. See Chapters 5 and 17 through 22 for fire-resistant protection of exterior walls and openings, as determined by location on property.

SECTION 1404. EXIT FACILITIES. See Chapter 33.

SECTION 1405. LIGHT, CEILING HEIGHTS, VENTILATION.
TOILET ROOM FACILITIES.
(a) Light. All portions of the building used by human occupants shall be provided with either natural or artificial light. Required windows shall open on a court, yard, or street, either directly or through a porch at least 7 feet high and not more than 7 feet deep, with at least one side 50 percent open.
(b) Ceiling Heights. Every habitable room shall have a minimum ceiling height of 7 feet or at least 50 percent of its area, and no portion of the remaining ceiling shall be less than 5 feet in height.
(c) Ventilation. See Chapter 52.
(d) Toilet Room Facilities. See Chapter 5.

14-2
SECTION 1406. FIRE PROTECTION SYSTEMS. See Chapter 38.

SECTION 1407. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapter 37, 51, 52 and 58.
(b) Heating or Equipment Rooms. See Chapters 17 and 33.
CHAPTER 15

REQUIREMENTS FOR GROUP J OCCUPANCIES

SECTION 1501. GROUP J OCCUPANCIES DEFINED.
Division 1: Private garages, carports, covered patios, storage sheds, agricultural buildings, laundry buildings and minor recreational buildings not exceeding 1000 sq. ft. in area and used as accessory to any other occupancy. (Revised 4/81 Ordinance No. 172)
Division 2: Separate structures such as swimming pools, retaining walls over 3 feet high, and fences over 4 feet high.

SECTION 1502. CONSTRUCTION, HEIGHT, ALLOWABLE AREA.
(a) General. Buildings or portions of buildings classified in Group J occupancy because of the use or character of the occupancy shall conform to the types of construction, area, and height requirements specified in Chapter 5.
(b) Occupancy Loads and Separations. See Chapter 33 for occupant loads. See Chapter 5 for occupancy separation requirements.

SECTION 1503. LOCATION.
(a) In City. See Chapter 16 for restrictions based on location in Fire Zones.
(b) On Property. See Zoning Regulations for property setbacks.
(c) Exterior Wall and Opening Protection. See Chapters 5, and 17 through 22 for fire resistive protection of exterior walls and openings, as determined by location on property.

SECTION 1504. VENTILATION. Under no circumstances shall a private garage have any opening directly into a room used for sleeping purposes.

SECTION 1505. TOILET ROOM FACILITIES. See Chapter 5.

SECTION 1506. SPECIAL REQUIREMENTS.
(a) Chimneys and Heating Apparatus. See Chapters 37, 51, 52, and 58.
(b) Heating or Equipment Rooms. See Chapters 17 and 33.

SECTION 1507. FENCES AND RETAINING WALLS.
(a) General.
   1. This Section shall apply to all fences or walls in excess of 4 feet in height; all retaining walls in excess of 3 feet in height; combination fences and retaining walls in excess of 4 feet in height and all fences, walls and retaining walls to be installed on corners or other locations, regardless of height as provided for in this Section.
2. When the Department determines that the installation, removal or repair of a fence shall be for the general welfare and safety of the public, notwithstanding the provisions of this Section, the Department may order such action be taken as is deemed to be necessary.

(b) Design. All fences, walls and retaining walls shall be designed in accordance with the following:

1. Retaining walls shall be so designed, and drainage provided, so as to resist all lateral pressure to which they may be subjected.

2. Fences shall be designed to resist any wind load to which they may be subjected.

(c) Prohibitions. The prohibitions, as indicated herein, shall apply to all fences, walls or retaining walls, regardless of height.

1. The use of barbed wire or any other sharp pointed material as a fencing material or on top of fences or retaining walls is hereby prohibited except when and where specifically approved by the Department.

2. The use of electrically charged fences, as such, or on top of fences or retaining walls, is hereby prohibited except when and where specifically approved by the Department.

(d) Review and Approval. Fences, walls or retaining walls to be installed on corner or other locations which may create traffic hazards or be in violation of other applicable Ordinances shall be subject to review by the appropriate City Agency and no such fence, wall or retaining wall shall be installed or maintained in derogation of the disapproval of any City Agency.

(e) Repair or Removal. When a fence, wall or retaining wall is declared by the Department to be dilapidated or hazardous, the Department may order the fence, wall or retaining wall to be removed or repaired.
CHAPTER 16

RESTRICTIONS IN FIRE ZONES

SECTION 1601. GENERAL.

(a) Fire Zones Defined. For the purpose of this Building Code, the City and County of Denver in its entirety shall be composed of Fire Zones 1, 2, and 3 described as follows:

1. Fire Zone 1 shall include all the area lying within the following boundaries: Beginning at the intersection of East Colfax Avenue and Sherman Street, thence north on Sherman Street to 20th Avenue, thence west on 20th Avenue to 20th Street, thence northwest on 20th Street to the alley between Larimer Street and Market Street, thence southwest on the alley between Larimer Street and Market Street to Cherry Creek, thence southeast on Cherry Creek to West Colfax Avenue, thence east on Colfax Avenue to the point of beginning.

2. Fire Zone 2 shall include all the area lying within the following boundaries, except that which is included in Fire Zone 1: Beginning at the intersection of East 14th Avenue and Grant Street, thence north on Grant Street to 21st Street, thence northwest on 21st Street to Blake Street, thence south west on Blake Street to Cherry Creek, thence southeast on Cherry Creek to West 14th Avenue, thence east on 14th Avenue to the point of beginning.

3. Fire Zone 3 shall include all the area of the City and County of Denver except that which is included in Fire Zones 1 and 2.

(b) Fire Zone Boundaries Defined. Where a street, alley, or right-of-way is referred to in this Chapter, it shall mean the center line of the street, alley, or right-of-way.

(c) Building Located in More Than One Fire Zone. A building or structure located partly in one fire zone and partly in another shall be considered to be in the more restrictive fire zone, if 1/3 or more of its total floor area is located in that zone.

(d) Moved Buildings. Any building or structure moved within or into any fire zone shall be made to comply with all the requirements for new buildings in that fire zone.

(e) Temporary Buildings and Structures. Regardless of type of construction, temporary buildings and structures otherwise conforming to the requirements of this Building Code may be erected in any Fire Zone. A special permit from the Department for a limited period of time not exceeding one year from the date of the permit shall be required for a temporary building or structure. Upon expiration of the time limit stated on the permit, a temporary building or structure shall be completely removed from the site.
EXCEPTION: Temporary building or trailers on construction sites during construction operation.

SECTION 1602. RESTRICTIONS IN FIRE ZONE 1.
(a) General. Buildings or structures erected, constructed or moved within or into Fire Zone 1 shall be only Type I, II, III-H.T., III one-hour, or IV one-hour construction, and shall otherwise meet the requirements of this Building Code.

EXCEPTIONS:
1. Open parking garages. See Chapter 12.
2. Type IV-N buildings not exceeding one story in height or 2500 square feet in area housing a Group F, G, or J Occupancy, except where otherwise restricted. See Chapter 5.
3. Type V one-hour buildings not exceeding one story in height and 400 square feet in area.

(b) Occupancies Prohibited. No group E, Division 2 Occupancy having a floor area exceeding 1500 square feet shall be permitted in Fire Zone 1. No Group E, Division 1 or 5 Occupancies shall be permitted in Fire Zone 1.

EXCEPTIONS:
1. Dry Cleaning plants which do not use highly flammable liquids.
2. Service Stations.

SECTION 1603. RESTRICTIONS IN FIRE ZONE 2.
(a) General. Any building or structure complying with the requirements of this Building Code may be erected, constructed or moved within or into Fire Zone 2.

(b) Occupancies Prohibited. No Group E, Division 2 Occupancy having a floor area exceeding 1500 square feet shall be permitted in Fire Zone 2. No Group E, Division 1 or 5 Occupancies shall be permitted in Fire Zone 2.

EXCEPTIONS:
1. Dry Cleaning plants which do not use highly flammable liquids.
2. Service stations.

SECTION 1604. RESTRICTIONS IN FIRE ZONE 3.
(a) General. Any building or structure complying with the requirements of this Building Code may be erected, constructed or moved within or into Fire Zone 3.
CITY and COUNTY of DENVER
Fire Zones 1 and 2

NOTE: Balance of map not indicated herein shall indicate that all areas outside Fire Zones
No. 1 and No. 2 shall be Fire Zone No. 3.
CHAPTER 17
CLASSIFICATION OF BUILDINGS BY TYPES OF CONSTRUCTION AND GENERAL REQUIREMENTS

SECTION 1701. GENERAL. Every building shall be classified by the Department into one of the types of construction specified in Table 17-A and described in Chapters 18 through 22. Any building which does not entirely conform to a type of construction specified in Table 17-A shall be classified by the Department into a type having an equal degree of fire-resistance. Buildings shall not be required to conform to the details of a Type of Construction higher than that type which meets the minimum requirements based on Occupancy (Chapters 5 through 15) or Restriction in Fire Zones (Chapter 16) although certain features of the building may conform to a higher Type of Construction. Where specific materials, types of construction and fire resistive protection are required, these requirements shall be the minimum requirements. Any material, type of construction and fire-resistive protection which will afford equal or greater public safety or resistance to fire, as specified in this Code, may be used. Portions of buildings separated by area separation walls, as provided for in Chapter 5, may be considered as separate buildings for classification of Type of Construction. Where there is no area separation, the area of the entire building shall not exceed that specified in Chapter 5.

SECTION 1702. STRUCTURAL FRAME. The structural frame shall be the columns, girders, beams, trusses and spandrels having direct connection to the columns, and all other members essential to the stability of the building as a whole. The members of floor, roof, and wall panels which have no connection to the columns shall be secondary members and not part of the structural frame.

SECTION 1703. FLOORS OVER BASEMENTS, CELLARS AND CRAWL SPACES. In unprotected Types III, IV, and V buildings, floor assemblies of metal or wood located over basements, cellars and crawl spaces shall be protected on the underside as required for one-hour fire-resistive construction. All structural members supporting these floors shall be of one-hour fire-resistive construction. Doors shall be self-closing 3/4 hour-rated or 1-3/4 inches solid wood core.
EXCEPTIONS:
2. Basements, cellars and crawl spaces provided with an approved fire sprinkler system.
3. Crawl spaces that are not used for storage.

SECTION 1704. ROOF CONSTRUCTION. For roof construction, see Chapter 32. For penthouses and roof structures, see Chapter 36. For skylights, see Chapters 54 and 60. For plastics, see Chapter 60.

SECTION 1705. EXCEPTIONS TO CONSTRUCTION REQUIREMENTS. The provisions of this Section are exceptions to construction requirements specified in Chapters 5 through 22.
(a) Fixed Partitions. Non bearing partitions subdividing spaces occupied by one tenant only, not requiring occupancy separation, and not part of a public corridor may be constructed of:
1. Noncombustible materials.
2. Fire-retardant treated wood. See Chapter 43.
3. One-hour fire-resistive construction.
4. Wood panels up to three-fourths the height of the room, but not exceeding 7 feet in height. The space between the top of these panels and the ceiling may be closed with glass.
5. Plastics as permitted by Chapter 60.
6. One-half inch regular gypsum board on each side of wood or metal studs in Type III one-hour, and Type V one-hour buildings only.
(b) Folding Partitions. Folding partitions need not have a fire-resistive rating provided:
1. They do not block required exits or establish an exit corridor.
2. Their location is restricted by means of permanent tracks, guides, or other approved methods.
3. Flammability meets the flame-spread requirements specified in Chapter 42.
(c) Walls Fronting on Streets or Yards. Certain elements of walls fronting on streets or yards having a width of 40 feet or more may be constructed as follows:
1. Bulkheads above and below show windows, show window frames, aprons and showcases may be of combustible materials provided the height of their construction does not exceed 20 feet above grade.

2. Wood veneer of boards not less than one-inch nominal thickness or exterior type panels not less than 3/8 inch thickness may be applied to walls provided the height of the veneer does not exceed 20 feet above grade. The veneer shall be applied either directly against or furred no more than 1-1/2 inches from a noncombustible surface.

(d) **Trim.** Trim, picture molds, chair rails, baseboards, handrails and show window backing may be of wood. Unprotected wood doors and windows may be used except where openings are required to be fire protected. Materials used for interior finish of walls and ceilings shall be as specified in Chapter 42.

(e) **Exterior Loading Platforms.** Exterior loading platforms shall be of noncombustible materials or wood at least 1-1/2 inches thick. Wood construction shall not extend through the exterior walls. All exterior loading platforms shall be provided with an enclosure to prevent the accumulation of debris beneath the platform.

(f) **Wood Sleepers.** Where wood sleepers are used for laying wood flooring more than 1-1/2 inches above noncombustible floors, the space between the floor and the flooring shall be filled with noncombustible material or firestopped so that no open spaces shall exceed 100 square feet in area. The space shall be filled solid under all partition.

(g) **Non-Metallic Fire Sprinkler Piping.** The installation of non-metallic fire sprinkler piping systems is permitted per section 3803(g). (Rev. 8/86 Ord. No. 519)

**SECTION 1706. ENCLOSURE OF VERTICAL OPENINGS.** (Revised 8/80 Ordinance No. 393)

(a) **General.** Openings extending vertically through floor shall be enclosed by fire-resistive construction as specified in Table 17-A. Exit enclosures shall be as specified in Chapter 33. See Section 1726 for Atrium Construction.

**EXCEPTIONS:**

1. In other than Group D Occupancies, an enclosure or perimeter fire sprinkler shall not be required for openings which serve only one adjacent floor and are not connected with openings serving other floors. This exception shall apply to basements and cellars only where they are provided with an approved fire sprinkler system throughout.
2. Enclosures shall not be required for escalators protected with fire sprinklers as specified in Chapter 38.

(b) **Protection of Openings.** Every opening into a vertical enclosure shall be protected by a self-closing fire assembly conforming to the requirements of Chapter 45. Openings through a one-hour rated enclosure wall shall be protected by a 3/4 hour rated fire assembly, and openings through a two-hour rated enclosure wall shall be protected by a 1-1/2 hour rated fire assembly.

**EXCEPTIONS:**
1. Openings to the exterior may be unprotected when permitted by Table 17-C.
2. Ducts penetrating vertical fire rated enclosure walls shall be protected by fire dampers.

(c) **Termination of Trash and Laundry Chutes.** In other than Group I Occupancies, trash and laundry chutes shall terminate in rooms separated from the remainder of the building by a one-hour fire-resistive occupancy separation. Openings into chutes shall not be located in exit stairways. See Chapter 48 for trash chute and incinerator requirements.

(d) **Elevator Shafts.** Elevator shafts shall be vented as specified in Section 1807 and Chapter 55. (Revised 7/83 Ordinance No. 389)

SECTION 1707. OPENINGS IN EXTERIOR WALLS.
(a) **General.** Exterior walls shall be provided for buildings located where openings are not permitted, and when protection of openings is required.

(b) **Openings Not Permitted.** Openings shall not be permitted in exterior walls located less than the following set-back distances from an adjacent property line or the center line of a street or alley:

1. Five feet for buildings housing Groups A through H Occupancies.
2. Three feet for buildings housing Groups I through J Occupancies, except carports and patios.

(c) **Protection of Openings Required.** All openings in exterior walls shall be protected by a fire assembly having 3/4 hour fire-resistive rating where the walls are located less than the set-back distances from an adjacent property line or the center line of a street or alley as specified in Table 17-C. Where openings in exterior walls are required to be protected, the sum of the areas of the openings shall not exceed 50 percent of the total area of the wall in each story.

**EXCEPTION 1:** In fully sprinklered buildings a sprinkler system designed as follows may be substituted for the required 3/4 hour fire resistive protection. Sprinklers of the pendant directional deflector type with 135 degree heads shall be located on the inside of the building adjacent to the opening being protected and in a position
where the sprinkler can "see" the exposing fire. The sprinklers shall be located within 18 inches of the opening and be spaced a maximum distance of six feet apart. The sprinkler system shall completely wet the entire surface of the glass or provide a spray that protects the entire opening. Obstructions such as curtains, draperies, blinds and like materials shall not be installed between the sprinkler system and the glass. Sprinklers shall be closed heads and may be taken off of the sprinkler system piping serving that floor. System shall be designed to distribute at least 3 gpm per lineal foot of wall opening. The sprinkler system serving the floor shall be designed to provide adequate water supply to either a hydraulically calculated remote floor area in accord with NFPA 13 or to all of the exposure protection heads on any one of the building - whichever demand is greatest.

**EXCEPTION 2:** Carports and patios in Groups I and J Occupancies.

(Revised 4/84 Ordinance No. 122)

(d) Buildings on Same Property and Buildings Containing Courts. For the purpose of determining the required opening protection in exterior walls of buildings on the same property and in court walls of buildings over one story in height, a property line shall be assumed between opposite walls.

**SECTION 1708. WEATHER PROTECTION.**

(a) Weather Resistive Barriers. All weather exposed wall surfaces shall have a weather resistive barrier. The barrier shall be waterproof building paper, asphalt saturated felt or an approved equal. Application shall be weatherboard lapped at least 2 inches at horizontal joints and at least 6 inches at vertical joints. The weather resistive barrier may be omitted in the following cases:

1. Where exterior covering is approved weatherproof materials.
2. In back plastered construction.
3. When there is no human occupancy.
4. Over water repellent sheathing.
5. Under approved paper backed metal lath.
6. In solid masonry construction.

(b) Flashing and Counterflashing. Exterior openings exposed to the weather shall be made weatherproof. All parapets shall be provided with a weatherproof coping. All flashing, counterflashing and coping of metal shall be at least No. 26 U.S. gauge corrosion resistant metal.

(c) Weather Exposed Area. Balconies, landings, exterior stairways and similar surfaces exposed to the weather and sealed underneath shall be made weatherproof.
SECTION 1709. MEMBERS SUPPORTING MASONRY OR CONCRETE WALLS. Metal members supporting masonry or concrete walls in buildings over one story in height shall be protected with at least one-hour fire-resistive protection. Fire protection may be omitted from shelf angles, plates and the bottom flange of lintels where these members are not part of the structural frame. Wood members shall not be used to support masonry or concrete walls except as permitted by Chapter 25.

SECTION 1710. PARAPETS.
(a) General. Parapets shall be provided on all exterior walls of buildings except as follows:
1. Walls not required to be of fire-resistive construction.
2. Walls which terminate at roofs of at least two-hour fire-resistive construction, or at roofs constructed entirely of noncombustible material.
3. Walls when unprotected openings are permitted.
4. Walls of buildings twenty feet or less in height.
5. Walls of buildings where the roof slope is 4:12 or greater.
(b) Construction. Parapets shall have the same degree of fire-resistance required for the wall upon which they are constructed. The height of the parapet shall be at least 30 inches above the point where the roof surface and the wall intersect.

SECTION 1711. PROJECTIONS FROM BUILDINGS.
(a) General. Cornices, canopies, marquees, roof extensions, mansards, eaves, balconies and similar projections extending beyond the exterior walls of buildings shall be constructed of noncombustible materials.
EXCEPTION: For Types III, IV, and V construction, projections from buildings may be of unprotected combustible materials provided the projections are separated from the remainder of the building by walls of at least one-hour fire-resistive construction. When combustible projections extend into the set-backs specified in Tables 17-B and 17-C, the projections shall be of one-hour fire-resistive construction.
(b) Projections. Projections from buildings extending over public property shall be constructed as specified in Chapter 45.

SECTION 1712. RANGES, HOT PLATES, AND COUNTERTOP UNITS. Gas and electric ranges, hot plates and countertop units shall bear the label of an approved testing laboratory, and shall be installed with clearances from combustible materials specified in the testing laboratory approval. Ventilation shall be as specified in Chapter 52.
SECTION 1713. HELIPORTS AND HELISTOPS.
(a) General. Heliports and helistops shall conform to the requirements of this Building Code, the Fire Code, the Zoning Ordinance and the Revised Municipal Code.
(b) Heliports and Helistops on Buildings. Heliports shall not be located on buildings. Helistops may be located on buildings provided they conform to the following requirements:
1. Landing Area. The landing area shall be surrounded on all sides by a clear area having a minimum average width of 15 feet, but no width shall be less than 5 feet.
2. Design. Helicopter landing areas and supporting structures shall be of noncombustible construction. Landing areas shall be designed to conduct fuel spillage away from all exits. Structural design and loading shall be as specified in Chapter 23.
3. Exits and Stairways. Helistops located on buildings shall have at least two exits. Exits and stairways shall comply with the provisions of Chapter 33. For landing areas less than 60 feet in length or less than 2000 square feet in area, the second exit may be a fire escape or ladder leading to the floor below.

SECTION 1714. GUARDRAILS. All unenclosed floor and roof openings, open and glazed sides of stairs, ramps and landings, balconies and porches more than 15 inches above grade, occupied roofs and areaways located within 5 feet of a public way shall be protected by guardrails. Guardrails shall be at least 42 inches high, except that stair guardrails may be the height specified in Chapter 33 for handrails. Open guardrails shall have intermediate rails, balusters or other members with not more than 6 inches clear spacing. Guardrails shall be designed to support the railing live loads specified in Chapter 23. (Revised 5/82 Ordinance No. 245)

EXCEPTIONS:
1. Guardrails in Group I Occupancies may be 36 inches high with intermediate members as specified above.
2. Guardrails in Groups E, G-1 and G-2 Occupancies may have one intermediate rail at mid-height. (Revised 5/82 Ordinance No. 245)
3. Guardrails need not be provided on the loading side of loading docks.
4. When the open side of a stair is within 12 inches horizontally of an adjacent stair, the stair guardrail may have one intermediate rail at mid-height.
5. Tempered glass at least 3/16 inch thick or laminated safety glass at least 1/4 inch thick, with adequate structural support and protection of edges, may be used in lieu of required guardrails.
6. Areaways may be protected by gratings in lieu of required guardrails.
7. Guardrails in the seating areas of auditoriums, reviewing stands, grandstands and bleachers may be as specified in Chapter 33.

SECTION 1715. MEZZANINES.
(a) General. Mezzanines shall be constructed as specified in Chapters 18, 19, 20 and 21.
(b) Mezzanine Limitations.
1. Not more than two mezzanine floors shall be located in any room of a building.
2. No mezzanine floor or floors shall cover more than one-third of the area of any room.
3. The clear height below a mezzanine floor shall be at least 7 feet.
4. Mezzanine exits shall be as specified in Chapter 33.

SECTION 1716. FURNACE AND BOILER ROOM ENCLOSURE. Unless otherwise required by special occupancy provisions, every furnace and boiler room shall be provided with a one-hour fire-resistive occupancy separation. Doors shall be one-hour rated with self-closing devices.

**EXCEPTION:** Furnace and boiler rooms in groups H-3, I-1 and J occupancies. See Chapter 14 for group I-2 occupancies. (Rev. 7/86 Ord. No. 423)

SECTION 1717. CRAWL SPACE VENTILATION AND ACCESS.
(a) Ventilation. Crawl spaces below wood construction shall be ventilated by mechanical means or by openings in exterior walls. The openings shall have a net area of 1/2 square foot for each 25 linear feet of exterior walls adjacent to the crawl space. Openings shall be located on opposite sides of the building, and as near to the corners as practicable. At least four openings shall be provided, covered with corrosion resistant wire mesh having not less than 1/4 inch nor more than 1/2 inch mesh size.
(b) Access. Except when heating equipment is located in a crawl space, access may be from the interior of the building. See Section 2903 and 5210 for specific requirements. (Revised 5/82 Ordinance No. 245)

SECTION 1718. TRANSMISSION OF CITY MICROWAVE SIGNALS. Construction permits or certificates of Occupancy shall not be issued for any building or structure exceeding 60 feet in height built or to be built within the City which interferes or may interfere with the transmission or reception of City microwave communication signals un-
less the owner of such building or structure provides for installation of equipment to retransmit or redirect the signal as necessary to eliminate any interference. Said equipment shall be approved by and installed at the direction of the City agency affected. A service agreement must also be approved by the City or agency whose transmission is affected by the proposed building or structure prior to the issuance of any permit or Certificate of Occupancy. Such agreement shall include provisions for easements and access for maintenance, electricity for operation and provision for the replacement of equipment. (Rev. 3/86 Ord. No. 131)

SECTION 1719. EMERGENCY POWER EQUIPMENT ROOM ENCLOSURE. Emergency power equipment rooms shall be provided with a one-hour fire-resistive occupancy separation. Doors shall be one-hour rated with self-closing devices. See Chapter 53.

SECTION 1720. TENTS AND CLOTH COVERED STRUCTURES. Tents and cloth covered structures exceeding 150 square feet in floor area shall be subject to approval of the Department and may be erected for a period of time not to exceed 120 days. In addition, Fire Department approval shall be required prior to the issuance of a permit for a tent or cloth covered structure.

SECTION 1721. MOBILE HOMES OR TRAILERS. In addition to the requirements of Article 633 of the Revised Municipal Code, the following shall apply:

(a) For the purpose of this Building Code, a mobile home or trailer shall be considered a vehicle when it is mobile, equipped with wheels and is not connected to a sewer or power supply.

(b) Mobile homes or trailers shall be permitted for dwelling occupancies only when located in a trailer park as defined in Article 633 of the Revised Municipal Code, and when approved by the Zoning Administration.

(c) Mobile homes or trailers shall not be permitted for any other occupancy unless meeting the requirements for buildings of this Building Code, and specifically approved by the Department.

EXCEPTION: Mobile homes or trailers used for temporary occupancy at construction sites.

SECTION 1722. VEHICLE EXIT FACILITIES. Where ramps are provided for vehicle exiting from buildings, the ramps shall be sloped at a rate equal to 0.5% min., 2.0% max., for a distance of at least 20 feet inside the property line. Said slope shall begin at the property line elevation consistent with street and sidewalk grades as usually calculated with 1/3 inch per foot rise from the top of the curb to the property line. Vertical curves should be used at all grade breaks. (Rev. 7/83 Ord. No. 389)
SECTION 1723. CONSTRUCTION IN A FLOOD PLAIN DISTRICT.

(a) All new buildings and additions to existing buildings hereafter erected in a Flood Plain shall comply with the requirements for location and elevation contained in Chapter 56, Article V of the Revised Municipal Code. (Rev. 12/86 Ord. No. 850)

(b) Water Supply and Sanitary Sewer System. New or replacement water supply and sanitary sewer systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into the flood waters.

(c) Design. The proposed construction shall be designed and anchored to prevent flotation, collapse, or lateral movement of the building or structure.

(d) One Hundred Year Flood. A flood that has the frequency of occurrence of once every one-hundred (100) years determined from an analysis of floods on a particular watercourse and other watercourses in the same general region. It has approximately a one percent chance of occurring in a given year. (Rev. 3/86 Ord. No. 159)

SECTION 1724. FIRE, SMOKE OR HEAT SHIELDS. In addition to the requirements in Chapter 52 for fire, smoke or heat shields, openings for these devices shall have a structural frame provided to carry the fire or smoke damper assembly. The fire rated material of the construction assembly shall be carried around this frame prior to the installation of the damper. See Chapter 52.

EXCEPTION: Masonry Walls.

SECTION 1725. EMERGENCY VEHICLE ACCESS. Every building shall be provided with access capable of sustaining the load of emergency vehicles as approved by the Department and the Fire Department. See Fire Code.

SECTION 1726. ATRIUMS (Revised 7/83 Ordinance No. 389)

(a) General. Buildings of other than Group D occupancy with automatic sprinkler protection throughout may have atriums complying with the requirements of this Section.

EXCEPTION: Individual guestrooms or dwelling units in group H-1 and H-2 occupancies may be equipped with a supervised smoke detection system in lieu of a sprinkler system within the room(s).
(b) **Floor Area.** When calculating the floor area for a refuge area as required in Section 1807 or for occupant load, the area of the atrium may be subtracted from the gross floor area.

(c) **Separation.** Atriums shall be separated from adjacent occupied spaces by not less than a one hour fire resistive construction. Openings in the atrium wall shall be protected in accordance with the requirements of Sections 1706 and 4308.

**EXCEPTION 1:** Any two levels may open directly to the atrium.

**EXCEPTION 2:** The tenant space may be separated from the atrium by a wired, tempered or laminated glass wall, subject to the following:

A. The glass shall be protected by a sprinkler system equipped with 135 degree F heads. The heads shall be installed on 6 foot centers spaced 6 to 12 inches from the glass. The system may be used to protect the glass exposure and the floor plate to the limit of the head’s coverage. The sprinkler system shall completely wet the entire surface of the glass wall when actuated. Where there are walking surfaces on both sides of the glass, both sides of the glass shall be so protected.

B. The glass shall be in a gasketed frame so installed that the glazing system may deflect without breaking (loading) the glass before the sprinkler system operates.

C. Obstructions such as curtain rods, drapery traverse rods, curtains, blinds, drapes or similar materials shall not be installed between the sprinkler system and the glass nor between the sprinkler system and the surrounding area if the sprinklers are used for floor plate protection as in A above.

(d) **Atrium Perimeter Fire Sprinklers.** Fire sprinklers shall be installed at 6 feet on center spacing around the atrium within 12 inches from the edge of the ceiling opening.

**EXCEPTION:** Where the atrium has a walkway ceiling less than 7 feet 6 inches wide and is protected as in (c) exception 2 above.

(e) **Smoke Detection.** The atrium shall be fully detected per NFPA 72 E (see Chapter 38). Smoke detectors shall be placed on the occupied side of any door opening into the atrium. Where a level is open to the atrium as in (d) exception 1 above, that level or portion of that level open to the atrium shall be fully detected.

(f) **Smoke Control.** Smoke control shall be provided in all atriums as follows:

1. Buildings not classified as high rise shall be provided with an atrium exhaust system as specified in this Section.

2. High rise buildings with atriums shall have pressurization and exhaust systems conforming to Section 1807 and this Section.
   A. In atriums 55 feet or less in height with a volume of 600,000 cubic feet or less, the system shall exhaust 6 air changes per hour. Gravity supply or fan inlets shall be provided within 10 feet of the lowest level of the atrium and be sized for 75% of the exhaust. Maintain maximum velocity of 1500 feet per minute across the net free area of the gravity opening(s).
   B. In atriums 55 feet or less in height with a volume in excess of 600,000 cubic feet, the system shall be sized to provide a minimum of 4 air changes per hour. Gravity supply or fan inlets shall be provided as in A above.
   C. In atriums in excess of 55 feet in height, regardless of volume, the exhaust system shall be sized to provide a minimum of four air changes per hour. Supply air shall be mechanically introduced within 10 feet of the lowest level of the atrium at a rate of 75% of the exhaust.
   D. In all three cases above, outside air intakes shall be less than 50 feet above grade. The atrium volume shall include all spaces open to the atrium.

4. Pressurization. In high rise buildings, pressurization systems shall be designed to provide a positive pressure in the atrium in relation to adjacent areas utilizing 100% outside air (see Section 1807). When pressurization and exhaust systems operate simultaneously, pressurization system shall provide 75% of exhaust quantity. Air shall be introduced within 10 feet of the lowest level of the atrium with outside air intakes located less than 50 feet above grade.

(g) Activation of Systems.
1. Low rise. The activation of any fire detection device shall operate the atrium exhaust and supply systems.

2. High rise. In addition to the requirements of Section 1807, the activation of any fire detection device shall start the atrium pressurization system. The activation of a smoke detector within the atrium shall activate the atrium exhaust system. The atrium supply system shall remain in operation.

(h) Annunciation.
1. Low Rise. Low rise buildings shall have a main annunciator panel in accordance with Chapter 38. Manual control for the atrium smoke control systems shall be located at a location approved by the Department and Fire Department.
2. **High Rise.** High rise buildings shall have an Operations Center in accordance with Section 1807. In addition, the following is required:
   A. Smoke Detectors in the atrium shall be on a separate zone per floor.
   B. Manual controls and status indicators for the atrium smoke control system shall be provided.

**SECTION 1727. TABLES.** (Revised 7/83 Ordinance No. 389)
TABLE NO. 17-A

TYPES OF CONSTRUCTION AND FIRE-RESISTIVE REQUIREMENTS IN HOURS
(For details, see Chapters under Occupancy and Types of Construction)
(Revised 5/80 Ordinance No.240)

<table>
<thead>
<tr>
<th>Materials of Construction</th>
<th>I Noncombustible</th>
<th>II Noncombustible</th>
<th>III Combustible</th>
<th>IV Noncombustible</th>
<th>V Combustible</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTERIOR BEARING AND NONBEARING WALLS</td>
<td>4 Sec. 1803(a)</td>
<td>4 Sec. 1903(a)</td>
<td>4 Sec. 2003(a)</td>
<td>4 Sec. 2003(a)</td>
<td>Bearing Walls 1-hr Non-Bearing 17-B, 2103 Table</td>
</tr>
<tr>
<td>INTERIOR BEARING WALLS</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>STRUCTURAL FRAME</td>
<td>3</td>
<td>2</td>
<td>1 or H.T.</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>PERMANENT PARTITIONS</td>
<td>1</td>
<td>1</td>
<td>1 or H.T.</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>VERTICAL OPENING ENCLOSURES</td>
<td>2</td>
<td>2</td>
<td>1 or H.T.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>FLOORS</td>
<td>2</td>
<td>1</td>
<td>1 or H.T.</td>
<td>N</td>
<td>1</td>
</tr>
<tr>
<td>ROOFS</td>
<td>2 Sec. 1806</td>
<td>1 Sec. 1906</td>
<td>1 or H.T.</td>
<td>N</td>
<td>1 Sec. 2107</td>
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</table>

See Section 1707 and Table 17-C

N - No general requirements for fire resistance.
H.T. - Heavy Timber
<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>FIRE ZONE</th>
<th>REQUIRED FIRE RESISTANCE OF EXTERIOR WALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>NA - See Chapter 6</td>
</tr>
<tr>
<td>B-1</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
</tr>
<tr>
<td>B-2</td>
<td>2,3</td>
<td>2 hours less than 10 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour elsewhere</td>
</tr>
<tr>
<td>B-3</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2 hours less than 5 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour elsewhere</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2 hours less than 5 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour less than 10 feet</td>
</tr>
<tr>
<td>B-4</td>
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<td>2 hours less than 20 feet</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1 hour less than 10 feet</td>
</tr>
<tr>
<td>C-1</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
</tr>
<tr>
<td>C-2</td>
<td>2</td>
<td>2 hours less than 10 feet</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2 hours less than 5 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour less than 10 feet</td>
</tr>
<tr>
<td>D-1</td>
<td></td>
<td>NA - See Chapter 9</td>
</tr>
<tr>
<td>D-2</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
</tr>
<tr>
<td></td>
<td>2,3</td>
<td>2 hours less than 5 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour elsewhere</td>
</tr>
<tr>
<td>E-1</td>
<td>1,2</td>
<td>Not permitted. See Chapter 16</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4 hours less than 5 feet</td>
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<tr>
<td></td>
<td></td>
<td>1 hour elsewhere</td>
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<tr>
<td>E-2</td>
<td>1</td>
<td>4 hours less than 20 feet</td>
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<tr>
<td>E-3</td>
<td>2</td>
<td>4 hours less than 5 feet</td>
</tr>
<tr>
<td>E-4</td>
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<td>4 hours less than 5 feet</td>
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<td>2 hours less than 10 feet</td>
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<tr>
<td></td>
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<td>1 hour less than 20 feet</td>
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<tr>
<td>E-5</td>
<td>1,2</td>
<td>Not permitted. See Chapter 16</td>
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<tr>
<td></td>
<td>3</td>
<td>1 hour less than 60 feet</td>
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<td>F-1</td>
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<td>1 hour less than 20 feet</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1 hour less than 10 feet</td>
</tr>
<tr>
<td>G-1</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
</tr>
<tr>
<td>G-2</td>
<td>2</td>
<td>1 hour less than 20 feet</td>
</tr>
<tr>
<td>G-3</td>
<td>3</td>
<td>1 hour less than 10 feet</td>
</tr>
<tr>
<td>OCCUPANCY</td>
<td>FIRE ZONE</td>
<td>REQUIRED FIRE RESISTANCE OF EXTERIOR WALL</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>H-1</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
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<tr>
<td></td>
<td></td>
<td>1 hour elsewhere</td>
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<tr>
<td>H-2</td>
<td>2</td>
<td>1 hour</td>
</tr>
<tr>
<td>H-3</td>
<td>3</td>
<td>1 hour less than 5 feet</td>
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<tr>
<td>I</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
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<td></td>
<td></td>
<td>1 hour elsewhere</td>
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<tr>
<td></td>
<td>2</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1 hour less than 3 feet</td>
</tr>
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<td>J-1</td>
<td>1</td>
<td>2 hours less than 20 feet</td>
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<tr>
<td></td>
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<td>1 hour elsewhere</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1 hour less than 20 feet</td>
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<td>1 hour less than 3 feet</td>
</tr>
<tr>
<td>J-2</td>
<td>1,2</td>
<td>Noncombustible construction not regulated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combustible construction shall be 1 hour</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Not regulated</td>
</tr>
</tbody>
</table>

Distances given are from the adjacent property line or center line of a street or alley to the wall.
NA - Not Applicable
# TABLE NO. 17-C

## SET-BACKS REQUIRING PROTECTION OF OPENINGS IN EXTERIOR WALLS

*(See Section 1707)*

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Fire Zone</th>
<th>Type of Construction</th>
<th>Set-Backs in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,2,3</td>
<td>I</td>
<td>20</td>
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<td></td>
<td>1,2,3</td>
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<td>NP</td>
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<td>B-1</td>
<td>1,2,3</td>
<td>I,II,III</td>
<td>20</td>
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<td>B-2</td>
<td>1</td>
<td>IV,V</td>
<td>20</td>
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<td>10</td>
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<td>C-1</td>
<td>1,2,3</td>
<td>I,II,III</td>
<td>20</td>
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<td>C-2</td>
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<td>IV,V</td>
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<tr>
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**NP** - Type of Construction not permitted  
**N** - No protection required beyond 3 feet.
CHAPTER 18
TYPE I BUILDINGS

SECTION 1801. GENERAL. The structural elements in Type I buildings shall be of steel, concrete or masonry. Walls and partitions shall be noncombustible fire-resistive construction except that interior non-bearing partitions of one hour or 2 hour fire-resistive construction, which are not part of a vertical enclosure, may have fire retardant treated wood within the rated assembly. Materials of construction and fire resistive requirements shall be as specified in Chapter 17.

SECTION 1802. STRUCTURAL FRAMEWORK. Structural framework shall be of structural steel as specified in Chapter 27, reinforced concrete as in Chapter 26 or masonry as in Chapter 24.

SECTION 1803. EXTERIOR WALLS AND OPENINGS.
(a) Exterior Walls. Exterior walls and all structural members therein shall comply with the requirements specified in Table 17A.

EXCEPTIONS:
1. Nonbearing walls fronting on streets or yards having a width of at least 40 feet may be of unprotected noncombustible construction.
2. In Groups F, G and H Occupancies, exterior bearing walls may be of 2 hour fire-resistive noncombustible construction where openings are permitted.
3. In other than Group E Occupancies, exterior nonbearing walls may be of one hour fire resistive noncombustible construction where unprotected openings are permitted and 2 hour fire-resistive noncombustible construction where fire protection of openings is required.

(b) Openings in Walls. All openings in exterior walls shall conform to the requirements of Chapter 17 and Table 17C.

SECTION 1804. FLOORS.
(a) Floor Construction. Floor assemblies shall be of noncombustible fire-resistive construction as specified in Table 17A except that wood flooring may be applied over a concrete floor slab. See Chapter 17.
(b) Mezzanine Floors. Mezzanine floors shall be constructed of one hour fire-resistive noncombustible materials. See Chapter 17 for
mezzanine limitations.

SECTION 1805. STAIRS. Stairs and landings shall be constructed of reinforced concrete or structural steel. Stairs shall be designed as specified in Chapter 33.

SECTION 1806. ROOFS. In Groups A, B and C Occupancies with fixed seating, except exhibition halls as defined herein, and where every part of the roof structure is at least 25 feet above any floor, the roof construction may be of unprotected noncombustible materials. In exhibition halls, and in all occupancies other than Groups A, B, and C where every part of the roof structure is at least 25 feet above any floor, the roof construction may be of noncombustible materials protected by one of the following:
1. A water spray fixed sprinkler system designed to provide the equivalent of one hour fire-resistive protection to the roof structure.
2. A water deluge or foam-water deluge sprinkler system designed to control fire at floor level.
3. One hour fire-resistive protection of all structural members and the roof deck.
4. A continuous ceiling equivalent to that required for one hour fire-resistant construction.
5. An approved fire sprinkler system installed throughout the building. For the purpose of this Section, exhibition hall shall be defined as any assembly building having facilities for trade shows, merchandise displays, conventions, carnivals, etc., when the combustible load exceeds 10 pounds or 9000 Btu per square foot of floor area in the display areas.

SECTION 1807. SMOKE CONTROL IN HIGH RISE BUILDINGS.
(Ordinance No. 581 Series 1981)

(a) General. Every building having a passenger elevator and having floors used for human occupancy more than 75 feet above the lowest level of Fire Department vehicle access and housing groups A, B, C, D, F, H-1 and H-2 occupancies, shall conform to the requirements of this section.
1. All new buildings shall conform to the requirements of this Section.
2. Existing buildings whose occupancy is being changed shall conform to the requirements of this Section.
3. Smoke barriers and smoke dampers shall be as defined and required below:
A. Required fire rated assemblies which separate areas to be pressurized or exhausted as part of a smoke control system shall be considered smoke barriers.

B. Smoke dampers shall be required only at the point where ducts pass through required smoke barriers and at connections between outside air and building exhaust air. The smoke dampers shall be installed before the first duct inlet or outlet and, in no case, more than two (2) feet from the barrier.

C. Smoke dampers shall meet the standards of U.L. 555S Class II and shall be listed by an approved testing laboratory. (Rev. 3/87 Ord. No. 119)

(b) Refuge Area

1. A refuge area, located at the elevator entrances, to allow for elevator evacuation shall be provided at each story served by a passenger elevator. Each refuge area shall have an area of at least one percent (1%) of the gross floor area of that story. EXCEPTION: Stories opening directly to grade or having ramps to grade.

2. The refuge area shall be enclosed by one hour fire-resistive construction, extending from floor to underside of floor above. The exceptions noted in Sections 507 and 3304 allowing deletion of one hour corridor construction for fully sprinklered buildings do not apply to this requirement.

A. Openings into refuge areas shall be protected by 3/4 hour rated self closing fire assemblies, in accordance with Section 4308. Table 33-B, note C, shall not apply. (Revised 7/83 Ordinance No. 389)

B. Locks or latches shall be in accordance with Section 3303(c) except that doors from occupied areas into the refuge area and into stairways shall be provided with lever type door handles or panic devices. Devices which would act to hold any door from an occupied area into the refuge area in an open position are not permitted. EXCEPTION: Type B closing devices which close refuge area doors throughout the building upon activation of the fire alarm system are permitted.

C. Door closing devices and pressurization systems shall be designed so that the opening of doors to the refuge area can be accomplished with the application of a force of not more than 25 pounds supplied at the latch side of the door on the door opening device.

3. Each refuge area shall exit directly to all required exit stairways.

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EXCEPTION: In Group F occupancies only, either stairway pressurization or full smoke detection may be substituted for direct access to required exit stairways if such a substitution is made to the entire building and complies with the following criteria. (This substitution does not delete the required refuge area.)

A. **Stairway Pressurization.** Each interior enclosed exit stairway shall be mechanically pressurized with outside air, when activated by any manual or automatic alarm initiating device, to maintain a minimum positive pressure of 0.05 inches of water column across any closed stairway door. The maximum pressure shall not create an opening force on any stairway door greater than 25 pounds, applied at the latch side of the door on the door opening device. Each interior exit stairway shall have a separate dedicated pressurization system. Supply air for the stairway shall be obtained from outside air intakes mounted so that they will not be contaminated by products of combustion, with a minimum of one intake located not more than 50 feet above grade. Stairway pressurization systems shall not have fire dampers. Each pressurization system shall be enclosed in a two-hour fire resistive enclosure when extended outside the stairway. Air volume introduced into the stairway shall be at least 15,000 cubic feet per minute, plus 200 cubic feet per minute per floor level.

B. **Full Floor Smoke Detection.** The entire building, excluding areas used for automobile parking garages, shall be provided with smoke detection in accordance with NFPA 72E.

4. Finish materials in refuge areas, atriums and corridors connecting stairways with refuge areas shall be of a minimum Class II Flame Spread Classification. See Tables 42-A and 42-B. (Revised 7/83 Ordinance No. 389)

5. Carpeting may be installed on the floors of refuge areas, atriums and corridors but shall not be coved up the walls for more than a maximum of 8 inches.

(c) **Pressurization**

1. Refuge areas and elevator hoistways, including elevator machine rooms which physically connect to hoistways, shall be pressurized, when activated, to maintain a minimum positive pressure of 0.05 inches of water column with respect to adjacent occupied spaces on all floors with doors to the refuge areas closed and general building pressurization systems not activated. The maximum pressure shall not create an opening force on any refuge area door greater than 25 pounds, applied at the
latch side of the door on the door opening device. Pressure shall not interfere with the opening and closing of elevator doors. When general building pressurization systems and refuge area systems are both activated, and four doors into a refuge area from a tenant area on the fire floor and one door on each other floor into a refuge area from a tenant area are opened, a minimum air flow of 150 feet per minute shall be maintained through each of the door openings on the fire floor. (If less than four doors open into the refuge area, all doors shall be opened and 150 feet per minute air flow shall be maintained.) Supply air for refuge areas shall be obtained from outside air intakes mounted so that they will not be contaminated by products of combustion, with a minimum of one intake located not more than 50 feet above grade. Each intake shall be provided with a smoke detector which shall close intake upon smoke detection.
(Revised 7/83 Ordinance No. 389)

2. Atriums. See Section 1726.

3. A general building pressurization system shall be provided which will, when activated, shut off all supply air to the fire floor (except refuge area) and shall exhaust air from the fire floor to the outside at a minimum design of 15 air changes per hour. Exhaust system is to be sized assuming supply air is available. Return air from all other floors must be shut off. Supply air to all other floors shall be provided from the outside. EXCEPTION: General building pressurization systems are not required in Group H occupancies provided the following conditions are complied with:
   A. Stairways shall be pressurized. See (b)3A for design requirements.
   B. Refuge areas shall be exhausted when a fire is detected within the refuge area. Exhaust systems shall be designed to comply with (c)3.

4. Smoke venting of elevator hoistways and elevator machine rooms to the exterior of the building shall not be required as provided for in ANSI A 17.1. See Chapter 55.

5. The refuge area shall be served by a separate dedicated pressurization system.
EXCEPTION: The general building pressurization system may be used to pressurize refuge areas if the system consists of more than one piece of air handling apparatus whose outside air intakes are located on opposite sides of the building and which comply with all other requirements of this Code. Each air handling apparatus shall be of sufficient size to provide required pressurization. Each piece of air handling apparatus shall be capable of being individually overridden from the Op-
erations Center. Sufficient air handling apparatus shall be connected to the emergency generator to provide required pressurization. Provisions shall be made so that fans on either side of the building may be operated by the emergency generator, although not simultaneously. Air handling apparatus shall be defined as a fan or bank of fans and return air/outside air damper assemblies dedicated to these fans. (Revised 7/83 Ordinance No. 389)

(d) Detection. Provide approved smoke detectors in the following locations: These detectors are in addition to any other requirements of this code.

1. Provide a detector, located down stream from air filters, in each fan system supplying air during alarm activation. The detector shall stop the fan when products of combustion are detected. With fan stopped, a system shall be so designed that smoke will not recirculate through building.

2. Not less than one foot and not more than three feet from door on occupied side of each door entering a refuge area.

**EXCEPTION:** In Group H-2 occupancies, and where permitted by the Department and Fire Department, detection shall be provided as follows:

A supervised rate of rise detector located per (d)2 above and a single station smoke detector conforming to the requirements of Section 3810 shall be installed in lieu of the supervised smoke detector required above. The supervised rate of rise detector shall actuate all systems in the same manner as the smoke detector required in (d)2. The single station smoke detector shall be wired to a 115 volt ac unswitched electric power source. When additional supervised smoke detectors are required by other Sections of this code, a supervised smoke detector or a supervised rate of rise detector with a single station smoke detector as above shall be provided. When more than one single station smoke detector is installed within a unit, they shall be interconnected so that activation of any one single station detector shall cause all to sound an alarm. (See Section 3810 and 3816) (Revised 7/83 Ordinance No. 389).

3. Not less than one foot and not more than three feet outside of each door into an exit stairway which is not directly exiting from a refuge area.

4. Refuge areas in accordance with NFPA 72E.

5. Mechanical, electrical and telephone equipment rooms.

6. At openings extending vertically through floors which are not required to be enclosed. Detectors shall be located on each level, and in location as approved by the Department.
(e) Activation.

1. **General System(s) Activation.**
   A. Activation of smoke detectors (except in refuge areas), water flow devices, or operation of pull stations shall activate the pressurization system for the refuge areas and elevator hoistways.
   B. Activation of smoke detectors (except in refuge areas) or water flow devices shall activate the general building pressurization system.
   C. Activation of any manual or automatic alarm initiating device shall cause the fire alarm system on the fire floor and the floors immediately above and below to sound.

2. **Refuge Area System(s) Activation.**
   A. Activation of a smoke detector in a refuge area shall activate the pressurization systems for the refuge areas, elevator hoistways and stairways and shall activate the general building ventilation system, and shall close the air supply to that refuge area and close the return air damper within the tenant area. The refuge area exhaust system shall provide 15 air changes per hour from the refuge area.
   B. Activation of a smoke detector in a refuge area shall cause the fire alarm system on the fire floor and the floors immediately above and below to sound.

3. Activation of any manual or automatic fire alarms causing activation of the general systems, refuge systems, or stairwell systems shall override all normal operating controls as required to comply with provisions of this Code and to prevent improper smoke control system operation which cannot be overridden at the fire command center. (e.g., temperature, timeclock, energy management, etc.) (Revised 7/83 Ordinance No. 389)

(f) Elevators

1. All passenger elevators serving a story shall open into a refuge area. Elevators used exclusively for service of the building must open into a refuge area if they occupy a common hoistway with passenger elevators.

2. Any fire alarm initiating device shall return to grade level, non-stop, elevators serving that zone. Elevators without a landing at grade level shall be returned to that landing closest to grade level or other approved level. Elevators will remain at that level with doors open until manually overridden by the key operator switch required by ANSI A17.1, Section 211.3a-1. See Chapter 55.

3. Provisions shall be made to prevent water from fire sprinkler systems from interfering with elevator operation.

(g) **Operations Center Equipment.** An Operations Center shall be provided in space approved by the Department and Fire Department.
The operations center shall be contained in a room separated from
the remainder of the building by 2-hour fire resistive construction.
The room shall be used for no other purpose unless that use is
approved by the Department and the Fire Department. No piping,
ducts or equipment foreign to the required operations shall be per-
mitted to enter, pass through or be installed within the room. The
room shall be equipped with a smoke detection system and shall not
be sprinklered. The Operations Center shall be located on the ground
floor with the door that opens directly into the main lobby at a point
in the lobby accessible directly from the exterior. The door to the
Operations Center shall not be located on a dead-end corridor. The
Operations Center shall contain the following: (Revised 7/83 Ord-
nance No. 389)

1. A HVAC status/control panel, utilizing graphics outlining the
building, and placing individual smoke control system fan and
damper controls relative to location within building. The HVAC
status/control panel shall be combined with the fire alarm an-
nunciator panel. The panel shall have a maximum height from
the floor of 6 feet 6 inches and may be in more than one section
to accommodate height limitations. The following features shall
be incorporated.

A. Individual manual override switches for orientation of all
system components utilized for smoke control, i.e., fans
and/or dampers for pressurization and exhaust. Provide
an individual switch, one per zone or level for exhaust
components and individual switch for orientation of 100%
outdoor air dampers.

B. Manual override switches shall be 3-function type, e.g.,
"Open-Auto-Close" for dampers or "On-Auto-Off" for fans,
etc. "Manual" positions shall override all automatic
modes.

C. Independent positive indication of orientation of each sys-
tem component provided with manual override per A
above; e.g., damper indication shall be for full closed and
fan indication shall be for "Run". Control signals cannot
be used for indication purposes. (Revised 7/83 Ordinance
No. 389)

D. Provide controls and indication for each refuge area's sup-
ply and exhaust dampers. Controls shall consist of an
"exhaust-automatic-pressurize" selector switch to control
the dampers when the refuge area pressurization system
is operating. In the automatic position, the dampers shall
be controlled by the smoke detectors within the refuge

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area. The indication required shall indicate whether the dampers are in pressurization or exhaust position.

E. A push to test switch shall be provided for all lights on control board.

2. Emergency Voice Communication System with the following features:
   A. Provide one-way communication on an individual and all-call basis to to each individual level. See Section 3816.
   B. Stairwell and elevator speakers shall be separate zones, controlled manually from the Operations Center.

3. Firefighter's (two-way) Telephone Communication System, with the following features:
   A. Firefighter's telephone jack at every fire alarm pull station and elevator lobby. The firefighter's telephone communication system shall have "In Use" indication, by zone, at Operations Center master panel, and switching provisions at master panel to allow silencing of any levels.
   B. Firefighter's telephone communication system shall be designed to serve as back-up to emergency voice communication system.
   C. Firefighter's telephone jacks shall be designed to prevent feedback by being arranged in such a manner that when a handset is inserted, it will disconnect any speaker in the immediate area while maintaining full supervision on the speaker circuit.
   D. A permanently mounted firefighter's telephone handset shall be located at building engineer's office, each mechanical room, emergency generator room, fire pump room, main electrical areas and each elevator cab. These units shall initiate a signal from the operations center to the individual handset, and from the individual handset to the operations center.

4. Emergency Generator Panel with the following features:
   A. Operating status (on-off) and malfunction indication panel as required by NFPA 70.
   B. Generator start/stop controls.
   C. Indication of transfer switch position (normal-emergency).
   D. Indication that generator is in automatic mode.
   E. Main fuel oil storage tank fuel level gauge.
   F. If pumping is required from main fuel tank to diesel generator, a duplex pumping system shall be provided. Emergency fuel flow controls are required in Operations Center.
5. If main electrical disconnects are located higher than 75 feet from grade, remote tripping switches shall be located within Operations Center.

6. Fire Pump Panel, with the following features:
   A. Operating status indication (motor on or off).
   B. If pumping is required from main fuel tank to diesel fire pump, a duplex pumping system shall be provided. Emergency fuel flow controls are required in Operations Center.
   C. Fuel level indicator for fire pump fuel tank, is provided.
   D. Fire Pump Start Control.

7. Fire Alarm Annunciation with the following features:
   A. Automatic fire sprinkler system zoned and annunciated per level. Main water flow indication.
   B. Manual fire alarm pull stations zoned and annunciated per level.
   C. Fire detection (duct, space) system zoned per level.

**EXCEPTION TO 7A, 7B, 7C:**
With main water flow annunciation and all concealed detectors (duct, electrical closet, etc.) provided with remote indicating pilot lights mounted directly below the detector(s) or directly outside door (electrical closers, etc.) for annunciation purposes, all initiating devices may be combined and annunciated as one zone per level. Remote indicating lamps may be mounted on a graphic plate at an alternate approved location.

D. In H-1 and H-2 occupancies, every detected space shall be annunciated individually. Annunciation shall be at main Operations Center annunciator panel by individual detected space or by individual level with a remote annunciator annunciating each detected space at each level at approved location. Main water flow annunciation at main annunciator panel. Individual level water flow shall be annunciated in same manner as detected space. With individual level remote annunciators, water flow, detection, and fire alarm pull stations may be annunciated as one zone per level.

E. Annunciator(s) shall be graphic, detailing building and placing annunciation indication relative to building level. The fire alarm annunciator panel may be combined with the HVAC status/control panel.

F. Automatic fire detection in individual level refuge areas shall be zoned and annunciated individually and separate from occupied area.
G. Special extinguishing systems shall be annunciated separately (hood-extinguishing system, halon, etc.).

8. Elevator Control(Status) Panel, with the following features:
   A. Identify each elevator cab numerically and the floors it serves on elevator status/control panel in Operations Center. Locate corresponding cab number in elevator cab at permanent handset.
   B. Indication of which elevator(s) are on emergency power.
   C. Placard at elevator status/control panel stating how many elevators can operate under emergency power simultaneously.
   D. Elevator car position indicator.

9. Emergency Graphics and Signs. Graphics and signs required by this Section shall be of durable construction, easily readable in normal room or corridor light, and have a smooth plastic surface.
   A. Diagrammatic Building Floor Plans (Table 18-A) shall be permanently mounted, unobstructed, on an interior wall of the Operation Center. One drawing may be used for all typical levels. Plans shall depict the following:
      Location of general building features.
      A brief legend shall be provided listing the levels on which general building features are located.
      Stairtowers (identified by building directional location).
      Elevators (numerically identified).
      Elevator machine room(s).
      Emergency generator.
      Fire pump(s).
      All fire sprinkler and standpipe valves.
      Mechanical area(s).
      Main electrical area(s).
      Fuel tank(s).
      Location of building services control(s).
      Electricity.
      Gas.
      Water supply (domestic), all valves, building entry location.
      Water supply (fire), all valves, building entry location.
      Ammonia, freon, chlorine, etc.
      Utility property line valves.
      Location of features on individual levels. One drawing may be used for all typical levels.
      Elevator(s).
Stairwell doors.
Refuge Area(s).
Fire sprinkler sectional valve(s).
Vertical shaft(s).
HVAC supply and return ducts (main each level).
Concealed detector(s) (duct, electrical closet, ammonia, etc.).
Partition layout and room function. For buildings or portions of buildings where partitions may be relocated from time to time, this information may be in notebook form.

B. A sign of 6 inches by 6 inches minimum size shall be mounted within each standpipe valve cabinet at each level of the building. This sign shall graphically depict the locations of sprinkler sectional valve(s), duct detector(s) and electrical closet(s) on that level. (Table 18-A)

C. A sign of 6 inches by 6 inches minimum size reading “Use stairs in case of fire unless otherwise instructed”, and graphically depicting exiting scheme (Table 18-A), shall be installed at each elevator call button in each refuge area.

(h) Emergency Generation. (See Chapter 53)

1. Sufficient emergency power shall be provided to operate enough elevators serving the fire floor to evacuate the occupants of the required refuge area on the fire floor to a minimum of two floors above or below the fire floor with a maximum of two elevator trips (assume one person per three square feet of required refuge area). A minimum of two elevators supplied with emergency power shall serve the fire floor refuge area at any time. In addition, emergency power shall be provided to operate an elevator(s) which serves all other floors, to operate air handling equipment for pressurization and exhaust systems as required and to operate other emergency system as required by this Code. (Revised 7/83 Ordinance No.389)

EXCEPTION: Where an elevator transfer floor is provided, only elevators in one bank providing access to the ground floor are considered to be serving that floor.

2. Emergency switchboards, panel boards, transfer switches and conductors supplying this equipment, shall be separated from main service equipment by a one-hour fire rated wall.

3. Provide sufficient fuel supply, on site, for eight (8) hours continuous operation under full load.

4. Emergency generation system shall be operated not less than once a month for not less than thirty (30) minutes at a minimum of thirty percent (30%) of full load. An accurate log shall be maintained on the premises indicating person or agency con
ducting test, dates tested, and length of test. Any defect, modification, or repair shall be recorded in the log. Logs shall be made available to the Fire Department.

(i) **Testing**

1. Each installation shall be tested prior to occupancy. Testing shall be scheduled in advance to allow for Building and Fire Department observation, prior to issuance of a Temporary or Permanent Certificate of Occupancy. Perform the following tests, and at the following intervals thereafter:
   A. Smoke detectors, fire alarms, voice communication and inter-communication systems, in accordance with Section 3809, paragraph (e)7 and Section 3811, paragraph (f)6, at the intervals stated in those paragraphs.
   B. Pressure differential, air flow and door opening force, in accordance with the criteria set forth in this Section, one time each year. Pressure differentials, air flows and door opening forces shall be measured at a minimum of three locations - a floor in the lower third of the building, a floor in the middle third, and one in the upper third.

2. Test reports shall:
   A. Detail procedures followed, equipment used, outside air temperature, wind conditions, humidity and barometric pressure.
   B. State sequence and timing of operation of smoke control systems.
   C. Record any defects noted in system operation, action taken to correct such defects, and results of subsequent testing.
   D. Verify that the system, as installed, operated as required by this code.

3. Copies of test reports, certified by a Registered Professional Engineer, licensed in the State of Colorado, shall be filed with the Fire Department following the pressure differential, air flow and door opening force testing each year thereafter. An accurate log of tests shall be maintained in the Command Center. Any defects, modification or repair shall be recorded in the log.

This ordinance shall be effective for plans for buildings and structures submitted to the Department on or after the first day of March, 1982 and for all buildings and structures on which permits are issued on or after the first day of May, 1982. (Ordinance No. 518 10/81)
SECTION 1808. TABLES

TABLE NO. 18-A
EXAMPLES OF EMERGENCY GRAPHICS
(Reduced in size)

levator Call Button Sign:

YOU ARE HERE

USE STAIRS IN CASE OF FIRE
UNLESS OTHERWISE INSTRUCTED
TABLE 18-A CONTINUED

Diagrammatic Building Floor Plans:

- BASEMENT

- TYPICAL FLOORS 2-11

- Stair Tower
- Elevator Shafts
- Mechanical Shafts
- TIE: Fire Hose Cabinet
- H0: Main Return Duct
- H0: Main H. Prey Duct
- 0: Concealed Detectors
- 1: Fire Sprinkler Floor Valve
- 2: Sprinkler Shutoff Valve
- 3: Exempt: Water Shutoff
- 4: Electrical Shutoff

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TABLE 18-A CONTINUED
Diagrammatic Building Floor Plans (continued)
TABLE 18-A CONTINUED

Standpipe Valve Cabinet Sign:

(Ordinance No. 518 10/81)
SECTION 1809. STANDARDS

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(Rev. 10/86 Ord. No. 687)
CHAPTER 19
TYPE II BUILDINGS

SECTION 1901. GENERAL. The structural elements in Type II buildings shall be of steel, concrete or masonry. Walls and partitions shall be of non-combustible fire-resistive construction except that interior nonbearing partitions of one-hour or 2 hour fire-resistive construction, which are not part of a vertical enclosure, may have fire-retardant treated wood within the rated assembly. Materials of construction and fire-resistive requirements shall be as specified in Chapter 17. Allowable floor area and maximum height shall be as specified in Chapter 5.

SECTION 1902. STRUCTURAL FRAMEWORK. Structural framework shall be of structural steel as specified in Chapter 27, reinforced concrete as in Chapter 26, or masonry as in Chapter 24.

SECTION 1903. EXTERIOR WALLS AND OPENINGS.
(a) Exterior Walls. Exterior walls and all structural members therein shall comply with the requirements specified in Table 17-A.

EXCEPTIONS:
1. Nonbearing walls fronting on streets or yards having a width of at least 40 feet may be of unprotected noncombustible construction.
2. In groups F, G, and H Occupancies, exterior bearing walls may be of 2 hour fire-resistive noncombustible construction where openings are permitted.
3. In other than Group E Occupancies, exterior nonbearing walls may be of one-hour fire-resistive noncombustible construction where unprotected openings are permitted and 2 hour fire-resistive noncombustible construction where fire protection of openings is required.

(b) Openings in Walls. All openings in exterior walls shall conform to the requirements of Chapter 17 and Table 17-C.

SECTION 1904. FLOORS.
(a) Floor Construction. Floor assemblies shall be of noncombustible fire-resistive construction as specified in Table 17-A except that wood flooring may be applied over a concrete floor slab. See Chapter 17.

(b) Mezzanine Floors. Mezzanine floors shall be constructed of one-hour fire-resistive noncombustible materials. See Chapter 17 for mezzanine limitation.

SECTION 1905. STAIRS. Stairs and landings shall be constructed of reinforced concrete or structural steel. Stairs shall be designed as specified in Chapter 33.
SECTION 1906. ROOFS. In Group A, B, and C Occupancies with fixed seating, except exhibition halls as defined herein, and where every part of the roof structure is at least 25 feet above any floor, the roof construction may be of unprotected noncombustible materials. In exhibition halls, and in all occupancies other than Group A, B, and C, where every part of the roof structure is at least 25 feet above any floor, the roof construction may be of noncombustible materials protected by one of the following:

1. A water-spray fixed sprinkler system designed to provide the equivalent of one-hour fire resistive protection to the roof structure.

2. A water deluge or foam-water deluge sprinkler system designed to control fire at floor level.

3. One-hour fire-resistive protection of all structural members and the roof deck.

4. A continuous ceiling equivalent to that required for one-hour fire-resistive construction

5. An approved fire sprinkler system installed throughout the building.

For the purpose of this Section, exhibition hall shall be defined as any assembly building having facilities for trade shows, merchandise displays, conventions, carnivals, etc., when the combustible load exceeds 10 pounds or 9000 Btu per square foot of floor area in the display areas.
CHAPTER 20

TYPE III BUILDINGS

SECTION 2001. GENERAL. The structural elements of Type III buildings may be of any material permitted by this Building Code. Type III One Hour buildings shall be of one hour fire-resistive construction. Type III Heavy Timber buildings shall conform to Section 2007 except that structural members and partitions may be of other materials having a fire-resistant rating of at least one hour. Materials of construction and fire-resistive requirements shall be as specified in Chapter 17. Allowable floor area and maximum height shall be as specified in Chapter 5.

SECTION 2002. STRUCTURAL FRAMEWORK. Structural Framework shall be of aluminum as specified in Chapter 28, structural steel as in Chapter 27, reinforced concrete as in Chapter 26, masonry as in Chapter 24, or wood as in Chapter 25 and this Chapter.

SECTION 2003. EXTERIOR WALLS.
(a) Exterior Walls. Exterior walls shall be constructed of noncombustible materials and shall comply with the fire-resistive requirements specified in Chapter 17 and Table 17-A.

EXCEPTIONS:

1. Nonbearing walls fronting on streets or yards having a width of at least 40 feet may be of unprotected noncombustible construction.
2. Exterior nonbearing walls may be one hour fire-resistive construction where unprotected openings are allowed and 2 hour fire-resistive construction where protection of openings is required.
3. Exterior bearing walls may be 2 hour fire-resistive construction where openings are permitted.
4. Approved fire retardant treated wood framing may be used within the assembly of exterior walls allowed by Exceptions 1, 2 and 3 if the required fire-resistance is maintained, and not less than one hour fire rated construction is provided.
5. Wood columns, beams and arches conforming to heavy timber sizes may be used externally where exterior walls are permitted to be unprotected, noncombustible construction, or where one hour fire-resistive exterior walls are permitted.

(b) Openings in Walls. All openings in exterior walls shall conform to the requirements of Chapter 17 and Table 17C.
SECTION 2004. FLOORS.
(a) Floor Construction. Floors may be of any materials permitted by this Building Code.
(b) Mezzanine Floors. Mezzanine floors located above the first story shall be one hour fire-resistive construction or heavy timber construction. See Chapter 17 for mezzanine limitations.

SECTION 2005. STAIRS. Stairs in Type III One Hour and Type III-N buildings may be constructed of any materials allowed by this Code. Stairs in Type III Heavy Timber buildings shall be constructed as specified in Section 2007. In Type III buildings more than 3 stories in height, stairs shall be reinforced concrete, structural steel, wood protected on the underside with 5/8 inch Type X gypsum board or heavy timber. Stairs shall be designed as specified in Chapter 33.

SECTION 2006. ROOFS. Roofs may be of any materials permitted by this Building Code.

SECTION 2007. HEAVY TIMBER CONSTRUCTION.
(a) General. Heavy Timber Construction shall be in accordance with the requirements of this Section. Unless otherwise specified, all dimensions are nominal, as defined in Chapter 25.
(b) Columns. Columns will be sawn or structural glued laminated timber at least 8 x 8 inches when supporting floor loads and at least 6 x 6 inches when supporting roof loads only.
(c) Floor Framing. Beams and girders shall be sawn or structural glued laminated timber at least 6 inches wide and 10 inches deep. Sawn or structural glued laminated timber arches which spring from floor level shall be at least 8 x 8 inches. Sawn or structural glued laminated timber trusses shall have members at least 8 x 8 inches.
(d) Roof Framing. Beams, girders, and trusses shall be sawn or structural glued laminated timber at least 4 inches wide and 6 inches deep. Arches shall be sawn or structural glued laminated timber at least 6 inches wide and 8 inches deep to a point 25 feet above the floor, and at least 6 x 6 inches above that point. Spaced members at least 3 inches wide with spaces blocked solid or closed on the underneath with wood cover plates at least 2 inches thick may be used. Beams, girders and trusses shall be at least 3 inches wide and 5 inches deep where protected by an approved fire sprinkler system under the deck.
(e) Floor Decks. Floor decks shall be tongue and groove planks at least 3 inches thick, or boards at least 4 inches wide set on edge. Decks shall be overlaid with one inch tongue and groove flooring or 1/2 inch plywood.
(f) **Roof Decks.** Roof decks shall be tongue and groove planks at least 2 inches thick, a double thickness of one inch boards with tongue and groove or staggered joints, boards at least 3 inches wide set on edge or 1 1/8 inch actual thickness plywood.

(g) **Partitions.** Nonbearing partitions shall be solid wood construction as required for roof decks or one hour fire-resistive construction. Bearing partitions shall be one-hour fire-resistive construction.

(h) **Stairs.** Stairs shall have wood treads and risers at least 2 inches thick or, if built on inclines constructed as required for floor decks, treads and risers may be one inch thick. Stairs may be constructed as required for Type I buildings.
CHAPTER 21

TYPE IV BUILDINGS

SECTION 2101. GENERAL. The structural elements of Type IV buildings shall be of noncombustible materials. Type IV One Hour buildings shall be of one hour fire-resistive noncombustible construction. Materials of construction and fire resistive requirements shall be as specified in Chapter 17. Allowable floor area and maximum height shall be as specified in Chapter 5.

SECTION 2102. STRUCTURAL FRAMEWORK. Structural framework shall be of aluminum as specified in Chapter 28, structural steel as in Chapter 27, reinforced concrete as in Chapter 26, or masonry as in Chapter 24.

SECTION 2103. EXTERIOR WALLS AND OPENINGS. Exterior walls shall be constructed of noncombustible materials and shall comply with the fire-resistive requirements specified in Chapter 17 and Tables 17-B and 17-C.

EXCEPTION:

1. Nonbearing walls fronting on streets or yards having a width of at least 40 feet may be of unprotected noncombustible construction.
2. Exterior walls of Type IV-N buildings not exceeding one story in height or 2500 square feet in area housing Group F, G and J Occupancies may be of unprotected noncombustible construction if the walls are located 20 feet from adjacent property lines in Fire Zone 1, or 10 feet from adjacent property lines in Fire Zone 2.
3. Exterior walls of Type IV-N buildings not exceeding one story in height, or 1500 square feet in area housing Group F, G or J Occupancies in Fire Zone 2 and Group F or G occupancy in Fire Zone 3 may be of unprotected noncombustible construction if the walls are located a minimum of 5 feet from adjacent property lines.

SECTION 2104. INTERIOR WALLS, PARTITIONS AND CEILINGS. Interior Walls, partitions and ceilings shall be of noncombustible materials or fire retardant treated wood except that combustible partitions and ceiling assemblies of one hour fire-resistive construction shall be permitted.

SECTION 2105. FLOORS.

(a) Floor Construction. Floor assemblies shall be of noncombustible materials except that wood flooring may be applied over a concrete floor slab.
(b) **Mezzanine Floors.** Mezzanine floors shall be of noncombustible materials except that combustible floor assemblies of one hour fire-resistant construction shall be permitted. See Chapter 17 for mezzanine limitations.

**SECTION 2106. STAIRS.** Stairs and landings shall be of noncombustible materials except that stairs and landings serving mezzanine floors may be of wood of at least 2 inches nominal thickness. Stairs shall be designed as specified in Chapter 33.

**SECTION 2107. ROOFS.** Roof assemblies shall be of noncombustible materials. In Type IV One Hour buildings, roofs may be as specified in Chapter 18.
CHAPTER 22

TYPE V BUILDINGS

SECTION 2201. GENERAL. Type V buildings may be of any materials allowed by this Building Code. Type V One Hour buildings shall be of one hour fire-resistive construction. Materials of construction and fire-resistive requirements shall be as specified in Chapter 17. Allowable floor area and maximum height shall be as specified in Chapter 5.

SECTION 2202. STRUCTURAL FRAMEWORK. Structural framework shall be of aluminum as specified in Chapter 28, structural steel as in Chapter 27, reinforced concrete as in Chapter 26, wood as in Chapter 25, or masonry as in Chapter 24.

SECTION 2203. EXTERIOR WALLS AND OPENINGS. Fire protection of exterior walls and openings shall comply with the requirements specified in Chapter 17 and Tables 17-B and 17-C.

EXCEPTION: Exterior walls of a Type V nonrated building, fronting on streets or yards having a width of at least 40 feet may be of unprotected construction. (Revised 4/81 Ordinance No. 172)

SECTION 2204. STAIRS. Stairs and landings may be constructed of any material permitted by this Building Code. Stairs shall be designed as specified in Chapter 33.
CHAPTER 23

STRUCTURAL DESIGN AND LOADING

SECTION 2301. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern all loads and forces acting upon a building or structure in such a manner to cause stresses and deformation within the building or structure, or any part thereof. All loads specified in this Chapter shall supersede loads indicated in other portions of this Building Code.

SECTION 2302. DEFINITIONS.
(a) Dead Load. The dead load of a building, structure, or utility shall include the weight of the walls, permanent partitions, framing, floors, roof and other permanent stationary construction.
(b) Live Load. The live load shall include the total of all loads and forces on the building, structure or utility except dead loads, wind loads and earthquake loads.

SECTION 2303. LOADS.
(a) General. Buildings, structures and all parts thereof shall be of sufficient strength to support in addition to the dead loads, live loads at least those specified in the following Sections, without exceeding the stresses specified elsewhere in this Building Code. Impact, vibration and moving loads shall be considered in the design of any structure where these loads occur and shall not be reduced in combination with unit live loads. Except in Group H, I and J Occupancies, floors shall be designed for a minimum load of 2000 pounds or other known concentrated loading upon any area 2-1/2 feet square wherever this load upon an otherwise unloaded floor would produce stresses greater than those induced by a uniformly distributed load as specified in Table 23-A.
(b) Critical Distribution of Live Loads. Where structural members are arranged to create continuity, the loading conditions which would cause maximum shear and bending movements along the member shall be considered. Where uniform floor loads are involved, consideration may be limited to full dead load on all spans in combination with full live load on adjacent spans and on alternate spans.
(c) Temporary Loads. Temporary loads imposed during construction shall be provided for by the person imposing these loads.

SECTION 2304. METHODS OF DESIGN. Any system or method of construction used shall consist of a rational analysis in accordance with well established principles of mechanics, and with design criteria and methods specified in Chapters 24, 25, 26, 27, 28, 29 and 30. Design calculations shall
be submitted to the Department when requested. Design uniform live loads and concentrated loads shall be indicated on all drawings submitted to the Department. All allowable stresses and soil bearing values specified in this Building Code may be increased 1/3 due to wind or earthquake forces either acting alone or when combined with vertical loads. No increase of stresses shall be allowed for vertical loads acting alone. Wind and earthquake loads need not be assumed to act simultaneously.

SECTION 2305. UNIT LIVE LOADS. The unit loads set forth in Table 23-A shall be considered the minimum live loads to be used in the design of buildings for the occupancies listed. For occupancies or uses not listed, the live loads shall be subject to approval by the Department.

SECTION 2306. ROOF LOADS.
(a) General. Roofs shall sustain, within the stress limitations of this Building Code, all dead loads plus unit snow loads set forth in Table 23-B. The snow loads shall be assumed to act vertically on the area projected on a horizontal plane. Potential accumulation of snow at valleys, parapets, roof structure and offsets in roofs of uneven configuration, shall be considered. Unbalanced loading shall be considered when the loading will result in larger members or connections.
(b) Special Purpose. Greenhouses, lath houses and farm accessory buildings shall be designed for a vertical live load of at least 10 pounds per square foot.
(c) Trusses and Arches. Trusses and arches shall be designed to resist the stresses caused by snow loads on 1/2 of the span if the loading results in a reversal of stresses, or stresses greater in any portion than the stresses produced by the required snow load upon the entire span.
(d) Water Accumulation. All roofs shall be provided with slope or camber to assure drainage after the longtime deflection from dead load, or shall be designed to support maximum loads, including possible ponding of water, due to deflection.

SECTION 2307. REDUCTION OF LIVE LOADS. The following reductions in unit live loads as set forth in Table 23-A for floors shall be permitted in the designing of columns, piers, walls, foundations, trusses, beams, and slabs. Except for places of public assembly and for live loads greater than 100 pounds per square foot, the design live load on any member supporting 150 square feet or more may be reduced at the rate of 0.08 percent per square foot of area supported by the member. * The reduction shall not exceed 40 percent for horizontal members, 60 percent for vertical members, nor R as determined by the following formula:

\[ R = 23.1 \left(1 + \frac{D}{L}\right) \quad \ldots \ldots \quad (23-1) \]
WHERE:

R = Reduction in percent;
D = Dead Load Supported by the member;
L = Live load supported by the member.

*In a multiple joist system, a member is defined as an individual joist. For storage loads exceeding 100 pounds per square foot, no reduction shall be made except that design live loads on columns may be reduced 20 percent. For roof decks used for parking, 50 psf of the total live load shall be considered reducible. The area for determining live load reduction for slabs shall be no more than the square of the shorter span.

SECTION 2308. LATERAL LOADS AND FORCES.

(a) Design Requirements.

1. Building Separations. All portions of structures shall be designed and constructed to act as an integral unit in resisting horizontal forces unless separated structurally by a distance sufficient to avoid contact under deflection from seismic action or wind forces.

2. Minor Alterations. Minor structural alterations may be made in existing buildings and other structures, but the resistance to lateral forces shall be at least that before alterations were made unless the building as altered meets the requirements of this Section.

3. Combined Vertical and Horizontal Forces. In computing the effect of seismic force in combination with vertical loads, gravity load stresses induced in members by dead load plus live load, except roof live load, shall be considered.

4. Exterior Elements. Precast, nonbearing, nonshear wall panels or other elements which are attached to or which enclose the exterior shall accommodate movements of the structure resulting from lateral forces or temperature changes. The concrete panels or other elements shall be supported by means of poured in place concrete or by mechanical fasteners in accordance with the following provisions:

   A. Connections and panel joints shall allow for a relative movement between stories of at least 2 times story drift caused by wind or seismic forces, or 1/4 inch, whichever is greater.

   B. Connections shall have sufficient ductility and rotation capacity to preclude fracture of the concrete or brittle failures at or near welds. Inserts in concrete shall be attached to or hooked around reinforcing steel, or otherwise terminated to transfer forces to the reinforcing steel.
C. Connections to permit movement in the plane of the panel for story drift may be designed sliding connections using slotted or oversize holes or may be connections which permit movement by bending of the steel.

(b) Definitions. The following definitions apply only to the provisions of this Section:

Box System. A structural system without a complete vertical load-carrying space frame. In this system, the required lateral forces are resisted by shear walls or braced frames as hereinafter defined.

Braced Frame. A vertical truss, or its equivalent, which is provided to resist lateral forces in the frame system, and in which the members are subjected primarily to axial stresses.

Lateral Force Resisting System. The part of the structural system to which the lateral forces prescribed in Section 2308(f)5B are assigned.

Shear Wall. A wall designed to resist lateral forces parallel to the wall.

Space Frame. A 3 dimensional structural system composed of interconnected members, other than bearing walls, laterally supported to function as a complete self-contained unit with or without the aid of horizontal diaphragms or floor bracing systems.

Space Frame, Ductile Moment Resisting. One complying with the requirements of Section 2308(f)4.

Space Frame, Moment Resisting. A vertical load carrying space frame in which the members and joints are capable of resisting design lateral forces by bending movements.

Space Frame, Vertical Load Carrying. A space frame designed to carry all vertical loads.

(c) Distribution of Horizontal Shear. Total shear in any horizontal plane shall be distributed to the various elements of the lateral force resisting system in proportion to their rigidities compared to the rigidity of the horizontal bracing system or diaphragm. Rigid elements which are assumed not to be part of the lateral force resisting system may be incorporated into buildings provided that their effect on the action of the system is provided for in the design.

(d) Drift. Lateral deflections, or drift, of a story relative to its adjacent stories shall be designed in accordance with accepted engineering practice.

(e) Overturning. Every building or structure shall be designed to resist the overturning effects caused by the wind forces and related requirements specified in Section 2308(g) or the earthquake forces specified in Section 2308(f), whichever governs. The overturning moment calculated from the wind or earthquake forces shall in no case exceed two thirds of the dead load resisting moment. The weight of earth superimposed over footings may be used to calculate the dead load resisting moment.
(f) Earthquake Regulations.

1. **General.** All structures and their parts shall be designed to resist seismic forces. Seismic forces on structures which have highly irregular shapes, large differences in lateral resistance or stiffness between different stories or other unusual structural features affecting seismic response shall be determined by an accepted dynamic analysis. The analysis may take inelastic response into account. More regular, usual structures shall be designed to resist minimum seismic forces as specified in this Section unless an accepted dynamic analysis is made to determine forces more accurately. Forces shall be assumed to act horizontally at each floor level above the foundation, and at the roof. Forces shall be assumed to come from either direction along both main axes of a structure but not along both axes simultaneously. Provisions shall be made for the increase in shear resulting from the horizontal torsion due to an eccentricity between the center of mass and the center of rigidity. Negative torsional shears shall be neglected. When the vertical resisting elements depend on diaphragm action for shear distribution at any level, the shear resisting elements shall be capable of resisting a torsional moment assumed to be equivalent to the story shear acting with an eccentricity of not less than five percent of the maximum building dimension at that level.

2. **Symbols and Notations.** The following symbols and notations apply only to the provisions of this Section:

- **C** = Numerical coefficient for base shear as specified in Section 2308(f)5A.
- **Cp** = Numerical coefficient as specified in Section 2308(f)5B and as set forth in Table No. 23-G.
- **D** = The dimension of the building in feet in a direction parallel to the applied forces.
- **D_s** = The plan dimension of the vertical lateral force resisting system in feet.
- **F_i, F_n, F_X** = Lateral forces applied to level i, n, or x respectively.
- **F_P** = Lateral forces on the part of the structure and in the direction under consideration.
- **F_T** = That portion of V considered concentrated at the top of the structure, at the level n. The remaining portion of the total base shear V shall be distributed over the height of the structure, including level n, according to Formula 23-8.
- **h_i, h_n, h_x** = Height in feet above the base to level i, n, or x respectively.
- **K** = Numerical coefficient as set forth in Table No. 23-F.
- **Level i** = Level of the structure referred to by the subscript i.
Level n = That level which is uppermost in the main portion of the structure.
Level x = That level which is under design consideration.
M = Overturning moment at the base of the building or structure.
Mₓ = The overturning moment at level x.
N = Total number of stories above exterior grade.
T = Fundamental period of vibration of the building or structure in seconds in the direction under consideration.
V = Total lateral load or shear at the base.

\[ V = Fₜ + \sum_{i=1}^{n} F_i \quad \text{(23-2)} \]

where \( i = 1 \) designates first level above the base.

W = Total dead load as defined in Section 2301 including the partition loading specified in Table 23-A where applicable.

**EXCEPTION:** W shall be equal to the total dead load plus 5 percent of the floor live load in storage and warehouse occupancies.

\( w_i, w_x \) = That portion of W which is located at or is assigned to level i or x respectively.

Wₚ = The weight of a part or portion of a structure.

3. **Setbacks.** Buildings having setbacks wherein the plan dimension of the tower in each direction is at least 75 percent of the corresponding plan dimension of the lower part may be considered as a uniform building without setbacks for the purpose of determining seismic forces.

For other conditions of setbacks, the tower shall be designed as a separate building using the larger of the seismic coefficients at the base of the tower determined by considering the tower as either a separate building for its own height, or as part of the overall structure. The resulting total shear from the tower shall be applied at the top of the lower part of the building which shall be otherwise considered separately for its own height.

4. **Structural Systems.**

A. **Design Requirements.** All buildings designed with a horizontal force factor \( K=0.67 \) or \( 0.80 \) shall have ductile moment resisting space frames. Moment resisting space frames and ductile moment resisting space frames may be enclosed by or adjoined by more rigid elements which would tend to prevent the space frame from resisting lateral forces where it can be shown that the action of the more rigid elements will not impair the vertical and lateral load resisting ability of the space frame.
Other structural concepts may be approved by the Department when evidence is submitted that equivalent ductility and energy absorption are provided.

B. Construction. The necessary ductility for a ductile moment resisting space frame shall be provided by a frame of structural steel with moment resisting connections complying with Chapter 27 or by a reinforced concrete frame complying with Chapter 26.

Braced frames in buildings shall be composed of axially loaded bracing members of structural steel with ASTM designations having yield points from 36 to 50 ksi; or reinforced concrete members conforming to the requirements of Chapter 26. In buildings where \( K = 0.67 \) and \( K = 0.80 \) all structural elements below the base required to transmit seismic forces to the foundation shall be composed of structural steel complying with Chapter 27, or reinforced concrete complying with Chapter 26.

5. Minimum Earthquake Forces for Structures.

A. Total Base Shear and Vertical Distribution. The minimum base shear force to be considered in design shall be

\[
V = 0.25 K C W \quad \text{................................. (23-3)}
\]

in which \( K \) is a coefficient reflecting the lateral stiffness of the structure and is given in Table No. 23-F.

\[
C = \frac{0.05}{\sqrt[3]{T}} \quad \leq \quad 0.10 \quad \text{................................. (23-4)}
\]

Except that \( C = 0.10 \) for all one and two story buildings \( T \) is the fundamental period of vibration of the structure in seconds in the direction considered.

Unless a more accurate determination is made,

\[
T = \frac{0.05 h_n}{\sqrt{D}} \quad \text{................................. (23-5)}
\]

except when the lateral force resisting system consists of a moment-resisting space frame which resists all the lateral forces and which is not enclosed by or adjoined by more rigid elements which would tend to prevent the frame from resisting lateral forces:

\[
T = 0.10N \quad \text{................................. (23-6)}
\]

The base shear force, \( V \) shall be distributed vertically according to the following equations:
\[ F_t = 0.004V \left( \frac{h_n}{D_s} \right)^2 \leq 0.15V \] \hspace{1cm} (23-7)

\[ F_t = 0 \text{ for } \left( \frac{h_n}{D_s} \right) \leq 3 \]

\[ F_x = \frac{(V-F_t)w_x h_x}{\sum_{i=1}^{n} w_i h_i} \] \hspace{1cm} (23-8)

For one and two story buildings, the distribution shall be considered uniform rather than as given above. The force, \( F \) at each level shall be assumed distributed horizontally in the same manner as the mass at that level.

B. Lateral Force on Parts or Portions of Structures. The minimum force on a part of portion of a structure shall be taken as:

\[ F_p = 0.25 \ C_p \ W_p \] \hspace{1cm} (23-9)

in which \( C_p \) is a coefficient given in Table 23-G.

The force shall be assumed distributed in the same manner as the weight.

(g) Wind Forces on Structures.

1. General. Buildings or other structures shall be designed to withstand the minimum wind loads set forth below, or set forth in the American National Standard Institute A58.1, at the option of the Engineer. The A58.1 Standard, if used, is to be applied in accordance with the requirements of Section 2308(g)8. If the A58.1 method is not used, the structures shall be designed to withstand the minimum horizontal pressures set forth in Table No. 23-C. A special wind study shall be required for the design of all buildings or other structures which exceed 300 feet in height above ground.

2. Walls. All exterior walls shall be capable of withstanding the basic wind loads at that level, acting either inwardly or outwardly, and all construction shall be anchored to resist these loads.

3. Doors and Windows. Doors and windows shall be capable of withstanding the same positive pressures and 1-1/4 times the negative pressure for walls.

4. Wind Loads on Roofs.

A. Test Determination. The effect of the shape of irregular or unusual roofs may be determined by wind tunnel tests. In determining the effect of shape, the assumed wind velocity shall be 90 miles per hour and the relative air density 0.85.

B. Pitched Roofs. The external wind forces on pitched roofs with a slope greater than 7 to 12 shall be assumed to be at
least 1/2 the basic pressure at the level normal to the windward side, and negative pressure of not less than 1/2 the basic pressure at that level normal to the leeward side. All roofs with a slope of 7 to 12 or less shall be designated for uplift of 3/4 times the basic pressure at that level.

C. Uplift of Eaves. Roofs of buildings unenclosed on one or more sides, marquees, or similar structures, overhanging eaves, cornices, and other roof projections shall be designed and constructed to withstand a total uplift of 2 times the basic pressure at that level.

D. Anchorage. Roof framing shall be anchored to supporting members, which in turn shall be anchored to the foundations to resist wind uplift and sliding. 75 percent of the dead load shall be considered in resisting these forces.

5. Solid Towers. Chimneys, tanks, and solid towers shall be designed and constructed to withstand the pressures specified in this Section, multiplied by the factors specified in Table 23-D.

6. Open Frame Towers. Radio towers and other towers of trussed construction shall be designed and constructed to withstand wind pressures specified in this Section, multiplied by the shape factors in Table 23-E. Wind pressures shall be applied to the total normal projected area of all the elements of one face excluding ladders, conduits, lights, elevators, etc., which shall be accounted for separately by using the indicated factor for these individual members.

7. Signs.

A. Signs in which the open area is less than 1/3 of the gross area shall be considered as solid signs and the gross area shall be used in computing wind loads. Solid signs shall be designed to withstand the wind loads given in Table 23-C.

B. Open signs shall be designed to withstand 1-1/2 times the wind loads, applied to the net exposed surface.

C. The requirements for structural drawings, specifications, and analysis indicated in Chapter 3 shall apply when required by the Department.

D. For signs not covered in A through C, see 5 and 6 of this Section.

8. Option. Where the option is taken to determine the structural loading in accordance with ANSI A58.1 Code, the following conditions shall be utilized:

A. The value of air density used in equation 2 of paragraph 6.3.4 shall be taken at 85 percent of air density at sea level.

B. The basic windspeed (extreme fastest mile) shall be taken as 80 miles per hour for a 50-year mean recurrence interval, and 90 mph for a 100-year mean recurrence interval.

C. All structures over 2 stories or 30 feet in overall height shall be designed for at least 50-year mean recurrence interval wind.
D. All structures over 10 stories or 120 feet in overall height shall be designed for at least 100-year mean recurrence interval wind.

9. Miscellaneous Structures. Greenhouses, lath houses, and agricultural buildings shall be designed for a wind pressure of at least 10 pounds per square foot.

10. Unusual Configuration. All structures of unusual configuration or heights as defined by the Department shall be designed in accordance with analysis and testing procedures approved by the Department.

(h) Structural Masonry or Concrete. All elements within a structure which are of masonry or concrete, and which are intended to resist either seismic or wind lateral forces shall be calculated by accepted structural analysis. When this analysis indicates stresses greater than allowed for unreinforced masonry or concrete, the elements shall be reinforced to qualify as partially reinforced masonry, reinforced masonry, or reinforced concrete as specified in Chapters 24 and 26 respectively.

(i) Anchorage. Concrete or masonry walls shall be anchored to all floors and roofs which provide lateral support for the wall or which are required to provide stability for the wall. The anchorage shall be capable of resisting the horizontal forces specified in this Chapter or a minimum force of 100 pounds per lineal foot of wall, whichever is the larger.

SECTION 2309. LIVE LOADS Posted. Live loads used for the design of warehouses, parking structures, or manufacturing buildings shall be conspicuously posted by the owner in that part of each story to which they apply. Durable metal signs shall be used, and it shall be unlawful to remove or deface such notices. The occupant of the building shall be responsible for maintaining actual loading equal to or below those posted loads.

SECTION 2310. RETAINING WALLS. Retaining walls shall be designed to resist the lateral pressure of the retained material in accordance with accepted engineering practice. Walls retaining drained earth may be designed for pressure equivalent to that exerted by a fluid weighing not less than 30 pounds per cubic foot and having a depth equal to that of the retained earth. Any surcharge shall be in addition to the equivalent fluid pressure.

SECTION 2311. INTERIOR WALLS. Interior walls, permanent partitions, and temporary partitions which exceed 6 feet in height shall be designed to resist all loads to which they are subjected but not less than a force of five pounds per square foot applied perpendicular to the walls. The deflection of such walls under a load of five pounds per square foot shall not exceed 1/240 of the span for walls with brittle finishes and 1/120 of the span for walls with flexible finishes.

23-10
SECTION 2312. HELISTOP LANDING AREAS.
(a) In addition to other design requirements of this Chapter, helistop landing or touchdown areas shall be designed for the maximum stress induced by the following:

1. Dead load plus actual weight of the helicopter.
2. Dead load plus a single concentrated impact load covering 1 square foot. The impact load shall be .75 times the fully loaded weight of the helicopter if it is equipped with hydraulic type shock absorbers, or 1.5 times the fully loaded weight of the helicopter if it is equipped with a rigid or skid type landing gear.
3. The dead load plus a uniform live load of 50 pounds per square foot.

The required live load may be reduced in accordance with the formula in Section 2307.

SECTION 2313. STANDARDS. Unless otherwise specified in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO</td>
<td>Policies on the Design of Urban Highways and Arterial Streets.</td>
</tr>
</tbody>
</table>

LEGEND

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>ORGANIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials 444 N. Capitol St. N.W., Suite 225 Washington, D.C. 20001</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute 1430 Broadway New York, N.Y. 10018</td>
</tr>
</tbody>
</table>

SECTION 2314. TABLES.
<table>
<thead>
<tr>
<th>OCCUPANCY OR USE</th>
<th>Live Load Lbs. Per Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assembly (Public)</strong></td>
<td></td>
</tr>
<tr>
<td>Armories and drill rooms</td>
<td>150</td>
</tr>
<tr>
<td>Lobbies, foyers, vestibules, balconies and similar public spaces of hotels,</td>
<td></td>
</tr>
<tr>
<td>theatres, clubs and public buildings,</td>
<td></td>
</tr>
<tr>
<td>churches and assembly halls without fixed seats, dance halls, public dining</td>
<td></td>
</tr>
<tr>
<td>rooms and restaurants including kitchens, gymnasiums, skating rinks</td>
<td></td>
</tr>
<tr>
<td>Auditoriums, churches, and assembly halls with fixed seats, including aisles,</td>
<td></td>
</tr>
<tr>
<td>passageways and balconies</td>
<td></td>
</tr>
<tr>
<td>Theatre stages, gridirons and fly galleries</td>
<td>125</td>
</tr>
<tr>
<td><strong>Business</strong></td>
<td></td>
</tr>
<tr>
<td>Offices</td>
<td>50</td>
</tr>
<tr>
<td>Structures shall be designed for file, computer, and special equipment loads,</td>
<td></td>
</tr>
<tr>
<td>when applicable.</td>
<td></td>
</tr>
<tr>
<td><strong>Corridors</strong></td>
<td></td>
</tr>
<tr>
<td>Serving assembly halls in theatres, penal institutions, churches, school</td>
<td>100</td>
</tr>
<tr>
<td>buildings</td>
<td></td>
</tr>
<tr>
<td>Other Corridors: Same loading as heaviest occupancy from which they provide</td>
<td></td>
</tr>
<tr>
<td>egress</td>
<td></td>
</tr>
<tr>
<td><strong>Educational</strong></td>
<td></td>
</tr>
<tr>
<td>Classroom, not exceeding 1200 sq. ft. in area, or larger size rooms with fixed</td>
<td>50</td>
</tr>
<tr>
<td>seats</td>
<td></td>
</tr>
<tr>
<td>Class and lecture rooms in excess of 1200 sq. ft. in area without fixed seats</td>
<td>75</td>
</tr>
<tr>
<td><strong>Libraries</strong></td>
<td></td>
</tr>
<tr>
<td>Stack rooms</td>
<td>150</td>
</tr>
<tr>
<td>Reading rooms</td>
<td>60</td>
</tr>
<tr>
<td><strong>Garages (Loads include impact)</strong></td>
<td></td>
</tr>
<tr>
<td>Passenger cars, floor and ramps used for parking</td>
<td>50</td>
</tr>
<tr>
<td>Passenger cars, roof decks used for parking including snow load</td>
<td></td>
</tr>
<tr>
<td>Trucks (Applicable AASHTO Loading)</td>
<td></td>
</tr>
<tr>
<td><strong>Industrial</strong></td>
<td></td>
</tr>
<tr>
<td>Equipment and machinery rooms designed for use, but not less than</td>
<td>125</td>
</tr>
<tr>
<td>Manufacturing: Load to be determined from proposed use or occupancy, but never</td>
<td></td>
</tr>
<tr>
<td>less than</td>
<td>100</td>
</tr>
</tbody>
</table>
TABLE NO. 23-A (cont’d.)

UNIT LIVE LOADS

<table>
<thead>
<tr>
<th>OCCUPANCY OR USE</th>
<th>Live Load Lbs. Per Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institutional</strong></td>
<td></td>
</tr>
<tr>
<td>Hospitals, asylums, infirmaries, sanitariums, nurseries, orphanages, home for aged, penal institutions, reformatories, jails and houses of correction</td>
<td>40</td>
</tr>
<tr>
<td>Operating and X-ray rooms</td>
<td>60</td>
</tr>
<tr>
<td><strong>Mercantile</strong></td>
<td></td>
</tr>
<tr>
<td>Retail (Light merchandise)</td>
<td>75</td>
</tr>
<tr>
<td>Wholesale (Light merchandise)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td></td>
</tr>
<tr>
<td>Lounge, recreational areas; exterior balconies</td>
<td>60</td>
</tr>
<tr>
<td>All parts of private dwellings, rooms and suites in apartment houses, lodging houses and clubs, educational and religious institutions, including corridors giving access thereto, and bedrooms of hotels</td>
<td>40</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>125</td>
</tr>
<tr>
<td>Heavy: (Load to be determined from proposed use or occupancy, but never less than)</td>
<td>250</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td></td>
</tr>
<tr>
<td>Bleachers, grandstands, stadiums: 100 pounds per square foot of horizontal projection for the structure as a whole. Seatboards and floorboards shall be designed for 120 pounds of vertical load per linear foot. In addition, the structure shall be designed to resist sway forces of 10 pounds front-to-back and 24 pounds side-to-side per linear foot of seats. Sway forces, wind forces, and seismic forces need not be applied simultaneously. Ceiling Framing: (Does not apply to ceilings which have sufficient total access from below, such that access is not required within the space above the ceiling)</td>
<td>10</td>
</tr>
<tr>
<td>Elevators, dumbwaiters, escalators, and moving loads in accordance with Chapter 55.</td>
<td></td>
</tr>
</tbody>
</table>

**Impact:**

Moving or vibrating loads shall be increased as follows:

Heavy equipment and moving loads, 25 percent.

All craneways shall be designed to resist a horizontal transverse force equal to 20 percent to the sum of the crane capacity and the weight of the trolley applied at the top of runway rails in proportion to the stiffness of the supporting structure. In addition, all craneways shall be designed to resist horizontal longitudinal forces equal to 10 percent of the total of the maximum wheel loads applied at the top of each rail. Moving loads not specified involving an impact load shall be as approved by the Department.
TABLE NO. 23-A (cont'd.)

UNIT LIVE LOADS

<table>
<thead>
<tr>
<th>OCCUPANCY OR USE</th>
<th>Live Load Lbs. Per Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partitions:</td>
<td></td>
</tr>
<tr>
<td>A uniform load</td>
<td></td>
</tr>
<tr>
<td>equivalent to 1/12</td>
<td></td>
</tr>
<tr>
<td>of the weight of</td>
<td></td>
</tr>
<tr>
<td>one linear foot of</td>
<td></td>
</tr>
<tr>
<td>partition or the</td>
<td></td>
</tr>
<tr>
<td>actual weight of the</td>
<td></td>
</tr>
<tr>
<td>partitions if known</td>
<td></td>
</tr>
<tr>
<td>Lateral load</td>
<td>5</td>
</tr>
<tr>
<td>Railings:</td>
<td></td>
</tr>
<tr>
<td>A uniform horizontal</td>
<td></td>
</tr>
<tr>
<td>or vertical force</td>
<td></td>
</tr>
<tr>
<td>applied at the top</td>
<td></td>
</tr>
<tr>
<td>of the rail equal</td>
<td>5</td>
</tr>
<tr>
<td>to 50 pounds per</td>
<td></td>
</tr>
<tr>
<td>linear foot</td>
<td></td>
</tr>
<tr>
<td>Rest rooms:</td>
<td></td>
</tr>
<tr>
<td>Loads shall be</td>
<td></td>
</tr>
<tr>
<td>not less than the</td>
<td></td>
</tr>
<tr>
<td>load for the</td>
<td></td>
</tr>
<tr>
<td>occupancy with which</td>
<td></td>
</tr>
<tr>
<td>they are associated</td>
<td></td>
</tr>
<tr>
<td>but need not exceed</td>
<td></td>
</tr>
<tr>
<td>50 pounds per square</td>
<td></td>
</tr>
<tr>
<td>foot.</td>
<td></td>
</tr>
<tr>
<td>Sidewalks and</td>
<td></td>
</tr>
<tr>
<td>driveways:</td>
<td></td>
</tr>
<tr>
<td>Over area ways or</td>
<td></td>
</tr>
<tr>
<td>basements</td>
<td>250</td>
</tr>
<tr>
<td>or in accordance</td>
<td></td>
</tr>
<tr>
<td>with AASHTO H-20.</td>
<td></td>
</tr>
<tr>
<td>Stairs:</td>
<td></td>
</tr>
<tr>
<td>Except in Type I</td>
<td>100</td>
</tr>
<tr>
<td>Occupancy</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE NO. 23-B

**SNOW LOADS**

Roof Snow Loads, in PSF, on Horizontal

Projection of Roof Member

(Also see Section 2306)

<table>
<thead>
<tr>
<th>Slope</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4 inches per foot</td>
<td>30</td>
</tr>
<tr>
<td>Between 4 inches and 12 inches per foot</td>
<td>25</td>
</tr>
<tr>
<td>Greater than 12 inches per foot</td>
<td>20</td>
</tr>
</tbody>
</table>

### TABLE NO. 23-C

**WIND PRESSURES**

Wind Pressure in PSF For Various Height Zones Above Ground

<table>
<thead>
<tr>
<th>Height Zone (Feet)</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 30</td>
<td>20</td>
</tr>
<tr>
<td>30 to 49</td>
<td>25</td>
</tr>
<tr>
<td>50 to 99</td>
<td>30</td>
</tr>
<tr>
<td>100 to 300</td>
<td>40</td>
</tr>
<tr>
<td>Over 300</td>
<td>Special Study Required</td>
</tr>
</tbody>
</table>

### TABLE NO. 23-D

**MULTIPLYING FACTORS FOR WIND PRESSURES**

**FOR CHIMNEYS, TANKS AND SOLID TOWERS**

<table>
<thead>
<tr>
<th>Horizontal Cross Section</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square or rectangular</td>
<td>1.00</td>
</tr>
<tr>
<td>Hexagonal or octagonal</td>
<td>0.80</td>
</tr>
<tr>
<td>Round or elliptical</td>
<td>0.60</td>
</tr>
</tbody>
</table>
### Table NO. 23-E

**SHAPE FACTORS FOR RADIO TOWERS AND TRUSSED TOWERS**

<table>
<thead>
<tr>
<th>Type of Exposure</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind normal to one face of tower:</td>
<td></td>
</tr>
<tr>
<td>four-cornered, flat or angular sections, steel or wood</td>
<td>2.20</td>
</tr>
<tr>
<td>three-cornered, flat or angular sections, steel or wood</td>
<td>2.00</td>
</tr>
<tr>
<td>Wind on corner:</td>
<td></td>
</tr>
<tr>
<td>four-cornered tower, flat or angular sections</td>
<td>2.40</td>
</tr>
<tr>
<td>Wind parallel to one face of three:</td>
<td></td>
</tr>
<tr>
<td>cornered tower, flat or angular sections</td>
<td>1.50</td>
</tr>
<tr>
<td>Factors for towers with cylindrical elements shall be two-thirds of those for similar towers with flat or angular sections.</td>
<td></td>
</tr>
<tr>
<td>Wind on individual members:</td>
<td></td>
</tr>
<tr>
<td>Cylindrical members</td>
<td></td>
</tr>
<tr>
<td>Two inches or less in diameter</td>
<td>1.00</td>
</tr>
<tr>
<td>Over two inches in diameter</td>
<td>0.80</td>
</tr>
<tr>
<td>Flat or angular sections</td>
<td>1.30</td>
</tr>
</tbody>
</table>
### TABLE NO. 23-F

**HORIZONTAL FORCE FACTOR “K” FOR BUILDING OR OTHER STRUCTURES**

<table>
<thead>
<tr>
<th>TYPE OF ARRANGEMENT OF RESISTING ELEMENTS</th>
<th>Value of K</th>
</tr>
</thead>
<tbody>
<tr>
<td>All building framing systems except as hereinafter classified.</td>
<td>1.00</td>
</tr>
<tr>
<td>Buildings with a box system specified in Section 2308 (b)</td>
<td>1.33</td>
</tr>
<tr>
<td>Buildings with a dual bracing system consisting of a ductile moment resisting space frame and shear walls using the following design criteria:</td>
<td></td>
</tr>
<tr>
<td>(1) The frames and shear walls shall resist the total lateral force in accordance with their relative rigidities, considering the interaction of the shear walls and frames.</td>
<td>0.80</td>
</tr>
<tr>
<td>(2) The shear walls acting independently of the ductile moment resisting portions of the space frame shall resist the total required lateral forces.</td>
<td></td>
</tr>
<tr>
<td>(3) The ductile moment resisting space frame shall have the capacity to resist not less than 25 percent of the required lateral force.</td>
<td></td>
</tr>
<tr>
<td>Buildings with a ductile moment-resisting space frame designed in accordance with the following criteria: The ductile moment-resisting space frame shall have the capacity to resist the total required lateral force.</td>
<td>0.67</td>
</tr>
<tr>
<td>Elevated tanks plus full contents on four or more cross-braced legs, and not supported by a building</td>
<td>3.00&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Structures other than buildings and other than those set forth in Table No. 23-G.</td>
<td>2.00</td>
</tr>
</tbody>
</table>

<sup>a</sup> Where wind loads as specified in Section 2304 would produce higher stresses, this load shall be used in lieu of the loads resulting from earthquake forces.

<sup>b</sup> The minimum value of “KC” shall be 0.12 and the maximum value of “KC” need not exceed 0.25.

<sup>c</sup> Elevated tanks which are supported by buildings or do not conform to type or arrangement of supporting elements as described above shall be designed in accordance with Section 2308 (f) 5B using “C<sub>p</sub>” = .2.
### TABLE NO. 23-G

**HORIZONTAL FORCE FACTOR “C_p” FOR PARTS OR PORTIONS OF BUILDINGS OR OTHER STRUCTURES**

<table>
<thead>
<tr>
<th>PART OR PORTION OF BUILDINGS</th>
<th>Direction of Force</th>
<th>Value of C_p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior bearing and nonbearing walls, interior bearing walls and partitions, interior nonbearing walls and partitions over 10 feet in height, masonry or concrete fences over 6 feet in height&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Normal to flat surface</td>
<td>0.20</td>
</tr>
<tr>
<td>Cantilever parapet and other cantilever walls, except retaining walls</td>
<td>Normal to flat surface</td>
<td>1.00</td>
</tr>
<tr>
<td>Exterior and interior ornamentations and appendages</td>
<td>Any direction</td>
<td>1.00</td>
</tr>
<tr>
<td>When connected to, part of, or housed within a building: tanks, towers, and tanks plus contents, storage racks over 6 feet in height plus contents, chimneys, smokestacks, and penthouses</td>
<td>Any direction</td>
<td>0.20&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
<tr>
<td>When resting on the ground, tank plus effective mass of its contents</td>
<td>Any direction</td>
<td>0.10</td>
</tr>
<tr>
<td>Suspended ceiling framing systems&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Any direction</td>
<td>0.10</td>
</tr>
<tr>
<td>Floors and roofs acting as diaphragms&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Any direction</td>
<td>0.10</td>
</tr>
<tr>
<td>Connections for exterior panels or for elements complying with Section 2208 (a)</td>
<td>Any direction</td>
<td>2.00</td>
</tr>
<tr>
<td>Connections for prefabricated structural elements other than walls, with force applied at center of gravity of assembly&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Any horizontal direction</td>
<td>0.30</td>
</tr>
</tbody>
</table>

<sup>a</sup> See also Table 23-A for minimum load criteria for interior partitions.

<sup>b</sup> When located in the upper portion of any building where the “h_W/D” ratio is five-to-one or greater, the value shall be increased by 50 percent.

<sup>c</sup> “W_p” for storage racks shall be the weight of the racks plus contents. The value of “C_p” for racks over two storage support levels in height shall be .16 for the levels below the top two levels.

<sup>d</sup> For purposes of determining the lateral force, a minimum ceiling weight of 5 pounds per square foot shall be used.

<sup>e</sup> Floors and roofs acting as diaphragms shall be designed for minimum value of “C_p” of 10 percent applied to loads tributary from that story unless a greater value of “C_p” is required by the basic seismic formula V = ZKCW.

<sup>f</sup> The “W_p” shall be equal to the total load plus 25 percent of the floor live load in storage and warehouse occupancies.
CHAPTER 24
MASONRY

SECTION 2401. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the design, construction, and materials of masonry for any building or structure. In the event of conflict with provisions of other Chapters, this Chapter shall govern.
(b) Masonry Defined. An assemblage of masonry units bonded together with mortar.
(c) Design and Construction. Design and construction of masonry shall conform to this Chapter and Colorado Masonry Institute Standard 301-76, "Building Code Requirements for Masonry Construction."

SECTION 2402. LOADS. Masonry shall be capable of supporting the applicable loads specified in Chapter 23.

SECTION 2403. APPROVAL OF SPECIAL SYSTEMS OF DESIGN OR CONSTRUCTION. See Chapter 1, Alternate Methods and Materials.

SECTION 2404. STRENGTH EVALUATION OF STRUCTURES.
(a) General. If doubt develops concerning the safety of a masonry structure or member, the Department shall have the right to order a structural strength investigation by analysis or by means of load tests.
(b) General Requirements for Analytical Investigations. If the strength evaluation is by analytical means, a thorough field investigation shall be made of the dimensions and details of the members, properties of the materials, and other pertinent conditions of the structure as actually built. The analysis based on this investigation shall satisfy the Department that the load factors meet the requirements and intent of this Building Code.
(c) Load Tests. If the strength evaluation is by load tests, a qualified engineer, acceptable to the Department, shall conduct the tests.
   1. A load test shall not be made until the portion of the structure subjected to load is at least 56 days old unless the owner of the structure, the contractor, and all involved parties mutually agree that the test may be made at an earlier age.
   2. When a load test is required, the member or portion of the structure under investigation shall be subject to a total load, including the dead loads already in place, equivalent to 0.85 (1.4D + 1.7L). This load shall be left in position for a period of 24 hours before removal. If during the test or upon removal of the load, the member or portion of the structure shows evidence of failure, changes
or modifications necessary to restore the structure to the rated capacity shall be made, or a lower rated capacity shall be established. A flexural member shall be considered to have passed the test if the maximum deflection "Δ" at the end of the 24-hour period does not exceed:

\[ \Delta = \frac{f}{200} \quad \text{nor} \quad \Delta = \frac{f^2}{4000t} \]

and the beams and slabs show a recovery of least 75% of the observed deflection within 24 hours after removal of the load.

**NOMENCLATURE:**

- \( D \) = dead load
- \( L \) = live load
- \( \Delta \) = deflection
- \( f \) = span of a member
- \( t \) = thickness or depth of a member

**SECTION 2405. APPLICABLE STANDARDS.** Unless provided for in other portions of this Building Code, the following Standards shall apply:

**ORGANIZATION**

<table>
<thead>
<tr>
<th>ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate for Masonry Mortar, C144. - 1970</td>
</tr>
<tr>
<td>Aggregate for Masonry Grout, C404. - 1970</td>
</tr>
<tr>
<td>Hydrated Lime for Masonry Purposes, C207.-1974</td>
</tr>
<tr>
<td>Masonry Cement, C91.0 1971</td>
</tr>
<tr>
<td>Portland Cement, Type I, IA, II, IIA, III, or IIIA, C150. - 1974</td>
</tr>
<tr>
<td>Calcium Silicate Face Brick (Sand-Lime Brick). - 1972</td>
</tr>
<tr>
<td>Hollow Non-Load-Bearing Concrete Masonry Units, C90. - 1970</td>
</tr>
<tr>
<td>Hollow Load-Bearing Concrete Masonry Units, C90. - 1970</td>
</tr>
<tr>
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Concrete Building Brick, C55 - 1971
Solid Load-Bearing Concrete Masonry Units, C145. - 1971
ICBO
Cast Stone, UBC Standard No. 24-14-1973
CMI
Building Code Requirements for Masonry Construction, Standard 301. 1976

LEGEND
ORGANIZATION
ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103
ICBO International Conference of Building Officials
(Uniform Building Code)
5360 South Workman Mill Road
Whittier, Calif. 90601
CMI Colorado Masonry Institute
3003 East Third Avenue
Denver, Co. 80206
CHAPTER 25
WOOD

(Revised 5/82 Ordinance No. 245)

SECTION 2501. GENERAL.

(a) Quality and Design. The quality and design of wood members and their fastenings shall conform to the provisions of this Chapter, and to the Standards hereinafter specified.

(b) Construction. All members shall be framed, anchored, tied and braced so as to develop the strength and rigidity necessary for the purposes they are intended.

(c) Fabrication. Preparation, fabrication, and installation of wood members and their fastenings shall conform to accepted engineering practices and to the requirements of this Building Code.

(d) Rejection. The Department may deny permission for the use of wood member where grade characteristics or defects are present in such a combination that they affect the serviceability of the member.

(e) Minimum Quality.

1. Minimum capacity of structural framing members may be established by performance tests. When tests are not made, capacity shall be based upon allowable stress and design criteria specified in this Building Code.

2. Studs, joists, rafters, foundation plates, or sills, planking 2 inches or more in depth, beams, stringers, posts, structural sheathing and similar load-bearing members shall be of at least the minimum grades set forth in the NFPA-NDs. Approved end-jointed lumber may be used interchangeably with solid sawn members of the same species and grade. Such use shall include, but not be limited to light framing joists, planks and decking.

3. Plywood shall be of species Group 1, 2, 3, or 4 and shall be one of the grades specified in PS-1.

4. Approved fire retardant treated wood shall be dried, following treatment, to a maximum moisture content as follows: solid sawn lumber 2 inches in thickness to 19 per cent and plywood to 15 per cent.
(f) **Shrinkage.** Design consideration shall be given to the possible effect of cross grain dimensional changes considered vertically which may occur in lumber fabricated in a green condition.

**SECTION 2502. DEFINITIONS AND SYMBOLS.**

(a) **Definitions.** The following terms used in this Chapter shall have the meanings indicated in this Section:

**Fiberboard.** A fibrous-felted, homogeneous panel made from lignocellulosic fibers (usually wood or cane) and having a density of less than 31 pounds per cubic foot but more than 10 pounds per cubic foot and conforming to PS-57.

**Glued Built-Up Members.** Structural elements, the sections of which are composed of built-up lumber, plywood, or plywood in combination with lumber with all parts bonded together with adhesive.

**Grade.** The classification of lumber with respect to strength and utility in accordance with the grading rules of an approved lumber grading agency listed at the end of this Chapter.

**Nominal Size (Lumber).** The commercial size designation of width and depth in standard sawn lumber and glued-laminated lumber grades in accordance with PS-20 for sawn lumber and AITC-113 for structural glued-laminated timber.

**Normal Loading.** A design load that stresses a member or fastening to the full allowable stress tabulated in the NFPA-NDS. This loading may be applied for approximately 10 years, either continuously or cumulatively, and 90 percent of this load may be applied for the remainder of the life of the member or fastening.

**Particle Board.** A mat-formed panel manufactured from lignocellulosic materials in the form of discrete pieces or particles, as distinguished from fibers, combined with a binder and bonded together under heat and pressure in accordance with ANSI A 208.1.

**Plywood.** A built-up panel of laminated veneers conforming to PS-1.

**Structural Glued-Laminated Timber.** Any member comprising an assembly of laminations of lumber in which the grain of all laminations is approximately parallel longitudinally; in which the laminations are bonded with adhesives; and which is fabricated in accordance with PS-56 and AITC 117 or 119.

**Treated Wood.** Wood treated with an approved preservative under the treating and quality control requirements specified in AWPA and AWPB Standards.

**Wood of Natural Resistance to Decay.** The heartwood of bald cypress, black locust, black walnut, the cedars and redwood.
SECTION 2503. SIZE OF STRUCTURAL MEMBER Size of lumber and structural glued-laminated timber referred to in this Building Code are nominal sizes. Computations to determine the required sizes of members shall be based upon net dimensions (actual sizes) and not the nominal sizes.

SECTION 2504. STRESSES.

(a) General.

1. Except as hereinafter provided, stresses shall not exceed the allowable unit stresses for the respective species and grades or fabricated products as set forth in the NFPA-NDS for lumber and AITC-117 and 119 for structural glued-laminated timber.

2. The values for allowable unit stress for extreme fiber in bending and for compression parallel to grain tabulated in the NFPA-NDS for visually stress-rated and machine stress-rated lumber are for the design of structures when the strength of an individual member is premised on the assumption that each individual piece carries its full design load.

3. The repetitive member design values for allowable unit stress for extreme fiber in bending tabulated in the NFPS-NDS may be used for the design of an assembly of repetitive framing such as joists, rafters and studs not over 4 inches in thickness spaced not more than 24 inches, not less than 3 in number and joined by transverse load distributing elements adequate to support the design load.

4. Values for species and grades not tabulated shall be approved by the Department.

5. Values for plywood shall be in accordance with Plywood Design Specifications APA Y510. All plywood designed to be exposed in outdoor applications shall be exterior type.

(b) Wood Poles and Piles. The values tabulated in Table 25-E shall be used for the design of round timber poles and piles. Poles shall conform to the requirements set forth in ANSI 05.1. Piles shall conform to the requirements set forth in ASTM D-25 and ASTM D-2899.

(c) Adjustment of Stresses.

1. General. The allowable unit stresses specified in this Chapter shall be subject to the adjustments set forth in the footnotes to the appropriate stress tables and to the requirement of this Subsection.

2. Preservative Treatment. The values for wood pressure impregnated with an approved process and preservative need no adjustment.
3. **Fire-Retardant Treatment.** The values shall be reduced 10 percent for lumber pressure impregnated with approved fire-retardant chemicals. The stress values for plywood so treated shall be reduced 16 percent, and modulus of elasticity shall be reduced 10 percent. Other adjustments are applicable. Where structural glued-laminated timber is fire-retardant treated, values shall be approved by the Department upon submission of test data.

4. **Duration of Load.** Values for wood and mechanical fastenings (when the wood determines the load capacity) are subject to the following adjustments for the various durations of loading:
   A. Where a member is fully stressed to the maximum allowable stress, either continuously or cumulatively, for more than 10 years under the conditions of maximum design load, the values shall not exceed 90 percent of those in the tables.
   B. When the duration of the full maximum load during the life of the member does not exceed the period indicated below, the values may be increased in the tables as follows:
      - 15 percent for 2 months duration, as for snow.
      - 25 percent for 7 days duration, as for construction loads.
      - 33-1/3 percent for wind or earthquake.
      - 100 percent for impact.
   The foregoing increases are not cumulative. For combined duration of loadings the resultant structural members shall not be smaller than required for the longer duration of loading.
   C. Values for normal loading conditions may be used without regard to impact if the stress induced by impact does not exceed the values for normal loading.

**SECTION 2505. IDENTIFICATION.**
(a) **General.** All lumber, plywood, particleboard, structural glued-laminated timber, end-jointed lumber, piles, and poles regulated by this Building Code shall conform to the applicable standards or grading rules specified in this Chapter and shall be identified by the grade mark or a Certificate of Inspection issued by an approved agency.
(b) **Treated.** All preservative treated lumber and plywood shall be identified by the Quality mark of an approved inspection agency.

**SECTION 2506. BEAM AND COLUMN DESIGN.**
(a) **General.** Provisions and formulas from NFPA-NDS shall be used in the design of wood beams and columns. Allowable stresses shall be as permitted in NFPA-NDS.
(b) **Notching.** Notching of beams should be avoided. Notches in sawn lumber bending members shall not exceed one-sixth the depth of the member and shall not be located in the middle third of the span. Where members are notched at the ends, the notch depth shall not exceed one-fourth the beam depth. The tension side of sawn lumber bending members of 4 inches or greater nominal thickness shall not be notched except at ends of members. Cantilevered portions of beams less than 4 inches in nominal thickness shall not be notched unless the reduced section properties and lumber defects are considered in the design. For effects of notch on shear strength, see NFPA-NDS.

(c) **Lateral Moment Distribution.** Lateral moment distribution of a concentrated load from a critically loaded beam to adjacent parallel beams shall be calculated.

(d) **Lateral Support.** Solid-sawn rectangular lumber beams, rafters and joists shall be supported laterally to prevent rotation or lateral displacement in accordance with the following:

   If the ratio of depth to thickness, based on nominal dimensions is:

   1. Two to 1, no lateral support is required.
   2. Three to 1 or 4 to 1, the ends shall be held in position, as by full depth solid blocking, bridging, nailing or bolting to other framing members, approved hangers or other acceptable means.
   3. Five to 1, one edge shall be held in line for its entire length.
   4. Six to 1, bridging, full-depth solid blocking, or cross bracing shall be installed at intervals not exceeding 8 feet unless both edges are held in line.

   **EXCEPTION:** In accordance with NFPA-NDS and when approved by the Department, bridging between supports may be omitted where the compression edge of the member is supported throughout its length to prevent lateral displacement, as by sheathing or subflooring, and the ends at points of bearing have lateral support to prevent rotation.

   5. Seven to 1, both edges shall be held in line for their entire length.

   If a beam is subject to both flexure and compression parallel to grain, the ratio may be as much as 5 to 1 if one is held firmly in line. If the dead load is sufficient to induce tension on the underside of the rafters, the ratio for the beam may be 6 to 1.

   As an alternate, lateral support of solid-sawn lumber beams, rafters and joists may also be provided in accordance with the procedures set forth in the NFPA-NDS.
(e) **Combined Loading.** Members subjected to both flexure and axial loading shall be proportioned in accordance with the provisions of NFPA-NDS.

SECTION 2507. TIMBER CONNECTIONS AND FASTENINGS.

(a) **Connections** Timber connectors and other fasteners such as bolts, drift pins, wood screws, lag screws, nails, and spikes may be used to transmit stress between wood members and between wood and metal members. The allowable loads and installation of timber fasteners shall be as set forth in the NFPA-NDS.

(b) **Loads.** Safe loads and design practices for types of connectors not mentioned or fully covered in the NFPA-NDS may be determined in a manner approved by the Department.

(c) **Spacing.**
   1. For wood to wood joints, the fastener spacing center-to-center shall be not less than the required penetration.
   2. Edge and end distances of fasteners shall be at least 1/2 of the required penetration.
   3. Holes for nails, where necessary to prevent splitting, shall be bored to a diameter smaller than that of the nails.

(d) **Joist Hangers and Framing Anchors.** Connections depending upon joist hangers or framing anchors, ties, and other mechanical fastenings not otherwise covered may be used where approved.

(e) **Metal Plate Connector.** Metal Plate connector employed as joint connector in light wood trusses shall conform to Design Specification for Light Metal Plate Connected Wood Trusses (TPI). Manufacturers shall provide certification that Metal Plate connected wood trusses have been fabricated in accordance with the requirements of the quality control manual of the Truss Plate Institute (TPI).

SECTION 2508. STRUCTURAL GLUED-LAMINATED TIMBER DESIGN.

(a) **General Provisions.**
   1. **Design Requirements.** Except as otherwise provided in this Section, structural glued-laminated members shall be designed in accordance with the applicable engineering formulas used for sawn members of glued-laminated timber included in NFPA-NDS.
   2. **Fastenings.** The pertinent provisions and allowable loads for fastenings stated in this Chapter shall apply to structural glued-laminated timber members.
   3. **Allowable Unit Stresses.** The allowable unit stresses for structural glued-laminated timber shall be in accordance with AITC-117, 119, 120 and as modified by this Section.
(b) **Standard Sizes.** Standard finished widths of laminated members shall be set forth in AITC-113. Depth of straight and curved members, length of all members and net dimensions shall be specified on the drawings.

(c) **Specifications.** For structural glued-laminated timber, the following shall be specified on the drawings:
   - Whether for dry or wet conditions of use.
   - Species and applicable standard.
   - Stress requirements.
   - If the temperature of the timber exceeds 150 degrees F. in service.

(d) **Design Stresses.**

1. **Dry Conditions of Use.** Allowable stress values for dry conditions of use shall be applicable for normal loading when the moisture content in service is less than 16 percent, as in most covered structures.

2. **Wet Conditions of Use.** Allowable stress values for wet conditions of use shall be applicable for normal loading when the moisture content in service is 16 percent or more, as may occur in exterior and submerged construction.

3. **Ponding.** Roof framing members shall be designed for the deflection criteria and ponding requirements specified in Section 2306(d). In no case shall the roof slope provide a positive vertical displacement less than that equivalent to 1/4 inch per foot of horizontal distance between the level of the drain and the high point of the roof for drainage. Such slope shall be in addition to the camber in glued-laminated timbers of one and one-half times the calculated dead load deflection. The calculation of the required slope shall not include any vertical displacement created by short taper cuts. Roofs having insufficient slope for drainage shall be investigated by a rational analysis to assure stability under ponding conditions, but in no case shall the deflection of such glued-laminated timbers exceed 1/2 inch for a 5-pound per square foot uniform load.

(e) **Tapered Faces.** No sawn tapered cuts shall be permitted on the tension face of any simple beam. Pitched or curved beams shall be so fabricated that the laminations are parallel to the tension face. Straight, pitched, or curved beams may have sawn tapered cuts on the compression face. For other members subject to bending, the slope of tapered faces, measured from the tangent to the lamination of the section under consideration, shall be not steeper than 1:24 on the tension side.
EXCEPTIONS:
1. This requirement shall not apply to arches.
2. Taper may be steeper at sections increased in size beyond design requirements for architectural projections.

(f) Manufacture and Fabrication. The manufacture and fabrication of structural glued-laminated timber shall be in accordance with PS-56. All work shall be under the supervision of qualified personnel.

(g) Exposed Structural Glued-laminated Timber. Those portions of glued-laminated timbers which form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave overhangs or similar covering shall be pressure treated with an approved preservative or be manufactured from wood of natural resistance to decay.

SECTION 2509. FORM FACTORS. The allowable unit flexural stresses in nonprismatic members shall not exceed the value established by multiplying such stress by the form factor determined from NFPA-ND5.

SECTION 2510. DESIGN OF GLUED BUILT UP MEMBERS. Plywood components shall be designed, fabricated and identified in accordance with APA Y510.

SECTION 2511. WOOD DIAPHRAGMS.
(a) General. Lumber and plywood diaphragms may be used to resist horizontal forces in horizontal and vertical distributing or resisting elements, provided the deflection in the plane of the diaphragm, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the permissible deflection of attached distributing or resisting elements. See APA U310 for a method of calculating the deflection of a blocked plywood diaphragm.
1. Permissible deflection shall be that deflection up to which the diaphragm and any attached distributing or resisting element will maintain its structural integrity under assumed load conditions, i.e. continue to support assumed loads without danger to occupants of the structure.
2. Connections and anchorages capable of resisting the design forces shall be provided between the diaphragms and the resisting elements. Openings in diaphragms which materially affect their strength shall be fully detailed on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.
3. Size and shape of diaphragms shall be limited as set forth in APA U310.
4. In buildings of wood frame construction where rotation is provided for, the depth of the diaphragm normal to the open side shall not exceed 25 feet or 2/3 the diaphragm width whichever
is the smaller depth. Straight sheathing shall not be permitted to resist shears in diaphragms acting in rotation.

EXCEPTIONS:

1. One-story, wood-framed structures with the depth normal to the open side not greater than 25 feet, may have a depth equal to the width.

2. Where calculations show that diaphragm deflections can be tolerated, the depth normal to the open end may be increased to a depth to width ratio not greater than 1-1/2:1 for diagonal sheathing 2:1 for special diagonal sheathed or plywood diaphragms.

3. In masonry or concrete buildings lumber and plywood diaphragms shall not be considered as transmitting lateral forces by rotation.

(b) Diagonally Sheathed Diaphragms.

1. Conventional Construction. Lumber diaphragms shall be made up of 1 inch nominal sheathing boards laid at an angle of approximately 45 degrees to supports. Sheathing boards shall be directly nailed to each intermediate bearing member in accordance with the requirements of Table 25-A for subfloor. An additional nail shall be used at diaphragm boundaries. End joints in adjacent boards shall be separated by at least one joist or stud space, and there shall be at least 2 boards between joints on the same support. Boundary members at edges of diaphragms shall be designed to resist direct tensile or compressive chord stresses and shall be tied together at corners. Conventional lumber diaphragms may be used to resist shear due to wind or seismic forces not exceeding 300 pounds per lineal foot.

2. Special Construction.

A. Special diagonally sheathed diaphragms shall conform to conventional construction and, in addition, shall have all elements designed in conformance with the provisions of this Building Code.

B. Each Chord or portion thereof may be considered as a beam loaded with a uniform load per foot equal to 50 percent of the unit shear due to diaphragm action. The load shall be assumed as acting normal to the chord, in the plane of the diaphragm, and either toward or away from the diaphragm. The span of the chord or portion thereof shall be the distance between structural members of the diaphragm such as the joists, studs, and blocking, which serve to transfer the assumed load to the sheathing.
C. Special diagonally sheathed diaphragms shall include conventional diaphragms sheathed with 2 layers of diagonal sheathing at 90 degrees to each other and on the same face of the supporting members.

D. Special diagonally sheathed diaphragms may be used to resist shears due to wind or seismic loads, provided such shears do not stress the nails beyond their allowable safe lateral strength and do not exceed 600 pounds per lineal foot.

(c) Plywood Diaphragms. Horizontal and vertical diaphragms sheathed with plywood may be used to resist horizontal forces not exceeding those set forth in APA U310.

1. Plywood for horizontal diaphragms shall be as set forth in APA U310 for corresponding joist spacing and loads. Plywood in shear walls shall be at least 5/16 inch thick for studs spaced 16 inches on center and 3/8 inch thick where studs are spaced 24 inches on center.

2. Maximum spans for plywood subfloor underlayment shall be as set forth in APA E30. Plywood used for horizontal and vertical diaphragms shall conform to PS-1.

3. All boundary members shall be proportioned and spliced where necessary to transmit direct stresses. Framing members shall be at least 2-inch nominal in the dimension to which the plywood is attached. In general, panel edges shall bear on the framing members and butt along their center lines. No unblocked panels less than 12 inches wide shall be used.

SECTION 2512. FIBERBOARD SHEATHING DIAPHRAGMS.
Wood stud walls sheathed with fiberboard sheathing complying with ASTM-C208, D2277, or PS57 may be used to resist horizontal forces not exceeding those set forth in Table 25-D. Nailing specified in Table 25-D shall be provided at the perimeter of the sheathing board, and at intermediate studs. Blocking not less than 2 inches in thickness shall be provided at horizontal joints when wall height exceeds length of sheathing panel, and specified in Table 25-D. Nails shall be spaced not less than 3/8 inch from edges and ends of sheathing. Marginal studs of shear walls or shear-resisting elements shall be anchored at top and bottom and designed to resist all forces. The maximum height-width ratio shall be 1-1/2:1.

SECTION 2513. WOOD COMBINED WITH MASONRY OR CONCRETE.
(a) Dead Load. Wood members shall not be used to permanently support the dead load of any masonry or concrete.
EXCEPTIONS:
1. Masonry or concrete nonstructural floor or roof surfacing not more than 4 inches thick may be supported by wood members.
2. Structures may rest upon wood piles constructed in accordance with the requirements of Chapter 29.

(b) Horizontal Forces. Wood members shall not be used to resist horizontal forces contributed by masonry or concrete construction in buildings over one story in height.

EXCEPTION: Wood floor and roof members may be used in horizontal trusses and diaphragms to resist horizontal forces imposed by wind, earthquake, or earth pressure, provided the forces are not resisted by rotation of the truss or diaphragm.

SECTION 2514. GENERAL CONSTRUCTION REQUIREMENTS.
(a) General. The requirements in this Section shall apply to all wood frame construction.

(b) Protection Against Decay and Termites.
1. Wood Support Embedded in Ground. Wood embedded in the ground, in direct contact with the earth and used for the support of permanent structures, shall be treated wood unless continuously below the ground waterline or continuously submerged in fresh water. Round or rectangular posts, poles and sawn timber columns supporting permanent structures which are embedded in concrete in direct contact with earth or embedded in concrete exposed to the weather shall be treated wood.

2. Underfloor Clearance. When wood joists or the bottom of wood structural floors without joists are located closer than 18 inches or wood girders are located closer than 12 inches to exposed ground in crawl spaces or unexcavated areas located within the periphery of the building foundation, the floor assembly including posts, girders, joists and subfloor, shall be approved wood of natural resistance to decay as listed in Section 2514(b)3 or treated wood. Accessible under-floor areas shall be provided with an 18 inch by 24 inch access crawl hole. See Section 2903 and 5210 for specific requirements. Pipes, ducts and other nonstructural construction shall not interfere with the accessibility to or within under-floor areas.

3. Plates, Sills and Sleepers. All foundation plates or sills and sleepers on a concrete or masonry slab, which is in direct contact with earth, and sills which rest on concrete or masonry foundations, shall be treated wood or Foundation redwood, all marked or branded by an approved agency, unless members are 6 inches above finished grade. Any species of wood permitted by this code may be used for sills when specifically approved by the building official.
4. **Columns and Posts.** Columns and posts located on concrete or masonry floors or decks exposed to the weather or to water splash or in basements and which support permanent structures shall be supported by concrete piers or metal pedestals projecting above floors unless approved wood of natural resistance to decay or treated wood is used. The pedestals shall project at least 6 inches above exposed earth and at least 1 inch above such floors. Individual concrete or masonry piers shall project at least 6 inches above exposed ground unless the columns or posts which they support are of approved wood of natural resistance to decay or treated wood is used.

5. **Girders Entering Masonry or Concrete Walls.** Ends of wood girders entering masonry or concrete walls shall be provided with 1/2 inch air space on tops, unless approved wood of natural resistance to decay or treated wood is used.

6. **Foundation Ventilation.** See Section 2903.

7. **Wood and Earth Separation.** Protection of wood against deterioration as set forth in the previous paragraphs for specified applications is required. In addition, wood used in construction of permanent structures and located nearer than 6 inches to earth shall be treated wood or wood of natural resistance to decay, as defined in Section 2502(a). Where located on concrete slabs placed on earth, wood shall be treated wood or wood of natural resistance to decay. Where not subject to water splash or to exterior moisture and located on concrete having a minimum thickness of 3 inches with an impervious membrane installed between concrete and earth, the wood may be of any species.

8. **Wood Supporting Roofs and Floors.** Wood structural members supporting moisture permeable floors or roofs which are exposed to the weather such as concrete or masonry slabs shall be approved wood of natural resistance to decay or treated wood unless separated from such floors or roofs by an impervious moisture barrier.

9. **Retaining Walls.** Wood used in retaining or crib walls shall be treated wood or as approved by the Department.

10. **Weather Exposure.** Approved wood of natural resistance to decay or treated wood shall be used for those portions of wood members which form the structural supports of buildings, balconies, porches or similar permanent building appurtenances when such members are exposed to the weather without adequate protection from a roof, eave, overhang or other cover
ing to prevent moisture or water accumulation on the surface or at joints between members, or as approved by the Department.

(c) **Wall Framing.** The framing of exterior and interior walls shall be in accordance with provisions specified in Section 2515 unless a specific design is furnished.

(d) **Floor Framing.**
1. Wood joist floors shall be anchored to supporting wood stud or masonry walls.

(e) **Fire and Draft Stopping.**
1. **Fire Stops - General.** Firestopping and draftstopping shall be provided in wood frame construction to cut off all concealed draft openings (both vertical and horizontal) and shall form an effective barrier between stories; between a top story and roof or attic space; and shall subdivide attic spaces, concealed roof spaces and floor-ceiling assemblies. The integrity of all fire and draft stops shall be maintained.

2. **Fire Stops.** Fire stopping shall be provided in the following locations:
   A. In concealed spaces of stud walls and partitions, including furred spaces, at the ceiling and floor levels;
   B. At all inter-connections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings, etc.;
   C. In concealed spaces between stair stringers at the top and bottom of the run;
   D. At openings around vents, pipes, ducts, chimneys, and fireplaces at ceiling and floor levels, with non-combustible materials;

Except as provided in Item D above, firestopping shall consist of 2 inch nominal lumber or two thicknesses of 1 inch nominal lumber with broken lap joints or one thickness of 3/4 inch plywood with joints backed by 3/4 inch plywood.
Fire stops may also be of gypsum board, cement asbestos board, mineral wool or other approved materials securely fastened in place.

3. **Draft Stops.** Draftstopping shall be provided in the following locations:
   A. **Floor-Ceiling Assemblies.**
      1. **Group I Occupancies.** In floor-ceiling assemblies separating usable spaces into two or more approximately equal areas with no area greater than 500 sq. ft. Draftstopping shall be provided parallel to the main framing members.
2. **Group H Occupancies.** In the floor ceiling assemblies above and in line with the tenant separation, when tenant separation walls do not extend to the floor sheathing above.

3. **Group A through G Occupancies.** In floor-ceiling assemblies so that horizontal areas do not exceed 1000 sq. ft.

**B Attics.**

1. **Group I Occupancies.** None required.

2. **Group H Occupancies.** In the attic, mansard, overhang, or other concealed roof space above and in line with the tenant separation, when tenant separation walls do not extend to the roof sheathing above or as approved by the Department.

**EXCEPTION:** Where approved fire sprinklers are provided draftstopping shall not be required.

3. **Group A through G Occupancies.** In attic spaces so that horizontal areas do not exceed 3,000 sq. ft.

**EXCEPTION 1.** Where flat roofs with solid joist construction are used, draftstopping over tenant separation walls is not required.

**EXCEPTION 2.** Where approved sprinklers are provided, draftstopping shall not be required.

Draftstopping materials shall be not less than 1/2 inch gypsum board, 1/2 inch plywood, or other approved material adequately supported.

Ventilation of concealed roof spaces shall be maintained in accordance with Section 3206.

(f) **Exterior Wall Coverings.**

1. **General.** Exterior wood stud walls shall be covered on the outside with the materials and in the manner specified in this Section and elsewhere in this Building Code. Studs or sheathing shall be covered on the outside face with a weather resistive barrier when required by Chapter 17. Exterior wall coverings of the minimum thickness specified in this Section are based upon a maximum stud spacing of 16 inches.

**EXCEPTION:**

**Corrugated Metal.** Corrugated metal may be used on stud walls without sheathing. Walls shall be braced, and nailing strips shall be provided to support the metal at intervals not exceeding 4 feet. Steel shall be 28 gauge minimum. Aluminum shall be 0.021 inches minimum.
2. **Siding.** Siding shall have a minimum thickness of 3/8 inch unless placed over sheathing permitted by this Building Code.
   A. Siding patterns known as rustic, drop siding, or shiplap shall have an average thickness in place at least 19/32 inch and shall have a minimum thickness of not less than 3/8 inch. Bevel siding shall have a minimum thickness measured at the butt section of not less than 7/16 inch and a tip thickness of not less than 3/16 inch. Siding of lesser dimensions may be used, provided the wall covering is placed over sheathing which conforms to the provisions specified elsewhere in this Building Code.
   B. All siding shall be securely nailed to each stud with at least one nail, or to solid 1-inch nominal wood sheathing or 1/2 inch plywood with at least one line of nails in each piece of the siding.

3. **Plywood.** Where plywood is used for covering the exterior of outside walls, it shall be exterior type not less than 3/8 inch thick, except the siding may be 5/16 inch thick when complying with special crossband requirements such as those given in APA Manufacturing Specifications for specialty siding. Plywood panel siding shall be installed in accordance with APA E30.
   A. Unless applied over 1-inch wood sheathing or 1/2 inch plywood sheathing, joints shall occur over framing members and shall be covered with a continuous wood batt, shall be lapped horizontally, or otherwise made waterproof.

4. **Shingles or Shakes.** Wood shingles or shakes and asbestos cement shingles may be used for exterior wall covering provided the frame of the structure is covered with building paper as specified in Chapter 17. All shingles or shakes attached to sheathing other than wood sheathing shall be secured with approved corrosion resistant fasteners, or on furring strips attached to the studs. Wood shingles or shakes may be applied over fiberboard shingle backer and sheathing with annular grooved nails. The thickness of wood shingles or shakes between wood nailing boards shall be not less than 3/8 inch. Wood shingles or shakes and asbestos shingles or siding may be nailed directly to approved fiberboard nailbase sheathing not less than 1/2 inch nominal thickness with corrosion resistant annular grooved nails. Fiberboard nailbase sheathing and shingle backer shall comply with PS57.
   A. The weather exposure of wood shingles or shake siding used in exterior walls shall not exceed maximums set forth in Table 25-F.
5. **Particleboard.** Where particleboard is used for covering the exterior of outside walls, it shall be exterior type 2-B-1 conforming to ANSI-208.1, not less than 3/8 inch thick when applied directly to framing spaced 16 inches on center and 3/4 inch thick when applied directly to framing spaced 24 inches on center. Unless applied over 5/8 inch net wood sheathing, or 1/2 inch plywood sheathing, or 1/2 inch particleboard sheathing, joints shall occur over framing members and shall be covered with a continuous wood batt; or joints shall be lapped horizontally and otherwise made waterproof.

6. **Plaster.** For exterior plaster, see Chapter 47.

7. **Hardboard.** Where hardboard siding is used for covering the outside of exterior walls, it shall conform to PS-60. Lap siding shall be installed horizontally direct to studs. Corner bracing shall be installed in conformance with Section 2515(f)5. A weather-resistive barrier shall be installed under the lap siding as required by Section 1708(a).

Square-edged nongrooved panels and shiplap grooved or non-grooved siding shall be applied vertically to sheathed or unsheathed walls. Siding that is grooved shall be not less than 1/4 inch thick in the groove.

Nail size and spacing shall follow PS 60 and shall penetrate framing 1-1/2 inches. Lap siding shall overlap 1 inch minimum and be nailed through both courses and into framing members with nails located 1/2 inch from bottom of the overlapped course.

Square-edged nongrooved panels shall be nailed 3/8 inch from the perimeter of the panel and intermediately into studs. Shiplap edge panel siding with 3/8 inch shiplap shall be nailed 3/8 inch from the edges on both sides of the shiplap. The 3/4 inch shiplap shall be nailed 3/8 inch from the edge and penetrate through both the overlap and underlap. Top and bottom edges of the panel shall be nailed 3/8 inch from the edge.

Shiplap and lap siding shall not be force fit. Square-edged panels shall maintain a 1/16 inch gap at joints. All joints and edges of siding shall be over framing members and shall be made resistant to weather penetration with battens, horizontal overlaps or shiplaps to the satisfaction of the Department. A 1/8 inch gap shall be provided around all openings.

8. **Nailing.** All fasteners used for the attachment of siding shall be corrosion-resistant.

(g) **Structural Floor and Roof Sheathing.** Structural floor and roof sheathing shall be designed in accordance with general provisions
of this Building Code, the provisions of Chapter 23 and APA E 30. See Standards.

1. Roof sheathing conforming to the provisions of Table 25-B or Table 25-C-1 or 25-C-2 shall be deemed to meet the requirements of this Subsection.

2. Plywood roof sheathing shall be bonded by intermediate or exterior glue.

(h) Fastenings.

1. Nailing Requirements. Unless otherwise required by structural design, the number and size of nails connecting wood members shall be not less than that set forth in Table 25-A. Other connections shall be fastened to provide equivalent strength. End and edge distances and nail penetrations shall be in accordance with the applicable provisions of NFPA-NDN.

2. Joist Hangers and Framing Anchors. Connections depending upon joist hangers or framing anchors, ties and other mechanical fastenings not otherwise covered may be used where approved.

(i) Water Splash. Where wood frame walls and partitions are covered on the interior with plaster, tile or similar materials and are subject to water splash, the framing shall be protected with approved waterproofing conforming to Chapter 17.

(j) Mechanically Laminated Floors and Decks. A mechanically laminated lumber floor or deck built up of wood members set on edge, may be designed as a solid floor or roof deck of the same thickness, when meeting the requirements of this Building Code.

(k) Post-Beam Connections. Where post and beam or girder construction is used, the design shall be in accordance with the provisions of this Building Code. Positive connection shall be provided to ensure against uplift and lateral displacement.

SECTION 2515. LIGHT FRAME CONSTRUCTION PROVISIONS.

(a) General. These provisions, as well as the requirements of other Sections of this Chapter, are minimum requirements for light frame construction.

EXCEPTION: For buildings more than one story in height, refer to Chapter 3 for design responsibility.

(b) Foundation Plates or Sills. Foundation plates or sills resting on concrete or masonry foundations shall be bolted to the foundation or foundation wall with not less than 1/2 inch diameter steel bolts embedded at least 7 inches into the concrete or reinforced masonry or 15 inches into unreinforced grouted masonry and spaced not more than 6 feet apart. There shall be a minimum of two bolts per piece.
with one bolt located within 12 inches of each end of each piece. Foundation plates and sills shall be the kind of wood specified in Section 2514(b).

(c) Girders.

1. Girders shall be designed to support all loads. Laminated built-up beams with laminations not less than 2 inches in thickness may be used for girders when the laminations are parallel to applied load. See Table 25-A for Nailing Requirements. The end joints shall occur over supports. Where a girder is spliced over a support, a tie shall be provided.

2. The ends of beams or girders supported on masonry or concrete shall provide 4-inch minimum bearing.

(d) Floor Joists.

1. General. Spans for joists shall be in accordance with NFPA Span Tables for Joists and Rafters.

2. Bearings. The end of each joist shall have not less than 1-1/2 inch minimum bearing on wood or metal, 3-inch minimum on masonry.

3. Framing Details.
   A. Joists shall be supported laterally at the ends and at each support by solid blocking except where the ends of the joists are nailed to a header, band or rim joist, or to an adjoining stud, or by other approved means. Solid blocking shall be not less than 2 inches in thickness and the full depth of joist.
   B. Notches in the top or bottom joists shall not exceed 1/6 the depth, and shall not be located in the middle third of the span. Holes bored in joists shall not be within 2 inches of the top or bottom of the joist and the diameter of any such hole shall not exceed 1/3 the depth of the joist.
   C. Joists framing from the opposite sides of a beam, girder, or partition shall be lapped at least 4 inches over the supports, or the opposing joists shall be tied together.
   D. Joists framing into the side of a wood girder shall be supported by framing anchors or joist hangers.

4. Framing Around Openings. Trimmer and header joists shall be doubled, or of lumber of equivalent cross section, when the span of the header exceeds 4 feet. The ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition, or wall. Tail joist over 12 feet long shall be supported at a header by framing anchors or joist hangers.

5. Supporting Bearing Partitions. Bearing partitions perpendicular to joists shall not be offset from supporting girders,
walls or partitions more than the joist depth. Joists under and parallel to bearing partitions shall be doubled.

6. **Blocking.** Floor joists shall be blocked and bridged as required by the provisions of Section 2506(d) and 2515(d) 3.

(e) **Subflooring.**

1. **Lumber Subfloor.** Sheathing used as structural subfloor shall conform to the limitations set forth in Table No. 25-B. Joints in subflooring shall occur over supports unless end matched lumber is used, in which case each piece shall bear on at least 2 joists. Subflooring may be omitted when joist spacing does not exceed 16 inches and one-inch nominal tongued-and-grooved wood strip flooring is applied perpendicular to the joists.

2. **Plywood.** Where used as structural subflooring, plywood shall be as set forth in Table 25-C-1. Plywood combination subfloor-underlayment shall have maximum spans as set forth in Table 25-C-3 or, where glued, the floor framing in Item 1 shall provide spans conforming to those given in APA E30.

3. **Plank Flooring.** Plank flooring shall be designed in accordance with the general provisions of this Building Code. In lieu of this design, 2 inch tongue-and-groove planking may be used in accordance with NFPA-Plank and Beam Framing Manual. Joints in this planking may be randomly spaced provided the system is applied to not less than 3 continuous spans, planks are center-matched and end-matched or splined, each plank bears on at least 24 inches in adjacent pieces. One inch nominal strip square edged flooring, 1/2 inch tongue-and-groove flooring, or 3/8 inch plywood shall be applied over random length decking used as a floor. The “strip” and tongue-and-groove flooring shall be applied at right angles to the span of the planks. The 3/8 inch plywood shall be applied with the face grain at right angles to the span of the planks.

(f) **Wall Framing.**

1. **Size.** Unless otherwise required by engineering analysis, studs in exterior walls and interior bearing walls of buildings 2 stories in height shall be at least 2 inches by 4 inches in size. For three story buildings these studs shall be not less than 3 inches by 4 inches or 2 inches by 6 inches to the bottom of the second floor joists, and 2 inches by 4 inches for the 2 upper stories. Interior nonbearing partitions may be framed with 2 inch by 2 inch studs.
2. Height
   A. Unless supported laterally by framing, the maximum allowable height for studs shall be 10 feet for 2 inch by 3 inch studs; 14 feet for 2 inch by 4 inch and 3 inch by 4 inch studs; and 20 feet for 2 inch by 6 inch studs.
   B. When approved for use by the Department, the maximum allowable height for utility grade studs shall be 8 feet for load bearing and exterior wall studs, and 10 feet for interior non-loadbearing studs. When used in bearing walls, utility grade studs shall support not more than a roof and ceiling load.

3. Spacing. Studs supporting floors shall be spaced not more than 16 inches. Except for Utility grade studs, 2 inch by 4 inch studs not more than 10 feet in length may be spaced not more than 24 inches when supporting only a ceiling and roof. The spacing of studs in nonbearing walls shall not exceed 24 inches. The spacing of 2 inch by 3 inch studs shall not exceed 16 inches. Roof trusses shall center over studs or solid blocking equal in size to the studs shall be installed to reinforce the plate above.

4. Framing Details.
   A. Studs shall be placed with their wide dimension perpendicular to the wall. At least 3 studs shall be installed at every corner of an exterior wall.
   B. Bearing and exterior wall studs shall be capped with double top plates installed to provide overlapping at corners and at intersections with other partitions. End joints in double top plates shall be offset at least 48 inches. Interior nonbearing partitions may be capped with a single top plate installed to provide overlapping at corners and at intersections with other walls and partitions. The plate shall be continuously tied at joints by solid blocking at least 16 inches in length and equal in size to the plate or by 1/8 x 1-1/2 inch metal ties with spliced sections fastened with 2 16d nails on each side of the joint. Studs shall provide full bearing on a plate or sill not less than 2 inches in thickness having a width not less than that of the wall studs.

5. Bracing. All exterior walls and main cross stud partitions shall be braced at each end and at least every 25 feet of length by one of the following methods:
   A. Nominal 1 inch by 4 inch continuous diagonal braces let into top and bottom plates and intervening studs and placed at an angle not more than 60 or less than 45 from the horizontal.
B. Wood boards of 5/8 inch net minimum thickness applied diagonally on studs spaced not over 24 inches.

C. Plywood sheathing with a thickness not less than 5/16 inch for 16 inch stud spacing and not less than 3/8 inch for 24 inch stud spacing in accordance with APA E30.

D. Fiberboard sheathing panels 4 foot by 8 foot size at least 7/16 inch thick applied vertically on studs spaced not over 16 inches.

E. Gypsum sheathing panels not less than 1/2 inch thick on studs spaced not over 16 inches, when installed in accordance with Chapter 47.

F. Particleboard Exterior Type 2-B-1 sheathing panels not less than 3/8 inch thick on studs spaced not more than 16 inches.

G. Gypsum wallboard not less than 1/2 inch thick on studs spaced not over 24 inches, when installed in accordance with Chapter 47.

H. For methods B, C, D, E, and F the braced panel shall be at least 48 inches in width, covering 3 stud spaces where studs are spaced 16 inches apart and covering 2 stud spaces where studs are spaced 24 inches apart.

I. Solid sheathing of one of the materials specified in paragraph B through F herein shall be applied on the exterior walls of the first story of all wood framed buildings 3 stories in height.

J. All vertical joints of panel sheathing shall occur over studs. Horizontal joints shall occur over blocking equal in size to the studding.

6. **Cripple Walls.** Cripple walls shall be framed of studs not less in size than the adjacent studding, or shall be framed of solid blocking. When exceeding 4 feet in height, these walls shall be framed of studs providing the size required for an additional story. Cripple walls shall be braced as required in Section 2515(f)5 for the first story exterior walls.

7. **Headers.** All openings 4 feet wide or less in bearing walls shall be provided with headers consisting of either 2 pieces of 2 inch framing lumber placed on edge and fastened together, or 4 inch lumber of equivalent cross section. All openings more than 4 feet wide shall be provided with headers or lintels with not less than 2 inch solid bearing at each end to the floor or bottom plate, unless other approved framing methods or joint devices are used.

8. **Pipes in Walls.** Stud partitions containing pipes shall be framed, and the joists underneath so spaced, to provide proper
clearance for the piping. When a partition containing piping runs parallel to the floor joists, the joist underneath the partitions shall be doubled and spaced to permit the passage of pipes, and shall be bridged. When pipes are placed in or partly in a partition, necessitating cutting the soles or plates, a metal tie not less than 1/8 inch thick and 1-1/2 inches wide shall be fastened across the plate and to each side of the opening.

9. **Bridging.** Unless covered by interior or exterior wall coverings or sheathing meeting the minimum requirements of this Building Code, all stud partitions or walls with studs having a height to thickness ratio exceeding 50 shall have bridging not less than 2 inches in thickness and the same width as the studs fitted snugly and nailed to provide lateral support.

10. **Cutting and Notching.** In exterior walls and bearing partitions, a wood stud may be cut or notched to a depth not exceeding 25 percent of its width. In nonbearing partitions supporting no loads other than the weight of the partition, cutting or notching of a stud to a depth not exceeding 40 percent of its depth shall be permitted.

11. **Bored Holes.** A hole not greater in diameter than 40 percent of the stud width may be bored in a wood stud. Bored holes not greater than 60 percent of the width of the stud are permitted in nonbearing partitions or in a wall where each bored stud is doubled provided not more than 2 successive doubled studs are bored. In no case shall the edge of the bored hole be nearer than 5/8 inch to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

(g) **Roof and Ceiling Framing.**

1. **General.** The framing details required in this Section apply to roofs having a pitch of 3:12 or more. When the roof pitch is less than 3:12, ridge boards, hips and valleys, and other members supporting rafters and ceiling joists shall be designed as beams.

2. **Spans.** Allowable spans for rafters and ceiling joists shall be in accordance with NFPA Span Tables for Joists and Rafters.

3. **Framing.** Rafters shall be framed directly opposite each other at the ridge. There shall be a ridge board at least one inch thickness at all ridges and not less in depth than the cut end of the rafter. At all valleys and hips there shall be a single valley or hip rafter not less than 2 inches thickness and not less in depth than the cut end of the rafter.

4. **Rafter Ties.** Rafters shall be nailed to adjacent ceiling joists to form a continuous tie between exterior walls when such joists
are parallel to the rafters. Where not parallel, rafters shall be tied to 1 inch by 4 inch minimum size cross-ties located as low on the rafter as possible. Rafter ties shall be spaced not more than 4 feet on center.

5. **Purlins.** Purlins to support roof loads may be installed to reduce the span of rafters within allowable limits and shall be supported by struts to bearing walls, but in no case shall the purlin be smaller than the supported rafter. Struts to bearing walls shall be not smaller than 2 inch by 4 inch members. The unbraced length of struts shall not exceed 8 feet and the minimum slope of the struts shall be at least 45 degrees from the horizontal.

6. **Blocking.** Rafters more than 8 inches in depth shall be supported laterally at the ends and at each support by solid blocking not less than 2 inches in thickness and the full depth of the rafter unless nailed to a header, band or rim joist, or to an adjoining stud.

7. **Roof Sheathing.**
   A. Roof sheathing shall be in accordance with Table 25-C-1 or 25-C-2 for plywood or Table 25-B for lumber.

   **EXCEPTION:** The use of 15/32 inch (minimum) thick plywood or 7/16 inch (minimum) thick non-veneer APA Rated Sheathing (oriented strand board panels, structural particle board panels, composite panels or wafer board panels) complying with a 24/16 span rating is a suitable alternate to 1/2 inch thick plywood. (Rev. 8/86 Ord. No. 517)

   B. Joints in lumber sheathing shall occur over supports unless end matched lumber is used, in which case each piece shall bear on at least 2 supports.

   C. Plywood used for roof sheathing shall be bonded by intermediate or exterior glue.

8. **Roof Planking.**
   A. Planking shall be designed in accordance with the provisions of this Building Code.

   B. In lieu of this design, tongue-and-groove planking may be used in accordance with NFPA Plank and Beam Framing Manual. Joints in the planking may be randomly spaced provided the system is applied to not less than three continuous spans, planks are center-matched and end-matched or splined, each plank bears on at least one support and joints are separated by at least 24 inches from adjacent pieces.
SECTION 2516. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>AITC</td>
<td>AITC 113-80 Standard for Dimensions of Glued Laminated Structural Members.</td>
</tr>
<tr>
<td>ANSI</td>
<td>ANSI 05.1-79 Specifications and Dimensions for Wood Poles.</td>
</tr>
<tr>
<td></td>
<td>ANSI A 208.1-79 Matformed Wood Particleboard.</td>
</tr>
<tr>
<td></td>
<td>Plywood Design Specification - Y510. (Includes references to design and fabrication specifications for plywood-lumber components, including curved panels, beams, stressed-skin panels, sandwich panels, and folded plates.)</td>
</tr>
<tr>
<td></td>
<td>Plywood Diaphragm Construction -U310.</td>
</tr>
<tr>
<td></td>
<td>D-25-79 Specifications for Round Timber Piles.</td>
</tr>
<tr>
<td></td>
<td>D-2899-74 Establishing Design Stresses for Round Timber Piles.</td>
</tr>
<tr>
<td></td>
<td>D-805-72 Testing Veneer, Plywood and Other Glued Veneer Constructions.</td>
</tr>
<tr>
<td>HPMA LF-71</td>
<td>Interim Industry Standards for Laminated Hardwood Block Flooring.</td>
</tr>
</tbody>
</table>
Plank and Beam Framing Wood Construction Data No. 4, 1970.
TPI  TPI-78 Design Specifications for Metal Plate Connected Wood Roof Trusses.

GRADING AGENCIES AND RULES:
Standard Grading Rules for Canadian Lumber U.S. Edition (Sept. 1, 1979) of the National Lumber Grades Authority. (NLGA)
Standard Grading Rules for West Coast Lumber No. 16 (Sept. 1970, Revised Jan. 1980) of the West Coast Lumber Inspection Bureau. (WCLIB)
Standard Grading Rules for Western Lumber of the Western Wood Products Association (June 1, 1980) (WWPA),
Grading Rules, Southern Pine Inspection Bureau (March 15, 1977) including supplements (No. 1, April 1, 1977), (No. 2 June 1, 1977),
(No. 3, Dec. 1, 1977), (No. 4, Aug. 15, 1978), (No. 5 Sept. 1, 1979),
(No. 6, Feb. 1, 1980) (SPIB).
Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service (June, 1978), Supplement No. 1,

LEGEND

<table>
<thead>
<tr>
<th>AITC</th>
<th>American Institute of Timber Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>333 West Hampden Avenue</td>
</tr>
<tr>
<td></td>
<td>Englewood, CO 80110</td>
</tr>
</tbody>
</table>

ORGANIZATION

08/87

25-25
ANSI  American National Standards Institute, Inc.
       1430 Broadway
       New York, N.Y. 10018

APA  American Plywood Association
     7011 South 19th
     P.O. Box 11700
     Tacoma, Washington 98411

ASTM  American Society for Testing and Material
      1916 Race Street
      Philadelphia, Pa. 19103

AWPA  American Wood Preservers Association
      1625 I Street
      Washington, D.C. 20006

AWPB  American Wood Preservers Bureau
      2772 S. Randolph Street
      Arlington,Va. 22206

AWPI  American Wood Preservers Institute
      1651 Old Meadow Road
      McLean, Va. 22101

CS  Commercial Standard
    (U.S. Department of Commerce)
    Superintendent of Documents
    Government Printing Office
    Washington, D.C. 20036

NFPA  National Forest Products Ass'n.
      1619 Massachusetts Ave. N.W.
      Washington, D.C. 24002

PS  Product Standard
    (U.S. Department of Commerce)
    Superintendent of Documents
    Government Printing Office
    Washington, D.C. 20036

TPI  Truss Plate Institute
     100 W. Church Street
     Fredrick, Md. 70740

HPMA  Hardwood Plywood Manufacturers Association
       P. O. Box 2789
       Reston, Va. 22090

SECTION 2517. TABLES.
<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>NAILING*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joist to sill or girder, toe nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>Bridging to joist, toe nail each end</td>
<td>2-8d</td>
</tr>
<tr>
<td>1&quot; x 6&quot; subfloor to each joist, face nail</td>
<td>2-8d</td>
</tr>
<tr>
<td>Wider than 1&quot; x 6&quot; subfloor to each joist, face nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>2&quot; subfloor to joist or girder, blind and face nail</td>
<td>2-16d</td>
</tr>
<tr>
<td>Sole plate to joist or blocking, face nail</td>
<td>16d at 16&quot; o.c.</td>
</tr>
<tr>
<td>Top plate to stud, end nail</td>
<td>2-16d</td>
</tr>
<tr>
<td>Stud to sole plate, toe nail</td>
<td>4-8d</td>
</tr>
<tr>
<td>Doubled studs, face nail</td>
<td>16d at 24&quot; o.c.</td>
</tr>
<tr>
<td>Doubled top plates, face nail</td>
<td>16d at 16&quot; o.c.</td>
</tr>
<tr>
<td>Top plates, laps and intersections, face nail</td>
<td>2-16d</td>
</tr>
<tr>
<td>Continuous header, two pieces</td>
<td>16d at 16&quot; o.c. along each edge</td>
</tr>
<tr>
<td>Ceiling joists to plate, toe nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>Continuous header to stud, toe nail</td>
<td>4-8d</td>
</tr>
<tr>
<td>Ceiling joists, laps over partitions, face nail</td>
<td>3-16d</td>
</tr>
<tr>
<td>Ceiling joists to parallel rafters, face nail</td>
<td>3-16d</td>
</tr>
<tr>
<td>Rafter to plate, toe nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>1&quot; brace to each stud and plate, face nail</td>
<td>2-8d</td>
</tr>
<tr>
<td>1&quot; x 8&quot; sheathing or less to each bearing, face nail</td>
<td>2-8d</td>
</tr>
<tr>
<td>Wider than 1&quot; x 8&quot; sheathing, face nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>Built-up corner studs</td>
<td>16d at 24&quot; o.c.</td>
</tr>
<tr>
<td>Built-up girder and beams</td>
<td>20d at 32&quot; o.c. at top and bottom and staggered</td>
</tr>
<tr>
<td>2&quot; planks</td>
<td>2-20d at ends and at each splice</td>
</tr>
<tr>
<td>2-16d at each bearing</td>
<td></td>
</tr>
</tbody>
</table>

**Particleboard:**
- Wall sheathing (to framing):
  - 3/8"-1/2"
  - 5/8"-3/4"
  - 8d
  - 6d

**Plywood:**
- Wall sheathing (to framing):
  - 1/2" and less
  - 5/8"-3/4"
  - 7/8"-1"
  - 1 1/8"-1 1/4"
- Combination Subfloor-underlayment (to framing):
  - 3/4" and less
  - 7/8"-1"
  - 1 1/8"-1 1/4"
- Panel Siding (to framing):
  - 1/2" or less
  - 5/8"
TABLE NO. 25-A (cont'd.)
NAILING SCHEDULE

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>NAILING*</th>
</tr>
</thead>
</table>
| Fiberboard Sheathing:*  
1/2”            | No. 11 ga.  
6d^c          | No. 16 ga.  
           |
| 25/32”          | No. 11 ga.  
8d^c          | No. 16 ga.  
           |

* Common or box nails may be used except where otherwise stated.
  b Common or deformed shank.
  c Common.
  d Deformed shank.
  e Nails not less than 3/8” from panel edge and end and spaced at 6 inches on center at edges, 12 inches at intermediate supports (10 inches at intermediate supports for floors), except 6 inches at all supports where spans are 48 inches or more. Nails for wall sheathing may be common, box or casing.
  f Corrosion resistant siding and casing nails.
  g Fasteners spaced 3 inches on center or exterior edges and 6 inches on center at intermediate supports.
  h Galvanized roofing nails with 7/8 inch diameter head and 1 1/2 inch length for 1/2 inch sheathing and 1 3/8 inch for 23/32 inch sheathing.
  i Galvanized staple with 7/8 inch crown and 1 1/8 inch sheathing and 1 1/2 inch length for 25/32 inch sheathing.
  j Nails shall be placed not less than 3/8 inch in from the panel edge, nor more than 12 inches apart along intermediate supports and 6 inches along panel edge bearings, and shall be firmly driven into the framing members.
### TABLE NO. 25-B
**ALLOWABLE SPANS FOR LUMBER FLOOR AND ROOF SHEATHING**

<table>
<thead>
<tr>
<th>Span (inches)</th>
<th>Minimum Net Thickness (inches) of Lumber Placed</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Perpendicular to Supports</td>
<td>Diagonally to Supports</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suraced Dry</td>
<td>Surface Unseasoned</td>
<td>Suraced Dry</td>
</tr>
<tr>
<td></td>
<td>Floors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>3/4</td>
<td>25/32</td>
<td>3/4</td>
</tr>
<tr>
<td>16</td>
<td>5/8</td>
<td>11/16</td>
<td>5/8</td>
</tr>
<tr>
<td></td>
<td>Roofs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>5/8</td>
<td>11/16</td>
<td>3/4</td>
</tr>
</tbody>
</table>

Installation details shall conform to Section 2515 (e) 1 and 2515 (g) 7 for floor and roof sheathing respectively.
Maximum 19 percent moisture content.

### SHEATHING LUMBER SHALL MEET THE FOLLOWING MINIMUM REQUIREMENTS:

<table>
<thead>
<tr>
<th>Board Grade</th>
<th>Solid Floor or Roof Sheathing</th>
<th>Spaced Roof Sheathing</th>
<th>Grading Rules Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
<td></td>
<td>Standard</td>
<td>NLGA, WCLIB, WWPA</td>
</tr>
<tr>
<td>4 Common</td>
<td></td>
<td>3 Common, or Standard</td>
<td>NLGA, WCLIB, WWPA</td>
</tr>
<tr>
<td>Utility</td>
<td></td>
<td>Standard</td>
<td>NHPMA, NELMA, SPIB</td>
</tr>
<tr>
<td>No. 3</td>
<td></td>
<td>No. 2</td>
<td>RIS</td>
</tr>
<tr>
<td>Merchantable</td>
<td></td>
<td>Construction Common</td>
<td></td>
</tr>
</tbody>
</table>

08/87

25-23
Table No. 25-C-1

Allowable Spans for Plywood Subfloor and Roof Sheathing Continuous Over Two or More Spans and Face Grain Perpendicular to Supports.

<table>
<thead>
<tr>
<th>Panel Identification</th>
<th>Plywood Thickness (inch)</th>
<th>Maximum Span (In Inches)</th>
<th>Load (in lbs. per sq. ft.)</th>
<th>Floor Maximum Span (In inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Edges Blocked</td>
<td>Edges Unblocked</td>
<td>Total Load</td>
</tr>
<tr>
<td>.12/0</td>
<td>5/16</td>
<td>12</td>
<td>12</td>
<td>155</td>
</tr>
<tr>
<td>16/0</td>
<td>5/16,3/8</td>
<td>16</td>
<td>20</td>
<td>95</td>
</tr>
<tr>
<td>20/0</td>
<td>5/16,3/8</td>
<td>20</td>
<td>24</td>
<td>75</td>
</tr>
<tr>
<td>24/0</td>
<td>3/8</td>
<td>24</td>
<td>24</td>
<td>65</td>
</tr>
<tr>
<td>24/0</td>
<td>1/2</td>
<td>24</td>
<td>24</td>
<td>65</td>
</tr>
<tr>
<td>30/12</td>
<td>5/8</td>
<td>30</td>
<td>26</td>
<td>70</td>
</tr>
<tr>
<td>32/16</td>
<td>1/2,5/8</td>
<td>32</td>
<td>28</td>
<td>55</td>
</tr>
<tr>
<td>36/16</td>
<td>3/4</td>
<td>36</td>
<td>30</td>
<td>55</td>
</tr>
<tr>
<td>42/20</td>
<td>5/8,3/4,7/8</td>
<td>42</td>
<td>32</td>
<td>40 6</td>
</tr>
<tr>
<td>48/24</td>
<td>3/4,7/8</td>
<td>48</td>
<td>36</td>
<td>40 6</td>
</tr>
</tbody>
</table>

1These values apply for C.C.C.D. Structural I and II grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.

2Uniform load deflection limitations: 1/80th of the span under live load plus dead load, 1/240th under live load only. Edges may be blocked with lumber or other approved type of edge support.

3Identification index appears on all panels in the construction grades listed in Footnote No. 1.

4Plywood edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless 1/4 inch thickness underlayment is installed, or finish floor is 25/32 inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 165 pounds per square foot.

5May be 16 inch if 25/32 inch wood strip flooring is installed at right angles to joists.

6For roof live load of 40 pounds per square foot or total load of 55 pounds per square foot, decrease spans by 13 percent or use panel with next greater identification index.

7May be 24 inch if 25/32 inch wood strip flooring is installed at right angles to joists.

8May be 24 inches where a minimum of 1-1/2 inches of approved cellular or lightweight concrete is placed over the subfloor and the plywood sheathing is manufactured with exterior glue.

(Rev. 8/86 Ord. No. 517)
Table No. 25-C-2

Allowable Loads for Plywood Roof Sheathing Continuous Over Two or More Spans and Face Grain Parallel to Supports

<table>
<thead>
<tr>
<th>Thickness</th>
<th>No. of Piles</th>
<th>Span</th>
<th>Total Load</th>
<th>Live Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>4</td>
<td>24</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>1/2</td>
<td>5</td>
<td>24</td>
<td>55</td>
<td>40</td>
</tr>
<tr>
<td>Other grades covered in PS 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>5</td>
<td>24</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>5/8</td>
<td>4</td>
<td>24</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>5/8</td>
<td>5</td>
<td>24</td>
<td>60</td>
<td>45</td>
</tr>
</tbody>
</table>

1 Uniform load deflection limitations: 1/180 of span under live load plus dead load, 1/240 under live load only. Edges shall be blocked with lumber or other approved type of edge supports.

Table 25-C-3

Allowable span for Plywood Combination Subfloor-Underlayment
Plywood Continuous over Two or More Spans and Face Grain Perpendicular to Supports

<table>
<thead>
<tr>
<th>Species Groups</th>
<th>Maximum Spacing of Joists</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16”</td>
</tr>
<tr>
<td>1</td>
<td>1/2”</td>
</tr>
<tr>
<td>2, 3</td>
<td>5/8”</td>
</tr>
<tr>
<td>4</td>
<td>3/4”</td>
</tr>
</tbody>
</table>

1 Applicable to Underlayment Grade, C-C (plugged) and all grades of sanded Exterior-type plywood. Spans limited to values shown because of possible effect of concentrated loads. Allowable uniform load based on deflection of 1/360 of span is 125 pounds per square foot. plywood edges shall have approved tongue and groove joints or shall be supported with blocking, unless 1/4 inch minimum thickness underlayment is installed, or finish floor is 25/32 inch wood strip. If wood strips are perpendicular to supports, thicknesses shown for 16 and 20 inch spans may be used on 24 inch span. Except for 1/2 inch, Underlayment Grade and C-C (plugged) panels may be of nominal thicknesses 1/32 inch thinner than the nominal thicknesses shown when marked with the reduced thickness.

2 See PS 1 for plywood species groups.
### TABLE NO. 25-D
ALLOWABLE SHEARS FOR WIND OR SEISMIC LOADING ON VERTICAL DIAPHRAGMS OF FIBERBOARD SHEATHING BOARD CONSTRUCTION FOR TYPE V CONSTRUCTION ONLY

<table>
<thead>
<tr>
<th>Size and Application</th>
<th>Nail Size</th>
<th>Shear value 3 inch Nail Spacing Around Perimeter and 6 inch At Intermediate Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/16&quot; x 4' x 8&quot;</td>
<td>No. 11 ga. gal. roofing nail 1 1/2&quot; long, 7/16 head</td>
<td>125b</td>
</tr>
<tr>
<td>25/32&quot; x 4' x 8&quot;</td>
<td>No. 11 ga. gal. roofing nail 1 3/4&quot; long, 7/16 head</td>
<td>175</td>
</tr>
</tbody>
</table>

* Fiberboard sheathing diaphragms shall not be used to brace concrete or masonry walls.
* The shear value may be 175 for 1/2 inch x 4 foot x 8 foot fiberboard nailbase sheathing.
* Fiberboard sheathing diaphragms shall be applied vertically to wood studs not less than 2 inch nominal in thickness spaced 16" on centers.

### TABLE NO. 25-E
ALLOWABLE UNIT STRESSES FOR ROUND TIMBER POLES AND PILES (In p.s.i. and for Normal Duration of Load)

<table>
<thead>
<tr>
<th>Species</th>
<th>Extreme Fiber In Bending(L/D=11) or Less</th>
<th>Compression Parallel to Grain</th>
<th>Compression Perpendicular to Grain</th>
<th>Horizontal Shear</th>
<th>Average Modulus of Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Pine</td>
<td>2400</td>
<td>1200</td>
<td>250</td>
<td>115</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Douglas Fir (Coast)</td>
<td>2450</td>
<td>1250</td>
<td>230</td>
<td>115</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Western Larch</td>
<td>2450</td>
<td>1250</td>
<td>230</td>
<td>115</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Red Oak</td>
<td>2450</td>
<td>1100</td>
<td>350</td>
<td>135</td>
<td>1,250,000</td>
</tr>
<tr>
<td>Ponderosa Pine</td>
<td>1200</td>
<td>830</td>
<td>100</td>
<td>80</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Lodgepole Pine</td>
<td>1200</td>
<td>800</td>
<td>155</td>
<td>85</td>
<td>1,280,000</td>
</tr>
<tr>
<td>Red (Norway) Pine</td>
<td>1900</td>
<td>900</td>
<td>100</td>
<td>85</td>
<td>1,280,000</td>
</tr>
</tbody>
</table>

* Extreme fiber in bending values include 18 percent increase allowed for round shape.

### TABLE NO. 25-F
WOOD SHINGLE AND SHAKE SIDEWALL EXPOSURES

<table>
<thead>
<tr>
<th>Shingle or Shake</th>
<th>MAXIMUM WEATHER EXPOSURES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single-Coursing</td>
</tr>
<tr>
<td></td>
<td>No. 1</td>
</tr>
<tr>
<td>16-inch Shingles</td>
<td>7 1/2&quot;</td>
</tr>
<tr>
<td>18-inch Shingles</td>
<td>8 1/2&quot;</td>
</tr>
<tr>
<td>24&quot;-inch Shingles</td>
<td>11 1/2&quot;</td>
</tr>
<tr>
<td>18-inch Resawn Shakes</td>
<td>8 1/2&quot;</td>
</tr>
<tr>
<td>18-inch Straight Split Shakes</td>
<td>8 1/2&quot;</td>
</tr>
<tr>
<td>24-inch Resawn Shakes</td>
<td>11 1/2&quot;</td>
</tr>
</tbody>
</table>
CHAPTER 26
CONCRETE

SECTION 2601. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this
Chapter shall govern the design and construction of reinforced con-
crete or composite structural concrete elements of any building or
structure. This Chapter shall govern in all matters pertaining to design
and construction whenever it is in conflict with the requirements of
other Chapters of the Building Code.
(b) Design and Construction. Design and Construction shall conform to
the requirements of this Chapter and ACI-318 including all revisions
through the 1975 Supplements. The provisions of Chapter 1 and Appen-
dix A of ACI-318 shall be excluded. See Standards.
(c) Special Structures. For special structures such as arches, chimneys,
tanks, reservoirs, grain elevators, shells, domes, and blast-resistant
structures, the provisions of this Chapter shall govern wherever ap-
licable.

SECTION 2602. COLD WEATHER REQUIREMENTS. When the am-
bient temperature falls below 40 degrees Farenheit, adequate equipment
shall be provided for heating the concrete materials and protecting the con-
crete. All concrete materials and all reinforcement, forms, fillers, and ground
with which the concrete is to come in contact shall be free from frost. No
frozen material or materials containing ice shall be used. See “Recommended
Practice for Cold Weather Concreting”. ACI-306.

SECTION 2603. HOT WEATHER REQUIREMENTS. When the am-
bient temperature reaches or exceeds 90 degrees Farenheit, proper attention
shall be given to ingredients, production methods, handling, placing, protec-
tion, and curing to prevent excessive concrete temperatures or water
evaporation which will impair the required strength or serviceability of the
member or structure. See “Recommended Practice for Hot Weather Concre-
ing”. ACI-305.

SECTION 2604. APPROVAL OF SPECIAL SYSTEMS OF DESIGN OR
CONSTRUCTION. See Chapter 1, Alternate Methods and Materials.

SECTION 2605. STRENGTH EVALUATION OF EXISTING
STRUCTURES.
(a) Analysis. If doubt develops concerning the safety of a concrete struc-
ture or member, the Department may order a structural strength in-
vestigation by analysis or by means of load tests.
(b) Load Tests. Load tests shall be conducted in accordance with ACI 318, Chapter 20, "Strength Evaluation of Existing Structures."

SECTION 2606. SEISMIC DESIGN. Space frames designed for continuity may be deemed as ductile moment-resisting if design consideration is given to the column and girder shears produced by seismic loads acting in combination with any other loads as specified in Chapter 23.

SECTION 2607. ACCEPTABLE CRITERIA FOR WALL PANELS.
(a) General.
1. The design provisions of ACI 318 shall be followed in conjunction with these criteria, including symbols noted herein. Where conflicts arise, these criteria shall govern.
2. All members subjected to a compression load shall be designed for the eccentricity, e, corresponding to the maximum moment which can accompany the load, but not less than 1.0 inch or 0.10 h, whichever is larger.
3. Prestressed wall panels shall be designed for behavior under service loads and for strength under design loads.
4. Nonprestressed, precast wall panels shall be designed either by strength design or by the alternate design method outlined in Section 2607 (c).
5. Minimum thickness shall be determined by:

\[ k \ell_{u}/h \leq 50 \left( \frac{3E_{c}}{4080} \right) \]  
where \( E_{c} \) is in ksi.

In computing the ratio \( k \ell_{u}/h \) for sections other than solid rectangular panels, an equivalent thickness, \( xx \), shall be substituted for \( h \) where:

\[ h_{e} = \frac{3}{12} (I_{g}/b) \]

For single spans, the effective length factor, \( k \), shall be assumed as follows:
- \( k = 1.0 \) for pinned ends, braced against sidesway
- \( k = 0.85 \) for partially fixed ends, braced against sidesway
- \( k = 2.0 \) for cantilevered condition

For other conditions, refer to ACI Commentary (318) Section 10.11.3.

(b) STRENGTH DESIGN.
1. Strength design shall consider the moment magnification effects, and the analysis shall be based on accepted principles of mechanics. In addition to the assumptions of Section 10.2 of the ACI Code (318), the following assumptions shall be used:
   A. The stress-strain curves for steel and concrete display nonlinear characteristics.
   B. Cracking occurs in concrete wherever concrete tension exceeds \( 7.5 \sqrt{F_{c}} \)
C. Failure is assumed to occur whenever concrete strain in compression, exclusive of creep and shrinkage strains, reaches 0.003 or whenever the load reaches its maximum on the load-deflection curve.

D. Additional deflections due to creep shall be considered.

2. The load factors and capacity reduction factors shall be in accord with Sections 9.3 of the ACI Code (318), with the following addition:

A. When only wind load is acting, the required strength shall be at least \( U = 1.4 \) \( W \).

(c) Alternate Design Method.

1. Nonprestressed wall panels shall be designed in accord with Section 8.10.2, ACI Code (318).

2. The minimum equivalent thickness requirements of Section 2607 (a) 5, and the deflection requirements of Section 2607 (e) 4, shall not be exceeded.

(d) Concrete Stresses at Service Load.

1. For prestressed concrete wall panels, the concrete stresses at service loads, after all losses, shall not exceed the following:

A. Compression under full dead + live load \( \ldots 0.45 f'_c \)

B. Compression under critical combination of all loads, including lateral loads due to either wind or earthquake \( 1.33 (0.45 f'_c) \)

C. Tension under critical combination of all loads, including lateral loads \( \ldots 12 \sqrt{f'_c} \)

D. Tension under all sustained loads \( \ldots 3 \sqrt{f'_c} \)

(e) Control of Deflections.

1. Whenever tension in the concrete does not exceed \( 7.5 \sqrt{f'_c} \), the deflection calculation may be based on the uncracked gross section. For tensions greater than \( 7.5 \sqrt{f'_c} \), the effect of cracking of the section shall be considered in computing the stiffness.

2. To account for inelastic effects under sustained loads, the additional time-dependent deflections shall be assumed equal to 1.75 times the initial deflection due to the sustained load.

3. Except for cantilevered members, maximum deflection may be assumed anywhere in the middle fifth of the span.

4. Deflections shall be limited as follows:

   Maximum deflection under full service loads, including lateral loads.

   A. if attaching elements are not likely to be damaged by large deflections \( \ldots \frac{L_u}{180} \)

   B. if attached elements are likely to be damaged by large deflections \( \ldots \frac{L_u}{360} \)
(f) Notations.

\[ b = \text{Width of Section} \]
\[ e = \text{Eccentricity of design load parallel to axis measured from the centroid of the section.} \]
\[ E_C = \text{Modulus of elasticity of concrete (ksi).} \]
\[ f'_C = \text{Specified compressive strength of concrete (psi).} \]
\[ h = \text{Overall thickness of member.} \]
\[ h_e = \text{Equivalent thickness of member.} \]
\[ I_g = \text{Moment of inertia of gross concrete section about the centroidal axis neglecting the reinforcement.} \]
\[ k = \text{Effective length factor for compression members.} \]
\[ L_u = \text{Unsupported length of compression member.} \]
\[ U = \text{Required Strength to resist design loads or their related internal moments and forces.} \]
\[ W = \text{Wind load or its related internal moment and forces.} \]

SECTION 2608. STANDARDS. Unless provided for in other portions of this Building Code, the ACI-301-72 (Chapter 1), and ACI-318, 1971 (Chapter 3), the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe, A648-73.</td>
</tr>
<tr>
<td></td>
<td>Test for Organic Impurities in Sands for Concrete, C40-73.</td>
</tr>
<tr>
<td></td>
<td>Test for Sieve or Screen Analysis of Fine and Coarse Aggregates, C136-71.</td>
</tr>
<tr>
<td></td>
<td>Test for Slump of Portland Cement Concrete, C143-71.</td>
</tr>
<tr>
<td></td>
<td>Specification for Air-Entraining Admixtures for Concrete, C260-73.</td>
</tr>
<tr>
<td>ACI</td>
<td>Specifications for Structural Concrete for Buildings, ACI 301-72 (Revised 1973)</td>
</tr>
<tr>
<td>CPMB</td>
<td>Concrete Plant Mixer Standards of the Plant Mixer Manufacturer Division, 1970.</td>
</tr>
<tr>
<td>CRSI</td>
<td>CRSI Recommended Practice for Placing Reinforcing Bars, 1975.</td>
</tr>
<tr>
<td>Organization</td>
<td>Address</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>NRMCA</td>
<td>Check list for Certification of Ready Mixed Concrete Production Facilities, 1976.</td>
</tr>
<tr>
<td><strong>LEGEND</strong></td>
<td><strong>ORGANIZATION</strong></td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td></td>
<td>1916 Race Street</td>
</tr>
<tr>
<td></td>
<td>Philadelphia, Pa. 19103</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td></td>
<td>P.O. Box 4754, Redford Station</td>
</tr>
<tr>
<td></td>
<td>Detroit, Michigan</td>
</tr>
<tr>
<td>AWS</td>
<td>American Welding Society, Inc.</td>
</tr>
<tr>
<td></td>
<td>2501 N.W. 7th Street</td>
</tr>
<tr>
<td></td>
<td>Miami, Florida 33125</td>
</tr>
<tr>
<td>CPMB</td>
<td>Concrete Plant Manufacturers Bureau</td>
</tr>
<tr>
<td></td>
<td>900 Spring Street</td>
</tr>
<tr>
<td></td>
<td>Silver Spring, Maryland 20910</td>
</tr>
<tr>
<td>CRSI</td>
<td>Concrete Reinforcing Steel Institute</td>
</tr>
<tr>
<td></td>
<td>228 North LaSalle Street</td>
</tr>
<tr>
<td></td>
<td>Chicago, Ill. 60601</td>
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<tr>
<td>NRMCA</td>
<td>National Ready Mixed Concrete Assn.</td>
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<td>Silver Spring, Maryland 20910</td>
</tr>
</tbody>
</table>
CHAPTER 27

STEEL AND IRON

SECTION 2701. SCOPE. In addition to the other provisions of this Building Code, this Chapter shall govern the design, fabrication, and erection of structural steel, open web steel joists, and cold formed steel for buildings, structures and utilities.

SECTION 2702. MATERIAL.
(a) Structural Steel. Structural steel shall conform to one or more of the following specifications.

1. Structural Steel - ASTM A36.
2. Welded and Seamless Steel Pipe - ASTM A53, Grade B.
4. Flat-Rolled Carbon Steel Sheet of Structural Quality - ASTM A570-A611 (For Cold Formed Steel Only).
5. High-Strength Low-Alloy Structural Manganese-Vanadium Steel ASTM A441.
6. Zinc-Coated Steel Sheets of Structural Quality, Coils, and Cut-Lengths ASTM A446 (For Cold Formed Steel Only.)
7. Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes - ASTM A500.
8. Hot-Formed Welded and Seamless Carbon Steel Structural Tubing - ASTM A501.
10. Structural Steel with 42,000 psi Minimum Yield Point - ASTM A529.
11. Hot-Rolled Carbon Steel Sheets and Strip, Structural Quality - ASTM A570, Grades D and E.
13. High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 Inch Thick - ASTM A588.
15. High-Strength Low-Alloy Cold-Rolled Steel Sheets and Strip - ASTM A606.
16. Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy, Columbium and/or Vanadium - ASTM A607.
17. Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing - ASTM A618.
18. Certified Mill test reports shall constitute evidence of conformity with the specifications designated in this Section.
19. Unidentified steel may be used where the precise physical properties of the steel and/or its weldability would not affect the strength of the structure.

(b) Other Metals.
1. Cast steel shall conform to one or more of the following specifications.
   A. Mild-to-Medium Strength Carbon-Steel Castings for General Application - ASTM A272, Grade 65-35.
   B. High-Strength Steel Castings for Structural Purposes - ASTM A148, Grade 80-50.
2. Steel forgings shall conform to one or more of the following specifications.
   A. Carbon Steel Forgings for General Industrial Use, ASTM A235, Class C1, F and G. (Class C1 Forgings that are to be welded shall be ordered in accordance with Supplemental Requirements S5 of ASTM - A235.)
   B. Alloy Steel Forgings for General Industrial Use ASTM A237, Class A.
3. Certified test reports shall constitute evidence of conformity with the Specifications designated in this Section.

(c) Rivets. Rivets shall conform to the provisions of the Specifications for Structural Rivets - ASTM A502, Grade 1 or 2.
1. Manufacturer's certification shall constitute evidence of conformity with the specifications designated in this Section.

(d) Bolts. High strength steel bolts shall conform to one or more of the following specifications.
1. High Strength Bolts for Structural Steel Joints, Including Suitable Nuts and Plain Hardened Washers - ASTM A325.
2. Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints - ASTM A490.
4. Manufacturer's certification shall constitute evidence of conformity with the specifications designated in this Section.

(e) Filler Metal for Welding.
2. Bare electrodes and granular flux used in the submerged-arc process shall conform to F60 and F70 AWS-flux classifications of the Specifications for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding - AWS A5.17.

3. E60S or E70S electrodes used in gas metal-arc process shall conform to the Specification for Mild Steel Electrodes for Gas Metal-Arc Welding - AWS A5.18.

4. E60T or E70T electrodes used in Flux-Cored-Arc process shall conform to the Specification for Mild Steel Electrodes for Flux-Cored-Arc Welding - AWS A5.20.

5. Manufacturer’s certification shall constitute evidence of conformity with the specifications designated in this Section.

(f) Used Steel. Used steel shall be permitted provided proper allowance is made for any reduction in section by corrosion, holes or other defects, and provided that the stresses used for an unidentified used steel do not exceed 73 percent of the stresses permitted by this Building Code for ASTM A36 steel. Unidentified used steel shall not be permitted in plastically designed structures. Allowable stresses for an identified used steel shall be that permitted for existing structures. See Section 2703(a)1.

SECTION 2703. SPECIFICATIONS FOR DESIGN, FABRICATION AND ERECTION. Unless specified elsewhere in this Building Code, the following specifications shall apply.

(a) Structural Steel. The materials, design, fabrication, application, handling and erection of structural steel shall conform to the American Institute of Steel Construction (AISC) Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.

1. Existing Structures. The permissible maximum stresses permitted by this Building Code for analyzing or reinforcing existing structures shall be a percentage of the stresses specified for ASTM A36 steel. The applicable percentage shall be governed by the year in which the structure was erected, in accordance with the following:

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to 1923</td>
<td>73 percent</td>
</tr>
<tr>
<td>1923 through 1935</td>
<td>82 percent</td>
</tr>
<tr>
<td>1936 through 1959</td>
<td>91 percent</td>
</tr>
<tr>
<td>1960 or thereafter</td>
<td>100 percent</td>
</tr>
</tbody>
</table>

unless it can be indicated that steel stronger than ASTM A36 was used in all or part of the structure.

The above percentages are conservative for columns and struts. It is permissible, therefore to use the applicable AISC Specifications and/or load tables for those eras prior to 1960 in analyzing columns and struts.
(b) **Open Web Steel Joists.** The materials, design, fabrication, application, handling, and erection of open web steel joists shall conform to the Steel Joist Institute (SJI) Specifications and Load Tables for Open Web Steel Joists, Longspan Steel Joists, and Deep Longspan Joists.

(c) **Cold Formed Steel.** The materials, design, fabrication, application, handling, and erection of cold formed steel shall conform to the American Iron and Steel Institute (AISI) Specifications for the design of Cold-Formed Steel Structural Members.

(d) **Cable Structures.** The materials, design, fabrication, application, handling, and erection of steel cables shall conform to the AISI Criteria for Structural Application of Steel Cables for Buildings, 1973 Edition.

(e) **Stainless Steel.** The materials, design, fabrication, application, handling, and erection of stainless steel structural members shall conform to the AISI Specification for the Design of Cold Formed Stainless Steel Structural Members, 1974 Edition.

**SECTION 2704. APPROVAL OF SPECIAL SYSTEMS OF DESIGN OR CONSTRUCTION.**

(a) **General.** Sponsors of any system of design or construction within the scope of this Chapter, the adequacy of which has been proven by analysis or test, and the design of which is either not consistent with, or not provided for by this Building Code, shall have the right to present data on which their design is based to the Department for approval or disapproval.

**SECTION 2705. LOAD TESTS OF STRUCTURES.**

(a) **General.** The Department may order a load test of any portion or all of a structure when there is doubt about its safety. A qualified Colorado Registered Professional Engineer, acceptable to the Department, shall supervise such tests. If the tests indicate evident failure of any part of the structure, the changes required to prove the structure adequate for its rated capacity shall be made, or a lower rating shall be provided.

**SECTION 2706. STANDARDS.** Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI</td>
<td>Specification for the Design of Cold-Formed Steel Structural Members, 1968.</td>
</tr>
</tbody>
</table>
ASTM
General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use. A6-73.
Structural Steel - A36-74.
Specification for Welded and Seamless Steel Pipe - A53-73.
High Strength Steel Castings for Structural Purpose - A148-73.
High Strength Low-Alloy Structural Steel A242-70a.
High Strength Low-Alloy Columbium - Vanadium Steels of Structural Quality A572-74a.
High Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 Inches Thick - A588-71.
Sheet Steel and Strip, Hot-Rolled and Cold-Rolled High Strength, Low-Alloy, with Improved Corrosion Resistance - A606-71.
High Strength Low-Alloy Cold-Rolled Steel Sheets and Strip - A606-71 and A607-70.
Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High Strength, Low-Alloy, Columbium and/or Vanadium - A607-70.
Specs for Steel, Cold-Rolled Sheet, Carbon Structural, A611-72.
Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing - A618-74.

AWS
Structural Welding Code - D1.1-74.
Mild Steel Covered Arc Welding Electrodes - A5.1-69.
Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding - A5.17-69.
Mild Steel electrodes for Gas Metal Arc Welding - A5.18-69.
Mild Steel Electrodes for Flux-Cored Arc Welding - A5.20-69.

SJI
LEGEND

AISC  American Institute of Steel Construction
      400 N. Michigan Avenue
      Chicago, Ill. 60611

AISI  American Iron and Steel Institute
      1000-16th St., N.W.
      Washington, D.C. 20036

ASTM American Society for Testing and Materials
        1916 Race Street
        Philadelphia, Pa. 19103

AWS  American Welding Society, Inc.
     2501 N. 7th Street
     Miami, Florida 33125

SJI  Steel Joist Institute
     1703 Parham Road, Suite 204
     Richmond, Va. 23229
CHAPTER 28
ALUMINUM

SECTION 2801. ALUMINUM.
(a) General. The quality, design, fabrication, and erection of aluminum used in buildings and structures shall conform to the requirements of Section 1 - Specifications for Aluminum Structures, as published by the Aluminum Association (S.A.S.-1).
(b) Alloys. The use of aluminum alloys and tempers other than those covered by specifications for aluminum structures shall be permitted for structural members and assemblies, provided standards of performance at least equal to those required by specification for aluminum structures are used and are substantiated to the satisfaction of the Department. Certification by the fabricator that the alloys and tempers specified on the drawings and specifications shall be provided to the Department.
(c) Identification. Aluminum for structural elements shall be handled in the fabricator's plant so the separate alloys and tempers are positively identified. Identification markings shall be affixed to structural members, prior to shipment.

SECTION 2802. ALLOWABLE STRESSES FOR MEMBERS AND FASTENERS.
(a) Allowable Unit Stresses. Allowable unit stresses in aluminum alloy structural members shall be determined in accordance with the formulas of Section 1 - Specifications for Aluminum Structures (S.A.S.-1). All safety factors shall be utilized. When 2 formulas are given, the formula resulting in the lower stresses shall be used.
(b) Welded Structural Members. The unit stresses shall be those specified in S.A.S.-1.
(c) Bolts and Rivets.
1. The unit stresses for Aluminum Alloy fasteners shall be those specified in S.A.S.-1.
2. The unit stresses for aluminized, galvanized, or double cadmium plated steel fasteners shall be 20,000 pounds per square inch in tension on the threaded root area of cross section; 10,000 pounds per square inch in shear, and shall be those stresses specified in S.A.S.-1 for bearing on aluminum alloy.
3. The unit stresses for stainless steel (300 series) fasteners shall be 32,000 pounds per square inch in tension on the threaded root area of the cross section; 19,000 pounds per square inch in shear, and shall be those stresses specified in S.A.S.-1 for bearing on aluminum alloy.
SECTION 2803. FABRICATION AND ERECTION.
(a) Fasteners. Bolts and other fasteners shall be aluminum, stainless steel (300 series) or aluminized steel, hot-dip galvanized or electrogalvanized steel, or double-cadmium plated AN steel bolts, conforming to Section 2802 (a).
(b) Dissimilar Materials. Where the aluminum alloy parts are in contact with dissimilar materials they shall be installed in accordance with S.A.S.-1.
(c) Painting. Painting or coating of aluminum alloy parts shall be in accordance with S.A.S.-1.
(d) Welding. Aluminum parts shall be welded with an inert gas shielded arc or resistance welding process. No welding process requiring a a welding flux shall be used. Filler alloys shall comply with the requirements of S.A.S.-1.
(e) Welder Qualification. All welds of structural members shall be performed by welders qualified in accordance with the procedures of the American Welding Society.
(f) Attachment. Methods of joining aluminum parts other than specified herein shall be submitted to the Department for their review and approval.
(g) Erection. During erection, structural aluminum shall be braced and fastened to resist dead wind and erection loads.

SECTION 2804. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

**ORGANIZATION**

**TITLE OF PUBLICATION**


**LEGEND**

**ORGANIZATION**

A.A. The Aluminum Association
750 Third Avenue
New York, N.Y. 10017

A.W.S. The American Welding Society, Inc.
2501 N.W. 7th Street
Miami, Florida 33125
CHAPTER 29
EXCAVATIONS, FOUNDATIONS AND RETAINING WALLS

SECTION 2901. SCOPE.
(a) General. In addition to the other requirements of this Building Code, this Chapter shall govern the construction of excavations, foundations, and retaining walls.
(b) Structural Design. All foundations shall be designed in accordance with accepted engineering practice by an Engineer or as approved by the Department.
(c) Quality and Design. The quality and design of materials used structurally in excavations and foundations shall conform to the requirements set forth in Chapters 23, 24, 25, 26, 27 and 28 of this Building Code.

SECTION 2902. EXCAVATIONS.
(a) General. Excavations for buildings and excavations accessory thereto shall be protected and guarded against danger to life and property, and shall be made in accordance with the requirements set forth in this Chapter. Excavations shall be retained by supports designed to retain the adjacent soils together with any surcharge loads.
1. All excavations shall be protected so that the adjoining property will not cave or settle. The person or persons making or causing the excavation to be made shall give notice, in writing at least 10 days before the excavation is started, to the owners of adjoining properties, advising them that the excavation is to be made. A copy of the notice will be submitted to the Department.
(b) Footings. Whenever an excavation for footings is carried below the planned depth, the space excavated below the proposed footing shall be filled solidly with concrete or structural fill as defined in Section 2905, or the footing shall be extended to adequate bearing.
(c) Trench Excavations. All vertical walled trenches more than 5 feet deep shall be furnished with minimum protection of 2" x 10" uprights held tightly against the banks with trench jacks or cross braces.
1. The horizontal spacing of pairs of uprights shall not exceed 10 feet and the vertical spacing of pairs of uprights shall not exceed 10 feet and the vertical spacing of trench jacks or cross braces shall not exceed 5 feet.
2. The Department may determine that a shoring or support system is inadequate and may require additional shoring and/or sheeting.
3. A trench shoring system designed by an Engineer to meet the loading and soil requirements for a particular job, when approved by the Department shall constitute an adequate support system.

4. Trench shoring as above specified may be omitted after investigation and written justification by a registered professional engineer and approval by the Department in the following circumstances.
   A. Trenches in sound rock formations.
   B. Trenches in which approved mobile shoring is provided so that workmen in the trench are at all times protected from caving.

5. Failure to comply with the minimum requirements of this Section shall be an unlawful act subject to penalty in accord with Section 112 of the Building Code.

(d) Inspection. Provisions shall be made to permit for inspection of footings, excavations and foundations.

SECTION 2903. FOUNDATIONS.

(a) General. Every structure shall be supported by a foundation designed to accommodate the bearing material and maximum allowable soil pressures as defined in Table 29-C. Foundations and foundation walls shall be designed to withstand all vertical and horizontal loads. The minimum foundation requirements for all types of buildings, as specified in this Chapter may be waived when designed by an Engineer. The Department may approve such deviations only after receiving a written opinion from this engineer together with substantiating evidence of acceptable laboratory and field investigation of the soils involved.

1. Every superstructure shall be anchored to the foundation to resist all superimposed loads.

2. Except for the special provisions of Section 2907 covering the design of cast-in-place piers, and Section 2908 covering the design of piles, all portions of footings shall be designed in accordance with this Building Code and shall be designed to minimize differential settlement.

3. Foundations shall not be placed on frozen soil, and shall not be placed in freezing weather unless the foundations and adjacent soil areas are protected against freezing.

4. One story buildings of Type IV and V construction which do not exceed 200 square feet in area may be constructed without a masonry or concrete foundation if the walls are supported on wood mudsills. The structure shall be anchored to prevent uplift or overturning.

EXCEPTION: Group I Occupancies, as approved by the Department.
(b) **Different Levels.** Where foundations are supported at different levels or at different levels from foundations of adjacent structures, the effect of such differences in foundation levels shall be included in the design.

(c) **Materials and Construction.** Footings and foundations, unless otherwise specifically provided, shall be constructed of masonry, concrete or treated wood in conformance with National Forest Products Association Technical Report No. 7. Foundation walls of concrete or masonry shall be as specified in Chapters 24 and 26, and shall be designed in accordance with the provisions or this Chapter. (Revised 5/82 Ordinance No. 245)

(d) **Depth.** Exterior foundations, footings, and grade beams of permanent structures, except when founded on rock, shall be placed not less than 3 feet below the finished grade. 
**EXCEPTION:** Buildings housing a Group J Occupancy may be placed on a minimum 4 inch reinforced concrete slab, with thickened edges. The bottom of the thickened edges shall extend at least 12 inches below the final exterior finished grade.

(e) **Height Above Ground.** Foundation walls supporting wood members directly above shall extend at least 6 inches above the finished grade.

(f) **Dampproofing.**
1. All foundation walls enclosing a basement or crawl space below finished grade shall be dampproofed outside by the application of approved dampproofing material.
2. When masonry units are used in foundation walls below grade, the exterior surfaces shall be plastered with at least 1/4 inch cement plaster before the application of dampproofing.

(g) **Ventilation.** The space between the bottom of floor joists or slab and the ground under the building (except the space as may be occupied by a basement or cellar) shall be provided with ventilation openings through foundation walls or exterior walls to insure ventilation of the crawl space area. The openings shall be covered with a corrosion-resistant wire mesh not greater than 1/2 inch nor less than 1/4 inch in any dimension. The minimum total area of ventilating openings shall be proportioned on the basis of 1/2 square foot for each 25 lineal feet of exterior wall. Openings shall be located on opposite sides of the building, and as near to the corner as practicable.

(h) **Crawl Space.** Minimum clearance between any obstruction and the ground beneath a crawl space shall be at least 18 inches. Access to a crawl space shall be at least 18 by 24 inches. See Chapter 52 for equipment access requirements.

**SECTION 2904. SOIL INVESTIGATION.**

(a) **General.** Prior to the issuance of a permit for erection or alteration of a permanent structure, the Department may require the owner to provide a soil investigation report performed by an Engineer.
(b) **Borings and Test Pits.** Borings and/or test pits shall be made at locations and depths with the materials sampled and tested, to provide a basis for determining the engineering performance characteristics of the materials underlying the site of the proposed structure.

(c) **Classification of Materials.** The classification of rock and soil shall be in accordance with generally accepted geological or engineering nomenclature.

(d) **Report.** The engineer shall prepare a report presenting the data gathered on soil, rock, and ground water conditions; the results of laboratory testing; the analysis of the data gathered; the recommendation on the best type and depth of foundations.

**SECTION 2905. FOOTINGS OR MAT FOUNDATIONS.**

(a) **General.** Footings or mat foundations shall rest upon undisturbed virgin soils or rock, or on compacted controlled structural fill.

(b) **Allowable Bearing Pressure.** The maximum pressure on soils beneath foundations shall not exceed the values set forth in Table 29-C, unless otherwise recommended by an engineer. Footings shall be placed at least one foot below the surface of virgin soil or on rock, except as otherwise specified for structural fill.

(c) **Erratic Foundation Soils.** Where portions of the foundations of a building or structure rest directly upon or underlain by soils having substantially different supporting capacities or layers of different materials which vary greatly in thickness, the magnitude and distribution of the probable settlement shall be investigated. If necessary, the allowable bearing pressures shall be reduced or special provisions be made in the design of the structure to minimize the risk of detrimental differential settlements.

(d) **Structural Fill.** Footings for buildings or structures may rest upon compacted structural fill if recommended by an engineer after a soil investigation as set forth in Section 2904. The fill shall be of approved materials placed at the moisture content and compacted to the density specified by the engineer. Placement and compaction of the structural fill shall be observed by the engineer. Footings placed on the fill shall be designed in accordance with the criteria recommended by the engineer.

(e) **Inflow of Water Into Excavation.** Whenever an inward or upward flow of water develops in an excavation in an otherwise satisfactory bearing material, special methods approved by the Department shall be immediately adopted to stop or control the flow, to prevent disturbance of the bearing material. If the flow of water seriously impairs the stability of the bearing material, the material shall be removed to adequate bearing.
SECTION 2906. LOAD TESTS. Where the bearing capacity of the soil is not definitely known or is in question, the Department may require suitable load tests or other proof of the permissible safe bearing capacity at that particular location. The load test shall be designed and supervised by an engineer.

SECTION 2907. CAST-IN-PLACE PIERS.
(a) General. The allowable axial and lateral loads on cast-in-place piers shall be determined by a foundation investigation in accordance with Section 2904.
(b) Quality. Concrete piers cast-in-place against earth in drilled or bored holes shall be made in a manner to insure the exclusion of any foreign matter, and to secure a full sized shaft. Concrete shall have an ultimate compressive strength of at least 2,500 pounds per square inch.
(c) Design. Cast-in-place piers shall be designed in accordance with accepted engineering practice by an engineer.
   1. Downdrag and Lateral Loads. Design of piers shall take into account downdrag and lateral loads where applicable.
   2. Column Action. All piers standing unbraced in air, water, or in material not capable of lateral support shall conform with the applicable column formula as specified in this Building Code. Piers drilled into firm ground may be considered laterally supported continuously.
   3. Group Action. Provision shall be made for the reduction of allowable pier load when piers are placed in groups.
   4. Static Load Test. When the allowable axial load of a single pier is determined by load test, it shall not exceed 50 percent of the yield point under test load. The yield point shall be defined as that point at which an increase in load produces a disproportionate increase in settlement. In addition, the allowable design load shall not exceed 50 percent of that load under which, during a 40-hour period of continuous load application, no additional settlement takes place.

SECTION 2908. PILES.
(a) General. The allowable axial and lateral loads on piles shall be determined by a foundation investigation made in accordance with Section 2904, by load test, or by recognized pile driving formulae.
(b) Design.
   1. Group Action. Provision shall be provided for the reduction of allowable pile load when piles are placed in groups.
   2. Static Load Tests. When the allowable axial load of a single pile is determined by load test, the test shall be designed and supervised by an engineer, and shall be in accordance with Section 2907(c)4.
3. Column Action. All piles standing unbraced in air, water, or material not capable of lateral support shall conform with the applicable column formula specified in this Building Code. Piles driven into firm ground may be considered laterally supported continuously.

4. Downdrag and Lateral Loads. Design of piles shall take into account downdrag and lateral loads where applicable.

5. Protection of Pile Materials. Where the boring records of site conditions indicate possible deleterious action on pile materials due to soil constituents, changing water levels, or other factors, the materials shall be protected by methods or processes approved by the Department. The effectiveness of the methods or processes used shall have been thoroughly established by satisfactory service records or other evidence which demonstrates the effectiveness of the protective measures.

(c) Jetting. Jetting shall not be used except where and as specifically permitted by the Department. When used, jetting shall be carried out in a manner that the carrying capacity of existing piles and structures shall not be impaired. After withdrawal of the jet, piles shall be driven down until the required resistance is obtained.

SECTION 2909. SPECIFIC PILE REQUIREMENTS.

(a) Round Wood Piles.

1. Material. Except where untreated piles are permitted, wood piles shall be pressure treated in accordance with the Standards of Chapter 25. The basic material shall conform to that of untreated piles. Untreated piles may be used only when it has been established that the cutoff will be below lowest ground water level assumed to exist during the life of the structure. Every wood pile shall conform to the specifications for Class A or Class B piles. See Section 2911.

2. Allowable Stresses. The allowable unit stresses for round wood piles shall not exceed those set forth in Chapter 25.

(b) Uneased Cast-In-Place Concrete Piles.

1. Material. Concrete piles cast-in-place against earth in drilled or bored holes shall be placed to insure the exclusion of any foreign matter and to secure a full-sized shaft. The length of the piles shall be limited to not more than 30 times the average diameter. Concrete shall have an ultimate compressive strength of at least 2,500 pounds per square inch.

2. Allowable Stress. The allowable compressive stress in the concrete shall not exceed 0.33 of the ultimate compressive strength of the concrete. The allowable stress in the reinforcing steel shall not exceed that specified for tied columns in Chapter 26.
(c) Metal-Cased Concrete Piles.

1. **Material.** All concrete used in metal-cased concrete piles shall have an ultimate compressive strength of at least 2,500 pounds per square inch.

2. **Installation.** Every metal casing for a concrete pile shall provide a sealed tip with a diameter of at least 8 inches.
   A. Concrete piles cast-in-place in metal shells shall have shells driven to their full length in contact with the surrounding soil and left permanently in place. The shells shall be designed to resist collapse and to exclude water and foreign material during the placing of concrete.
   B. Piles shall be driven in an order and spacing to insure against distortion of, or injury to, piles already in place. No pile shall be driven within four and one-half average pile diameters of a concrete-filled pile less than 24 hours old unless approved by the Department.

3. **Allowable Stresses.** Allowable stresses shall not exceed the values specified in Section 2909(b)2, except that the allowable concrete stresses may be increased to a maximum value of 0.40 of the ultimate compressive strength of concrete for that portion of the pile meeting the following conditions:
   A. The thickness of the metal casing is not less than No. 14 gauge.
   B. The casing is seamless or is provided with seams of equal strength and is of a configuration which will provide confinement to the cast-in-place concrete.
   C. The ultimate compressive strength of the concrete does not exceed 5,000 pounds per square inch and the ratio of metal yield strength to concrete ultimate strength shall be at least 6.
   D. The pile diameter is not greater than 16 inches.

(d) Precast Concrete Piles.

1. **Material.** Precast concrete piles prior to driving after pouring shall develop an ultimate compressive strength of at least 3,000 pounds per square inch.

2. **Reinforcement Ties.** The longitudinal reinforcement in driven precast concrete piles shall be laterally tied with steel ties or wire spirals. Ties and spirals shall be spaced not more than 3 inches apart, center-to-center, for a distance of 2 feet from the ends, and not more than 8 inches elsewhere. The gauge of ties and spirals shall be as follows:
   A. For piles having a diameter of 16 inches or less, wire shall be not smaller than No. 5 gauge.
   B. For piles having a diameter of more than 16 inches and less than 20 inches, wire shall be not smaller than No. 4 gauge.
   C. For piles having a diameter of 20 inches and larger, wire shall be not smaller than 1/4 inch round or No. 3 gauge.
3. **Allowable Stresses.** Precast concrete piling shall be designed to resist permanent stresses induced by handling and driving as well as by loading. The allowable stresses shall not exceed the values specified in Section 2909(b)2.

(e) **Precast Prestressed Concrete Piles (Pretensioned).**

1. **Material.** Precast prestressed concrete piles shall develop a compressive strength of not less than 4,000 pounds per square inch before driving and an ultimate compressive strength of not less than 5,000 pounds per square inch.

2. **Reinforcement.** The longitudinal reinforcement shall be high tensile wire strand conforming to the Standards of Chapter 26. Longitudinal reinforcement shall be laterally tied with steel ties or wire spirals.
   
   A. Ties or spirals reinforcement shall be spaced not more than 3 inches apart, center to center, for a distance of 2 feet from the ends, and not more than 8 inches elsewhere.

   B. At each end of the pile, the first 5 ties or spirals shall be spaced 1 inch center to center.

   C. For piles having a diameter of 24 inches or less, wire shall be not smaller than No. 5 gauge. For piles having a diameter greater than 24 inches but less than 36 inches, wire shall be not smaller than No. 4 gauge. For piles having a diameter greater than 36 inches, wire shall be not smaller than 1/4 inch round or No. 3 gauge.

3. **Allowable Stresses.** Precast prestressed piling shall be designed to resist stresses induced by handling and driving as well as by permanent loading. The effective prestress in the pile shall be not less than 400 pounds per square inch for piles up to 30 feet in length, 550 pounds per square inch for piles up to 50 feet in length, and 700 pounds per square inch for piles greater than 50 feet in length. The compressive stress in the concrete due to externally applied load shall not exceed:

\[
f_c = 0.33f_{oc} - 0.27f_{pc}
\]

WHERE:

- \(f_{pc}\) is the effective prestress stress on the gross concrete section.
- Effective prestress shall be based on an assumed loss of 30,000 pounds per square inch in the prestressing steel. The allowable stress in the prestressing steel shall not exceed the values specified in Chapter 26.

(f) **Structural Steel Piles.**

1. **Material.** Structural steel piles and fully welded steel piles fabricated from plates shall conform to the requirements of Chapter 27. No section shall have a nominal thickness of metal less than 3/8 inch.
2. Allowable Stresses. The allowable stresses shall not exceed 0.35 of the minimum specified yield strength. The yield strength shall not be assumed greater than 36,000 pounds per square inch for computation purposes.

(g) Concrete-Filled Steel Pipe Piles.
1. Material. Steel pipe piles shall conform to the requirements of Chapters 26 and 27. The concrete used in concrete-filled steel pipe piles shall have an ultimate compressive strength of not less than 2,500 pounds per square inch.
2. Allowable Stresses. The allowable stresses shall not exceed 0.35 of the minimum specified yield strength of the steel plus 0.33 of the ultimate compressive strength of the concrete, provided the yield strength of the steel shall not be assumed greater than 36,000 pounds per square inch for computation purposes.

SECTION 2910. RETAINING WALLS. Retaining walls shall be designed to resist the lateral pressure of the retained material and other applied loads in accordance with accepted engineering practice. The Department may require a soil investigation as specified in Section 2904, and a design by an engineer. Walls retaining drained earth, where sufficient movement of the wall is allowable to enable mobilization of the soil strength, may be designed for pressure equivalent to that exerted by a fluid weighing at least 30 pounds per cubic foot, and having a depth equal to that of the retained earth.

EXCEPTION: Where the elevation difference of retained earth (higher grade to lower grade) is 3 feet or less, and where the retaining wall is not part of any other structure, the depth below the lowest grade to the bottom of the footing as specified in Section 2903(d), may be reduced to 1 foot 6 inches.

SECTION 2911. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards, and those included in Chapters 25, 26, and 27 shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Sheet Piling. A328-1970.</td>
</tr>
</tbody>
</table>
LEGEND
ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

SECTION 2912. TABLES.

TABLE NO. 29-A

MINIMUM FOUNDATION REQUIREMENTS FOR TYPE III BUILDINGS

<table>
<thead>
<tr>
<th>Number of Stories</th>
<th>Depth of Foundation Below Finish Grade in Inches</th>
<th>Width of Footing in Inches*</th>
<th>Thickness of Footing in Inches</th>
<th>Thickness of Foundation Wall in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36**</td>
<td>20</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>24</td>
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<tr>
<td>3</td>
<td>36</td>
<td>24</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

NOTES: For reinforced concrete see Chapter 26.
* Does not apply in the case of expansive soils—special investigation required. See Table 29-C.
** For J occupancy, 18” minimum or thickened edge slab as approved by the Department.

TABLE NO. 29-B

MINIMUM FOUNDATION REQUIREMENTS FOR TYPES IV AND V BUILDINGS

<table>
<thead>
<tr>
<th>Number of Stories</th>
<th>Depth of Foundation Below Finish Grade in Inches</th>
<th>Width of Footing in Inches*</th>
<th>Thickness of Footing in Inches</th>
<th>Thickness of Foundation Wall in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36**</td>
<td>14</td>
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<tr>
<td>2</td>
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<td>16</td>
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<td>8</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>18</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

NOTES: For reinforced concrete see Chapter 26.
* Does not apply in the case of expansive soils—special investigation required. See Table 29-C.
** For J occupancy, 18” minimum or thickened edge slab as approved by the Department.
### TABLE NO. 29-C
### ALLOWABLE SOIL PRESSURE

<table>
<thead>
<tr>
<th>CLASS OF MATERIAL</th>
<th>MAXIMUM ALLOWABLE SOIL PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound unweathered claystone, sandstone, or siltstone</td>
<td>20,000 psf</td>
</tr>
<tr>
<td>Compact, course sand and/or gravel</td>
<td>4,000 psf</td>
</tr>
<tr>
<td>Compact, fine sand</td>
<td>3,000 psf</td>
</tr>
<tr>
<td>High density silt</td>
<td>2,000 psf</td>
</tr>
<tr>
<td>Clays, silty, or sandy clays, and weathered claystone</td>
<td>Usually expansive*</td>
</tr>
<tr>
<td>Loose sand</td>
<td>1,000 psf</td>
</tr>
<tr>
<td>Organic soils, very soft soils, muck, filled ground</td>
<td>*</td>
</tr>
</tbody>
</table>

* Special investigations required—see Section 2904. Provision shall be made for the possible effect of moisture changes on the bearing capacity of the soil.
CHAPTER 30

VENEER

SECTION 3001. SCOPE.

(a) General. All veneer (materials, design, application and maintenance) shall conform to the requirements of this Building Code.

(b) Limitations. Veneer shall not be attached to wood frame construction at a point more than 25 feet in height above the adjacent ground elevation except when approved by the Department considering special construction designed to provide for differential movement.

SECTION 3002. DEFINITIONS. For purposes of this Chapter, certain terms are defined as follows:

1. Backing. The surface or assembly to which veneer is attached.

2. Bonding Agent. An adhesive or cementing material used to adhere similar or dissimilar materials together in such a manner that the agent develops the required bond stresses.

3. Veneer. A nonstructural facing of material attached to a backing for the purpose of ornamentation, protection, or insulation.
   A. Veneer, Adhered. Veneer secured and supported through adhesion to a bonding material applied over the backing.
   B. Veneer, Anchored. A veneer secured to, and supported by, mechanical fasteners attached to the backing.
   C. Veneer, Exterior. A veneer applied to weather-exposed surfaces, as defined in Chapter 4.
   D. Veneer, Interior. A veneer applied to surfaces other than weather-exposed surfaces, as defined in Chapter 4.

SECTION 3003. Materials.

(a) General. Materials used in the application of veneer shall conform to the applicable requirements for materials as set forth elsewhere in this Building Code.
   For aluminum See Chapter 28.
   For glass See Chapter 54.
   For masonry units and mortar See Chapter 24.
   For plastics See Chapter 60.
   For Portland Cement plaster See Chapter 47.
   For precast concrete See Chapter 26.
   For steel and iron See Chapter 27.
   For wood See Chapter 25.

(b) Interior Veneers. Veneer used as an interior finish shall conform to the requirements of Chapter 42.

(c) Anchors, Supports and Ties. Anchors, supports and ties shall be of noncombustible material and corrosion resistant.
SECTION 3004. DESIGN.

(a) General.
1. The design of all veneer shall comply with the requirements of Chapter 23 and this Section.
2. Veneer shall not be assumed to add to the strength of any structure.
3. Exterior veneer, including its backing, shall provide a weatherproof covering.
4. Veneer shall support no load other than its own weight.
5. Surfaces to which veneer is attached shall be designed to support the additional vertical and lateral loads imposed by, and transferred from the veneer.
6. For additional backing requirements, See Chapters 25 and 47.
7. Consideration shall be given for differential movements including that caused by expansion and contraction, shrinkage, creep, and deflection.

(b) Adhered Veneer.
1. Adhered veneer and its backing shall be designed to provide a bond to the supporting element sufficient to withstand a shearing stress of 50 pounds per square inch.
2. Backing shall be continuous and may be of any material permitted by this Building Code.
3. The height and length of veneered areas shall be unlimited except as required to control expansion and contraction and as limited elsewhere in this Chapter.
4. Veneer units shall not exceed 36 inches in the greatest dimension, nor more than 720 square inches in total area, and shall weight not more than 15 pounds per square foot unless approved by the Department.

**EXCEPTION:** Veneer units weighing less than 3 pounds per square foot shall not be limited in dimensions or area.
5. In lieu of the design required by this Chapter, adhered veneer may be applied by one of the methods specified in U.B.C. Standard No. 30-1.
6. All material shall be compatible; and the bonding agent shall be insoluble in water, and shall retain its adhesive qualities.

(c) Anchored Veneer.
1. Anchored veneer and its attachments shall be designed to resist a minimum horizontal force equal to twice the weight of the veneer.
2. Anchored veneer shall be supported by noncombustible supports. Where anchored veneer is applied to a wall more than 25 feet above the adjacent ground elevation, it shall be supported by non-combustible, corrosion-resistant, structural framing having horizontal supports spaced not over 12 feet vertically above the 25-foot height.
3. Noncombustible, corrosion resistant lintels and noncombustible supports shall be provided over all openings where the veneer units are not self-spanning. The deflections of all structural lintel and horizontal supports shall not exceed 1/500 of the span under full load of the veneer.

4. The area and length of anchored veneer walls shall be unlimited except as required to control expansion and contraction and by this Chapter.

5. In lieu of the design required by Chapter 30, anchored veneer may be applied by one of the methods specified in U.B.C. Standard No. 30-1.

SECTION 3005. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards, and those applicable Standards in Chapter 24 shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.B.C.</td>
<td>Veneer Application-Standard No. 30-1.</td>
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LEGEND

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<tr>
<td>U.B.C.</td>
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<tr>
<td>(Uniform</td>
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<tr>
<td>Building</td>
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<tr>
<td>Code)</td>
</tr>
</tbody>
</table>

International Conference of Building Officials
5360 So. Workman Mill Road
Whittier, California 90691
CHAPTER 31
REHABILITATION OF OLDER BUILDINGS
(HERITAGE)

SECTION 3101. GENERAL.
(a) Scope. This Chapter shall govern the rehabilitation of buildings, structures, and utilities of Group B-2, B-3, C, F, H, I, and J Occupancies which were built prior to January 1, 1950, and shall supercede all the requirements of this Building Code which are in conflict with the provisions of the Chapter except the requirements of Chapter 1 relating to unsafe buildings, structures, or utilities.

(b) Declaration. It is hereby declared, as a matter of Public Policy, that the rehabilitation, preservation, and restoration of older buildings, located within the City, is a public necessity and is required in the interest of the general welfare of the people. Special consideration shall be given to buildings that are Denver Landmarks, on the National Register of Historic Places, or National Historic Districts.

(c) Exception for the Rehabilitation of Existing Buildings. Buildings, structures, and utilities, conforming with Section 3101(a) of this Building Code, may be granted an exception from the requirements of this Building Code, permitting the repair, rehabilitation, or change of use or occupancy (within the occupancy as enumerated in Section 3101(a)), when such would not comply with the provisions of this Building Code. No exception shall be authorized hereunder unless the Director shall find the following conditions exist:

1. The building, structure or utility was constructed prior to January 1, 1950.

2. The building, structure or utility, is structurally sound and the proposed repair, rehabilitation, or change of use or occupancy will substantially improve the use, safety, and welfare of the occupants.

   A. The Director, in making this determination, may request an Engineer's or Architect's report to determine the condition of the building, structure, or utility.

3. The proposed repair or rehabilitation of a building, structure or utility, for Residential use does not violate the provisions of the Housing Code, Article 631 of the Revised Municipal Code.
4. The Fire Department concurs in any alternative method, utility, appliance, or system related to fire safety.

SECTION 3102. REHABILITATION ADVISORY PANEL.

(a) Creation. An Advisory Panel of 25 persons, with experience in the rehabilitation of buildings, structures, or utilities, shall be appointed by the Mayor. Individual members of City Council may submit names to the Mayor for consideration for appointment to this Advisory Panel. Their term of office shall be as follows at the discretion of the Mayor:

1. Five persons for one year.
2. Five persons for 2 years.
3. Five persons for 3 years.
4. Five persons for 4 years.
5. Five persons for 5 years.

(a) After the initial appointments are made, each appointment shall be for a 5 year term. This Advisory Panel shall serve without compensation.

(b) Composition of the Advisory Panel. The Advisory Panel shall consist of the following:

1. Three members shall be Architects.
2. Three members shall be Engineers.
3. Two members shall be Class A or B Licensed Building Contractors.
4. One member shall be a Certified Plumbing Journeymen.
5. Two members shall be Class A Licensed Heating and Ventilating Contractors.
6. One member shall be a Certified Heating and Ventilating Journeymen.
7. Two members shall be Licensed Steam and Hot Water Contractors.
8. One member shall be a Certified Steamfitter.
9. Two members shall be Colorado Electrical Master Licensee’s.
10. One member shall be a Colorado Electrical Journeyman Licensee.
11. Two members shall be Licensed Class A Plumbing Contractors.
12. The remaining five members of the Panel shall be appointed from the Real Estate and Financial Fields.

(c) Fire Department and Health and Hospitals Representative. The Chief of the Fire Prevention Bureau or his authorized represen-
tative and the Manager of the Department of Health and Hospitals or his authorized representative shall be ex-officio members to the Panel, but shall have no voting power. Terms of office and compensation shall not be applicable to these members.

(d) **Vacancy.** Should a vacancy occur on the Panel during a members term, the Mayor may fill the vacancy for the unexpired term. Any member of the Panel, after serving a complete term, may be reappointed to another full term.

**SECTION 3103. REHABILITATION BOARD.**

(a) **Creation.** The Chairman of the Advisory Panel, in determining compliance with this Chapter, shall upon the request of the Director establish a Rehabilitation Board consisting of 7 voting members. These members shall be taken from the Advisory Panel. The Fire Department and Health and Hospitals representatives to the Board shall be Non-Voting members. The Board shall consist of the following:

1. One person and an alternate who are licensed Architects.
2. One person and an alternate who are professional Engineers.
3. One person and an alternate who is the holder of a Building Contractor Class A, B, or C license.
4. One person and an alternate who is the holder of a Class A Plumbing Contractor license.
5. One person who is the holder of a Colorado Electrical Master license or Journeyman license.
6. A person who is the holder of a City Class A Heating and Ventilating or Steam and Hot Water license.
7. A person from the Real Estate or Financial field.

Chief Public Safety Inspector of the Department shall be the coordinator of this Board. The Department shall furnish a Secretary to the Board. The duties of the Secretary shall be those as outlined by the Board.

In the absence of any member of the Board, the respective alternates shall be authorized to fill the vacancy so created, with the full power and compensation accorded the regular member.

(b) **Meetings.** There shall be at least one meeting in each month. For purposes of this Chapter, a meeting shall consist of a simple majority of the Board. Rules and Regulations governing this body shall be established by a majority of the Board. Roberts Rules of Procedure and Order shall be used as a guideline for this purpose. Matters brought before the Board shall be discussed and dates set for physical inspection of buildings as may be required.
(c) **Compliance.** The Director, in determining compliance with the conditions set forth in this Chapter, shall receive recommendations from the Board. Upon completion of his review, the Director shall notify the applicant accordingly, in an affirmative or negative manner. In addition, the Director shall notify the Board of his findings.

(d) **Compensation.** Each member of the Board except the Fire Department and Health and Hospitals representatives, shall receive $35.00 per each regular meeting. No compensation shall be paid for meetings held in excess of 2 per month.

(e) **Board Guidelines.** From time to time, the Board shall establish guidelines for the use of the Director and the Board in the implementation of this Chapter. These guidelines shall be approved by the Advisory Panel prior to their use by the Board or the Director. These guidelines shall not be changed more often than twice a year.

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**SECTION 3104. METHOD OF APPLICATION AND FEE.** Prior to any action taken by the Board, an application shall be filed in the office of the Department on a form providing the necessary information required by the Board. Upon filing the application with the Department, a fee of $100.00 shall be paid to the Department. All checks shall be made payable to the Manager of Revenue. This fee is not refundable. (Revised 5/87 Ord. No.97)
CHAPTER 32
ROOF AND ATTIC CONSTRUCTION

SECTION 3201. GENERAL. In addition to other requirements of this Building Code, this Chapter shall govern the materials, flashings, construction, application, alteration, and repair of all roof coverings.

SECTION 3202. DEFINITIONS. For the purposes of this Chapter, the following definitions shall apply:

1. Asphalt. A dark brown to black bitumen used in the manufacture of roofing materials.


3. Asphalt Mastic. A mixture of asphaltic material, graded mineral aggregate, and fine mineral matter which can be poured when heated, but which required mechanical manipulation to form.


5. Backnailing. The practice of blind-nailing, in addition to hot-mopping, all the plies to a substrate to prevent slippage.

6. Base Sheet. One or more layers of felt or combination sheet manufactured for use as a roofing base layer.

7. Bitumen. A class of black, cementitious substances, natural or manufactured, composed principally of high molecular weight hydrocarbons, asphalts, tars, and pitches.


10. Built-Up Roof Covering. 2 or more layers of roofing consisting of a base sheet, cap sheets, and gravel or mineral aggregate, when used.

11. Built-Up Roofing Membrane. A continuous, semiflexible roof covering of laminations, or plies, or saturated or coated felts alternated with layers of bitumen, surfaced with mineral aggregate or asphaltic materials.

12. Cant Strip. A beveled strip placed in the angle or the abutting wall to avoid a sharp bend in the roofing material.
13. **Cap Sheet.** The top layer of a built-up roof.
14. **Cementing.** A solidly mopped application of hot asphalt, cold liquid asphalt compound, hot coal tar pitch, or other approved cementing material.
15. **Coal Tar Pitch.** A bitumen by-product of coke used in pitch felts.
16. **Coated Base Sheet (or Felt).** A felt that has previously been impregnated with asphalt, and later coated with harder, more viscous asphalt.
17. **Coatings.** Liquid bitumen without additives, or with asbestos fibers added and occasionally thinned with petroleum solvent.
18. **Cold-Process Roofing.** A bituminous membrane consisting of layers of coated felts bonded with cold-applied asphalt roof cement, and surfaced with a cutback or emulsified asphalt roof coating.
19. **Combination Sheet.** A glass fiber felt integrally attached to kraft paper.
20. **Counterflushing.** See Flashing.
21. **Cricket.** A small false roof on the upper side of the junction of the roof with another surface, sloped to shed water.
22. **Cutback.** An organic, solvent-thinned, soft, or fluid cold-process bituminous roof coating or flashing cement.
23. **Edge Stripping.** Application of felt strips to start the felt-shingling pattern at a roof edge.
24. **Edge Venting.** Regularly spaced openings at a roof perimeter to relieve the pressure of water vapor entrapped in the insulation.
25. **Emulsion.** A mixture of bitumen and water, with uniform dispersion of the bitumen globules achieved through a chemical or clay emulsifying agent.
26. **Envelope.** A continuous edge formed by folding an edge base felt over the plies above.
27. **Exposure.** The transverse dimension of a felt not overlapped by an adjacent felt in a built-up roofing membrane.
28. **Felt.** Matted fibers, saturated with bituminous compound.
29. **Flashing.** A device or seal to cover open joints or edges where the membrane is interrupted.
30. **Flashing Cement.** A trowelable, plastic mixture of bitumen and asbestos, or other inorganic reinforcing fibers, and a solvent.
31. **Flood Coat.** The top layer of bitumen in an aggregate-surfac ed built-up membrane.

32. **Glaze Coat.** (1) The top layer of asphalt in a smooth-surfac ed built-up roof assembly; (2) a thin protective coating of bitumen applied to the lower plies or top ply of a built-up membrane when the top pouring and aggregate surfacing are delayed.

33. **Gravel.** An inorganic material of rock, ceramic, and other appro ved materials used as top surfacing materials for built-up roofs.

34. **Gravel Stop.** A flanged device designed to prevent loose aggreg ate from washing off the roof and to provide a finished edge for a built-up roofing assembly.

35. **Hip.** The external angle formed by the junction of two sloping sides of a roof.

36. **Metal Roofing.** Metal shingles or sheets for application on solid roof surfaces, and corrugated or otherwise shaped metal sheets or sections for application on solid roof surfaces or roof framings.

37. **Mineral-Surfaced Sheet.** An asphalt saturated felt, coated on one or both sides and surfaced on the weather-exposed side with mineral granules.

38. **Mopping.** An application of bitumen applied hot with a mop or mechanical applicator to the substrate or the felts of a built-up roofing membrane.
   A. **Solid Mopping.** A continuous mopping surface with no unmopped areas.
   B. **Spot Mopping.** A mopping pattern in which the hot bitum en is applied in roughly circular areas, generally about 18 inches in diameter, with a grid of unmopped, perpendicular bands.
   C. **Strip Mopping.** A mopping pattern in which the hot bitumen is applied in parallel bands, generally 8 inches wide, with 4 inch unmopped spaces.
   D. **Sprinkle Mopping.** A random pattern of heated bitumen beads hurled onto the substrate from a broom or mop.

39. **Pitch Pans or Pitch Cups.** Metal used to contain asphalt bitumen or plastic roof cement.

40. **Ply.** A layer of felt in a built-up roofing membrane.

41. **Prepared Roofing.** Manufactured or processed roofing mat erial other than untreated wood shingles and shakes as distin guished from built-up roof covering.
42. Rake. The edge of a roof at its intersection with a gable.
43. Reglet. A groove in a wall or other vertical surface adjoining a roof surface for the embedment of counterflashings.
44. Roofing System. An assembly of interacting roof components designed to weather-proof a building's top surface.
45. Roofing Square. 100 square feet of roofing surface.
46. Roof Tape. Cotton fabric asphalt saturated, burlap asphalt saturated, or treated glass fiber.
47. Saddle. A small false roof on the upper side of a roofing surface to divert drainage two ways from a projection through the roof.
48. Shingling. The pattern formed by laying parallel felt rolls with lapped joints so that one longitudinal edge overlaps the longitudinal edge of one adjacent felt.
49. Slope. The tangent of the angle between the roof surface and the horizontal.
50. Smooth Surfaced Roof. A built-up roofing membrane surfaced with a layer of hot mopped asphalt or cold-applied asphalt-clay emulsion or asphalt cutback, or sometimes with an unmopped, inorganic felt.
51. Substrate. The surface upon which the roofing membrane is placed.
52. Underlayment. One or more layers of felt or approved paper over which the prepared roofing is applied.
53. Valleys. The junction of 2 sloping roofs producing an acute angle.
54. Vapor Barrier. A material designed to restrict the passage of water vapor.
55. Wood Shakes. Tapered or nontapered pieces of Western red cedar or redwood of random widths.
56. Wood Shingles. Tapered pieces of Western red cedar or redwood, sawed both sides, of random widths.

SECTION 3203. GENERAL REQUIREMENTS.
(a) Except as provided for in this Chapter, roof coverings shall be Class A, B, or C built-up or prepared roofing.
(b) Roof coverings shall be securely fastened to the supporting roof construction and shall provide weather protection for the building.
(c) Roofing materials shall be delivered to the construction site in packages bearing the manufacturer’s label or identifying mark.

1. Each package of prepared roofing and built-up roof covering materials shall bear the label of an approved inspection bureau or agency, which provides an inspection service for the manufacturing process and the finished products.
2. Each bundle of wood shakes and wood shingles shall comply with the grading and packing rules of hand-split red cedar shakes of the Red Cedar Shingle and Hand-Split Shake Bureau, and shall bear the label of an approved inspection bureau or agency specifying of the grade.

3. Slate Shingles shall comply with ASTM - C 406.

4. Asphalt or pitch shall be delivered in one of the following methods:
   A. In cartons indicating the manufacturer and the softening point of the product.
   B. Bulk shipments of asphalt or pitch to the construction site shall be accompanied by a certification by the manufacturer of the softening point.

(d) A current copy of the manufacturer’s specifications shall be provided by the roofing contractor at the job site for reference during construction.

(e) All Class A, B, or C roof systems shall be approved and listed by an approved agency and shall be installed in accordance with the manufacturer’s specifications.

SECTION 3204. FIRE-RETARDANT REQUIREMENTS.

(a) Fire Zones 1 and 2. A Class A or B roof shall be required for buildings of all types of construction.

(b) Fire Zone 3. A Class A or B roof shall be required for buildings of constructions Types I, II, III, IV. A Class C roof shall be required for buildings of construction type V.

EXCEPTION: In Groups H-2, H-3, I and J Occupancies, wood shingles and shakes shall be permitted without classification.

SECTION 3205. BUILT-UP and OTHER FLAT ROOF COVERINGS.

(a) General. Class A, B or C built-up and other flat roof systems shall be approved per Section 3203 and shall be installed per the manufacturer’s instructions. (Revised 5/82 Ordinance No. 245)

(b) Group J Occupancies. For roofing of group J occupancies, one layer of type 90 heavy Mineral Surfaced Roll Roofing may be used under the following conditions:
   1. With a roof incline of one inch per foot or greater, the roofing shall be applied with a minimum two inch lap.
   2. With a roof incline of less than one inch per foot, the concealed nailing method shall be used.
SECTION 3206. ROOF AND ATTIC CONSTRUCTION.

(a) Framing. All roofs shall be framed and tied into the framework and supporting walls to form an integral part of the structure.

(b) Joints. The joints of all roof trusses shall be well fitted, and all tension members shall be tightened prior to being loaded.

(c) Stresses. The stresses of materials used in trusses shall be as specified in Chapters 23, 25, and 27. In determining the strength of a truss at any point, the minimum net section of the members after framing shall be used.

(d) Plywood. Plywood used for roof sheathing shall provide a minimum of 1/2 inch thickness laminated, with exterior type glue.

EXCEPTION: The use of 15/32 inch (minimum) thick plywood or 7/16 inch (minimum) thick non-veneer APA Rated Sheathing (oriented strand board panels, structural particle panels, composite panels or wafer board panels) complying with a 24/16 span rating is a suitable alternate to 1/2 inch thick plywood. (Rev. 8/86 Ord. No. 518)

(e) Ventilation of Enclosed Attic and Rafter Spaces. Cross-ventilation shall be provided for all attics and for each separately enclosed space formed when ceilings are applied to the underside of roof rafters.

1. Ventilating openings shall be protected against the entry of rain or snow.

2. The net free opening of the ventilating area shall be at least 1/300th of the area of the space to be ventilated, and shall be located in the upper 1/2 of the space to be ventilated. In Group H and I Occupancies, soffit vents may be provided.

(f) Attic Access. Attic space with a vertical clear height of more than 30 inches, in buildings with combustible ceiling or roof construction, shall be provided with access from the top floor of the building.

1. The access opening shall measure at least 22 by 30 inches.

2. The access opening shall provide at least 30 inches clear headroom above the opening.

3. If mechanical equipment is located in an attic or roof, see Chapters 33 and 52.

(g) Draft Stops. Draftstopping shall be provided in accordance with the requirements specified in Section 2514. (Revised 5/82 Ordinance No. 245)
(h) Curtain Boards.
   1. **Required Curtain Boards.** Curtain boards shall be installed in all occupancies when any undivided floor area exceeds 35,000 square feet, or in Group E Occupancies when the undivided floor area exceeds 15,000 square feet.
   2. **Construction.** Curtain Boards shall be constructed of sheet metal, asbestos millboard, lath and plaster, gypsum wallboard.
   3. **Location and Depth.**
      - A. Except in a Group E Occupancy, curtain boards shall extend down from the ceiling a minimum distance of 6 feet, except that curtain boards need not extend below a point 8 feet above the floor.
      - B. In Group E Occupancies, curtain boards shall extend down from the ceiling a distance of 12 feet, except that curtain boards need not extend below a point 8 feet above the floor if the curtain is not less than 6 feet in depth.
   4. **Spacing.**
      - A. Except in Group E Occupancies the distance between curtain boards shall not exceed 200 feet, and the curtained area shall not exceed 35,000 square feet.
      - B. In Group E Occupancies, the distance between curtain boards shall not exceed 100 feet and the curtained area shall not exceed 15,000 square feet.

SECTION 3207. NEW ROOF COVERINGS.
(a) **Application.** All roofing shall be applied on clean and dry decks in accordance with manufacturer’s current instructions.
(b) **Construction of Built-Up Roofing.**
   1. The base sheet shall be cemented or spot mopped to non-nailable decks in accordance with the manufacturer’s instructions.
   2. The base sheet shall be nailed over an approved nailable surface in accordance with the manufacturer’s instructions.
   3. Successive layers shall be cemented using no less cementing material than that specified for a solidly cemented base sheet.
   4. Gravel surfaced roofs shall be surfaced with hot asphalt or pitch in which is embedded gravel or an approved surfacing material, installed in accordance with the manufacturer’s instructions.
   5. Cap sheets shall be cemented to the base or felts using no less cementing material than that required for solid mopping.
6. Asphalt shall be heated and applied at temperatures specified by the manufacturer.
7. Built-up roofing shall be applied by beginning at the low spots and working toward the ridges, or high point, shingling the adjacent felts and cap sheets and applying all felts and cap sheets in solid, uniform moppings of bitumen.
8. A base sheet used in built-up composition roofing shall be considered as one ply or layer.
9. All non-nailable decks, parapet walls, party walls, or any protrusion through a roof shall be coated with primer prior to intermittent application, in accordance with the manufacturer’s specifications.
10. 90 pound mineral roofing shall not be used on roofs having a slope of less than 1 inch in 12 inch rise except on a Group J Occupancy and shall be applied when the atmospheric temperature is in excess of 45 degrees F.
11. A cant strip shall be installed to all vertical projections where they meet the roof.
12. Pitch pans and roof jacks shall be installed on top of finished felts with 2 layers of Type 15 felt applied over the top of metal flanges. All roof jack flashing around pipes and projections protruding through roof decking, shall extend a minimum of 6 inches above the finished roof and be tightly fitted to the pipe. Flanges shall extend a minimum of 4 inches onto the deck with all seams soldered. All metal shall be set in and covered with plastic cement prior to the application of the 2-plies of Type 15 felt.
13. Projections such as ladder struts, flag poles, sign braces, and similar projections shall have pitch pans or pitch cups around the projections. The pans or cups shall be filled with a minimum of 2 inches of plastic cement and rounded off. The base flange shall protrude 4 inches beyond the outside edge of the cup and be installed on top of the finished roofing and covered with 2-plies of Type 15 felt.
14. Gravel stops or guards with a minimum height of 3/4 inch and an apron extending at least 4 inches onto the roofing shall be installed on top of the finished membrane on all built-up roofs without parapet walls. Gravel stops or guards shall be set in a bed of plastic cement, nailed to the roof decking on 3 inch centers, covered with plastic cement, and stripped or covered with 2 plies of Type 15 felt.
15. Nails.
   A. Built-up roof nails shall be long enough to penetrate into the deck 3/4 inch or through the thickness of the sheathing, whichever is less.
   B. Nails for wood deck shall be no less than No. 12 gauge, with 3/8 or 7/16 inch heads driven through tin caps, or approved nails with integral caps.
   C. On plywood decks, ring shank nails driven through tin caps or approved nails with integral caps will be used.
   D. For decks made of gypsum, insulating concrete, cementitious wood fiber, and other materials, nails as specified in Table 32-A shall be used.
   E. Fasteners recommended by deck manufacturers shall be used for any deck material not covered in this Section.

(c) Asphalt Shingles.
   1. Asphalt shingles may be applied to solid wood sheathed roofs with a slope of more than 2 inches in 12 inch run.
   2. When the roof slope is 2 to 4 inches in 12 inch run, two layers of Type 15 felt shall be applied shingle fashion prior to installation of the shingles. The two layers of felt shall be cemented together from the extreme edge of the roof for a distance of 2 feet.
   3. When the roof slope is 4 inches or more in 12 inch run, one layer of Type 15 felt shall be applied shingle fashion prior to installation of the shingles.
   4. Shingles shall be fastened according to manufacturer's instructions, except that the following minimum number of nails shall be used:
      A. Self-sealing type shingles: 4 nails per 36 inch strip.
      B. Standard 3 tab (non-sealing) shingles: 6 nails per 36 inch strip.
      C. Individual shingles less than 18 inches wide: 2 nails per shingle.
   5. Nails used to fasten asphalt shingles shall meet or exceed the manufacturer's recommendations, and shall meet the following minimum standards:
      A. Shall be at least 12 gauge wire with heads 3/8 to 7/16 of an inch in diameter.
      B. Shall be galvanized or corrosion resistant metal.
      C. Shall be long enough to penetrate the roofing material and at least 3/4 of an inch into the wood deck lumber or through the sheathing, whichever is less. STAPLES SHALL BE PERMITTED ONLY.
6. Hips and ridges shall be centered and provided double coverage, with a maximum of 5 inches exposure.

(d) Slate Shingles. Slate shingles may be used when they comply with ASTM C 406, and are installed in accordance with the manufacturer’s specifications.

(e) Asbestos Cement Shingles. Asbestos cement shingles may be installed when they meet the standards of ASTM C 222, and are installed in accordance with the manufacturer’s specifications.

(f) Metal Shingles, Corrugated, or Flat Sheets. Metal shingles may be used when installed in accordance with manufacturer’s specifications and the Standards.

(g) Tile of Clay or Concrete. Tile of clay or concrete shall be installed in accordance with the manufacturer’s specifications and shall be securely fastened to the deck with approved mechanical fasteners. Tile roofs shall have an underlayment of at least 2 layers of Type 15 felt, or 1 layer of type 30 felt.

(h) Wood Shingles. Wood shingles may be applied to roofs with solid sheathing or spaced sheathing with spaces not exceeding 2-1/2 inches. Wood shingles shall be applied as follows:
   1. Shingles shall be layed with a side lap of at least 1-1/2 inches between joints in adjacent courses, and not in direct alignment in alternate course.
   2. Spacing between shingles shall be not less than 1/4 of an inch.
   3. Each shingle shall be fastened with not more than 2 nails or staples positioned approximately 3/4 of an inch from each edge and above the overlapping course lines.
   4. Starter courses at eaves shall be doubled.
   5. Weather exposures shall not exceed those specified in Table 32-B. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof.

(i) Wood Shakes. Wood shakes shall be applied to roofs with solid sheathing only, and shall be applied over an underlayment of at least one layer of type 30 felt or 2 layers of type 15 felt, lapped 1/2 the width of the sheet. The installation of wood shakes shall be as follows:
   1. Shakes shall be laid with a side lap of at least 1-1/2 inches between joints in adjacent courses and not in direct alignment with alternate courses.
2. Spacing between shakes shall be not less than 3/8 of an inch.
3. Each shake shall be fastened to the sheathing with not more than 2 nails or staples, positioned approximately 1 inch from each edge and above the overlapping course lines.
4. The starter course at eaves shall be doubled, the bottom or first layer being wood shingles.
5. 15 or 18 inch shakes shall be used for the final course at the ridge.
6. Weather exposures shall not exceed those specified in Table No. 32-B, hip and ridge weather exposures shall not exceed those permitted for the field of the roof.
7. Under each hip or ridge there shall be placed one layer of type 30 felt, at least 6 inches in width.

SECTION 3208. REROOFING.

(a) General. All reroofing shall comply with the requirements of this Chapter for the class and type of roof, and the following requirements:

1. Prior to any reroofing, the existing surface shall be carefully inspected, and all wrinkles, buckles, blisters, areas containing moisture, and unsecured layers of the existing surface shall be removed or repaired.

2. Built-up roofs shall not have more than a total of 2 roofing applications, including the original roof. Shingle roofs shall have not more than 3 roofing applications, including the original roof. For purposes of this Section, 2 layers of 90 pound rolled roofing or 2 layers of split-roll roofing shall be counted as one covering. (Rev. 5/87 Ord. No. 250)

3. Prior to reroofing of any shingle type roof, the existing hip and ridge shingles shall be removed.
4. Vent flashings, metal edgings, drain outlets, metal counterflashing, pitch pans, and collars may be reused when conforming to the requirements of this Chapter. Rusted metal shall be replaced. Metal shall be primed with cutback primer prior to installation. Collars and flanges shall be flashed per the roofing manufacturer’s instructions.

(b) Reroofing of Built-up Roofs. One of the following methods of reroofing shall be followed for built-up roofs:

1. Existing roofing shall be completely removed and the deck prepared to receive a new roof in accordance with the manufacturer’s instructions.
2. Existing gravel clay surfacing shall be completely removed to existing membrane unless otherwise approved by the Department. Existing membrane shall be made free of all wrinkles, buckles, blisters, or areas containing moisture or unsecured layers.

EXCEPTION: When specifically approved, the following method may be utilized:

A. Existing roof shall be cleaned by a power broom, vacuum, or similar mechanical device, of all loose or fine materials and covered with a porous (self-venting) insulation. Insulation shall be a minimum of 11/16 inch thick if preformed type, and minimum of 2 inches thick if poured in place. Roof shall not have more than one application of this method.

(c) Reroofing of Asphalt Shingle Roofs.

1. Prior to reroofing, the existing roofing shall be cleaned of loose and curled shingles and debris, and any damaged area repaired. (Revised 5/82 Ordinance No. 245)

2. Wood shingles may be applied over asphalt shingles without the use of nailer strips.

(d) Reroofing Over Slate, Asbestos Cement, Tile and Wood Shake Roofs. Reroofing over slate, asbestos cement, cement, tile, and wood shake roofs is prohibited.

(e) Reroofing Over Wood Shingles. Only composition shingles may be used over wood shingles.

(f) Reroofing Over Metal Roofs. Wood sheathing or rigid insulation shall be applied prior to any reroofing over metal roofs.

(g) Staples. Staples shall be permitted on new installations only.

SECTION 3209. FLASHING.

(a) General. Flashing shall be installed on all vertical walls and curbs in accordance with the manufacturer's specifications and:

1. All flashing surfaces shall be primed.

2. A minimum of one ply of reinforced asbestos flashing sheet and one ply of asbestos finishing felt shall be used, but shall not be less than the manufacturer's flashing recommendations.

EXCEPTION: For Group I and J Occupancies, the flashing shall be equivalent to the type of roofing being installed.

3. All flashing shall extend at least 8 inches, but not more than 12 inches, up all vertical surfaces, and at least 4 inches out onto the roof.
4. The top edges of the flashing shall be fastened at 3 inch intervals and sealed with plastic cement.

5. End laps shall be at least 3 inches long, nailed vertically and covered with 4 inches of asbestos felt embedded in plastic cement.

6. The entire base of the flashing shall be covered with a coating of the applicable surfacing materials in accordance with the manufacturer's specifications.

7. The top edges of all felts and roofing shall be given a coating of approved plastic cement upon completion of the nailing requirements.

8. On smooth-surfaced roofs, the bottom edge of the flashing extending out onto the roof shall be covered with a 4 inch strip of asbestos felt.

9. All vertical walls and projections shall be counterflashed with a 2 piece metal system installed watertight.

10. Nailer strips shall be provided on vertical walls, drips in edge and curbs which will not accept conventional nailing.

11. Remove all existing flashing before installing new flashing and/or roof.

(b) Valley Flashings.

1. Metal valley flashing for shingle roofing shall be at least 28 gauge galvanized or corrosion-resistant metal over an underlayment of one layer of type 30 felt or 2 layers of type 15 felt. The metal shall extend at least 10 inches on each side of the center line of the valley. (Revised 5/82 Ordinance No. 245)

2. When noninterlocking asphalt shingles are used, the valley flashing may be woven, closed-cut, or open-valley type, in accordance with the Standards.

3. When interlocking composition shingles are used, valley flashing shall be open type.

4. Open valley flashing shall be constructed of metal or type 90 roofing applied in 2 layers, the first layer 18 inches in width and the second 36 inches in width.

5. All valley flashings shall be centered in the valley.

6. When wood shakes, slate, asbestos cement, tile, or shingles are used, they shall have an open type metal flashing.

7. Closed valleys shall be lined with a 36 inch wide type 90 roll roofing.
(c) **Vertical Surfaces.** Flashing shall be provided wherever vertical surfaces meet a roof, and shall be constructed as follows:

   1. On new construction, when the roofs are of rigid asbestos, slate, wood, or asphalt shingles, a metal base flashing and metal counterflashing of at least 28 gauge galvanized metal shall be installed.
   2. Base flashing of the step type shall be installed between each course of material.
   3. Under clay or concrete shingles, a metal base flashing and counterflashing shall be installed on all roofs.
   4. Where the new roof is installed over an existing composition shingle roof, all pipes and vertical projections shall be flashed with plastic cement.
   5. A saddle or cricket shall be installed on the upper side of all projections 30 inches or more in width on all sloping roofs.

   A. All saddles or crickets on the upper side of all projections shall be covered with galvanized metal, with soldered joints, or asphalt rolled roofing at least 18 inches wide and equivalent to the type of roofing being applied, nailed over the saddles or crickets and sealed with plastic cement.

   B. Areas where saddles and crickets are not required on the upper side of projections shall be flashed with galvanized metal with a minimum width of 18 inches or asphalt rolled roofing 18 inches wide, equivalent to the type of roofing being applied, and shall be nailed and sealed with plastic cement.

(d) **Vertical Projections.**

   1. All projections penetrating the roof deck shall be finished off with a roofjacket. The roofjacket shall provide a 4 inch flange and 6 inches of pipes.
   2. Pitch pans shall be used with all objects setting on top of completed roofs but not penetrating the roof deck, with a 4 inch flange and 2 inches in depth.

**SECTION 3210. EQUIPMENT ON ROOFS.**

(a) Mechanical equipment placed, replaced, or reset over roofing shall be supported by curbs or legs which shall be flashed to the roofing and made watertight. Mechanical equipment shall include, by way of example, and not limitation, heating, cooling, refrigeration, ventilating, fans, blowers and similar type equipment.

(b) **Flat Roofs.** On roofs having a pitch of less than 2 inches rise in a 12 inch run, mechanical equipment shall be supported on a square
or rectangular platform, which shall be sheathed over solid and
covered with metal of at least 26 gauge and surrounded by curbs.
All seams and mitre corners of the metal on the platform shall be
riveted and soldered so as to be watertight. The platform shall be a
minimum of 9 inches above the finished roof or, the units may be
set on legs when the following is adhered to:

1. Units and ductwork, in which at any point one horizontal di-
   mension of the equipment on a roof is less than 4 feet, a clear-
   ance of at least 18 inches shall be provided from the bottom of
   the unit or ductwork to the finished roof.
2. Units and ductwork, in which at any point one horizontal di-
   mension of the equipment on a roof is more than 4 feet but less
   than 8 feet, a clearance of at least 36 inches shall be provided
   from the bottom of the unit or ductwork to the finished roof.
3. Units and ductwork, in which at any point one horizontal di-
   mension of the equipment on a roof is in excess of 8 feet, a
   clearance of at least 48 inches shall be provided from the bottom
   of the unit or ductwork to the finished roof. (Rev. 4/84 Ord. No.
   122)

(c) Sloped Roofs. On roofs having a pitch of more than 2 inch rise in
a 12 inch run, mechanical equipment may be set on legs which
provide a minimum of 11 inches clearance between the equipment
frame and the finished roof.

(d) Piping, Conduits, Etc. Except where they vertically penetrate the
roof, all piping or conduits shall provide a minimum of 12 inches
above the surface of the finished roof and shall be supported on
metal stands installed in pitch pans no more than 10 feet between
stands.

(e) Structures. Supports for signs, mansard roofs and other miscellane-
ous structures shall be installed in pitch pans with a minimum of
12 inches clear distance above the finished roof to the structure.

SECTION 3211. ROOF DRAINAGE.

(a) General. All roofs or other enclosed structures shall be provided
with drains or gutters and downspouts sufficient to drain the roof
deck. All downspouts shall discharge upon concrete blocks at least
12 inches in width by 36 inches in length.

EXCEPTION: On structures and greenhouses, when the roof ex-
tends at least 3 feet horizontally beyond the building wall, and the
wall is at least 10 feet from adjacent property lines, shall not be
required to have gutters and downspouts except when the roof drains
into a sidewalk or pedestrian way.
(b) **Roof Drains.** Except when roofs are sloped to drain to the roof perimeter, interior drains shall be installed, and shall be sized to convey the water to the storm drainage system. See Chapter 50.

(c) **Flashing.** Flashing for interior roof drains shall be one of the following:

1. A minimum of 2 x 2 feet, 4 pound lead sheet or lead-copper coated sheet, set on completed felts in flashing cement.
2. The metal shall be turned a minimum of 1/2 inch into a drain sump and plied with two plies of Type 15 felt.
3. A two component drain system. The membrane flashing shall be polyvinylchloride sheet measuring 22 inches in its overall length, and factory-attached to the underside of the strainer flange. The membrane flashing shall be applied on top of the completed felt, shall extend a minimum of 7 inches from the outside diameter of the drain throat, shall be set into hot asphalt or roofing cement, and plied in with two plies of Type 15 felt.

(d) **Overflow Drains, Scuppers, and Downspouts.** When roof drains are installed, overflow drains (one (1) per roof drain) shall be installed with the inlet flow line a maximum of 4 inches above the low point of the roof. In lieu of overflow drains, overflow scuppers having 3 times the capacity of the roof drains shall be installed in adjacent parapet walls. The scupper drain inlet flow line shall be 4 inches above the low point of the adjacent roof and have a minimum opening height of 4 inches. No overflow drains or scuppers are required if the maximum water depth cannot exceed 4 inches.

**EXCEPTION:** If greater water detention is required, overflow drains and scuppers may extend beyond 4 inches height provided roof loading calculations are submitted and approved by the Department. (See Chapter 23). (Revised 8/80 Ord. 393)

(e) **Concealed Piping.** Roof drains and overflow drains, when concealed within the construction of the building, shall be installed in accordance with Chapter 50.

(f) **Discharge Water.** Water shall not be discharged from any conductor pipes onto any public sidewalk, but shall be conducted underneath the walk to the gutter or street.

(g) **Gutters and Downspouts.**

1. Gutters shall be installed so that the line of the slope of the roof intersects the inside face of the gutter. Gutters shall slope to drain.
2. Hangers shall be the same material as the gutters and installed level with the gutter.
3. Maximum spacing of hangers shall be as follows:
   Stainless steel gutter: 60 inches on centers.
   Galvanized steel gutters: 36 inches on centers.
   Copper, aluminum, or zinc-copper alloy gutters: 24 inches on centers.
4. Gutters shall be anchored to the roof deck.
5. All joints shall be soldered or riveted and sealed with an approved sealant.
6. Gutter backs shall extend beneath roof covering a minimum of one inch, or be provided with a drip edge one inch beneath the roof covering and extending down a minimum of 2 inches into the gutter trough.
7. Downspouts shall be anchored to the building by supporting straps not more than 8 feet on centers, and be of the same material as the gutter.

SECTION 3212. STANDARDS. Unless provided for in other portions of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt Roll Roofing Surfaced with Powdered Talc or Mica. D224-68.</td>
</tr>
<tr>
<td></td>
<td>Asphalt Shingles Surfaced with Mineral Granules. D225-70.</td>
</tr>
<tr>
<td></td>
<td>Asphalt Saturated Roofing Felt for Use in Waterproofing and in Construction of Built-Up Roofs. D227-70.</td>
</tr>
<tr>
<td></td>
<td>Coal-Tar Saturated Roofing Felt for Use in Waterproofing and in Construction of Built-Up Roofs. D227-70.</td>
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<tr>
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<td>Asphalt Roll Roofing Surfaced with Mineral Granules. D249-73.</td>
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<tr>
<td></td>
<td>Asphalt Saturated Asbestos Felts for Use in Waterproofing and in Constructing Built-Up Roofs. D250-70.</td>
</tr>
<tr>
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<td>Definition of Terms Relating to Bituminous and Other Organic Materials for Roofing, Waterproofing and Related Building or Industrial Uses. D1079-73.</td>
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Asphalt-Based Emulsions for Use as Protective Coatings for Built-Up Roofs. D1227-70.
Woven Glass Fabrics Treated for Use in Waterproofing and Roofing. D1668-73.

ASTM
Asphalt-Impregnated Glass Fiber Mat (Felt). D2178-74.
Asphalt-Based Aluminum Roof Coatings. D2824-69.
Class A Asphalt Shingles Surfacd with Mineral Granules. D3018-72.
Coated Asphalt Felt for Use in Construction of Built-Up Roofs. D3158-72T.
Slate Shingles. C406-70.
Roofing Asphalt. D312-71.

UL
Roof Coverings. 55A-70.
Roofing and Shingles, Class C Asphalt Organic Felt Sheet. 55B-70.

RCS HSB

ICBO
Roofing Tile Standards. 32-12-73.

SMACCNA

ARMA
LEGEND

ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

UL Underwriters Laboratories
333 Pfingsten Road
Northbrook, Ill. 60062

RCS HSB Red Cedar Shingle and Handsplit Shake Bureau
5510 White Building
Seattle, Washington

ICBO International Conference of Building Officials
(Uniform Building Code)
5560 So. Workmen Mill Road
Whittier, California 90601

SMACCNA Sheet Metal and Air Conditioning Contractors
National Association, Inc.
107 Center Street
Elgin, Ill.

ARMA Asphalt Roofing Manufacturer's Association
1500 Eastgate Dr., Suite 100B
Garland, Texas 75041

FM Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, Mass. 02062

NRCA National Roofing Contractors Association
1515 North Harlem Avenue
Oak Park, Ill. 60302

SECTION 3213. TABLES.
# TABLE NO. 32-A

## FASTENERS

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<thead>
<tr>
<th>No.</th>
<th>Illustration</th>
<th>Description</th>
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<tr>
<td>1.</td>
<td><img src="image1" alt="Roofing Nail" /></td>
<td>Annular Thread 11 Gauge 1/2&quot; Diam. Head</td>
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<td>2.</td>
<td><img src="image2" alt="Roofing Nail" /></td>
<td>Spiral Thread 11 Gauge 1/2&quot; Diam. Head</td>
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<tr>
<td>3.</td>
<td><img src="image3" alt="Screwed Cap Nail" /></td>
<td>Annular Thread 1&quot; Diameter</td>
</tr>
<tr>
<td>4.</td>
<td><img src="image4" alt="Screwed Cap Nail" /></td>
<td>Spiral Thread 1&quot; Diameter</td>
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<td>5.</td>
<td><img src="image5" alt="Gypsum Roofing Nail" /></td>
<td>1&quot; Diameter Cap</td>
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<tr>
<td>6.</td>
<td><img src="image6" alt="Shingle Cut Nail" /></td>
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<tr>
<td>7.</td>
<td><img src="image7" alt="Capped Vinyl Nail" /></td>
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<td>8.</td>
<td><img src="image8" alt="Tube-Loc Nail" /></td>
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<tr>
<td>9.</td>
<td><img src="image9" alt="Loc-Nail" /></td>
<td>1/4&quot; Cap</td>
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<td>10.</td>
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<td><img src="image11" alt="Riv-Nail" /></td>
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<td>12.</td>
<td><img src="image12" alt="Insulation Clips" /></td>
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<tr>
<td>13.</td>
<td><img src="image13" alt="Zonotile or Mark III" /></td>
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<tr>
<td>14.</td>
<td><img src="image14" alt="Nail-Tite-Type A" /></td>
<td>1 1/2&quot; Diam. Cup</td>
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<td>15.</td>
<td><img src="image15" alt="Roofing Staple" /></td>
<td>for power driven application only</td>
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32-20  
08/87
<table>
<thead>
<tr>
<th>DECKS</th>
<th>Fastener Recommendation</th>
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<tbody>
<tr>
<td>Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boards</td>
<td>2-4</td>
<td>**</td>
</tr>
<tr>
<td>Plywood</td>
<td>1-3</td>
<td>½”</td>
</tr>
<tr>
<td>Structural Wood Fiber</td>
<td>7</td>
<td>1 ½”</td>
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<tr>
<td></td>
<td>8</td>
<td>1”</td>
</tr>
<tr>
<td>Poured Gypsum</td>
<td>Nail-Tite Type A*</td>
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</tr>
<tr>
<td>Precast Gypsum</td>
<td>6</td>
<td>1 ½”</td>
</tr>
<tr>
<td>Precast Nailable Concrete</td>
<td>5 &amp; 6</td>
<td>1 ½”</td>
</tr>
<tr>
<td>Precast Lightweight Concrete</td>
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<td>1 ½”</td>
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<tr>
<td>Poured Lightweight Insulating Concrete (Min. 1:4 Mix)</td>
<td>Nail-Tite Type A* and 6</td>
<td>1 ½”</td>
</tr>
<tr>
<td>Fiberboard Roof Insulation (1” Thick Min. to 2” Max.)</td>
<td>2-4</td>
<td>**</td>
</tr>
<tr>
<td>Over Wood Boards</td>
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<td></td>
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<tr>
<td>Fiberboard Roof Insulation (1” Thick Min. to 2” Max.) Over Metal Roof Deck</td>
<td>11</td>
<td>⅛” longer than 1”, 1 ½”, or 2” R.I.</td>
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<tr>
<td></td>
<td>12</td>
<td>Driven past locking tongue</td>
</tr>
<tr>
<td>Built-Up Roofing over Fiberboard Roof Insulation (1” Thick Min. to 2” Max.)</td>
<td>8</td>
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<td></td>
<td>10</td>
<td>1 ⅜”</td>
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* Deck Manufacturer's Approved Recommendations.
** Must penetrate into deck at least ⅛ inches but not protrude through underside of deck.
<table>
<thead>
<tr>
<th>Grade Length</th>
<th>WOOD SHINGLES</th>
<th>Slope of Roof</th>
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<tbody>
<tr>
<td></td>
<td>3&quot; to less than 4&quot; in 12&quot;</td>
<td>4&quot; in 12&quot; and Steeper</td>
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<tr>
<td>No. 1 16-inch</td>
<td>3 1/4&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td>No. 2 16-inch</td>
<td>3 1/4&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>No. 3 16-inch</td>
<td>3&quot;</td>
<td>3 1/4&quot;</td>
</tr>
<tr>
<td>No. 1 18-inch</td>
<td>4 1/4&quot;</td>
<td>5 1/4&quot;</td>
</tr>
<tr>
<td>No. 2 18-inch</td>
<td>4&quot;</td>
<td>4 1/4&quot;</td>
</tr>
<tr>
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<td>4&quot;</td>
</tr>
<tr>
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<td>7 1/4&quot;</td>
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<td>No. 2 24-inch</td>
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<td>6 1/4&quot;</td>
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<tr>
<td>No. 3 24-inch</td>
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<table>
<thead>
<tr>
<th>TAPERED WOOD SHAKES</th>
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<tr>
<td>18-inch</td>
<td>7 1/4&quot;</td>
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<tr>
<td>24-inch</td>
<td>10&quot;</td>
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<table>
<thead>
<tr>
<th>STRAIGHT-SPLIT WOOD SHAKES</th>
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<tr>
<td>18-inch</td>
<td>5 1/4&quot;</td>
</tr>
<tr>
<td>24-inch</td>
<td>7 1/4&quot;</td>
</tr>
</tbody>
</table>
CHAPTER 33

STAIRS, EXITS AND OCCUPANT LOADS

SECTION 3301 GENERAL.

(a) Purpose. In addition to the other requirements of this Building Code, this Chapter shall govern and determine the occupant loads and exit facilities of buildings, structures, or any portion thereof.

(b) Scope. Every building, structure, or portion thereof shall be provided with exits as required by this Chapter. Where there is a conflict between a general requirement and a specific requirement for an individual occupancy, the specific requirement shall govern.

(c) Definitions. For purposes of this Chapter, certain terms are defined as follows:

1. Balcony, Exterior Exit. A landing or porch projecting from the wall of a building and serving as a required means of egress.

2. Corridor. A horizontal space dedicated to providing pedestrian communication within a building.

3. Corridor, Dead End. A corridor which provides only one means of egress.

4. Corridor, Private. A corridor other than a public corridor.

5. Corridor, Public. A corridor open to general use, or used by more than one tenant.

6. Exit. A continuous and unobstructed means of egress to a public way, including intervening doors, doorways, corridors, exterior exit balconies, ramps, stairways, horizontal exits, exit passageways, exit courts and yards.

7. Exit Court. A yard or court which provides egress to a public way.

8. Exit, Horizontal. A means of passage from one building into another building, or from one section of a building into another section of the same building through a separation wall. See Section 3307.


10. Exit, Vertical. A means of egress between two or more floors or levels, including exterior stairways, fire escapes, ramps, and interior stairways.

11. Floor Area. See Chapter 4.
12. **Occupant Load.** The total number of persons permitted to occupy a building or portion thereof at any one time.

13. **Panic Hardware.** A bar which extends across at least one-half of the width of each door leaf, which will open the door when subjected to pressure.

14. **Public Way.** Any parcel of land unobstructed from the ground to the sky and at least 10 feet in width, dedicated to the free passage of the public.

15. **Stairway.** See Chapter 4.

16. **Stairway, Exit.** One or more flights of stairs and the necessary landings, platforms, handrails, and guardrails connecting them to form a continuous and uninterrupted passage from one floor to another.

17. **Stairway, Private.** A stairway serving one adjacent floor only, for one tenant only. (Revised 8/88 Ordinance No. 172)

18. **Stairway, Spiral.** A stairway which provides a circular form in its plan view, with uniform sector shaped treads attached to and radiating about a supporting column. The effective tread shall be delineated by the nosing radius line exterior arc (center line of railing), and the overlap radius line (nosing line of tread above). Effective tread dimension shall be taken along a line perpendicular to the center line of the tread.

19. **Stairway, Winder.** A tread of a stair which, because of the arrangement of the stair, does not have a uniform horizontal dimension measured from riser to riser at each tread.

(d) **Determination of Occupant Load.** The occupant load permitted in any building or portion thereof shall be determined by dividing the floor area assigned to that use by the square foot per occupant set forth in Table No. 33-A. When the number of square feet per occupant is not given for a particular occupancy, it shall be determined by the occupancy which it most nearly resembles. In determining the occupant load, all portions of the building shall be presumed to be occupied at the same time, except as permitted by the Department.
EXCEPTIONS:

1. The occupant load of an area which provides fixed seats shall be determined by the number of fixed seats installed. Aisles serving fixed seats, and not used for other purposes, shall not be considered as adding to the occupant load.

2. Accessory use areas which ordinarily are used primarily by persons that occupy the main areas of an occupancy shall be provided with exits as though they were completely occupied, but their occupant load need not be included in computing the total number of occupants for the story or building.

(e) Posting of Occupant Load. Rooms in Group A or B Occupancy and dining or drinking establishment in a Group F Occupancy which provide an occupant load of more than 50 shall have the capacity of the room posted in a conspicuous place. The wording of the sign shall be as determined by the Department.

(f) Overcrowding. The number of occupants of any building or portion thereof shall not exceed the permitted posted capacity.

(g) Benches, Pews, and Booths. When benches or pews are used, the number of seats shall be based on one person for each 18 inches of length of the benches or pews. When booths are used in drinking or dining areas, the number of seats shall be based on one person for each 24 inches or major portion thereof, of the length of the booths.

(h) Mixed Occupancies. The maximum occupant load of a building containing mixed occupancies shall be determined by adding the number of occupants of each occupancy as specified in Table 33-A.

(i) Mixed Occupancy Exit Requirements. For determining exit requirements for a building or portion thereof which is used for more than one occupancy, the capacity shall be determined by the occupant load for the largest number of persons.

(j) Exit Obstruction. Obstructions shall not be placed in the required width of an exit, except those projections permitted by this Chapter.

(k) Heating Equipment and Incinerator Rooms. Boiler or furnace rooms containing an incinerator, liquified petroleum gas, or liquid fuel-fired equipment, shall be provided with at least two means of egress. All interior openings shall be protected as set forth in Table 33-B. See Chapter 49 for Machinery Room Exits.
(l) Changes in Elevation. Changes in elevation of less than 12 inches along an exit shall be made by means of a ramp. EXCEPTION: Group I and J Occupancies and along aisles adjoining seating areas.

(m) Exit Ramp Requirements. Every building housing Group A, B-1, B-2, B-3, B-4, C-1, C-2, D-1, D-2, F-1, F-2, H-1, or H-2 Occupancies shall provide one means of exit from the first floor for the handicapped confined to wheel chairs, unless otherwise approved by the Department.

SECTION 3302. EXITS REQUIRED.

(a) Determination of the Number of Exits Required. Building or floors, including basements, cellars, or occupied roofs shall have not less than two exits where required by Table No. 33-A. In all occupancies, floors above the first story having an occupant load of more than 10 shall have not less than two exits.

(b) Mezzanines. Each mezzanine used for other than storage purposes, if greater than 2,000 square feet in area or if more than 60 feet in any dimension, shall provide at least 2 stairways to the adjacent floor below.

(c) Special Requirements for All Occupancies. See Section 3315 through 3323, and Chapters 12 and 49.

(d) Stage Exits. See Chapter 39.

(e) Three Exits Required. Every story or portion thereof which provides for an occupant load of 500 to 999 shall have at least three exits.

(f) Four Exits Required. Every story or portion thereof which provides for an occupant load of 1,000 or more shall have at least four exits.

(g) Multiple Story Exit Determination. The number of exits required from any story of a building shall be determined by using the occupant load of that story plus the percentages of the occupant loads of floors which exit through the level under consideration as follows:

1. Fifty percent of the occupant load in the first adjacent story above and the first adjacent story below when the story below exits through the level under consideration.

2. Twenty-five percent of the occupant load in the story immediately above and below the first adjacent story.

(h) Final Exitting. The maximum number of exits required for any story shall be maintained until egress is provided from the building.
(i) **Motion Picture Projection Room Exits.** Every projection room shall be provided with at least one exit, or as otherwise required by Table 33-A. The door opening shall be at least 30 inches in width and at least 6 feet 6 inches in height. Entrances to a projection room shall be protected by a self-closing assembly having a 3/4-hour fire-resistant rating. The doors shall open outward and lead to exits as required by this Chapter.

(j) **Width.** The total width of exits in feet shall be at least the total occupant load served divided by 50. The width of exits shall be divided approximately equally among the separate exits. The total exit width required from any story shall be determined by using the occupant load of that story, plus percentage of the occupant loads of floors which exit through the level under consideration as follows:

1. Fifty percent of the occupant load in the first adjacent story above, and the first adjacent story below when a story below exits through the level under consideration.
2. Twenty-five percent of the occupant load in the story immediately above and below the first adjacent story.
3. The maximum exit width required from any story of a building shall be maintained until egress is provided from the building.

(k) **Arrangement of Exits.** When more than one exit is required from a portion of a building or story, at least 2 of the exits shall be remote from each other and arranged and constructed to minimize any possibility that both may become blocked by any one fire or other emergency condition. Means of egress shall be arranged so that, from any room door, exits will be accessible in at least 2 different directions except as permitted in Section 3304. Minimum travel distance between exit doors shall be 25 feet for a building or story.

(l) **Distance to Exits.** The maximum travel distance in any occupied space to at least one exit, measured in accordance with the following requirements, shall not exceed the limits specified for individual occupancies. See Sections 3315 to 3324. Means of egress shall be so arranged that there are no dead end pockets, hallways, corridor passageways, or courts whose depth exceeds the dead end corridor regulations of this Chapter. Exit distance and length of dead end corridors shall be measured from the most remote point on the floor or
dead end corridor along the shortest travel distance to the center of the exterior door, horizontal exit, or exit enclosure.

m) Exit Through Adjoining or Accessory Areas. Exits from a room may open into an adjoining or intervening room or area, provided the adjoining room is accessory to the area served and provides a direct means of egress to an exit corridor, exit stairway, exterior exit, horizontal exit, exterior exit balcony, or exit passageway.

EXCEPTION: Exits shall not pass through kitchens, storerooms, rest rooms, closets, heating or mechanical rooms, or spaces used for similar purposes. In Group H-3 and I Occupancies, exits may pass through kitchens.

Foyers, lobbies and reception rooms constructed as required for corridors shall not be construed as intervening rooms.

SECTION 3303. EXIT DOORS.
a) General. This Section shall apply to every exit door serving an area having an occupant load of more than 10, or serving hazardous rooms or areas. Buildings or structures used for human occupancy shall have at least one exit door which meets the requirements of Sub-Section (d). Sub-Section (h) and (i) shall apply to all doors, regardless of occupant load.

b) Swing. All doors shall swing in the direction of exit travel when serving any hazardous area, or when serving an occupant load of 30 or more. Double-acting doors shall not be used as exits serving an occupant load of more than 100, used as a part of a fire assembly, nor equipped with panic hardware. A double-acting door shall be provided with a view panel of at least 200 square inches.

c) Type of Lock or Latch. Exit doors shall be operable from the inside without the use of a key or any special knowledge or effort. Doors shall not be equipped with more than one latch or locking device. The use of double keyed locking devices is prohibited.

EXCEPTIONS:
1. Sliding surface bolts may be installed for extra security in F and G Occupancies with the following provisions:
   A. Only one sliding bolt per door.
   B. The sliding bolt shall be within 6 inches of the primary latch and above same.
C. The sliding bolt shall be of a type that is easily operated.
D. The sliding bolt shall be open during business hours.
E. When a sliding bolt is installed, the door shall provide a sign posted with minimum 1 inch letters reading, "THIS DOOR TO BE UNLOCKED DURING BUSINESS HOURS. IF THIS DOOR IS LOCKED DURING BUSINESS HOURS, NOTIFY THE FIRE DEPARTMENT."

F. Non-Conformance with this provision shall result in Department orders for removal of the sliding bolts.

2. A double keyed lock may be installed on the main entrance door when approved by the Department. When exit doors are used in pairs, and approved automatic flush bolts are used, the door leaf providing the automatic flush bolts shall have no door knob or surface mounted hardware. The unlatching of any leaf shall not require more than one operation.

(d) **Width and Height.** Every required exit doorway shall permit the installation of a door at least 3 feet in width and at least 6 feet 8 inches in height. Exit doors shall be capable of opening 90 degrees and shall be so mounted that the clear width of the exitway is at least 34 inches. In computing the exit width required by Section 3302 (j), the net dimension of the exitway shall be used.

(e) **Door Leaf Width.** No leaf of an exit door shall exceed 4 feet in width.

(f) **Special Doors.** Revolving, sliding, overhead, or power operated doors shall not be used as a required exit.

**EXCEPTION:** Sliding door fronts may be used only where glass store fronts are permitted and where a second means of exit is provided. The sliding store front shall be kept in the fully open position at all times during business hours.

(g) **Egress from Door.** Every exit door required by this Section shall give immediate access to an approved means of egress from the building.

(h) **Change in Floor Level at Doors.** Regardless of occupant load, there shall be a floor or landing on each side of a door. The floor or landing shall not be more than one inch lower than the threshold of the doorway. Where doors open over landings, the landings shall have a length of not less than forty-four inches.
EXCEPTION: In Group I Occupancies, and within individual units of Group H Occupancies, a door may open on the top step of a flight of stairs or on an exterior landing, provided the door does not swing over the top step or exterior landing, and the landing is not more than 7-1/2 inches below the floor level. (Revised 4/81 Ordinance No.172)

i) **Door Identification and Marking.** Exit doors shall be marked to be readily distinguishable from the adjacent construction. Stairway and elevator doors shall be marked on the stairway side and the elevator side with the appropriate floor number. These numbers shall be conspicuous and not less than 2 inches in height. Glass doors shall be marked in accordance with the requirements of Chapter 54.

j) **Public Way.** Doors shall not swing into the public way.

k) **Exit Doors in High Rise Buildings.** Exit doors in buildings over 75 feet in height shall comply with other requirements of this Code and the following:

1. All stairway doors which are to be locked from the stairway side shall have the capability of being unlocked simultaneously without unlatching upon a signal from the operations center. (See Chapter 18)

2. A telephone or other two-way communications system connected to an approved emergency service which operates continuously shall be provided at not less than every fifth floor in each required stairway where other provisions of this Code permit the doors to be locked. (Revised 5/82 Ordinance No.245)

**SECTION 3304. CORRIDORS AND EXIT BALCONIES.**

1. **General.** This Section shall apply to every public corridor serving as a required exit. For purposes of this Section, the term corridor shall also include exterior exit balconies and covered or enclosed exit passageways, including walkways, tunnels and malls.

   1. Foyers, lobbies and reception rooms meeting the construction requirements of corridors as specified in this Section may be considered as corridors.

   2. Partitions, rails, counters, and similar space dividers less than 6 feet in height above the floor shall not be construed to form corridors.
(b) **Width.** Corridors shall be at least 44 inches in width. For special requirements for Groups C and D Occupancies, see Section 3317 and 3318.

(c) **Height.** Corridors shall provide a clear height of at least 7 feet, measured to the lowest projection from the ceiling.

(d) **Projections.** The required width of corridors shall be unobstructed. For purposes of this Chapter, a door, when fully opened, shall be perpendicular to the opening.

**EXCEPTIONS:**

1. Trim and handrails shall not reduce the required width by more than a total of 7 inches.

2. Exit doors may swing into the corridor a maximum of 1 foot when the corridor exceeds 6 feet in width. The required width of the corridor shall not be decreased by the projection into the corridor.

3. Doors may swing into a corridor from rooms that are infrequently used, and provided with a lock; such as janitors, telephone, and electrical closets.

(e) **Access to Exits.** When more than one exit is required, exits shall be arranged so that it is possible to go in either direction from any point in a corridor to a separate exit, except for dead end corridors permitted by this Section.

(f) **Dead End.** Corridors in all occupancy groups may have dead ends not to exceed 20 feet in length. Dead end corridors permitted by this Section shall comply with the following requirements:

   1. All doors opening onto a dead-end corridor shall be protected by a labeled fire assembly which provides a fire-resistive rating of at least 45 minutes. These doors, except in Group H Occupancies shall also be provided with an approved self-closing device to maintain the door in closed position.

   2. Branch corridors shall not be permitted from a dead end corridor. **EXCEPTION:** Except in Groups C and D Occupancies, when the entire building and/or floor is provided with automatic fire extinguishing system, the dead end corridor may be extended to a total length of 50 feet.

(g) **Construction.** Walls of public corridors shall be of at least one-hour fire-resistive construction and the ceilings shall be at least that required for a one-hour fire-resistive floor or roof system. The long side
of an exterior exit balcony shall be at least 50 percent open, with the open area distributed to prevent the accumulation of smoke or toxic gases. Exterior exit balconies shall be of noncombustible construction, except that in Type III and Type V buildings not exceeding two stories in height, the balconies may be of wood at least 2 inches in nominal thickness.

EXCEPTIONS:
1. One-story buildings housing Group G Occupancies.
2. When the entire building is provided with an automatic fire extinguishing system throughout. See Section 1807 for corridors in high rise buildings. (Revised 10/81 Ordinance No. 518)

(h) Openings. When corridor walls are required to be one-hour fire-resistive construction, every interior door opening shall be protected as set forth in Table No. 33-B. Other interior openings, except ventilation louvers equipped with automatic fire dampers, shall be 1/4 inch fixed wire glass set in metal frames. The total area of all openings, other than doors, in any portion of an interior corridor shall not exceed 25 percent of the area of the corridor wall of the room which it is separating from the corridor.

EXCEPTIONS:
1. Protection of openings at interior walls of exterior exit balconies.
2. When the building or floor is protected with an automatic fire extinguishing system throughout, openings in corridor walls need not provide a fire-resistive rating.

(i) Location of Property. Exterior exit balconies shall not be located in an area where openings are required to be protected due to location on the property.

SECTION 3306. STAIRWAYS.

(a) General. Every stairway serving any building or portion thereof shall conform to the requirements of this Section.

EXCEPTION: In buildings less than 4 stories in height, stairs or ladders used only to attend equipment or access to an unoccupied roof are exempt from the requirements of this Section. Ladders shall extend a minimum of 2 feet above the floor, roof, parapet, or landing.
(b) **Width.** Stairways serving an occupant load of more than 50 shall be at least 44 inches in width. Stairways serving an occupant load of 50 or less shall be at least 36 inches in width. Private stairways serving an occupant load of less than 10 shall be at least 30 inches in width. Trim and handrails shall not reduce the required width by more than 3-1/2 inches on each side. See Section 3317 for stair width requirements in Group C occupancies.

(c) **Rise and Run.** The rise of every step in a stairway shall not exceed 7-1/2 inches, and the run shall be at least 10 inches. Except as provided under Sub-Sections (d) and (e), the maximum variations in the height of risers and the width of treads in any one flight shall be 1/4 inch. 

**EXCEPTION:** Private stairways serving an occupant load of less than 10 and stairways to unoccupied roofs may be constructed with an 8 inch maximum rise and 9 inch minimum run.

(d) **Winding Stairways.** Winders may be used in private stairways of Group H and I Occupancies if the required tread width is provided at a point 12 inches from the side of the stairway where the treads are narrower. In no case shall the width of run be less than 6 inches at any point. All risers in one flight between landings shall have identical dimensions with 1/4 inch tolerance.

(e) **Circular Stairways.** Circular stairways may be used as an exit, provided the minimum width or run is not less than 10 inches at a point 12 inches from the side of the stairway where the treads are narrower. All risers in any one flight between landings shall have identical dimensions within a 1/4 inch tolerance.

(f) **Spiral Stairways.** For purposes of this Chapter, spiral stairways shall be permitted only as private stairways, and shall be permitted in all occupancies.

1. The tread must provide a clear walking area measuring at least 26 inches from the outer edge of the supporting column to the inner edge of the handrail. A run of at least 7 1/2 inches is to be provided at a point 12 inches from where the tread is the narrowest. The rise must be sufficient to provide 6 foot 6 inch headroom. The rise shall not exceed 9 1/2 inches.

2. The stair shall be designed, constructed, and installed to carry a live load of 5 times the live load required.
3. Spiral stairways may be installed as a required exit in Group I Occupancies. Access shall be to an area no greater than 400 square feet. (Revised 4/81 Ordinance No. 172)

(g) **Landings.** Every landing shall have a dimension measured in the direction of travel equal to the width of the stairway. The dimension need not exceed 5 feet when the stair has a straight run. Landings, when provided, shall not be reduced in width by more than 3-1/2 inches by a door when fully opened. See Section 3303 (h).

1. The vertical distance between landings shall not exceed 12 feet, 6 inches.

2. On all floors above the first floor, a space at least 25 inches by 42 inches shall be provided for one wheelchair in each stairway enclosure as an area of refuge for handicapped persons confined to wheelchairs where exits usable by the handicapped persons are not provided. The refuge area shall be required only in buildings with elevators to upper floors.

**EXCEPTION:** Section 1807 for refuge areas in high rise buildings.

(Revised 10/81 Ordinance No. 518)

(h) **Basement and Cellar Stairways.** When a basement or cellar stairway and a stairway to an upper story terminate in the same exit enclosure, a barrier shall be provided to prevent persons from continuing into the basement or cellar. See Section 3308 (e). Directional exit lights shall be provided as set forth in Section 3312 (b).

(i) **Handrails.** Stairways shall have handrails on each side. In addition, every stairway required to be more than 88 inches in width shall be provided with at least one intermediate handrail for each 88 inches of required width. Intermediate handrails shall be spaced approximately equal within the entire width of the stairway.

1. Handrails shall be placed not less than 30 inches, or more than 34 inches above the nosing of the treads. Handrails shall be continuous the full length of the stairs and except for private stairways, at least one handrail shall extend at least 6 inches beyond the top and bottom risers, with the ends returned or terminating in posts or safety terminals.

2. Handrails projecting from a wall shall provide a space of at least 1-1/2 inches between the wall and the handrail.
EXCEPTIONS:

1. Stairways 44 inches or less in width and stairways serving one individual dwelling unit in Group H or I Occupancies may have one handrail, except that stairways open on one or both sides shall have handrails provided on the open side or sides.

2. Stairways serving one individual dwelling units in Group H or I Occupancies having less than four risers need not have handrails.

(j) Guardrails. See Chapter 17.

(k) Exterior Stairway Protection. Openings in the exterior wall below or within 10 feet, measured horizontally, of an exterior stairway serving a building in excess of two stories in height, shall be protected by a self-closing fire assembly having a three-quarter hour fire-resistive rating.

EXCEPTION: Openings may be unprotected when two separated exterior stairways serve an exterior exit balcony.

(l) Interior Stairways. Interior stairways shall be constructed as specified in Chapters 17 through 22 of this Building Code. In occupancies other than I, J and individual units of Group H Occupancies, when stairs or ramps are not required to be enclosed and usable space is provided under these stairs or ramps, an automatic fire extinguishing system shall be installed as required by Chapter 38. The space shall be enclosed as required for one-hour fire-resistive construction.

(m) Exterior Stairways. Exterior stairways shall be constructed of non-combustible material, except that on Type III buildings not exceeding two stories in height, and on Type V buildings, stairs may be constructed of wood at least 2 inches in thickness. Exterior stairways shall not project into yards where protection of openings is required. See Section 3304 (i) for Exit Balcony requirements. When enclosed usable space is provided under stairs, the walls and soffits of the enclosed space shall be protected on the enclosed side as required for one-hour fire-resistive construction.

(n) Stairway to Roof. In every building four or more stories in height, one interior stairway shall extend to the roof surface, unless the roof has a slope greater than 4 in 12. Openings onto the roof shall have a 3' 0" by 6' 8" hinged vertical door. (Revised 4/81 Ordinance No. 172)

(o) Escalators. Escalators shall not be considered as a required exit.
(p) **Headroom.** Every required stairway shall have a headroom clearance of at least seven feet. Clearances shall be measured vertically from a plane parallel and tangent to the stairway tread nosing to the soffit above all points.

(q) **Obstructions.** There shall be no obstructions in a stairway.

(r) **Stairways Required.** All buildings under construction shall be provided with temporary or permanent stairways when the building exceeds one story in height. These stairways shall be continuous through its expected height, as construction progresses. The stairway shall be provided on all floors below the top floor under construction.

   1. The temporary stairways may be constructed of concrete, steel or wood. If wood, the nominal dimension shall be 2 inches in thickness.

**SECTION 3306. RAMPS.**

(a) **General.** Ramps used as exits shall conform to the provisions of this Section.

(b) **Width.** The width of ramps shall be the same as required for stairways.

(c) **Slope.** The maximum pitch of a ramp shall not exceed one vertical to 12 horizontal from the first floor to grade in all Group A through H Occupancies. The slope of all other exit ramps shall not exceed one vertical to 8 horizontal.

(d) **Landings.** Ramps having slopes greater than one vertical to 15 horizontal shall have landings at the top and bottom. At least one intermediate landing shall be provided for each 5 feet of rise. Landings shall have a dimension of at least 5 feet, measured in the direction of ramp run. Doors in any position shall not reduce the landing dimension to less than 42 inches nor the required width by more than 3-1/2 inches.

(e) **Handrails.** Handrails shall be provided on at least one side of every ramp, at least 32 inches in height, measured from the surface of the ramp. Handrails shall extend one foot beyond the top and bottom of the ramp. Intermediate handrails shall not be required.

(f) **Construction.** The enclosures for ramps shall be constructed as required for stairways.

(g) **Surface.** The surface of ramps shall be roughened or shall be of non-slip materials.
(h) Vehicle Exit Facilities. See Chapter 17.
(i) See Chapter 64 for requirements for ramps for handicapped access.

SECTION 3307. HORIZONTAL EXIT.
(a) Used as a Required Exit. When conforming to the provisions of this Chapter, a horizontal exit may be considered as a required exit.
(b) Openings. All openings in a wall which provides a horizontal exit shall be protected by a fire assembly having a fire-resistive rating of at least one-hour. The fire assembly shall be self-closing as required in Chapter 43.
(c) Discharge Areas. A horizontal exit shall lead into a floor area having a capacity for an occupant load of at least the occupant load served by this exit. The capacity shall be determined by allowing 3 square feet of net clear floor area per occupant and 20 square feet per nonambulatory occupant. The area in which the horizontal exit leads shall be provided with exits other than additional horizontal exits.

SECTION 3308. EXIT ENCLOSURES.
(a) General. Every interior stairway, ramp, or escalator shall be enclosed as specified in this Section.

EXCEPTIONS:
1. In other than Group D Occupancies, an enclosure shall not be required for a stairway, ramp, or escalator serving only one adjacent floor, and not connected with corridors or stairways serving other floors.
2. Stairways in Group I Occupancies and stairways within individual apartments in a Group H Occupancy, need not be enclosed.
3. An enclosure shall not be required for escalators if an automatic fire sprinkler system is installed in accordance with the provisions of Chapter 38.
4. The enclosure for private stairways need not be provided when the stairway is provided with an automatic fire sprinkler system installed in accordance with the provisions of Chapter 38 and the stairway does not inter-connect with more than one adjacent floor.
(b) Enclosure Construction. Enclosure walls shall be constructed of at least 2 hour fire-resistive construction in Type I and II buildings and shall be at least one-hour fire-resistive construction elsewhere. When stairs and stair platforms are required to be constructed of reinforced
concrete, iron or steel, the finish of these treads and risers shall be of hard noncombustible materials.

(c) **Openings Into Enclosures.** There shall be no openings into exit enclosures except exit doorways and openings in exterior walls. All doors in an exit enclosure shall be protected by a fire assembly having a fire-resistive rating of at least one-hour where one-hour enclosure construction is permitted and one-and-one-half hours where two-hour enclosure construction is required. Doors shall be self-closing or shall close automatically when actuated by means of products of combustion detectors. See Table 33-B. There shall be no enclosed usable space under stairways in an exit enclosure. In all buildings having floors used for human occupancy located more than 75 feet above the lowest level of Fire Department vehicle access, and housing a Group C, D, F-2, H-1, and H-2 Occupancy, the exit stairway doors shall be openable from the stairway side at levels not exceeding 5 floors. See Section 3303 (k). (Revised 5/82 Ordinance No. 245)

(d) **Extent of Closure.** Stairway and ramp enclosures shall include landings and parts of floors connecting stairway flights and shall also include a corridor on the ground floor leading from the stairway to the exterior of the building. Enclosed corridors or passageways shall not be required from unenclosed stairways. Every opening into the corridor shall comply with the requirements of Section 3308 (c).

**EXCEPTIONS:**

1. Exits may discharge through street floor lobbies or corridors with unprotected openings provided the required exit width is free and unobstructed and the entire street floor is protected with an automatic fire extinguishing system.

2. Where one remote exit leads directly to the outside with all openings protected as per Section 3308 (c), a maximum of 50 percent of the exits may discharge into a lobby provided the lobby is protected with an automatic fire sprinkler system, and all unprotected openings are provided with a row of sprinkler heads on the accessory use side.

(e) **Barrier.** A stairway in an exit enclosure shall not continue below the grade level exit unless a door or gate is provided at the ground level to prevent persons from accidentally continuing into the basement. The door or gate shall be equipped with self closing hinges and shall swing
in the direction of exit from the lower level. Gates shall be a minimum of 3 feet 6 inches in height and shall comply with other requirements for doors. See Section 3303 for door requirements. (Revised 5/82 Ordinance No. 245)

EXCEPTION: A barrier shall not be required for a building with only one story and basement.

SECTION 3309. SMOKEPROOF ENCLOSURES. Deleted.

SECTION 3310. EXIT COURTS.
(a) General. Every exit court shall discharge into a public way or exit passage.
(b) Width. Exit court minimum widths shall be determined in accordance with the provisions of Section 3302, based on the tributary occupant load. The required width shall be unobstructed except for projections permitted in corridors in Section 3304. Where the width is reduced from any cause, the reduction shall be effected gradually by a guardrail at least 3 feet in height and making an angle of not more than 30 degrees with the axis of the exit court.
(c) Number of Exits. Every exit court shall be provided with exits as determined by Section 3302.
(d) Openings. All openings into an exit court less than 10 feet wide shall be protected by fire assemblies having not less than a three-fourths-hour fire-protection rating.

EXCEPTION: Openings more than 10 feet above the floor of the exit court may be unprotected.

SECTION 3311. EXIT PASSAGEWAYS.
(a) Construction. The walls of exit passageways shall be without openings other than required exits, and shall have walls, floors, and ceilings of the same fire-resistive rating required for the walls, floors and ceilings of the building served, with a minimum of one-hour fire-resistive construction. Exit openings throughout the enclosing walls of exit passageways shall be protected by fire assemblies having a three-fourths-hour fire-protection rating.
(b) Detailed Requirements. Exit passageways shall have width, height, and other construction requirements as required for corridors in Section 3304.
SECTION 3312. EXIT SIGNS AND ILLUMINATION.
(a) Exit Illumination. Exit areas shall be illuminated at all times the building is occupied, with light having an intensity of at least one foot candle at floor level.
   EXCEPTION: Group I, J and H-3 Occupancies. Exit illumination shall be provided from separate circuits or separate sources of power (but not necessarily separate from exit signs) when there are requirements for exit sign illumination. See Chapter 53 for additional requirements.
(b) Exit Signs. An illuminated exit sign, with white letters at least 5 inches high on a green background shall be provided from all areas serving the occupant load specified in this sub-section. The letters of the signs shall be lighted with 2 electric lamps of not less than 15 watts each. In addition, in interior stairways, an exit sign shall be provided at the floor level leading directly to the exterior. An exit sign shall be provided at every required exit doorway in Groups A through H Occupancies with an occupant load of more than 30, and shall clearly indicate the direction of egress.
   EXCEPTION: Main exterior exit doors which are clearly identifiable as exits need not have exit signs.
(c) Power Sources. See Chapter 53.
(d) Standby Source. In addition to the requirements of Chapter 53, the following occupancies shall be required to provide a standby power source separate from the Public power supply. (See Chapter 53 for wiring methods).
   1. Groups A, B, and F Occupancies with an occupant load of 300 or more, except churches.
   2. Group H-1 and H-2 Occupancies with an occupant load of 100 or more.
   3. See Chapter 53 for Group D Occupancies.
   4. See Chapter 38 for High Rise Building Requirements.

SECTION 3313. AISLES.
(a) General. Every portion of a building in which fixed seats are installed shall be provided with aisles leading to an exit.
(b) Width. Every aisle shall not be less than 3 feet wide if serving only one side, and not less than 3 feet 6 inches if serving both sides. The minimum width shall be measured at the point farthest from an exit, cross
aisle, or foyer, and shall be increased by 1-1/2 inches for each 5 feet in length toward the exit, cross aisle, or foyer. With continental seating as specified in Section 3314 (a), the side aisle shall be not less than 44 inches in width.

(c) **Distances to Nearest Exit.** In areas occupied by seats, and in Groups A and B Occupancies without seats, the line of travel to an exit door by an aisle shall be not more than 150 feet. Except as permitted in Sections 3315 and 3316.

(d) **Aisle Spacing.** With standard seating, as specified in Section 3314 (a), aisles shall be located so that there will be not be more than 6 intervening seats between any seat and the nearest aisle. With continental seating, as specified in Section 3314 (a), the number of intervening seats may be increased to 29 where exit doors are provided along side aisle in the proportion of one pair of exit doors for each five rows of seats. The exit doors shall provide a minimum clear width of 66 inches.

(e) **Cross Aisles.** Aisles shall terminate in a cross aisle, foyer, or exit. The width of the cross aisle shall be at least the sum of the required width of the widest aisle plus 50 percent of the total required width of the remaining aisles leading thereto. Dead end aisles shall not exceed 20 feet in Groups A, B and C Occupancies.

(f) **Vomitories.** Vomitories connecting the foyer or main exit with the cross aisles shall have a total width of at least the sum of the required width of the widest aisle leading thereto plus 50 percent of the total required width of the remaining aisles leading thereto.

(g) **Slope.** The slope portion of aisles shall not exceed 1 foot in 8 feet.

**SECTION 3314. SEATS.**

(a) **Seat Spacing.** With standard seating, the spacing of rows of seats shall provide a space of at least 12 inches from the back of one seat to the front of the most forward projection of the seat assembly immediately behind it, measured horizontally between vertical planes. With continental seating, the spacing of rows of seats shall provide a clear width measured horizontally as follows:

- 18 inches clear for rows of 18 seats or less.
- 20 inches clear for rows of 35 seats or less.
- 21 inches clear for rows of 45 seats or less.
- 22 inches clear for rows of 46 seats or more.
Automatic or self-rising seats shall be measured in the seat-up position; other seats shall be measured in the seat-down position.

(b) Bleacher Seats. Seats used in grandstands, bleachers and reviewing stands shall conform to Section 3324

SECTION 3315. EXITS: GROUP A OCCUPANCIES.

(a) Main Exit. Every Group A Occupancy shall be provided with a main exit. The main exit shall be of width to accommodate one-half of the total occupant load, but shall be at least the total required width of all aisles, exit passageways, and stairways leading thereto, and shall connect to a stairway or ramp leading to a public way.

(b) Side Exits. Every auditorium, of a Group A Occupancy shall be provided with exits on each side. The exits on each side of the auditorium shall be of width to accommodate one-third of the total occupant load served. Side exits shall open directly to a public way or into an exit court, exit stairway, exterior stairway, or exit passageway leading to a public way. Side exits shall be accessible from a cross aisle.

(c) Balcony Exits. Every balcony having an occupant load of more than 10 shall be provided with a minimum of 2 exits. Balcony exits shall open directly into a stairway or ramp. When there is more than one balcony, exits shall be accessible from a cross aisle. The number and distribution of exits shall be as specified in this Chapter.

(d) Panic Hardware. All exit doors specified in Sections (a), (b), and (c) herein shall not be provided with a latch or lock other than panic hardware.

(e) Aisles. See Section 3313.

(f) Maximum Travel Distance. Exits shall be so arranged so that the total length of travel from any point to an exit shall not exceed 150 feet.

EXCEPTION: When the building is protected throughout by an automatic fire sprinkler system, the distance may be increased to 200 feet.

SECTION 3316. EXITS: GROUP B OCCUPANCIES.

(a) Group B, Divisions 1, 2 and 3. Group B Divisions 1 and 2 shall have exits as required by Section 3315. In Group B, Division 3 Occupancies having an occupant load of more than 100, exit doors shall not be provided with a latch or lock other than panic hardware.

EXCEPTION: Panic hardware shall not be required on exit doors in churches with an occupancy load of less than 300.
(b) **Group B, Division 4.** In Group B, Division 4 Occupancies having an occupant load of more than 100, exit doors shall not be provided with a latch or lock other than panic hardware. Panic hardware may be waived on gates surrounding stadiums when the gates are under constant immediate supervision while the public is present, and provided dispersal areas are located between the stadium and fence. The required dispersal area shall be located at least 50 feet from the stadium.  

(c) **Skating Rinks.** Skating rinks shall be located at or near the adjacent ground level, and exits shall be by means of ramps.  

(d) **Maximum Travel Distance.** Exits shall be arranged so that the total length of travel from any point to an exit shall not exceed 150 feet.  
**EXCEPTION:** When the building is protected throughout by an automatic fire extinguishing system, the distance may be increased to 200 feet.  

**SECTION 3317. EXITS: GROUP C OCCUPANCIES.**  
(a) **Definitions.** For the purpose of this Section, certain terms are defined as follows:  

**Room.** A room is a space or area bounded by an obstruction to an exit passage which encloses more than 80 percent of the area. In computing the unobstructed perimeter, openings less than 3 feet clear width and less than 6 feet 8 inches high shall not be considered. Interior Room. A room whose only means of egress is through an adjoining or intervening room which is not an exit corridor.  

(b) **Maximum Travel Distance.** Exits shall be arranged to conform to the following:  

1. No point in a room in a building shall be more than 75 feet from an exit corridor, enclosed stairway, or exterior of the building.  
**EXCEPTION:** In buildings not more than two stories in height, an increase to 90 feet shall be permitted when the building is protected throughout with detectors of products of combustion other than heat. When a building is protected throughout by an automatic fire sprinkler system, the distance may be increased to 110 feet.
2. No point in a building without an automatic fire-sprinkler system shall be more than 150 feet measure along the line of travel, from exit door, horizontal exit, exit passageway, or enclosed stairway. In buildings not more than two stories in height, protected throughout with detectors of products of combustion other than heat, the distance may be increased to 175 feet. In a building protected throughout with an automatic fire sprinkler system, the distance may be increased to 200 feet.

c) Exits Through Adjoining Rooms. Interior rooms may exit through adjoining or intervening rooms, provided the total distance of travel through rooms to an exit corridor does not exceed that specified in Sub-section (b) 1, and provides a direct and unobstructed means of travel. The routes of exit travel shall not pass through kitchens, storerooms, rest rooms, closets, laboratories using hazardous materials, industrial shops, or similar spaces. Foyers and lobbies constructed as required for exit corridors shall not be construed as adjoining or intervening rooms. Where the only means of exit from a room, detectors of products of combustion other than heat shall be installed in the area of the common atmosphere through which the exit must pass. See Chapter 38.

d) Corridors and Exterior Exit Balconies. The width of a corridor in a Group C, Division 1 Occupancy shall be the width required by Section 3302, plus 2 feet; but no corridor shall be less than 6 feet wide.

**EXCEPTION:** When the number of occupants served is less than 100, the corridor may be 44 inches wide.

1. Corridor walls shall be of at least one-hour fire-resistive construction, with openings protected as required in Section 3304 (h).

**EXCEPTION:** When each room used for instruction has at least one exit door directly to the exterior at ground level, and when rooms used for assembly purposes have at least one-half of the required exits directly to the exterior at ground level, one-hour fire-resistive construction of corridor walls and ceilings shall not be required.

2. There shall be no change in elevation of less than 2 feet in a corridor or exterior balcony unless ramps are used.
(e) **Exit Serving Auditoriums in Group C, Division 1 Occupancy.** An
exit serving both an auditorium and other rooms need provide only for
the capacity of whichever requires the greater width if the auditorium
is not used simultaneously with the other rooms.

(f) **Stairs.** Each floor above or below the ground level shall have at least
two exit stairs. The required exit width shall be equally divided be-
tween the stairs. Stairs serving an occupant load of more than 100 shall
be at least 5 feet in clear width.

(g) **Basement or Cellar Rooms.** Exit stairways from a cellar or base-
ment shall open directly to the exterior of the building without enter-
ing the first floor corridor.

(h) **Panic Hardware.** Exit doors from rooms having an occupant load of
more than 50, and from corridors, shall not be provided with a latch or
lock other than panic hardware.

(i) **Fences and Gates.** School grounds may have fencing and gates
equipped with locks, provided dispersal areas are available for persons
between buildings and fences. Gates shall not be permitted across cor-
rridors or passageways leading to dispersal areas unless they comply
with exit requirements. See Section 3324 for exits from dispersal areas.

(j) **Arrangement and Access of Exits.** See Section 3302 (m).

**SECTION 3318. EXITS: GROUP D OCCUPANCIES.**

(a) **Patient Room Exits.** Every patient room in a Group D Occupancy
shall have access to at least 2 means of egress from the building without
passage through intervening rooms other than corridors, or lobbies or
accessory rooms. Required exterior exit doors shall open in the direc-
tion of exit travel.

(b) **Minimum Size of Exits.** Every exit opening through which patients
are transported in wheelchairs, stretchers, or beds shall provide a clear
width of at least 44 inches. There shall be no projections within the 44
inch clear width.

(c) **Corridors.** The minimum clear width of a corridor shall be 44 inches,
except that corridors serving any area housing nonambulatory persons
shall be at least 8 feet in width. There shall be no change of elevation
in a corridor serving nonambulatory persons unless ramps are used.
In Group D, Division 1 Occupancies such as jails, prisons, refor-
matories and similar buildings with open-barred cells forming corridor walls, the corridor and cell doors need not be fire resistive.

(d) **Basement Exits.** One exit accessible to every room below grade shall lead directly to the exterior at grade level.

(e) **Ramps.** See Section 3306.

(f) **Hardware.** Exit doors serving an occupant load of more than 50 shall not be provided with a latch or lock other than panic hardware. Patient room doors shall be openable from either side without the use of keys. **EXCEPTION:** No requirements of this Chapter shall be construed to prohibit the construction of cell blocks in jails, or prevent the use of any locks or safety devices where it is necessary to forcibly restrain the inmates.

(g) **Locking Devices.** In buildings housing occupancies in which the personal liberties of inmates or patients are restrained within the building, the exterior doors may be fastened with locks, provided that room doors shall not be fastened by other means than doorknobs or similar devices which can be opened readily from the corridor side without the use of keys or any special knowledge or effort.

(h) **Maximum Travel Distance.** Exits shall be arranged so that the total length of travel from any point to an exit shall not exceed 150 feet. **EXCEPTION:** When the building is protected throughout by an automatic fire sprinkler system, the distance may be increased to 200 feet.

**SECTION 3319. EXITS: GROUP E OCCUPANCIES.**

(a) **Number of Exits.** Every portion of a Group E Occupancy having a floor area of 200 square feet or more shall be served by at least 2 exits.

(b) **Maximum Travel Distance.** Exits shall be arranged to conform to the following:

1. In Divisions 1 and 2, no part of any room shall be more than 75 feet from an exit. In Divisions 3, 4, and 5, no part of any room shall be more than 150 feet from an exit. **EXCEPTION:** In a one-story Group E-5 Occupancy, the exit travel distance may be increased to 400 feet if the building is equipped throughout with an automatic fire extinguishing system.

(c) **Corridor Doors.** Doors leading to a corridor of fire-resistive construction shall have a minimum three-fourths hour fire protection rating, shall have not more than 100 square inches of wired glass set in steel
frames, shall be maintained by self-closing or automatic closing as required by Table 33-B, and shall open in the direction of exit travel.

SECTION 3320. EXITS: GROUP F OCCUPANCIES.
(a) Special Exit Requirements. At least 1/2 of the required exits shall be located to be reached without going through checkout stands. In no case shall check-out stands or associated railings or barriers obstruct exits or required aisles or approaches.
(b) Arrangement and Access of Exits. See Section 3302 for the number and arrangement of exits.
(c) Maximum Travel Distance. Exits shall be arranged so that the total length of travel from any point to an exit shall not exceed 150 feet.
EXCEPTION: When the building is protected throughout by an automatic fire sprinkler system, the distance may be increased to 200 feet.

SECTION 3321. EXITS: GROUP G OCCUPANCIES.
(a) Arrangement of Exits. See Section 3302 (k).
(b) Maximum Travel Distance. Exits shall be arranged so that the total length of travel from any point to an exit shall not exceed 150 feet.
EXCEPTIONS:
1. When the building is protected throughout by an automatic fire sprinkler system, the distance may be increased to 200 feet. See Chapter 38.
2. In open parking garages, the distance may be increased to 200 feet.

SECTION 3322. EXITS: GROUP H OCCUPANCIES.
(a) Arrangement of Exits. See Section 3302 (k).
(b) Maximum Travel Distance. Exits shall be arranged so that the total length of an individual living unit shall not exceed 50 feet or traverse more than one flight of stairs. The entrance door to any unit shall be within 100 feet of an exit or 150 feet when the entire building is protected by an automatic fire sprinkler system.
(c) Emergency Exits H-3 Occupancy. Sleeping rooms shall have at least one openable window or exterior door approved for emergency exit or rescue in accordance with Section 3323.

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SECTION 3323. EXITS: GROUP I AND J OCCUPANCIES.

(a) Emergency Exits. Sleeping rooms shall have at least one openable window or exterior door approved for emergency escape or rescue. All escape or rescue windows from sleeping rooms shall have a minimum net clear opening of 5.7 square feet and shall be operable from the inside without separate tools. The minimum net clear opening width dimension shall be 20 inches. The minimum net clear height dimension shall be 24 inches. Where windows are used as a means of escape or rescue they shall have a finished sill height not more than 44 inches above the floor. Screens shall be made easily removable. Bars, grills, grates or similar devices may be installed on an emergency escape or rescue window or door, provided:

1. Such devices are equipped with approved release mechanisms which are operable from the inside without the use of a key or special knowledge or effort, and
2. The building is equipped with smoke detectors installed in accordance with Section 3810.
3. Required escape windows below grade shall have a window well as defined in Section 3803(a)(1)E or as approved by the Department. (Rev. 4/84 Ord. No. 122)

(b) Stair Width. Stairways shall provide at least thirty inches of clear width. (Revised 4/81 Ordinance No. 172)

(c) Stair Rise and Run. The rise in every step in a stairway shall not exceed eight inches and the run shall not be less than nine inches. (Revised 4/81 Ordinance No. 172)

(d) Stair Handrails. See Section 3305 (i).

(e) Stair Headroom. Every required stairway shall have a headroom clearance of at least 6 feet 6 inches. Clearances shall be established by measuring vertically from a plane parallel and tangent to the stairway tread nosing to the soffit above.

(f) Door Width and Height. See Section 3303 (a) and (d).

(g) Change in Floor Level at Doors. See Section 3303 (h).
SECTION 3324. REVIEWING STANDS, GRANDSTANDS AND BLEACHERS.

(a) General. In addition to the requirements of Section 3316, reviewing stands, grandstands, and bleachers shall conform to the provisions of this Section.

(b) Definitions. For the purpose of this Section, certain terms are defined as follows:

**Bleachers.** Bleachers are seating facilities without backrests in which less than 3 square feet per person is assigned in computing the occupant load.

**Dispersal Area.** A dispersal area is an area which will accommodate a number of persons equal to the total capacity of the stands and building which it serves in a manner that persons within the area are at least 50 feet from the stand or building. Dispersal areas are based upon an area of not less than 3 square feet per person.

**Footboards.** Footboards are those parts of a raised seating facility, other than an aisle or cross-aisle, upon which the occupant of the stands walks to reach a seat, or upon which he may rest his feet.

**Grandstands.** Grandstands are seating facilities wherein an area of 3 square feet or more is provided for each person and where rows of seats are on an increasing height level by means of a terraced arrangement for placement of seats.

** Permanent Stands.** Permanent stands are seating facilities which remain at a location for more than 90 days.

**Reviewing Stands.** Reviewing stands are elevated platforms accommodating not more than 50 persons.

(c) **Height of Grandstands and Bleachers.** Grandstands or bleachers employing combustible members in the structural frame shall be limited to 11 rows or 9 feet in height.

(d) **Design Requirements.** See Chapter 23.

(e) **Row Spacing.** There shall be a clear space of at least 12 inches between the back or backrest of each seat and the front of the seat immediately behind it, measured horizontally. The minimum spacing of rows of seats, measured from back to back shall be:

1. Twenty-two inches for seats without backrests.
2. Thirty inches for seats with backrests.
3. Thirty-two inches for fixed or movable chair seating.

(f) Aisles.
1. Aisles Required. Aisles shall be provided in all seating facilities, except that aisles may be omitted when all of the following conditions exist:
   A. Seats are without backrests.
   B. The rise from row-to-row does not exceed 12 inches per row.
   C. The number of rows does not exceed 11 in height.
   D. The top seating board is not over 10 feet above grade.
   E. The first seating board is not more than 20 inches above grade.

2. Width. Aisles serving seats on both sides shall have a minimum width of 42 inches. When serving seats on only one side, the aisle shall have a minimum width of 36 inches.

(g) Cross-Aisle and Vomitaries. Cross-aisles and vomitories shall be at least 54 inches in clear width and shall extend to an exit, enclosed stairway, or exterior ramp.

(h) Stairs and Ramps. Stairs and ramps shall have a maximum rise and run as provided in Section 3305 (c) and Section 3306. Those within the seating area, and which serve as aisles perpendicular to the rows of seating shall have a rise not greater than 8 inches.

(i) Guardrails. Perimeter guardrails or enclosing walls shall be provided for all portions of elevated seating facilities more than 30 inches above the horizontal level. Construction and design of guardrails shall comply with Chapters 17 and 23.

EXCEPTION: The minimum guardrail height shall be 30 inches and a minimum of 36 inches in height at the end of an aisle or at the front of steps. Guardrails need not meet the 9 inch maximum spacing specified in Chapter 17; however, a mid-rail shall be installed.

(j) Toeboards. A 4 inch high vertical barrier shall be installed along the edge of walking surface wherever guardrails are required.

(k) Footboards. Footboards shall be provided for all rows of seats above the third row, or beginning at a point where the seating plank is more than 2 feet above grade. When the same platform is used for both seating and foot rests, footboards, will not be required, provided each level or platform is at least 24 inches wide.

(l) Special Requirements: Grandstands and Bleachers.
1. Grandstands and Bleachers Within Buildings. Grandstands within a building shall comply with the applicable Sections of this Chapter.

EXCEPTION: When seats are without backrests, there may be a maximum of nine seats between any seat and an aisle.

2. Open-Air Grandstands and Bleachers.

A. Number of Seats Between Aisles. The number of seats between any seat and an aisle shall not be greater than twenty when the seats have backrests.

B. Dead Ends. Dead ends in vertical aisles shall not exceed a depth of sixteen rows for permanent grandstands and twenty-six rows for temporary grandstands.

C. Distance to Exit. The line of travel from any seat to dispersal area, exit ramp, enclosed stairway, or vomitory shall not be more than 200 feet. When seats have no backrests, the distance may be measured by direct line.

D. Dispersal Area. Each dispersal area shall have a minimum of two exits. There shall be a minimum of three exits when more than 6000 persons are to be accommodated in a dispersal area, and a minimum of four exits when more than 9000 persons are to be accommodated. The aggregate clear width of exits from a dispersal area shall be determined on the basis of not less than one exit unit of 22 inches for each 500 persons to be accommodated, but no exit shall be less than 44 inches in width.

E. Exits Required. Two exits shall be provided from every grandstand which accommodates more than 300 persons. Three exits shall be provided from every grandstand which accommodates more than 1000 persons.

F. Determination of Exit Width. The total width of exits in feet shall be at least the total occupant load served divided by 150 when exiting by stairs, or divided by 200 when exiting by ramps, corridors, tunnels, or vomitories. No exit shall be less than 42 inches in width.

SECTION 3325. TABLES.
# TABLE NO. 33-A

## AVAILABLE SQUARE FEET PER OCCUPANT AND EGRESS FACILITIES

<table>
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<tr>
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<th>Rooms</th>
<th>Square Feet per Occupant</th>
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<td>Exits Req.</td>
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*Refer to Sections 3315 through 3323 for other specific requirements.*
# TABLE NO. 33-A

AVAILABLE SQUARE FEET PER OCCUPANT
AND EGRESS FACILITIES *

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<thead>
<tr>
<th>USE</th>
<th>Rooms</th>
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*TABLE NO. 33-B

REQUIREMENTS FOR FIRE RATED DOORS*
TABLE NO. 33-B
REQUIREMENTS FOR FIRE RATED DOORS *

A. Self-closing.
B. Automatic self-closing doors when activated by a magnetic device (See Chapter 43).
C. None required, except in dead-end corridors.
   * For occupancy separations and protection of openings. See Table 5-B.
   b Doors, with a minimum thickness of 1 3/4" solid wood may be permitted. Wire glass shall be installed in approved metal frames. (See Chapter 43).
   c Except jails, prisons, etc., where open barred cells are provided.
   d Less than 5 stories in height, one hour is permitted.
   e None required in patient room doors in institutions providing 24 hour supervision.
   f Doors rated over one hour shall be provided with a label by a recognized testing laboratory.
   s Wire glass (1/4 inch minimum thickness).

NOTE: See Chapter 17 for Boiler-Furnace Enclosures
CHAPTER 34

PREFABRICATED CONSTRUCTION

SECTION 3401. GENERAL.
(a) Purpose. The purpose of this Chapter is to regulate materials and establish methods of safe construction where any new structure or portion thereof is wholly or partially prefabricated.
(b) Scope. Unless otherwise specifically stated in this Chapter, all prefabricated construction and all materials used therein shall conform to all the requirements of this Building Code. See Chapter 1.
(c) Definition. (Prefabricated Assembly). A building or utility unit, the integral parts of which have been fabricated or assembled prior to incorporation in the building.

SECTION 3402. TESTS OF MATERIALS. Every approval of a material not specifically mentioned in this Building Code shall incorporate as a provision the kind and number of tests to be made during prefabrication.

SECTION 3403. TESTS OF ASSEMBLIES. The Department may require special tests to be made on assemblies to determine their durability and weather resistance.

SECTION 3404. CONNECTIONS. Every device designed to connect prefabricated assemblies shall be capable of developing the strength of the members connected as specified in Chapter 23. The connection device shall be designed as required by other Chapters in the Building Code. Connections between roofs, supporting walls and foundations shall be capable of withstanding an uplift force equal to the requirements contained in Chapter 23.

SECTION 3405. PIPES AND CONDUITS. Structural provisions shall be made for the removal or alteration of any member required for the installation of pipes, conduits, or other equipment.

SECTION 3406. CERTIFICATE AND INSPECTION.
(a) Materials. Materials and the assembly thereof shall be inspected to determine compliance with this Building Code. Every material shall be graded, marked, or labeled where required elsewhere in this Building Code.
(b) **Certificate.** A certificate of approval shall be furnished with every prefabricated assembly, except where the assembly is readily accessible to inspection at the site. The certificate of approval shall certify that the assembly in question has been inspected and meets all the requirements of this Building Code. When mechanical, electrical, or plumbing equipment is installed so that it cannot be inspected at the site, the certificate of approval shall certify that the equipment complies with the Chapters applying thereto. The certificate of approval shall be made by an approved Agency.

(c) **Field Erection.** Placement of prefabricated assemblies at the building site shall be inspected by the Department to determine compliance with this Building Code.

(d) **Continuous Inspection.** If continuous inspection is required for certain materials where construction takes place on the site, it shall also be required where the same materials are used in prefabricated construction.

**EXCEPTION:** Continuous inspection shall not be required during prefabrication if the approved agency certifies to the construction and furnishes evidence of compliance.

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**SECTION 3407. MANUFACTURED HOUSING.**

(a) **Definitions.**

1. Manufactured Housing shall mean factory assembled structures which are completely finished to include all utilities and are transported to a site for permanent installation as a residential unit(s). This shall include mobile homes and factory built housing as defined in State and Federal regulations.

2. Federal Act shall mean the National Manufactured Home Construction and Safety Standards Act of 1974, 42 USCA, Section 5401 to 5426 and the rules and regulations promulgated thereunder.

(b) **Factory Approval of Manufactured Housing Units (MHU)**

1. MHU manufactured in or out of state under the Federal Act are inspected and approved by a HUD authorized product Inspection Primary Inspection Agency (IPIA). The manufacturer shall permanently attach a HUD label (seal) to the exterior of the home on the tail light end of each transportable section. Each manufactured home shall bear a data compliance sheet (plate) permanently affixed to the interior of the home near the electrical panel in a visible location. The data compliance sheet (plate) shall show structural zone, snow and wind loads for which the home has been designed, thus determining whether the home does or does not meet the Colorado requirements of the Federal Act.

2. MHU manufactured in State and not constructed to the Federal Act shall be constructed in compliance with the Colorado Housing Act. The Colorado Division of Housing shall be the inspection agency and shall require a permanent Colorado approval label (seal) on each unit and shall contain a factory built (FB) certification number.

3. Other MHUs are not allowed. Prefabricated systems used for residential use shall comply with the other sections of this Chapter. For example:
   - A. Stressed skin panels assembled at the site for roof, floor and walls,
   - B. Shell type units

(c) **Permits Required**

1. The installation of MHUs shall comply with all provisions of the building code except that plans for the MHU are not required when either of the following items are provided to the Department:
   - A. A data compliance sheet for HUD approved manufactured housing units.
   - B. A copy of the Colorado approval label (seal) with a legible F.B. (Factory Built) certification number.

(d) **Colorado Division of Housing approval label (seal)** must be permanently affixed to each factory built home.

(e) **Inspection and Notice.** The Federal Act and the Colorado Housing Act preempt the Building Code to be applied to manufactured housing units, therefore the Department does not inspect them; however, shall
inspect the foundation, installation of utilities to the MHU and the installation of the MHU to the foundation.

1. The following notice shall be given to all persons applying for any permit relating to manufactured homes and factory built homes from any agency of the city;
   *In accordance with Federal and Colorado law, this manufactured housing unit has not been inspected by the City and County of Denver and may or may not meet the requirements of the Denver Building Code.*

   It shall be the obligation of the permit applicant to forward this notice to the owner of the manufactured home or factory built home.

2. The notice set forth in subsection 1 above shall be permanently installed in a visible location by the permit applicant adjacent to the data plate required by Federal Act on manufactured homes (HUD Code) or in the furnace closet on factory built homes (UBC).

(Rev. 6/21/88 Ord. No. 379)
CHAPTER 35

INSULATION

SECTION 3501. GENERAL.
(a) Scope. This Chapter shall require and govern the criteria for the approval and installation of thermal and sound insulation in all buildings and structures.

(b) Approval for Use.
1. All insulation, except those indicated in this Chapter for other test methods, shall be tested in accordance with ASTM E-84 for flame spread and smoke developed.
2. Noncombustible insulation shall be tested in accordance with ASTM E-136.
3. Fire resistive assemblies using insulation as a component thereof, shall be tested in accordance with ASTM E-119.
4. Insulation material shall be manufactured in conformance with the appropriate ASTM Standards as listed in this Chapter.
5. Insulation material shall be tested by an approved testing agency which provides a listing and a periodic inspection service.

(c) Additional Requirements.
1. Breather paper and vapor seals used as a component of insulating material shall be treated and tested as a component product in accordance with ASTM E-84.
   EXCEPTION: Breather paper not fire treated and tested, shall not be left exposed except as otherwise approved by the Department.
2. For additional insulation requirements of Heating, Cooling and Ventilating, See Chapters 50, 52 and 58 of this Building Code.

SECTION 3502. INSTALLATION.
(a) General. The following requirements shall apply to all insulation installed in or on walls, ceilings, floors, attics or crawl spaces unless otherwise specifically approved by the Department.

(b) Requirements. Insulation to be installed shall comply with the following provisions:
1. Insulation having a flame spread rating of 75 or less and a smoke rating of 450 or less may be installed within the cavity of a masonry or concrete wall, sealed on all sides.
2. Insulation having a flame spread rating of 75 or less and a smoke developed rating of 450 or less may be installed in conforming or non-conforming walls provided the insulation is protected from the interior atmosphere of the building by a thermal barrier having a finish rating of at least 15 minutes as determined by ASTM E-119, or as may be approved by the Department for cold rooms.
The method of attachment of the thermal barrier shall be in accordance with the method of attachment used in the test which establishes the finish rating.

(c) **Type III and V Buildings.** Insulation having a flame spread of 25 or less and a smoke developed of 50 or less may be installed in attics without protection.

(d) **Non-Combustible Insulation.** Non-Combustible insulation may be left exposed.

(e) **Fire Rated Assemblies.** Insulation may be installed in fire rated assemblies when the insulation was a part of the tested fire rated assembly.

**SECTION 3503. R-FACTOR REQUIREMENTS.**

(a) **H-3 and I Occupancies.** Insulation installed in new or existing Group H-3 and I Occupancies shall provide a minimum R Factor of 11 for walls and 19 for ceilings.

**SECTION 3504. IDENTIFICATION - TAG.**

(a) **General.** Each application of insulating material shall be identified by an appropriate tag or card permanently affixed in a conspicuous place near the insulated areas. The tag or card shall be on a form approved by the Department and shall include, without limitation, the following information:

1. The manufacturer's name, address and trade name of material used.
2. The contractors name and address.
3. Type of insulation (batt, blanket, loose, etc.)
4. Density, depth (inches), number of bags if loose fill, weight of each bag.
5. R-Factor (wall-ceiling.)
6. Laboratory approval number indicating conformance with ASTM C-739 requirements. Also label listing and follow-up service indication, flame spread and smoke.
7. Date of installation.
8. Signature of applicator certifying that these requirements have been complied with.

**SECTION 3505. PROHIBITIONS.**

(a) **General.** Insulation shall be prohibited in the following locations:

1. Insulation shall not be placed closer than 3 inches horizontally to transformers, recessed lighting. See N.E.C.
2. Insulation shall not be placed within 1 inch of Type B heating equipment vents, and 6 inches from any other type of heating vents or flues.
3. Insulation shall not be placed within 24 inches of attic type furnaces unless of non-combustible material.
4. Insulation shall not be placed over soffit, roof or foundation vents.
5. Loose type insulation shall not be placed over attic access doors. The access doors shall be insulated with batts or blanket insulation and securely fastened to the access door.
6. Insulation shall not be permitted in air plenums unless approved by the Department.
7. Foam plastics shall not be left exposed.

SECTION 3506. COMBUSTIBLE INSULATION BAG IDENTIFICATION.
(a) Requirements. In addition to the markings on each bag desired by the manufacturer, markings shall be provided in compliance with ASTM C-739, Section 12, and shall also include the following:
1. CAUTION (in enlarged letters). Do not cover recessed light fixtures and attic vents. Loose fill insulation shall be no closer than one inch to any Type B furnace or water heater vent pipe, bathroom vents or kitchen vents. Loose fill insulation shall not be placed closer than 24 inches of an attic type (horizontal) furnace or air handling equipment, or within 6 inches of any chimney.
2. Manufacturer's name, address, City and State including the Zip Code.
3. Average minimum weight in pounds.
4. The label of an approved independent testing laboratory listing compliance with CSPC Cellulose Insulation Standards HH-1-515 C or D.

SECTION 3507. ROOF INSULATION. Insulation to be installed in roofs shall conform to the manufacturer's instructions and shall be approved by the Department. When a Class A, B, or C roof is required, the insulation shall not deter from its classification.

SECTION 3508. INSULATION IN COLD ROOMS (Refrigerated). Insulation installed in cold rooms shall provide a flame-spread of 25 or less. This insulation shall be covered with galvanized sheet metal of not less than 26 gauge or aluminum of at least 0.032 lb. weight and shall be fabricated with mechanical fasteners.
SECTION 3509. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply.

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CHAPTER 36
PENTHOUSES AND ROOF STRUCTURES

SECTION 3601. PENTHOUSES AND ROOF STRUCTURES.

(a) Height. No penthouse or other projection above the roof in structures of other than Type I construction shall exceed 28 feet in height above the roof when used as an enclosure for tanks or for elevators which run to the roof, and in all other cases shall not exceed more than 12 feet in height above the roof.

(b) Area. The aggregate area of all penthouses and other roof structures shall not exceed 33-1/3 percent of the area of the supporting roof.

(c) Prohibited Uses. No penthouse or any other similar projection above the roof shall be used for purposes other than shelter of mechanical equipment or shelter of vertical shaft openings in the roof. Penthouses used for purposes other than permitted by this Section shall conform to the requirements of this Building Code for an additional story.

(d) Construction. Roof structures shall be constructed with walls, floors and roof as required for the main portion of the building.

EXCEPTIONS:

1. On Type I and II buildings, the exterior walls and roofs of penthouses which are 5 feet or more from an adjacent property line may be of one-hour fire-resistive noncombustible construction.

2. On Type III buildings, walls not less than 5 feet from a property line may be of one-hour fire-resistive noncombustible construction.

3. Enclosures housing only mechanical equipment and located at least 20 feet from adjacent property lines may be of unprotected noncombustible construction.

4. On one-story buildings, unroofed mechanical equipment screens, fences, or similar enclosures may be of combustible construction when located at least 20 feet from adjacent property lines, and when not exceeding 6 feet in height above the roof surface.

SECTION 3602. TOWERS AND SPIRES.

(a) General. Towers or spires, when enclosed, shall have exterior walls as required for the building to which they are attached. Towers not enclosed, and which extend more than 75 feet above grade, shall have their framework constructed of structural steel or reinforced concrete. No tower or spire shall occupy more than 1/4 of the street frontage of any building to which it is attached, and in no case shall the base area exceed 1,600 square feet, unless it conforms entirely to the type of construction requirements of the building to which it is attached and is limited in height as a main part of the building. The roof covering of
spires shall be fire retardant if required for the main roof of the building to which it is attached. Skeleton towers used as radio masts and placed on the roof of any building shall be constructed entirely of non-combustible materials when more than 25 feet in height. When placed on existing buildings, the structure shall be checked by an Engineer and a report or drawings submitted to the Department in order to assure that the building can sustain this additional loading.
CHAPTER 37

CHIMNEYS AND VENTS

SECTION 3701. GENERAL.

(a) **Scope.** In addition to the other requirements of this Building Code, this Chapter shall govern the installation, maintenance, repair and approval of all chimneys, vents, and connectors. For additional requirements for incinerators, see Chapter 48.

(b) **Special Engineered Vent System Tables.** Approved vent system tables may be used in determining vent and vent connector sizing.

(c) **Prohibitions:**
   1. The use of a shelf or bracket type chimney is prohibited.
   2. Draft hoods shall not be used on equipment with power burners or induced draft fans.

(d) **Existing Chimneys.** When inspection reveals that an existing chimney is not safe for the intended application, the chimney shall be rebuilt, replaced, or repaired to conform to the requirements of this Chapter.

(e) **Access.** A cleanout or connector shall be accessible. Crawl spaces shall not be used for this purpose.

(f) **Starting Level and Support.** Only vents and factory-built chimneys may start at any desired level. Vents and factory-built chimneys shall be securely anchored to the building so that they cannot be dislodged in any direction. All runs shall be strapped. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of not more than 5 feet and at every change in direction.

(g) **Offsetting Inlets.** Where 2 or more inlets are provided in any vent or chimney, the inlets shall be offset so that no portion of any inlet shall be opposite other inlets.

SECTION 3702. DEFINITIONS. Except as otherwise provided, terms and symbols used in this Chapter shall be defined as follows:

(a) **Appliance Connector.** The pipe used to connect a fuel-fired appliance to a vent or a chimney.

(b) **Chimney.** A chimney is a hollow shaft containing one or more passageways, vertical or nearly so, for conveying products of combustion to the outside atmosphere.

(c) **Chimney, Bracket or Shelf Chimneys.** One which terminates below the ceiling of the area in which they originate.

(d) **Chimney, Factory-Built.** An approved, listed chimney.

(e) **Chimney, Masonry.** A chimney of solid masonry units, brick, stone, hollow masonry units, or reinforced concrete.

(f) **Chimney, Metal.** A single-wall unlisted sheet metal hollow cylinder used for conveying products of combustion.
(g) **Chimney, Residential Appliance Type.** An approved factory-built or masonry chimney suitable for removing products of combustion from residential type appliances of 1000 degrees F. or less measured at the appliance flue outlet.

(h) **Chimney, Low Heat Appliance Type.** A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning low-heat appliances producing combustion gases not in excess of 1000 degrees F. under normal operating conditions but capable of producing combustion gases of 1400 degrees F. during intermittent forced firing for periods of up to one hour. All temperatures shall be measured at the appliance flue outlet.

(i) **Chimney, Medium-Heat, Appliance Type.** A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning medium-heat appliances producing combustion gases in excess of 2000 degrees F. measured at the appliance flue outlet.

(j) **Chimney, High-Heat Appliance Type.** A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning high-heat appliances producing combustion gases in excess of 2000 degrees F. measured at the appliance flue outlet.

(k) **Chimney Liner.** A product of fire clay or other approved material that meets the requirements of ASTM C-27.

(l) **Combustible Material.** (See Chapter 4).

(m) **Draft Hood.** A device attached to or made a part of the vent outlet from an appliance, and designed to:
   1. Insure the ready escape of the products of combustion in the event of no draft, back-draft, or stoppage in the vent beyond the draft hood.
   2. Prevent a backdraft from entering the appliance.
   3. Neutralize the effect of stack section of the flue during operation of the appliance.

(n) **Firebrick.** A refractory brick which meets the requirements of ASTM Standard C-27.

(o) **Listed.** Products published by an approved nationally recognized testing agency.

(p) **Power Induced Draft Fan.** A fan installed in or on a chimney, vent, or the connector to a chimney or vent, to induce a draft at the connected appliance.

(q) **Vent.** A conduit or passageway, for conveying products of combustion to the outside atmosphere.

(r) **Venting System, Manufactured.** A vent, vent connector, and cowl cap assembled to form a continuous open passageway from the appliance to the outside atmosphere for the purpose of removing combustion gases.
1. Types of Venting Systems.
   A. Type B and Type B-W. A gas venting system consisting of listed vent piping, fittings, and cowl cap listed for use with listed gas appliances with draft hoods.
   B. Type L. A venting system consisting of listed vent piping and fittings for use with Type L or with listed appliances.

SECTION 3703. MASONRY CHIMNEYS.

(a) Draft. Every chimney, vent or venting system shall be capable of producing a draft at the appliance not less than that required for the safe operation of the appliance connected thereto.
   1. Induced draft or forced draft fans may be used to increase insufficient draft. See Chapter 48 for incinerators.
   2. When a fan is used, provisions shall be made to shut off the fuel supply to the appliance in the event of failure of the fan.
   3. When equipment is power-vented, no other atmospheric vented equipment shall be vented into the same chimney or vent.

(b) Structural Design Masonry. Chimneys shall be designed, anchored, supported and reinforced as required in this Chapter and Chapters 23, 24, 26, and 29. Chimneys shall not support any structural load other than their own weight unless designed to act as supporting members. Chimneys in exterior walls of wood-frame buildings shall be anchored laterally at the ceiling line or at each floor line which is more than 6 feet above grade, except when entirely within the framework.

(c) Walls. Every masonry chimney shall provide walls of masonry units, brick, stone, reinforced concrete or equivalent solid thickness of hollow masonry, and lined with suitable liners in accordance with the following requirements:
   1. Masonry Chimneys for Residential-Type Appliances. They shall be constructed with walls at least 4 inches thick, or stone at least 12 inches thick. A chimney liner shall be provided in accordance with item (d) of this Section.
   2. Masonry Chimneys for Low-Heat Appliances. They shall be constructed with walls 8 inches thick, or stone at least 12 inches thick. A chimney liner shall be provided in accordance with item (d) of this Section.
   3. Masonry Chimneys for Medium-Heat Appliances. They shall be constructed with walls at least 8 inches thick, or stone at least 12 inches thick. In addition, they shall be lined with at least 4-1/2 inches of firebrick laid in a solid bed of fire clay mortar with solidly filled head, bed, and wall joints. The lining shall commence at least 2 feet below the chimney connector entrance and extend for a distance of at least 25 feet above the chimney connector entrance.
4. Masonry Chimneys for High-Heat Appliances. They shall provide exterior walls constructed of solid masonry units or of reinforced concrete of at least 8 inches in thickness. The interior walls shall be of at least 4-1/2 inches firebrick in thickness laid in a solid bed of fire clay mortar with solidly filled head, bed, and wall joints, with a 2-inch air space between the firebrick and the chimney wall.

(d) **Fire Clay Lining.** Fire clay lining shall be 5/8 inch thick extended from a point 8 inches below the lowest inlet, or in the case of fireplaces, from the throat of the fireplace to a point above enclosing masonry walls. Each liner shall be installed ahead of the construction of the chimney, carefully bedded on the lower section in fire clay mortar, with close-fitting joints left smooth on the inside. Firebrick, 2 inches thick, may be used in lieu of fire clay chimney lining as set forth in Table 37-A.

(e) **Area.** Chimney passageways shall not be smaller in area than the vent connection of the appliance attached thereto and at least that as set forth in Table 37-A. Engineering methods approved by the Department may be used to design the system. The effective cross-sectional area of the chimney shall not exceed 4 times the cross-sectional area of the chimney connectors entering the chimney.

(f) **Height.** Unless otherwise required in this Chapter, every masonry chimney shall extend at least 3 feet above the highest elevation of any part of a building within 10 feet of the chimney.

(g) **Corbeling.** See Chapter 24.

(h) **Change in Size or Shape.** Changes in the size or shape of a masonry chimney, where the chimney passes through the roof, shall not be permitted within a distance of 6 inches above or below the roof joist or rafters.

(i) **Separation of Masonry Chimney Passageways.** When more than one passageway is contained in the same chimney, masonry separation at least 4 inches thick, bonded into the masonry wall of the chimney, shall be provided to separate the passageways.

(j) **Inlet Openings.** Every inlet opening in a masonry chimney shall enter its side. Each opening shall be lined with a thimble or sleeve of at least 25 gauge metal.

(k) **Clearance.** Combustible material shall not be placed within 4 inches of the interior chimney liner or masonry walls when built within a structure, or within one inch when the chimney is built entirely outside the structure. For other requirements for fireplaces, see Chapter 48.

(l) **Cleanouts.** An accessible cleanout assembly consisting of a thimble or sleeve with a tight fitting cover shall be provided at least 12 inches below the lowest inlet opening into the chimney.
SECTION 3704. TYPES OF CHIMNEYS AND VENTS REQUIRED. The type of chimney to serve the various classification of appliances shall be as set forth in Tables 37-B and 37-C.

SECTION 3705. METAL CHIMNEYS.
(a) Design. Metal chimneys shall be listed, or provide a minimum thickness equal to No. 10 U.S. gauge steel and shall be designed and constructed as specified in Table 37-F and Chapters 23 and 27.
(b) Construction. Unlisted single-wall metal chimneys shall be riveted or welded, and unless structurally self-supporting, shall be guyed, or firmly anchored to, or otherwise supported by the building or structure served thereby.
1. Lining. See Table 37-F.
2. Termination. Metal chimneys shall terminate as required by Table 37-F.
3. Clearance. See Table 37-F.
4. Foundations. Metal chimneys shall be supported on properly designed foundations of masonry, reinforced concrete, or other non-combustible material.
5. Enclosure for Interior Chimneys. Metal chimneys in other than a one-story building shall be enclosed above the story in which the appliance served is located in a chase of noncombustible construction which provides fire-resistive rating of at least one hour, if the building is less than 4 stories in height; and not less than 2 hours if the building is 4 stories or more in height. There shall be space on all sides of the chimney accessible for examination and repair. The enclosing walls shall be without openings. EXCEPTION: Inspection openings equipped with an equivalent fire rating may be permitted at each floor level for inspection purposes.

SECTION 3706. FACTORY-BUILT CHIMNEYS.
(a) Factory-Built Chimneys. Listed chimneys shall be installed in strict accordance with the terms of their listings and the manufacturer's instructions.
(b) Multiple Venting in Vertical Shafts. Factory-built chimneys utilized with pre-fabricated metal fireplaces may be used in a common vertical shaft having the required fire-resistive rating.

SECTION 3707. USE OF VENTING SYSTEMS.
(a) Type B Gas Vents. Type B gas vents shall be used only with listed gas appliances with drafthoods and shall not be used for venting the following:
1. Incinerators.
2. Appliances which may be converted to the use of solid or liquid fuels.
3. Appliances listed for use with chimneys only.
4. Any appliance which produces flue products in excess of 550 degrees F. at the inlet of the diverter.
5. The use of draft regulators (barometric dampers) with type B gas vents is prohibited.

(b) **Type BW Gas Vents.** They shall be used only with vented recessed gas wall furnaces listed for use with these vents.

(c) **Type L Venting System.** They shall be used only with appliances listed for this use.

**SECTION 3708. INSTALLATION REQUIREMENTS FOR VENTS.**

(a) **Termination.** Each vent shall extend above the roof surface through its flashing and shall terminate in an approved listed cap with a venting capacity of at least that of the vent. The outlet opening of any vent shall be at least 24 inches from any portion of the building; at least 10 feet from any portion of the building or structure which extends at an angle of more than 45 degrees upward from the horizontal. Also see Table 37-F.

1. Gravity operated vents shall not terminate less than 5 feet in vertical height above the lower skirt of the draft hood of the highest connected appliance.

(b) **Venting System.** Draft fans may be used in lieu of natural draft vents for any gas appliance when the appliance is approved for this use. When fans are used with gas appliances requiring venting, controls shall be installed to prevent the flow of gas to the main burner in the event of failure of the fan.

1. The vent terminals of power-equipped gas venting systems shall be located at least 10 feet from any building opening and at least 10 feet above grade when located adjacent to public walkways.

(c) **Venting Through Ventilating Hoods and Exhaust Systems.**

1. **Commercial Appliances.** Ventilating hoods and power exhaust systems may be used to vent gas-burning appliances installed in commercial applications.

2. **Dampers Prohibited.** When automatically operated appliances, such as water heaters, are vented through ventilating hoods, dampers shall not be installed in the ventilating system.

3. **Interlock Controls.** The appliance control system shall be interlocked so as to permit appliance operation only when the power exhaust system is in operation.

(d) **Type B, BW Termination.** A Type BW gas vent, or combination of Type BW and Type B, shall terminate at an elevation of at least 12 feet above the bottom of the wall furnace.
(e) **Clearances.** All vents shall be installed with clearances to combustibles as specified in this Section, or in accordance with the individual listings.

1. Single-wall metal pipe may be used as a gas vent only, provided it is installed with minimum clearances from combustible material as follows:
   
   A. Appliances without draft hoods: 18 inches.
   B. Boilers and furnaces equipped with listed conversion burners and draft hoods: 9 inches.
   C. Listed appliances with draft hoods: 6 inches.
   D. For listed gas-burning appliances with draft hoods, when penetrating a combustible wall, an approved thimble, 4 inches larger in diameter than the vent, may be used. If there is a run of 6 feet or more of vent pipe in the open, between the draft hood outlet and the thimble, the thimble may be 2 inches larger in diameter than the vent pipe.
   E. Metal pipe vents passing through a wall or roof constructed of combustible material, shall be guarded at the point of passage as specified for exterior wall by Subsection D; or by metal thimbles at least 2 inches larger in diameter than the pipe packed with approved noncombustible insulating material.

(f) **Protection.** Provisions shall be made to prevent mechanical injury to the vents where subject to damage.

(g) **Support.** All portions of gas vents and chimneys shall be properly supported and spaced in accordance with their listings and the manufacturer's instructions.

(h) **Size.** Every gravity vent shall be of a size at least that of the draft hood collar of the appliance attached. In no case shall the area be less than the area of a 3 inch diameter pipe. When more than one appliance is connected into a vent, the vent area shall be at least the area of the largest vent connector plus 50 percent of the areas of the additional vent connectors.

**EXCEPTION:** The size of gravity vents and their connectors shall not apply when engineered venting methods are approved by the Department.

(i) **Vent Offsets.** Unless part of an engineered venting system, vents shall have no more than 2 offsets of not more than 45 degrees from the vertical.

1. When approved by the Department, a vent may have one offset of not more than 60 degrees from the vertical.
2. Any angle greater than 45 degrees from the vertical is considered horizontal.
SECTION 3709. CHIMNEY CONNECTORS AND VENT CONNECTORS.

(a) Materials. Vent or chimney connectors shall be constructed of metal of at least the following gauges:

<table>
<thead>
<tr>
<th>Galvanized Sheet</th>
<th>Diameter of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge No.</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Less than 6 inches</td>
</tr>
<tr>
<td>26</td>
<td>Less than 10 inches</td>
</tr>
<tr>
<td>22</td>
<td>10 to 12 inches</td>
</tr>
<tr>
<td>20</td>
<td>14 to 16 inches</td>
</tr>
<tr>
<td>16</td>
<td>Over 16 inches</td>
</tr>
</tbody>
</table>

1. Connectors serving listed appliances with draft hoods may be constructed of Type B, or when the former is not required, it may be constructed of single-wall metal provided it meets the limitations of use specified in this Chapter.

(b) Installation.

1. Inter-connections. 2 or more vent or chimney connectors shall not be joined unless the common connector, the manifold, and the vent or chimney are properly sized to serve the appliances connected. Adequate draft shall be made available to remove all products of combustion to the outdoors. Gas and oil appliances so connected shall be equipped with primary safety controls. Connectors serving gravity-vent type appliances shall not be connected to a chimney, vent, or venting system served by a power exhauster or power burner.

2. Clearance. Single-walled metal connectors shall be installed with clearance to combustibles as indicated in Table 37-D.

3. Size. The connector, for its entire length, shall be not smaller than the flue collar of the appliance.

   EXCEPTION: Unless otherwise recommended by the manufacturer of the appliance, chimney or vent, or part of an engineered venting system as may be approved by the Department.

4. Location. When the connector used for a gas appliance with a draft hood is located in or passes through an attic, crawl space, or other cold area, that portion of the connector shall be of listed Type B vent material.

5. Length. All connectors shall be as short and straight as possible. The appliance shall be located as close as practical to the chimney, gas vent, or venting system. The connector shall not exceed 75 percent of the portion of the chimney or vent above the inlet connection. In no case shall the total horizontal length be greater than 15 feet unless part of an engineered venting system.
6. Passage Through Walls. Connectors for listed gas appliances with draft hoods may pass through walls or partitions constructed of combustible material if made of listed Type B, or Type L material, and installed with not less than listed clearances to combustible material. Connectors shall be exposed to view throughout their length. Connectors serving low, medium, or high-heat appliances as classified in Table 37-B shall not pass through walls or partitions, but shall be located in the same space as the appliance and shall be visible throughout their entire length.

7. Resistance. Connectors shall be installed so as to avoid sharp turns or other construction features which would create excessive resistance to the flow of combustion gases. Devices which will obstruct the free flow of combustion gases shall not be installed in a connector, chimney, or vent. This shall not be construed to prohibit the use of devices specifically listed for installation in a connector, such as draft regulators and safety controls.

8. Joints. Chimney and vent connectors shall be securely supported, and joints fastened with sheet metal screws, rivets, or welds. All runs shall be strapped. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of not more than 5 feet, and at every change in direction.

9. Connection. A connector to a masonry chimney shall extend through the wall to the inner face of the liner but not beyond. A thimble shall be used to facilitate removal of the connector for cleaning. The thimble shall be permanently cemented in place with high temperature cement. See Section 3703(k). Chimneys or vents shall not have connector openings in each story of a building, unless provision is made for completely closing the openings with devices made of noncombustible materials whenever their use is discontinued.

10. Fireplace. A connector shall not be connected to a chimney serving a fireplace unless the fireplace opening or the chimney which vents the fireplace is permanently sealed below the connection, and a cleanout provided as per Section 3703(m).

11. Draft Regulators. A draft regulator shall be installed in the connector serving a liquid fuel-burning appliance unless the appliance is approved for use without the regulator. A draft regulator may be installed in the connector serving a listed gas incinerator when recommended by the incinerator manufacturer. These draft regulators shall be installed in accordance with the installation instructions accompanying the incinerator. A draft regulator, furnished as part of a listed gas appliance shall be installed in the connector serving the appliance. A draft regulator, when used, shall be installed in the same room or enclosure as the appliance.
so that no difference in pressure between air in the vicinity of the
regulator and the combustion air supply will exist.

12. **Rise.** Every vent connector which is part of a gravity-type venting
system shall have a continuous rise of at least 1/4 inch per foot of
length, measured from the appliance vent collar to the vent.

**SECTION 3710. SPECIAL VENTING ARRANGEMENTS.** Listed ap-
ppliances which provide a sealed combustion chamber and which are so con-
structed and installed that all air for combustion is derived from outside the
building and all flue gases are discharged to the outside atmosphere shall be
considered as properly vented when installed in accordance with their listing
and manufacturer's instructions. Venting requirements as set forth in this
Chapter shall not apply. For other requirements, See Chapters 51 and 52.

**SECTION 3711. DRYER VENTS.**

(a) **Vents for Domestic Clothes Dryers (Type I).**

1. A clothes dryer shall not be connected into any vent connector,
gas vent or chimney serving other equipment. Dryer vents shall
not terminate in a crawl space, attic, or other similar concealed
space.

2. Clothes dryer vents shall be constructed of galvanized steel
(minimum gauge No. 26), or aluminum (minimum gauge No. 24).
All joints and seams shall be tight fitting with a minimum of 3
sheet metal screws (not to exceed 1/4 inch in length) or blind
rivets. Rivets shall not be installed at the vent connection to the
dryer. This joint shall be provided with metal screws. All joints
shall be lapped in the direction of the air flow. The use of duct tape
on vents is prohibited.

3. The size of the clothes dryer vents shall be at least the size
specified by the manufacturer. The length of the vent shall not ex-
ceed the manufacturer's recommendations.

4. Clothes dryers shall be vented independently. All vents shall dis-
charge to the outside atmosphere. A minimum of 12 inches shall
be provided from vent discharge opening to any door, window or
from any opening into the structure.

5. Clothes dryer vent discharge openings shall be provided with a
back draft damper.

6. The use of flexible ducts or vibration isolation connectors on gas
fired dryer vents is prohibited.

(b) **Vents for Commercial Clothes Dryers (Type II).**

1. A clothes dryer vent shall not be connected into any vent connec-
tor, gas vent, or chimney serving other equipment. Dryer vents
shall not terminate in a crawl space, attic or other similar con-
cealed space.
2. Vents for commercial clothes dryers shall be constructed of not less than No. 24 gauge galvanized sheet steel.
3. Commercial type clothes dryers shall be equipped or installed with lint controlling devices.
4. Vents from commercial clothes dryers shall have a clearance of at least 6 inches to combustible material.
5. All joints and seams shall be tight fitting with a minimum of 3 sheet metal screws (not to exceed 1/4 inch in length) or 3 blind rivets. Rivets shall not be installed at the vent connection to the dryer but shall be provided with metal screws. All joints shall be lapped in the direction of the air flow. The use of duct tape on vents is prohibited.
6. The use of flexible ducts or vibration isolation connectors on commercial dryer vents is prohibited. The use of slip sleeves to eliminate vibration in exhaust ducts shall be permitted. Slip sleeves, if used, shall provide a minimum length of 12 inches.
7. The size of commercial clothes dryer vents shall be at least the size specified by the manufacturer. The length of the vent shall not exceed the manufacturer's recommendations.
8. All clothes dryers shall be vented independently. All vents shall discharge to the outside atmosphere.

**EXCEPTION:** Engineered systems.

9. Dryer vent discharge openings shall not be located within 10 feet of openings into the building.

10. All dryer vent openings shall be provided with a U bend or discharge earthward to be weather-proof. Screens shall not be used on dryer vent discharge duct openings. Vent openings shall be located a minimum of 3 feet above the roof surface. Back draft dampers may be used at exhaust discharge openings.

**SECTION 3712. STANDARDS.** Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
</table>

37-11
**LEGEND**

**ORGANIZATION**

**ASTM**
American Society for Testing and Materials  
1916 Race Street  
Philadelphia, Pa. 19103

**ANSI**
American National Standards Institute  
1430 Broadway  
New York, New York 10018

**NFPA**
National Fire Protection Association  
Battery March Park  
Quincy, Mass. 02269

**SECTION 3713. TABLES.**

---

**TABLE NO. 37-A**

**MINIMUM PASSAGE AREAS FOR MASONRY CHIMNEYS**

<table>
<thead>
<tr>
<th>Type of Masonry Chimney</th>
<th>MINIMUM CROSS SECTIONAL AREA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Round</td>
<td>Square or Rectangle</td>
</tr>
<tr>
<td>Residential&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50 Sq. In.</td>
<td>50 Sq. In.</td>
</tr>
<tr>
<td>Fireplace&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1/12 of opening</td>
<td>1/10 of opening</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>Minimum</td>
</tr>
<tr>
<td></td>
<td>50 Sq. In.</td>
<td>64 Sq. In.</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> Areas for medium and high-heat chimneys shall be determined using accepted engineering methods and as approved by the Department.

<sup>b</sup> Where fireplaces open on more than one side, the fireplace opening shall be measured along the greatest dimension.
TABLE NO. 37-B
CHIMNEY SELECTION CHART
TYPES OF APPLIANCES TO BE USED WITH EACH TYPE CHIMNEY
(See Table 37-C for gas appliances)

<table>
<thead>
<tr>
<th>COLUMN I</th>
<th>COLUMN II</th>
<th>COLUMN III</th>
<th>COLUMN IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COLUMNS FOR RESIDENTIAL APPLIANCES</strong></td>
<td><strong>COLUMNS FOR LOW HEAT APPLIANCES</strong></td>
<td><strong>COLUMNS FOR MEDIUM HEAT APPLIANCES</strong></td>
<td><strong>COLUMNS FOR HIGH HEAT APPLIANCES</strong></td>
</tr>
<tr>
<td>1. Factory Built (Residential)</td>
<td>1. Factory Built (low heat)</td>
<td>1. Factory Built (medium heat)</td>
<td>1. Masonry (high heat type)</td>
</tr>
<tr>
<td>3. Metal (smokestack)</td>
<td>3. Metal (smokestack)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appliances such as:</th>
<th>All appliances in Column I.</th>
<th>Columns I and II, and</th>
<th>Columns I, II and III, and</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ranges</td>
<td>Heating equipment other than</td>
<td>Appliances such as:</td>
<td>Appliances such as:</td>
</tr>
<tr>
<td>2. Warm-air furnaces</td>
<td>residential.</td>
<td>1. Albaster gypsum kilns</td>
<td>1. Bessemer retorts and cupolas</td>
</tr>
<tr>
<td>3. Water heaters</td>
<td>Appliances such as:</td>
<td>2. Annealing furnaces</td>
<td>2. Billet and bloom furnaces</td>
</tr>
<tr>
<td>(not over 15 p.s.i.g.)</td>
<td>3. Boiling vats, for fibre</td>
<td>5. Feed, fertilizer and pulp</td>
<td>5. Brass furnaces</td>
</tr>
<tr>
<td></td>
<td>12. Nickel plate driers</td>
<td>not over 50 p.s.i.g.</td>
<td>14. Pudding furnaces</td>
</tr>
<tr>
<td></td>
<td>not over 50 p.s.i.g.</td>
<td>16. Wood-gas retorts</td>
<td>17. Stacks, carburetor or super-</td>
</tr>
<tr>
<td></td>
<td>15. Sulphur furnaces</td>
<td>17. Incinerators (Commercial</td>
<td>heating furnaces</td>
</tr>
<tr>
<td></td>
<td>16. Type and lead furnaces</td>
<td>and industrial)</td>
<td>18. Vitreous enameling ovens</td>
</tr>
<tr>
<td></td>
<td>18. Zinc amalgamating furnaces</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* May be used to vent Domestic Incinerators in Group I Occupancies if constructed of 4 inch brick, with tile liner and does not leak flue gas, provided the incinerator is listed.
<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type B Gas Round</td>
<td>Type BW Gas</td>
<td>Type L</td>
<td>Metal Pipe</td>
</tr>
<tr>
<td>All listed gas</td>
<td>1. Recessed wall furnaces</td>
<td>1. Low temperature flue gas appliances</td>
<td>(Single wall)</td>
</tr>
<tr>
<td>appliances with</td>
<td></td>
<td>listed for use with Type L venting</td>
<td></td>
</tr>
<tr>
<td>draft hoods such as:</td>
<td></td>
<td>systems</td>
<td></td>
</tr>
<tr>
<td>1. Central furnaces</td>
<td></td>
<td>2. Gas appliances shown in Column I</td>
<td></td>
</tr>
<tr>
<td>2. Heating boilers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Ranges and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ovens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Recessed wall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>furnaces (above wall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>section)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Room and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unit heaters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Water heaters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Duct Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Horizontal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE NO. 37-D

**CONNECTOR CLEARANCE**

<table>
<thead>
<tr>
<th>DESCRIPTION OF APPLIANCE</th>
<th>MINIMUM CLEARANCES (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESIDENTIAL APPLIANCES</strong></td>
<td></td>
</tr>
<tr>
<td>Column I (Table 37-B)</td>
<td></td>
</tr>
<tr>
<td>Gas appliances without draft hoods</td>
<td>18</td>
</tr>
<tr>
<td>Electric, gas and oil incinerators</td>
<td>18</td>
</tr>
<tr>
<td>Oil and solid-fuel appliances</td>
<td>18</td>
</tr>
<tr>
<td>Unlisted gas appliance with draft hoods</td>
<td>9</td>
</tr>
<tr>
<td>Boilers and furnaces with listed burner and draft hood</td>
<td>6</td>
</tr>
<tr>
<td><strong>COMMERCIAL-INDUSTRIAL APPLIANCES</strong></td>
<td></td>
</tr>
<tr>
<td>Low-heat Appliances. Column II (Table 37-B)</td>
<td></td>
</tr>
<tr>
<td>Gas, oil, and solid-fuel boilers, furnaces and water heaters</td>
<td>18</td>
</tr>
<tr>
<td>Ranges, restaurant type</td>
<td>18</td>
</tr>
<tr>
<td>Oil unit heaters</td>
<td>18</td>
</tr>
<tr>
<td>Unlisted gas unit heaters</td>
<td>18</td>
</tr>
<tr>
<td>Listed gas unit heaters with draft hoods</td>
<td>6</td>
</tr>
<tr>
<td>Other low-heat industrial appliances</td>
<td>18</td>
</tr>
<tr>
<td>Medium-heat Appliances. Column III (Table 37-B)</td>
<td></td>
</tr>
<tr>
<td>All gas, oil, and solid-fuel appliances</td>
<td>36</td>
</tr>
</tbody>
</table>

*a These clearances apply except if the listing of an appliance specifies different clearances in which case the listed clearance takes precedent.

*b If listed Type B or Type L vent material is used, the clearance may be in accordance with the vent-material listing.

### TABLE NO. 37-E

**INSULATING CASTABLE LINING FOR METAL INCINERATOR STACKS**

<table>
<thead>
<tr>
<th>Stack diameter</th>
<th>Lining thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 thru 14&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>15 thru 20&quot;</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td>21 thru 30&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>Over 30&quot;</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>
## TABLE NO. 37-F
CONSTRUCTION CLEARANCE AND TERMINATION REQUIREMENTS FOR UNLISTED SINGLE WALL METAL CHIMNEYS

<table>
<thead>
<tr>
<th>CHIMNEYS SERVING</th>
<th>Wall</th>
<th>Lining</th>
<th>Above Roof</th>
<th>Termination</th>
<th>CLEARANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Minimum Thickness</td>
<td>Opening</td>
<td>10'</td>
<td>25'</td>
</tr>
<tr>
<td>Building Heating and Industrial type Low-Heat Appliances (1000° F. operating - 1400° F. Temp. Maximum)(^a),(^b)</td>
<td>Mfgs</td>
<td>Std</td>
<td>None</td>
<td>3'</td>
<td>2'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ga.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium-Heat Industrial Type Appliances (2000° F. Maximum)(^c),(^d)</td>
<td>Mfgs</td>
<td>Std</td>
<td>4'' on 4 1/4'' bed</td>
<td>Up to 18''</td>
<td>10'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ga.</td>
<td></td>
<td>dia / 2 1/2''</td>
<td></td>
</tr>
<tr>
<td>High-Heat Industrial Type Appliances (Over 2000° F.)(^e),(^f)</td>
<td>Mfgs</td>
<td>Std</td>
<td>4 1/4'' laid</td>
<td>4 1/4'' on</td>
<td>10 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 1/4''</td>
<td>4 1/4''</td>
<td></td>
</tr>
<tr>
<td>Residential Type Incinerators(^e)</td>
<td>Mfgs</td>
<td>Std</td>
<td>None</td>
<td>3'</td>
<td>2'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ga.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial or industrial Type Incinerators(^b),(^c)</td>
<td>Mfgs</td>
<td>Std</td>
<td>4 1/4'' laid</td>
<td>3' above</td>
<td>10 ga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 1/4''</td>
<td>sloping roof</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or 8' above flat roof</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) See Table 37-B for types of appliances to be used with each type of chimney.
\(^b\) Lining shall extend from bottom to top of chimney.
\(^c\) Lining shall extend from 24 inches below connector to 24 feet above.
\(^d\) Clearance shall be as specified by the design engineer and shall have sufficient clearance from buildings and structures to avoid overheating combustible materials (maximum 160° F.).
\(^e\) Firebrick in fire clay mortar or equal.
CHAPTER 38
FIRE PROTECTION SYSTEMS

SECTION 3801. GENERAL.
(a) Scope. The provisions of this Chapter shall govern the design, installation, repair, operation and maintenance of fire protection systems in all Group A through I Occupancies. See Chapter 31 (Rehabilitation.)
(b) Systems Not Required. Where fire protection systems are not required by this Building Code but are installed, the installation shall meet all the requirements of this Chapter except that a central station system connection need not be provided and the installation may be designed for and limited to those areas approved by the Department and the Fire Department. The Fire Department shall be notified prior to disconnecting a non-required system. When a non-required system is disconnected, all external appurtenances including heads, pull stations, valves, outlets and fire department connections shall be removed.
(c) Fire Protection System Shut-Off. When a fire protection system is interrupted for repairs or other necessary reasons, the owner and tenant shall advise the Fire Department prior to disconnection, and shall diligently prosecute the restoration of the system. The Fire Department shall be notified when the system is reactivated and returned to service.
(d) Threads. All threads provided for fire department connections, hose outlets, or other threads to be used for the connection of fire hose shall comply with Fire Department specifications.
(e) Signs. A sign shall be provided on the door of the entrance to the room housing the fire sprinkler and standpipe controls. The sign shall be red in color and at least 4 inches in height, with contrasting letters at least 1 1/4 inches in height, and shall read “Fire Valves.”
(f) Annunciation of Fire Protection Equipment. The method of establishing interconnection, activation and annunciation of system alarms shall be determined in conjunction with the Department and the Fire Department.

1. Interconnection and Annunciation of Fire Protection Equipment.
A. Interconnection. All fire alarm, fire detection equipment, fire sprinkler and special extinguishing systems shall be interconnected in such a manner so that activation on any initiating device or system shall cause all audible and visual alarms to be actuated and a signal to be transmitted to a central station if required. (See Section 3815)

B. Annunciator. Location of annunciator(s) shall be approved by the Department and Fire Department. See 3804, 3809 (e) and 3811 (f) for zoning and specific location requirements. (Revised 5/82 Ordinance No. 245)

(g) Special Extinguishing Systems. A special extinguishing system may be installed in lieu of, or in addition to, a required system when approved by the Department and the Fire Department.

(h) Material and Equipment. All materials and equipment used in a fire protection system shall be approved in accordance with the requirements of this Building Code and the Standards listed in Section 3818. (Revised 5/82 Ordinance No. 245)

(i) Corrosion Protection. All underground piping shall be adequately protected from corrosion. Galvanized and black pipe and fittings shall be provided with approved coverings.

(j) Maintenance. The owner and tenant of every building or structure shall be responsible for the care and maintenance of all fire protection systems.

(k) Drawings. Installation drawings, prepared to scale and showing detailed design of the fire protection system shall be submitted to and approved by the Department and Fire Department prior to issuance of a Permit. See Chapter 3.

SECTION 3802. DEFINITIONS. For purposes of this Chapter, certain terms are defined as follows:

Approved - Approval. See Chapter 4.

Approved Extinguishing Agents. As approved by the Department and the Fire Department.

Audible Alarm. An approved horn or electronically generated signal for the purpose of alerting building occupants. (Bells are not permitted.)

See Section 3809 for use of chimes in Group D occupancies. (Revised 5/82 Ordinance No. 245)

Automatic Detection Device. An individual device or combination of devices designed to detect flame, heat, smoke, or combustion gases.
resulting from a fire and to automatically operate electrical signaling contacts. Detectors shall be classified as one of the following:

1. **Products of Combustion.** A device designed to detect one or more products of combustion. These products may consist of gases, ions, water vapor, or invisible smoke particles.

2. **Photo-electric Type.** A device designed to detect an abnormal density of visible smoke particles only, either by obscuration of a projected light path or reflection of light from the visible smoke particles onto a light sensitive element.

3. **Flame Type.** A device designed to detect flames, either in the infra-red or ultra-violet regions.

4. **Thermostatic Type.** An integral assembly of heat-responsive elements and noncoded electrical contacts which function automatically under conditions of increase in air temperature.

**Central Station System.** An approved system of electrically supervised circuits employing a connection between signaling devices at the protected premises and signal receiving equipment at the Fire Alarm Headquarters or other location approved by the Fire Department.

**Fire Alarm System.** An approved integrally supervised system consisting of manual stations which will actuate audible and visual alarm signals throughout the building or structure and an annunciator at an approved location.

**Fire-Smoke Detection System.** An approved integrally supervised system of automatic detection devices connected to operate an audible and visual alarm system throughout the building or structure and an annunciator at an approved location.

**Fire Protection System.** Includes fire sprinkler systems, fire alarm systems, fire-smoke detection systems, standpipe systems, special extinguishing systems, water supplies, and other extinguishing agents suitable for the specific purpose for which they are designed and installed.

**Fire Sprinkler System.** An approved arrangement of open or closed fire sprinkler heads, automatically or manually operated, attached to piping containing an approved extinguishing agent.

**Grade.** See Chapter 4.

**Partial System.** A fire suppression system designed to protect a portion of a building or less than the entire floor area. (Revised 5/82 Ordinance No. 245)

**Pre-signal System.** A fire alarm or detection system which, when activated, will immediately transmit a signal to an approved central
station and transmit a local alarm to pre-determined locations on
the protected premises.

**Special Extinguishing System.** An approved fire extinguishing
system utilizing a particular agent for a specific use or application.

**Standpipe System.** An approved system of wet or dry piping and
all required appurtenances.

**SECTION 3803. FIRE SPRINKLER SYSTEMS.**

(a) **Where Required.** Fire sprinkler systems shall be installed and
maintained in full operating condition as specified in this Chapter
and the Standards herein in the following locations:

1. In every story, cellar and basement of all buildings when the
floor area exceeds 1500 square feet, except Group I Occupancies.

**EXCEPTION:** Sprinkler systems shall not be required when
at least 20 square feet of window opening is provided in each
50 linear feet, or fraction thereof, of exterior wall in each story,
cellar, or basement. These windows shall be provided on at
least 2 sides of the building.

   A. When the side of a building is less than 50 feet in length,
   the required window area may be in proportion to the
   actual length. Minimum window dimensions shall be
   maintained.

   B. The required window opening shall be a glazed surface at
   least 30 inches clear in its smallest dimension.

   C. Doors may be included as required openings if provided
   with the minimum glazing requirements.

   D. Required window openings shall not be approved if fully
   covered or filled with:
   
   1. Glass in excess of 1/4 inch thickness.
   2. Safety glass, glass block, or louvers.
   3. Plastics not approved by the Department and Fire De-
   partment.
   4. Metal bars or mesh exceeding 1/4 inch in any cross
   section dimension.

   E. Windows located below grade shall be provided with area-
ways which provide enclosing walls of masonry, concrete,
or metal extending 4 inches above grade and 4 inches
below the bottom of the window. The bottom of the area-
way shall provide a masonry, concrete or gravel floor. The
inside dimensions of the areaway shall be at least 6 feet
in length, 4 feet in width, and not more than 4 feet in
depth. The areaway shall extend the full length of the window when the window is longer than 6 feet.

2. When any portion of a basement or cellar is more than 50 feet from required openings, the entire basement or cellar shall be provided with an approved fire sprinkler system.

3. When any portion of a story is more than 75 feet from required window openings, the entire story shall be provided with an approved fire sprinkler system.

4. Throughout open parking garages and storage garages which exceed 75 feet in height above grade. See Chapter 12 for additional requirements for open parking garages. (Revised 10/81 Ordinance No. 519)

5. In all buildings or structures housing Group E Occupancies.

EXCEPTIONS:

A. In Group E-3 and E-4 Occupancies less than 2500 square feet in area, not over one story in height, entirely above grade, and with the required window openings.

B. Aircraft storage hangars.

6. Stages of any size at the following locations:

A. The proscenium arch, by providing a line of open type fire sprinklers installed on the stage side and immediately back of the proscenium arch or curtain, not more than 5 feet above the arch and spaced not more than 6 feet on centers. The system shall be controlled by manually operated quick opening valves located on each side of the proscenium opening, not more than 5 feet above the stage floor.

B. Under the gridiron.

C. Under the stage floor.

D. In tie and fly galleries.

E. In areas adjacent to a stage, without limitation, such as: dressing rooms, store rooms, property rooms, carpenter shops, paint shops, and passageways.

7. Under platform floors containing usable space beneath.

8. Spray painting rooms, booths, and any area where painting, brushing, dipping, or mixing of flammable materials is regularly conducted.

9. Rooms or areas used for incineration, trash and laundry collection areas, and at the top of all chutes, and in chutes at alternate floors in all buildings which require standpipes. These systems shall provide separate OS & Y control valves.
10. In all existing buildings or structures where a fire hazard is
determined to exist. See Chapter 1.
11. Underground tunnels used as passageways which exceed 6 feet
in width or height and are more than 10 feet in length. Over-
head passageways more than 65 feet above grade and which
exceed 6 feet in width or height and are more than 10 feet in
length.
12. Unenclosed vertical openings between floors, where permitted
by other Sections of this Building Code.
   A. Fire sprinklers shall be provided around the perimeter of
      the opening and shall be spaced not more than 6 feet apart
      at each level open to the atrium.
   B. Fire sprinklers shall be provided in all ceiling surfaces
directly above and parallel to each escalator or stair flight,
and at the ceiling above the vertical opening required for
the escalator or stair.
13. Dead end corridors except as permitted in Chapter 33.
14. Enclosed usable space under stairs. See Section 3308. (Revised
   4/81 Ordinance No. 172)
15. In high rise buildings. See Section 3816.
   (b) Partial Fire Sprinkler Systems. A maximum of 10 fire sprinkler
      heads in a building or structure may be supplied from the domestic
      water system, provided the water supply and pressure is adequate
      to operate the fire sprinklers. See Standards.
   (c) Signs. Legible signs, tags, or labels are required on all valves. In-
      structions for care and maintenance of the valve shall be attached
      to the riser or mounted on the wall adjacent to it.
   (d) Water Supply. See Section 3808.
   (e) Draft Stops and Draft Curtains for Sprinklered Buildings. See
      Chapter 32.
   (f) Valves. Automatic fire sprinkler system valves shall be electrically
      monitored or secured with a chain and padlock which will lock the
      valve in an open (operating) position.

   (g) Non-Metallic Piping Systems. Approved and listed non-metallic
      piping systems may be installed for fire sprinkler piping in ac-
      cordance with their listings and the following requirements:
      1. Non-metallic piping shall not be used as a vertical riser or
         combination riser and standpipe in a multi-story building. A
         control valve shall be installed at point of connection to metal
         riser.
EXCEPTION: Group H-3 and I occupancies.
2. Penetrations of fire-rated walls shall comply with Chapter 43.
3. Non-metallic piping shall not be exposed in any part of the system. (Rev. 8/86 Ord. No. 520)

SECTION 3804. FIRE SPRINKLER ALARMS. (Revised 5/82 Ordinance No. 245)

(a) Zoning. Fire sprinkler piping systems shall be zoned as follows:
   1. Zoning shall conform to the area limitations set forth in National Fire Protection Association (NFPA) Pamphlet 13. (See Section 3818, Standards.) The maximum floor area of any one zone shall not exceed 52,000 square feet.
   2. In a multi-story building each floor shall be zoned separately. If the floor area exceeds 52,000 square feet, additional zoning shall be provided.
   EXCEPTION: Buildings of four (4) stories or less above grade and 2,500 square feet or less per floor may be one zone (See Section 3801(f) when other types of fire protection are involved.)
   3. When the system serves more than one building, each building shall be zoned separately.
   4. Additional zones may be required where deemed necessary by the Department and Fire Department.

(b) Annunciation. Fire sprinkler systems shall be annunciated as follows:
   1. Each main fire sprinkler supply shall be equipped with a \( \text{waterflow alarm device which shall actuate the following alarms or signals:} \)
      A. The exterior visual and audible alarm required in (c) below.
      B. The building fire alarm system, if so equipped. (See Section 3801(f).)
      C. The local zone annunciator panel required in 2 below.
      D. Interior alarms required in (c) below.
   2. Each individual zone shall be equipped with a \( \text{waterflow alarm device. The \text{waterflow devices shall be electrically connected to a local zoning annunciator panel located as approved by the Department and Fire Department. The annunciator shall indicate the floor and/or area of the alarm. When the building has a fire alarm system, the \text{sprinkler and fire alarm zones may} \)
be combined where the zones are compatible and the main fire alarm control panel and annunciator panel indicate there is a workflow alarm.

**EXCEPTION:** In buildings with one fire sprinkler zone, a local zone annunciator panel will not be required.

3. The above workflow and annunciation systems will not be required to be electrically supervised unless interconnected with a fire alarm or detection system. See Section 3801(f).

(c) **Fire Sprinkler Alarms.** Exterior and interior alarm devices shall be installed as follows:

1. An approved exterior audible and visual alarm device shall be connected to every fire sprinkler system. The devices shall be located on the exterior of the building at least 10 feet above grade and within 25 feet of and visible from the fire department connection. When more than one building is supplied by a yard main, the alarm devices shall be located on the exterior of each building in an approved location.

2. Interior audible visual alarm devices shall be installed as follows:
   
   **A.** Each required fire sprinkler system shall provide a minimum of two alarm devices, one located near the riser at an approved location, the second at the annunciator required in 3804(b) above.
   
   **EXCEPTION:** Buildings not requiring an annunciator shall have an alarm device located near the riser at an approved location.

   **B.** In addition to the requirements in A above, required fire sprinkler systems in new retail sales establishments shall be connected to a Central Station. (See Section 3815).

   **C.** Group E occupancies shall have audible and visual alarms located throughout the building.

   **D.** Alarms and alarm attachments shall not be required for partial fire sprinkler systems supplied from the domestic water system. See Section 3803(b) (Revised 5/82 Ordinance No. 245)

**SECTION 3805. FIRE DEPARTMENT CONNECTIONS.** See Section 3807 for temporary standpipes.

(a) **Required.** All fire sprinkler and standpipe systems shall be provided with at least one 2-way fire department connection. Each inlet of the fire department connection shall be 2 1/2 inch diameter. The
pipe from the system to the fire department connection shall not be smaller than 4 inch diameter. Single fire department connections may be installed on a 3 inch or smaller riser when approved by the Department and the Fire Department.

(b) **Connections.** Fire department connections shall be arranged so that the use of any one connection will serve all the fire sprinklers and standpipes within the building, unless otherwise approved by the Department and the Fire Department.

(c) **Location.** Fire department connections shall be located and be visible on a street front in a location approved by the Department and the Fire Department. Connections shall be located so that ready access can be made by the Fire Department. Obstructions such as fences, bushes, trees, walls, or any other object, shall not be permitted.

(d) **Height.** Fire department connections shall not be less than 1 foot 6 inches and not more than 3 feet 6 inches in elevation above the ground level on the center line of the inlets.

(e) **Projection.** When the fire department connection would project beyond the property line or into the public way, flush type fire department connections shall be provided.

(f) **Hose Threads.** Hose threads shall meet Fire Department specifications.

(g) **Fittings.** Fire department inlet connections shall be installed with check valves, ball drip valves, and plugs with chains and caps.

(h) **Signs.** A metal sign with raised letters at least one inch in height shall be mounted on all fire department connections serving fire sprinklers and standpipes. The sign shall read “Automatic Sprinklers” or “Standpipe”.

**SECTION 3806. STANDPIPE SYSTEMS.**

(a) **When Required.** Wet standpipes shall be installed in all buildings or structures 4 or more stories in height above grade and shall be installed and maintained in full operating condition as specified in this Chapter and the Standards. See Chapter 12 for additional requirements for open parking garages.

**EXCEPTION:** Open parking garages may have dry standpipes in lieu of wet standpipes. The standpipes shall conform to all the requirements of wet standpipes, except water supply. (Revised 10/81 Ordinance No. 519)

(b) **Location.** Outlets shall be located in a public corridor within 10 feet of the opening of a required stairway, on all floor levels, or as approved by the Department and the Fire Department. In no case shall the outlet be located in a stairway.
EXCEPTION: Where the maximum distance from the required standpipe outlets is exceeded and a horizontal fire separation is provided in a corridor, a standpipe and the required outlets shall be provided on each side of the separation. The standpipe outlets shall not be located more than 10 feet from either side of the fire separation.

(c) Distance. The maximum distance from a required standpipe outlet to any point in the building or structure shall not exceed 100 feet in the line of travel.

(d) Size.

1. Buildings, or portions thereof, having 4 or more stories above grade, shall be equipped with one or more 4 inch standpipes extending from the lowest portion of the building to a height 5 feet above the finished floor of the topmost story.

2. Buildings, or portions thereof, having 7 or more stories above grade, shall be equipped with one or more 6 inch standpipes extending from the lowest portion of the building to the topmost outlet. At least one 2-way roof manifold with 2 1/2 inch hose valves, with caps and chains, connected to a standpipe, shall be provided on each building rooftop. The main control valve on a roof manifold shall be located in a heated area and equipped with an automatic drain. These valves shall be accessible from the outside, within 3 feet of the manifold, and shall be plainly marked.

(e) Extinguishers and Hose. A 2 1/2 gallon approved water-air pressure type extinguisher, or other extinguisher approved by the Fire Department, shall be provided at each standpipe outlet location at each floor level. Hose shall not be required for standpipes.

(f) Material. Wet standpipes shall be constructed of standard weight wrought iron, steel, or Type L hard-drawn copper as approved by the Department. Copper pipe and fittings shall be joined with a low temperature brazing alloy. Dry standpipes shall be constructed of steel. All pipe, fittings, and valves shall be extra heavy pattern when the working pressure will exceed 175 pounds per square inch.

(g) Capacity. Standpipes shall be capable of discharging a minimum of 500 gallons per minute for the first standpipe and 250 gallons per minute for each additional standpipe, the total supply not to exceed 2500 gallons per minute, for a period of at least 30 minutes. The supply shall be sufficient to maintain a minimum residual pressure of 65 pounds per square inch at the topmost outlet of each standpipe.
with 500 gallons per minute flowing.

(h) **Outlets.** At each floor level a 2 1/2 inch hose valve with cap and chain and a 1 1/2 inch hose valve with cap and chain shall be connected to each standpipe. Outlets shall be at least 3 feet and not more than 6 feet above finished floor. The valves shall be readily accessible and plainly identified.

(i) **Valves.** All main control valves of a standpipe shall be electrically monitored or secured with a chain and padlock which will lock the valve in an open (operating) position.

(j) **Water Supply.** See Section 3808.

(k) **Standpipes in Sprinklered Buildings.** In fully sprinklered buildings, a separate standpipe riser and the 1 1/2 inch hose outlet may be omitted. The sprinkler water supply riser may be used for the standpipe. The maximum distance from required standpipe outlets to any portion of the building or structure shall not exceed 200 feet in the line of travel. All other requirements for standpipes shall apply.

(l) **Pressure.** Where the pressure at any standpipe outlet exceeds 100 pounds per square inch, an approved pressure regulating device which regulates pressure under both flow and no-flow conditions shall be installed to reduce the pressure with required flow at the outlet to 100 pounds per square inch.

**SECTION 3807. STANDPIPES FOR BUILDINGS UNDER CONSTRUCTION OR DEMOLITION.**

(a) **General.** Wet or dry standpipes shall be provided for all buildings under construction which exceed 3 stories above grade, and shall comply with all the requirements of Section 3806. Standpipes shall be available for use when construction reaches the third floor level, and remain in service until the permanent installation is completed and in service.

(b) **Height.** The standpipe and outlets shall be operable on all floors below the top floor of construction.

(c) **Fire Department Connections.** At the street level there shall be provided, for each temporary or permanent standpipe installation, one or more two-way fire department inlet connections. Fire department inlet connections shall be prominently marked and readily accessible at all times. See Section 3805.

(d) **Standpipes for Buildings Under Demolition.** When a building is being demolished, and a standpipe is existing within the building, the standpipe shall be maintained in an operable condition so as to
be available for use by the Fire Department. The standpipe shall be
demolished with the building, but in no case shall the standpipe be
inoperable more than one floor below the top remaining floor of the
structure.

SECTION 3808. WATER SUPPLY AND OTHER EXTINGUISHING
AGENTS.
(a) **Required.** Fire sprinkler systems and wet standpipes shall be pro-
vided with at least one reliable water supply. Other types of exting-
guishing agents permitted by this Building Code shall supply the
extinguishing material in quantities adequate to perform the func-
tion intended.
(b) **Insufficient Pressure.** When the city water pressure is insufficient
to produce the required volume and pressure required in this Chapter
and Standards, a booster pump system shall be installed and main-
tained in operating condition at all times.
(c) **Booster Pumps.** Booster pumps shall be of an approved type, and
shall have a rated capacity sufficient to produce and maintain the
required volumes and pressures. Booster pumps shall be equipped
with a controller which will provide both automatic and manual
operation. Booster pumps taking suction from a street water main
shall be installed in a bypass. Electric wiring to the pump motor
shall be on a separate circuit and connected to the emergency system.
See Chapter 53. Booster pumps shall be installed in a separate non-
combustible room, boiler room, or pump house of at least one hour
fire-resistive construction. Room doors shall be equipped with a self
closing device and shall be rated 3/4 hour fire resistive.
(d) **Combined Water Supply.** Where both sprinklers and standpipes
are installed, they shall have a common water main as their com-
bined source of supply. The connection shall not be made to any City
water main of less than 4 inch diameter. The common water supply
for both standpipes and sprinkler systems shall be at least the largest
connection required for either.
(e) **Combination Domestic Water Supply.** A fire sprinkler system
may be connected to the domestic water supply system provided the
supply system is of adequate pressure, capacity, and size for the
combined fire sprinkler system and domestic water needs. An OS & Y
gate valve and check valve shall be installed in the sprinkler supply
line.
(f) **Size.** The water supply for complete or partial fire sprinkler systems
shall be sized in accordance with NFPA Pamphlet No. 13, for the
quantity of heads provided. See Standards, Section 3818. (Revised
5/82 Ordinance No. 245)

(g) Standpipes.

1. Standpipes shall be connected to a street water main at least
equal to the size of the largest standpipe within the building.
The size of the water service at the base of the standpipe risers
shall be at least the size of the largest standpipe.

2. The required water supply shall be connected to the base of
each standpipe. Where more than one standpipe is required,
all standpipes shall be interconnected at their base. An
approved shutoff valve shall be installed at the base of each
standpipe.

(h) Water supplies for buildings over 550 feet to highest standpipe
outlet. (Revised 7/83 Ordinance No. 389)

1. A water storage tank(s), with the top of the tank located less
than 550 feet above the lowest level of Fire Department access,
shall be installed to provide water to the sprinkler and
standpipe systems above 550 feet. The tank shall conform to
the following requirements:

   A. Construction and maintenance of the tank and appurten-
       nances shall conform to the requirements of NFPA 22.
   B. The minimum total capacity shall be equal to 30 minutes
       of required flow.
   C. The tank shall consist of at least two approximately equal
       sections, capable of being drained independently for clean-
       ing and maintenance. The Fire Department shall be
       notified prior to draining of the tank section and after
       refilling. Not more than one section of the tank shall be
       out of service at the same time. A minimum of 15 minutes
       at required flow shall be available at all times.
   D. Under emergency conditions the low zone fire pump and
       standpipe system shall be capable of automatically refil-
       ling the tank. The low zone risers shall be interconnected
       at the top.
   E. Low water level and overflow indication shall be provided
       in the Fire Command Center. Supervisory monitoring
       shall be provided with a trouble signal to the Central
       Station.
   F. Tank refill shall be so arranged to prevent an alarm con-
       dition during normal refilling due to evaporation. Domes-
       tic water system may be used for non-emergency refilling.
G. The room containing the tank shall be sprinklered.

2. Each high zone shall be served by two automatic fire pumps, with one pump serving as a standby pump. The pump system shall conform to the following requirements:
   A. The high zone pumps may be individually driven by diesel engines or electric motors or a combination of both. If both pumps are driven by electric motors, the electrical system including the emergency generator shall be capable of powering one pump and automatic selector switching shall be provided so that either pump may be operated off the generator. If both pumps are diesel, fuel supply shall be sized for one pump per Section 1807.
   B. If both pumps are electric, the controllers shall be interlocked to allow only one pump to run at a time.
   C. Controller shall be protected against the entry of water per NFPA 20.
   D. Each fire pump and its associated controller shall be located in a separate one hour fire rated enclosure, and the room shall be sprinklered.
   E. A fire department connection is not required for any zone supplied from the tank. All other zones shall comply with Section 3805. Fire Department connection shall be provided for the low zone pump(s).

SECTION 3809. FIRE DETECTION SYSTEMS.

(a) Where Required. A complete fire detection system shall be required and maintained in all new and existing C and D occupancies, and all new F-1, B-2 and B-3 occupancies which provide for the serving of alcoholic beverages. For additional requirements see Section 1807 and 3816.

EXCEPTIONS:

1. Group C-1 occupancies with more than 20 and less than 50 children need not be connected to a central station.

2. For purposes of this exception, a Group C-2 occupancy housing 6 or less children shall be provided with battery type smoke detectors as approved by the Department and Fire Department.

3. Existing Group C-2 Occupancies (7 through 20 children) and Group D-2 Occupancies with 10 or less occupants shall be provided with approved residential type multiple station smoke detectors wired to a 115 volt AC unswitched electric power source. The detectors shall be installed in routes of egress, and
as may be required by the Department and Fire Department.
(Revised 10/81 Ordinance No. 518)

(b) **Not Required.** A fire detection system may be installed in lieu of
a fire sprinkler system, when approved by both the Department and
the Fire Department. When a fire sprinkler system is installed in
a building or area where a fire detection system was originally
required, the detection system need not be provided when approved
by both the Department and the Fire Department.

(c) **Manual Pull Stations.** Manual pull stations, conforming to the
requirements of Section 3811, shall be installed in conjunction with
fire detection systems.

**EXCEPTION:** Manual pull stations need not be installed in new
Group F-1 or B-3 Occupancies with an occupant load of less than
150, which provides for the serving of malt or alcoholic beverages.

(d) **Power Supply.** Electric power supply shall be provided from the
building emergency system. See Chapter 53.

(e) **Detailed Requirements.** Fire detection systems shall be of an ap-
proved type, shall be electrically supervised, and shall comply with
the following:

1. Wiring shall conform to the requirements of Chapter 53 and
NFPA Pamphlets as listed in the Standards. See Section 3818.
(Revised 5/82 Ordinance No. 245)

2. Audible alarms conforming to Section 3802 shall be provided.
In addition, visual alarms shall be provided where required by
other portions of this Chapter and Chapter 64. (Revised 5/83
Ordinance No. 259)

**EXCEPTION:** In Group D Occupancies, chimes may be instal-
led in lieu of audible alarms required above when approved by
the Department and Fire Department. When chimes are instal-
led, visual alarms shall also be provided. (Revised 5/82 Ord-
inance No. 245)

   A. Visual and audible alarms shall be provided in occupan-
cies housing the hard of hearing as approved by the De-
partment and the Fire Department.

   B. Audible alarms shall be located to be heard above all other
sounds by the occupants in occupied space in the building.

   C. The operation of any detection device shall cause all audi-
ble and visual alarms to operate.

3. Fire detection systems shall incorporate smoke type detectors
in routes of egress and storage rooms opening into routes of
egress. Smoke type detectors shall be installed in operating
rooms, x-ray rooms, delivery rooms, cardiac and intensive care rooms, and patient sleeping rooms. Other spaces shall be provided with the type of detectors approved for the particular application.

**EXCEPTION:** Fire protection systems in Group F-1, B-2, and B-3 Occupancies which provides for the serving of malt or alcoholic beverages shall incorporate approved thermal rate of rise detectors in routes of egress and all other areas.

A. Fire detecting devices shall be installed to comply with the lineal or square footage allowances specified based on Standards 3818. (Revised 5/82 Ordinance No. 245)

4. **A presignal system may be installed in Group D Occupancies.** Presignal systems shall not be installed in other occupancies, unless approved by the Department and the Fire Department. All presignal systems shall be connected to an approved central station system.

A. When a presignal system is installed, 24 hour personnel supervision will be provided at locations approved by the Fire Department.

5. The master keys for manual pull stations, and for the master fire alarm panel, shall be located within the elevator fire control key cabinet or other location approved by the Department and the Fire Department.

6. Each floor shall be zoned separately. If the floor area exceeds 20,000 square feet, additional zoning shall be provided. In no case shall the length of any zone exceed 200 feet in any direction.

A. Zoning indicator panels and controls shall be in a location approved by the Department and the Fire Department. Annunciators shall lock in until the system is reset.

B. Fire Detection Systems located in a Group H Occupancy, more than 4 stories in height, shall provide annunciation at each floor level, at an approved location. Each living unit shall also be annunciated at either the main annunciator, at an annunciator located on each floor, or over the doorway to the living unit.

7. All systems shall be tested semi-annually.

A. Accurate logs shall be maintained on the premises indicating box numbers, location and type of devices tested. Any defect, modification, or repair shall be recorded in the log. Logs shall be made available to the Fire Department.
8. Fire detecting devices shall be installed to comply with the lineal or square footage allowance as specified, based on the Standards as indicated in Section 3818. (Revised 5/82 Ordinance No. 245)

9. When approved by the Department and the Fire Department, supervised smoke detectors in Group H occupancies, new or existing, may be installed in accordance with Section 1807 (d) 2. Exception (supervised rate of rise detector(s) and single station smoke detector(s) in combination). The single station smoke detector(s) shall be wired to a 115 volt AC unswitched power source or to a supervised power source supplied from an approved fire alarm panel. (Rev. 2/86 Ord. No. 45)

SECTION 3810. SINGLE STATION DETECTING DEVICES.

(a) Household Fire Warning Equipment. (See NFPA Pamphlet No. 74) Household fire warning detectors shall be installed in the following occupancies and areas:

1. New C-2 and D-2 Occupancies as required in Section 3809 (a) and new Group H Occupancies.

   EXCEPTION: Where an alarm system is required or installed, the detectors required herein shall be of the supervised type and shall be interconnected with the building system. (See Sections 3809, 3811 and 3816)

2. New Group I Occupancies.

(b) Location. Location of detectors in C-2 Occupancies shall be in the corridor or central area or as approved by the Department and Fire Department. Detector(s) in H-1 Occupancies shall be located in each room utilized for sleeping purposes. Detector(s) in H-2, H-3 and I Occupancies shall be located in the corridor or central area within each unit adjacent to the sleeping area or as approved by the Department and Fire Department.

(c) Power Supply. Detectors required by this Section shall be wired to a 115 volt AC unswitched electric power source and when activated shall initiate an audible alarm.

   EXCEPTION:

   1. Battery powered detectors shall be permitted in existing Group I Occupancies and no Permit shall be required for this installation.

   2. Detectors installed in Group H Occupancies of more than 4 stories in height and not covered in Section 3816, shall be installed in accordance with Section 3810 (b), 3809 (d), and 3809 (e). See also section 1807 (d) 2.
SECTION 3811. FIRE ALARM SYSTEMS.

(a) Where Required. A fire alarm system shall be required, installed, and maintained in all new and existing Group A, B, C, D and H Occupancies and in all new Group F-2 Occupancies.

EXCEPTIONS:

1. F-2 and H Occupancies of 4 stories or less above grade.
2. Churches.
3. Group C-2 Occupancies with 20 or less occupants.
4. Group C-1 Occupancies of more than 20 occupants and less than 50 shall be provided with a complete fire alarm system that need not be connected to an approved central station system.
5. Group B-3 with an occupant load of 150 or less and B-4 Occupancies.

(b) Approval. Manual pull stations shall be approved for the particular application and shall be used for fire protective signaling purposes only. Alarm boxes shall be painted red.

(c) Location and Signs. Manual pull stations shall be located in each corridor of each story, basement, or cellar so that from each corridor door not more than 100 feet will be traversed in order to reach a manual station. Stations shall be located as near as possible, but not more than 5 feet from each stair exit. The height of the boxes shall be not less than 4 1/2 feet, and not more than 6 feet above the floor. In areas required to be accessible to the handicapped, the height of the boxes shall conform to the requirements of Chapter 64. When corridors are not provided, manual stations shall be located so that no point in the building is more than 100 feet from a station. When a stage is provided, a manual pull station shall be located adjacent to the lighting control panel. Manual pull stations shall be located at or near each exit from the building.

Where a central station is not required, an engraved plaque with letters no smaller than 1/4 inch in height, shall be provided within 4 inches of the pull station. The plaque shall state “AFTER PULLING ALARM - PHONE 911, THIS IS A LOCAL ALARM ONLY.” (Revised 5/83 Ordinance No. 259)

EXCEPTION: In Group C Occupancies, manual pull stations may be located in areas under supervision of persons in authority as approved by the Department and the Fire Department.
(d) **Coding.** Coded stations shall be coded in conformance with the Standards as listed in Section 3818. (Revised 5/82 Ordinance No. 245)

(e) **Power Supply.** Electric power supply shall be provided from the building emergency system. See Chapter 53.

(f) **Detailed Requirements.** Fire alarm systems shall be of an approved type, shall be electrically supervised, and shall comply with the following:

1. All wiring shall conform to the requirements of Chapter 53 and NFPA Pamphlets listed in the Standards. See Section 3818. (Revised 5/82 Ordinance No. 245)

2. Audible alarms conforming to Section 3802 shall be provided. (Revised 5/82 Ordinance No. 245)
   
   A. Visual and audible alarms shall be provided as required by this Chapter and Chapter 64.
   
   B. Audible alarms shall be located to be heard above all other sounds by the occupants in occupied spaces in the building. (Revised 5/82 Ordinance No. 245)
   
   C. The operation of any signal initiating device shall cause all audible and visual alarms to operate.

3. A presignal system may be installed in Group D Occupancies. Presignal systems shall not be installed in other occupancies unless approved by the Department and the Fire Department. All presignal systems shall be connected to an approved central station system.
   
   A. When a presignal system is installed, 24 hour personnel supervision shall be provided at locations approved by the Fire Department.

4. The master keys for the stairway doors, manual pull stations and for the master fire alarm panel shall be located within the elevator fire control key cabinet or other location approved by the Department and the Fire Department.

5. Each floor shall be zoned separately. If the floor area exceeds 20,000 square feet, additional zoning shall be provided. In no case shall the length of any zone exceed 200 feet in any direction.

   A. Zoning indicator panels and controls shall be located as approved by the Department and the Fire Department. Annunciators shall lock in until the system is reset.

6. All systems shall be tested semi-annually.

   A. Accurate logs shall be maintained on the premises indicating box numbers, location and type of devices tested. Any defect, modification or repair shall be recorded in the log. Logs shall be made available to the Fire Department.
SECTION 3812. SPECIAL EXTINGUISHING SYSTEMS.

(a) **Where Required.** An approved special extinguishing system shall be installed and maintained in range hoods, connecting duct systems, and special hazards such as deep fat fryers, ranges, griddles and broilers used in conjunction with frying and cooking operations in food preparation centers within any Group A through H Occupancies.

**EXCEPTIONS:**

A. New or existing restaurants in one story buildings with an occupant load of less than 50.

B. Churches, schools, and noncommercial installations when the food preparation center is used less than 8 hours per week.

C. Dwelling units.

1. **General Requirements.** All systems shall comply with the following:

   A. A manual station controlling the actuation of the extinguishing system shall be located in the path of egress from the cooking area and a minimum of 10 feet from the range hood, unless otherwise approved by the Department and the Fire Department. Manual stations shall be securely mounted at an approved location not less than 4 1/2 feet or more than 6 feet above the floor.

   B. Extinguishing systems required by this Section shall provide both automatic and manual actuation.

   C. System nozzles shall be accessible for cleaning and replacement.

   D. Operating instructions shall be posted at the manual station.

   E. When a fire alarm system is required by other Sections of this Building Code, the special extinguishing system shall be connected to the central station system.

   F. Containers for the extinguishing agent shall not be subject to weather conditions affecting proper operation, physical damage, chemical, or other damage, or exposure to fire or explosion occurring in the hazard area.

   G. Upon activation of the extinguishing system, a valve shall shut off the gas pilot and burners and electric power supplying the cooking equipment. Fan operation and fire damper installation and control shall be in accordance with the Standards governing the particular system. See Section 3818.
H. A visual indicator shall signify the readiness of the extinguishing system.
I. Approved portable fire extinguishers shall be installed and maintained as required by the Fire Code.
J. The system shall be maintained in full operating capacity as required by this Building Code and shall be serviced at least once every 6 months. A record of the service company and dates of service shall be posted and available for inspection.

SECTION 3813. SERVICE STATIONS INSIDE BUILDINGS. Prohibited. See Chapter 10 and Fire Code.

SECTION 3814. FIRE HYDRANTS. See Fire Code.

SECTION 3815. CENTRAL STATIONS.
(a) Central Stations Required. Required fire protection systems shall be connected to an approved central station system. When approved by the Fire Department, the fire protection system may be connected to the City alarm signaling system.

EXCEPTIONS:
1. C-2, E, G, and I Occupancies.
2. Special extinguishing systems unless otherwise required. See Section 3812 (a) 2-E.
3. Standpipes.
4. F-2 and H Occupancies when 4 stories or less above grade. See Section 3804 for fire sprinklers in new retail sales establishments. (Revised 5/82 Ordinance No. 245)
5. Churches.
6. F-1 Occupancies not including those serving malt or alcoholic beverages.

(b) Responsibility. It shall be the responsibility of the owner and tenant of a building or structure to provide and maintain the required central station connection.

SECTION 3816. SPECIAL REQUIREMENTS FOR HIGH RISE BUILDINGS. (Revised 10/81 Ordinance No. 518)
(a) **Scope.** In addition to the other requirements of this Building Code, this Section shall apply to all buildings having floors used for human occupancy more than 75 feet above the lowest level of Fire Department vehicle access, and housing Groups A, B, C, D, F-2, H-1, and H-2 Occupancies. (Rev. 3/87 Ord. No. 119)

(b) **Fire Sprinkler System.**

1. **Required.** Automatic fire sprinkler installed in accordance with the requirements of this Chapter shall be provided throughout all A, B, C, D, F-2, H-1, and H-2 Occupancies.

   **EXCEPTIONS:** An approved product of combustion detection system complying with the requirements of this Chapter may be installed in lieu of sprinklers:
   A. In Group C Occupancies in classrooms.
   B. In Group D Occupancies in hospital corridors, patient rooms, computer rooms, nurseries, and specialized diagnostic and treatment rooms.
   C. In the individual dwelling units of Group H-1 and H-2 Occupancies. See Section 1807 (d) 2.

2. **Valves.** Automatic sprinkler valves required by this Section shall be electrically monitored.

(c) **Fire Detection Systems.** Approved duct detectors shall be installed in accordance with the requirements of Chapters 18, 38, and 52. The actuation of any detector shall activate the fire alarm system as required in Chapter 18 and this chapter.

(d) **Communication Systems.** A communication system shall be provided, and shall function as follows:

1. A voice communication system designed to be clearly heard by all occupants of the building and operated from the Operations Center. The detection system, fire alarm system and sprinkler system will activate on a voice communication system. It shall provide one way communication on a selective and general basis to the following locations:
   A. Elevators.
   B. Elevator lobbies.
   C. Public corridors.
   D. Exit stairways.
   E. Rooms exceeding 2,500 square feet.
   F. Apartment dwelling units.
   G. Hotel and motel guest rooms.
2. A Fire Department communication system designed to provide two-way communication between the Operations Center and the locations specified in Chapter 18. The communications system shall be designed and installed so that damage to any station will not affect the operation of the remainder of the system. The system shall be continuously electrically supervised.

3. The communication systems shall be continuously electrically supervised. Design of the communication systems shall be such that the speakers and telephone jacks on any one floor shall be connected to an alternate cable system so that damage or loss of any one speaker, telephone jack, cable, amplifier, or pre-amplifier will not cause the failure of more than one-half of the communication systems of a given floor. The communication cable system shall be routed in a minimum of 2 separate vertical risers remotely located from each other.

(e) Operations Center. See Chapter 18 for Operations Center requirements.

(f) Standby Power System. See Chapter 18 for Standby Power Systems (Emergency Generator) requirements. The standby power requirements shall be sufficient to provide for the following:
   1. Fire Alarm and Detection System.
   2. Exit and Emergency Lighting.
   4. Mechanical Ventilation as required by Chapter 18.
   5. Emergency Elevators.

SECTION 3817. FIRE PROTECTION IN EXISTING BUILDINGS
(Revised 1/82 Ordinance No. 6, 11/82 Ordinance No. 696)

(a) Scope. This section provides for the installation of fire protection systems in existing buildings. The requirements for existing buildings in Section 3809 and 3811 shall apply. The provisions of this Section shall become effective per the following:

1. A design complying with the requirements of Chapter 3 shall be submitted to the Department on or before September 1, 1982 for Group H-1 occupancies. Design for Group F-2 occupancies is subject to the completion dates below. Design plans for F-2 occupancies may be submitted (and constructed) in phases upon approval by the Department.

2. Installation shall be completed on or before January 1, 1984 for Group H-1 occupancies.
In Group F-2 occupancies, installation of all systems except the communications systems (3817(c)3A and B) shall be completed by November 1, 1987. Installation of the communications systems shall be completed by November 1, 1988.

(b) Requirements for Group H-1 Occupancies in Buildings over 75 feet in Height.

1. A fire sprinkler system conforming to the requirements of this chapter shall be installed throughout the building. For purposes of this Section only, bathrooms of 55 square feet or less and closets of 25 square feet or less that are within a guestroom need not be equipped with sprinkler heads.

**EXCEPTION 1:** In lieu of the above requirements on floors with guestrooms, one of the following alternate systems may be used.

A. Alternate 1. Corridors in all areas shall be fully sprinklered. Annunciation of sprinkler shall be by individual level waterflow indication. Guestrooms shall have supervised smoke detectors, installed and annunciated per Section 3809.

**EXCEPTION:** In lieu of individual level waterflow annunciation, supervised smoke detectors shall be provided in front of stairwell doors on the corridor side and at entrances to elevator lobbies or in front of elevators. Main riser waterflow indication will be required.

B. Alternate 2. Corridors in all areas shall be fully sprinklered. Annunciation shall be by individual level. Each guestroom shall have a sprinkler head in the foyer of the room within 3 feet of the door opening onto the corridor. Each guestroom shall also have a single station detector wired to a 115 volt AC unswitched electric power source.

**EXCEPTION:** In lieu of individual level waterflow annunciation, supervised smoke detectors shall be provided in front of stairwell doors on the corridor side and at entrances to elevator lobbies or in front of elevator. Main riser waterflow indication will be required.

C. Alternate 3. All areas shall be provided with a supervised smoke detection system installed per Section 3809. Doors opening into public corridors shall be provided with automatic closers per Section 4308(c).

**EXCEPTION 2:** In lieu of a sprinkler system, assembly, service and retail areas and equipment rooms shall be
provided with a smoke detection system per Section 3809. Assembly areas with the ceiling heights in excess of 16 feet shall have a specially engineered system.

**EXCEPTION 3:** In lieu of a sprinkler system kitchens may be equipped with fixed temperature heat detection in addition to requirements of Section 3812.

2. Standpipe systems shall be required as follows:
   
   A. All buildings shall have a standpipe system complying with the requirements of this Chapter.

   **EXCEPTION 1:** In buildings with an existing standpipe, a separate sprinkler riser, sized per NFPA Pamphlet 13 and interconnected with the standpipe system at the base of the riser may be installed to serve the sprinkler system.

   **EXCEPTION 2:** Where building is fully or partially sprinklered, the combination standpipe or sprinkler riser shall operate the sprinklers on any floor properly as per NFPA Pamphlet 13 without Fire Department pumping into the system to increase the pressure. In addition, the standpipe shall have adequate capacity to supply two 1 1/2 inch hose outlets with each outlet capable of maintaining a pressure of 100 pounds per square inch with 150 gallons per minute flowing with the Fire Department pumping into the system.

   **EXCEPTION 3:** Where building is fully detected, the standpipe shall supply two 1 1/2 inch hose outlets with each outlet capable of maintaining a pressure of 100 pounds per square inch with 150 gallons per minute flowing with the Fire Department pumping into the system.

   B. A Fire Department connection as required in this Chapter.
   
   C. 1 1/2 inch hose connections shall be provided on each floor.
   
   D. Main riser waterflow indication/annunciation shall be provided.

3. Communication system shall be required as follows:
   
   A. A one-way communication system conforming to the requirements of this code shall be provided.

   **EXCEPTION:** Speakers will not be required in individual guestrooms, elevators, elevator lobbies and stairways, but shall be audible in those areas.

   B. A two-way telephone communication system (Fire Fighter's Communication System) shall be provided conforming to the requirements of this code.
EXCEPTION 1: Phone Jacks will be required only at stairway entrances adjacent to manual pull stations.

EXCEPTION 2: Phone Jacks at stairway entrances may be on one zone per stairway.

4. The control center shall be located on the first floor (ground) level at a location approved by the Department and Fire Department. The control center shall consist of the main fire alarm panel and/or annunciator panel, controls for the voice communications systems, controls for the fire fighter's communication system and a graphic diagram of the building by floor (typical floors may use a single graphic).

(c) Requirements for Group F-2 occupancies in buildings over 75 feet in height.

1. A fire sprinkler system conforming to the requirements of this Chapter shall be installed throughout the building.

EXCEPTION 1: In buildings utilizing a central structural concrete or masonry core, the areas outside the core shall be provided with a fire sprinkler system conforming to the requirements of this Chapter; areas within the core may be provided with a supervised smoke detection system installed per Section 3809 in lieu of the fire sprinkler system.

EXCEPTION 2: In lieu of a full sprinkler system, all areas shall be provided with a supervised smoke detection system installed per Section 3809.

EXCEPTION 3: A sprinkler system shall be provided in the corridor with smoke detectors provided outside each door into an exit stairway and on the occupied (tenant) side of each door opening into the corridor. The above detectors shall be located not less than one foot nor more than 3 feet from the protected door. Detectors shall also be installed in mechanical, electrical, and telephone equipment rooms and in all janitor's closets and storage closets opening into the corridor. Detectors not located in the corridor shall have an indicator light above the door in the corridor or be annunciated on a panel at an approved location.

EXCEPTION 4: Where the building has at least two means of exiting from each floor complying with the requirements of Chapter 33 and has a fire stand pipe system complying with the requirements of Section 3817 (c) 2 Exception 3, a smoke detection system shall be installed as follows: detectors shall be provided in the corridor outside each door into an exit stairway and on the occupied (tenant) side of each door opening into the corridor. The above detectors shall be located not less than
one foot nor more than 3 feet from the protected door. Detectors shall also be provided in the corridor connecting the exit stairways; in all elevator lobbies; in mechanical, electrical, and telephone equipment rooms; and in all janitor and storage closets opening into the corridor. Where there is no enclosed corridor (open floor plan) detectors shall be located as above at each stairway entrance, in all elevator lobbies, equipment rooms, janitor closets, closets intended to be entered (walk-in) and used for storage of combustible materials, and with a minimum of 4 additional detectors provided for the rest of the floor area. Detectors installed in enclosed areas such as equipment rooms and closets shall have an indicator light over the door in the corridor, or outside the room, or be annunciating on a panel at an approved location.

2. Standpipe systems shall be required as follows:
   A. All buildings shall have a standpipe system complying with the requirements of this Chapter.
   EXCEPTION 1: In buildings with an existing standpipe, a separate sprinkler riser, sized per NFPA Pamphlet 13 and interconnected with the standpipe system at the base of the riser may be installed to serve the sprinkler system.
   EXCEPTION 2: Where building is fully or partially sprinklered, the combination standpipe or sprinkler riser shall operate the sprinklers on any floor properly as per NFPA Pamphlet 13 without fire department pumping into the system to increase the pressure. In addition, the standpipe shall have adequate capacity to supply two 1 1/2 inch hose outlets with each outlet capable of maintaining a pressure of 100 pounds per square inch with 150 gallons per minute flowing with the fire department pumping into the system.
   EXCEPTION 3: Where the building is fully or partially detectored, the standpipe system shall supply two 1 1/2 inch hose outlets with each outlet capable of maintaining a pressure of 100 pounds per square inch with 150 gallons per minute flowing with the fire department pumping into the system.
   B. A fire department connection shall be provided as required in this chapter.
   C. 1 1/2 inch hose connections shall be provided on each floor.
   D. Main riser water flow indication/annunciation shall be provided.
E. When the existing standpipe cannot meet the above criteria, a new standpipe system sized per Section 3806 shall be required.

EXCEPTION 1: Connection to city main water supply and the installation of a fire pump is not required.

EXCEPTION 2: System shall be supervised by air pressure or by water (as approved by the Denver Water Board).

EXCEPTION 3: New standpipe risers may be installed in stairwells providing the exitway is not obstructed. Outlets shall be located per Section 3806.

3. A communication system shall be required as follows for existing F-2 high rise occupancies:
   
   A. A one-way communication system shall be provided. The system shall be provided with a minimum of two (2) one-way communication zones. Design of the communication system shall be such that half the speakers on each floor are connected to one zone and half connected to the other zone, so that damage or loss of any one speaker, cable, amplifier, preamplifier, or any other single component will not cause the failure of more than one-half of the communication systems on each floor. The cable system shall be routed in a minimum of two (2) vertical risers remotely located from each other. Speakers connected to each system shall be evenly distributed on each floor with adjacent speakers connected to opposite zones.

   EXCEPTION 1: Speakers will not be required in stairways but shall be audible in these areas.

   EXCEPTION 2: Speakers will not be required in elevators.

   B. A two-way telephone communication system (fire fighter's communication system) shall be provided conforming to the requirements of this code.

   EXCEPTION 1: Phone jacks will be required only at stairway entrances adjacent to manual pull stations.

   EXCEPTION 2: Phone jacks at stairway entrances may be on one zone per stairway.

4. The control center shall be located on the first floor (ground) level at a location approved by the Department and Fire Department. The center shall consist of the main fire alarm panel and/or annunciator panel, controls for the voice communications systems, controls for the fire fighter’s communication sys-
SECTION 3818. STANDARDS. Unless provided for in other portions of this Building Code, the following standards shall apply:

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</table>
Household Fire Warning Equipment, Pamphlet 74, 1980
Air Handling Systems, Pamphlet 90A, 1978
Commercial Cooking Equipment, Smoke and
Grease- Laden Vapor Removal, Pamphlet 96, 1980
Aircraft Fire Extinguishers, Pamphlet 408, 1973
Aircraft Hangers, Pamphlet 409, 1979

LEGEND

NFPA
National Fire Protection Association
BatteryMarch Park
Quincy, MA 02269
CHAPTER 39

STAGES AND PLATFORMS

SECTION 3901. SCOPE. In addition to the other requirements of this Building Code, this Chapter shall govern the requirements for stages and platforms.

SECTION 3902. STAGES AND PLATFORMS DEFINED. See Chapter 4.

SECTION 3903. GRIDIRONS. Gridirons, fly galleries, and pinrails shall be constructed of noncombustible materials, but protection of steel and iron members may be omitted. Gridirons and fly galleries shall be designed to support the live loads as indicated in Chapter 23.

(a) Loft Blocks. Each loft block well shall be designed to support 250 pounds per lineal foot, and the head block well shall be designed to support the aggregate weight of all the loft block wells served. The head block well shall be provided with a strongback or lateral brace to offset torque.

(b) Sheaves. The main counterweight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load, sufficient to accommodate the weight imposed by the total number of loft blocks in the gridiron. The sheave blocks shall be designed to accommodate the maximum load of the loft blocks served with a safety factor of 5.

SECTION 3904. ROOMS ACCESSORY TO STAGES. Rooms accessory to a stage shall be separated from each other and from the stage by at least a one-hour noncombustible fire separation.

SECTION 3905. PROSCENIUM WALLS.

(a) Construction. Stages shall be completely separated from the auditorium by a proscenium wall of at least one-hour noncombustible construction. The proscenium wall shall extend to the underside of the roof deck over the auditorium.

(b) Openings. All openings, other than proscenium openings, shall be protected with fire dampers as required in Chapter 52.

SECTION 3906. STAGE FLOORS.

(a) Construction. All portions of stage floors shall be built in accordance with the requirements of this Building Code, and shall be constructed of materials no less fire resistant than the building or structure housing the stage, and in no case shall the construction be less than one-hour
fire-resistive noncombustible construction. Wood coverings may be installed, providing such wood covering shall be of at least 2 inch nominal thickness. Where wood sleepers are used for the laying of wood floors, the space between the floor slab and the underside of the wood covering shall be filled with noncombustible material or firestopped, so that there will be no open spaces under the flooring which will exceed 100 square feet in area. See Chapter 38 for fire sprinklers under stages.

(b) Openings. Openings through stage floors shall be equipped with tight-fitting trap doors of wood at least 2 inches in nominal thickness.

SECTION 3907. PLATFORMS.
(a) Construction. Walls and ceilings of an enclosed platform in an assembly room shall be of at least one-hour fire-resistive construction. See Chapter 38 for fire sprinklers under platforms.
(b) Accessory Rooms. Rooms accessory to a platform shall be separated from each other by at least a one-hour fire-resistive separation.

SECTION 3908. STAGE EXITS. At least one continuous exit, not less than 36 inches in width, shall be provided from each side of the stage, opening directly or by means of a passageway to a street or exit court.
(a) Width. An exit stair at least 2 feet 6 inches wide, shall be provided for egress from each fly gallery.
(b) Egress. Each group or vertical tier of dressing rooms shall be provided with at least 2 means of egress, and each shall be at least 2 feet 6 inches in width.
(c) Enclosure. Stairs required in this Section need not be enclosed.
(d) Stairs. Stairs shall be constructed as specified in Chapter 33.

SECTION 3909. SWITCHBOARD. A noncombustible protecting hood shall be provided over the full length of the stage switchboard.

SECTION 3910. FLAME-RETARDING REQUIREMENTS. Combustible scenery, drops, props, decorations, or other combustible effects shall not be placed or utilized on any stage or enclosed platform, unless the materials have been treated with a fire-retardant solution. All materials shall be maintained in a nonflammable condition as approved by the Fire Department. See Chapter 42.

SECTION 3911. FIRE PROTECTION SYSTEMS. Fire protection systems shall be installed as required in Chapter 38.
CHAPTER 40
FILM PROJECTION ROOMS OR BOOTHS

SECTION 4001. REQUIREMENTS.
(a) General. In addition to the other requirements of this Building Code, this Chapter shall govern the requirements for motion picture film projection rooms or booths.

(b) Scope. The provisions of this Chapter shall apply only where motion picture film larger than 16 mm is used or is intended to be used. See Chapter 53 for electrical requirements.

(c) Projection Room Required. Every motion picture projector using film as set forth in this Chapter, together with all electrical devices, rheostats and equipment located in any Group A, B, and C occupancy, shall be enclosed in a projection room of a size which will permit the operator access to all parts of the projector.

SECTION 4002. CONSTRUCTION.
(a) General. Every projection room shall be of permanent construction consistent with the construction requirements for the type of building in which the projection room is located, but not less than one-hour construction. Openings need not be fire rated.

(b) Floor Area Assignment. The room shall have a floor area of at least 80 square feet for a single projector, and at least 40 square feet for each additional projector. Each motion picture projector, floodlight, spotlight, or similar piece of equipment shall have a clear working space at least 30 inches by thirty inches on each side and at the rear thereof, but only one such space shall be required between two adjacent projectors.

SECTION 4003. EXITS. See Chapter 33.

SECTION 4004. VENTILATION. See Chapter 52.

SECTION 4005. SANITARY FACILITIES. Sanitary facilities shall be required in all projection rooms or booths, except those located in churches or schools.

SECTION 4006. FLAMMABLE FILM.
(a) Prohibition. The use or storage of flammable film (for example nitrocellulose) in new and existing Group A through H occupancy buildings is prohibited.
(b) Signs. There shall be posted within the projection room or booth a conspicuous sign with one-inch block letters stating "SAFETY FILM ONLY PERMITTED IN THIS ROOM".

SECTION 4007. PROJECTION PORTS AND OPENINGS.

(a) Openings. The aggregate of openings of projection equipment shall not exceed 25 percent of the area of the walls between the projection room and the auditorium. All openings shall be provided with glass, so as to completely close the opening.
CHAPTER 41
DOMESTIC APPLIANCES

SECTION 4101. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation, repair and replacement of domestic appliances as herein defined.
(b) Water Supply Connection. All connections made to a potable water supply system, including water bypasses for water conditioning appliances, for purposes of installing, altering, repairing, or replacing appliances, as herein defined, shall conform to the provisions of this Chapter and, where applicable, with Chapter 50 of this Building Code.

SECTION 4102. DEFINITIONS.
(a) General. The following words, phrases, terms and their derivatives shall be interpreted as set forth in this Section.
1. Air Break (drainage system). A piping arrangement in which a drain from an appliance discharges indirectly into a plumbing fixture at a point above the floor level rim of the fixture.
2. Air Gap (drainage system). The unobstructed vertical distance through the free atmosphere between the domestic appliance waste pipe outlet and the flood level rim of the receptacle into which it is discharging.
3. Air Gap (water distribution system). The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to the domestic appliance and the flood level rim of the receptacle.
5. Approved. See Chapter 4.
6. Backflow. The flow of water or other liquids, mixtures, or substances into the distributing piping system of potable water from any source other than its intended source. Back-siphonage is one type of backflow.
7. Backflow Preventor. A backflow preventor is a device or means to prevent backflow.
   A. Atmospheric Type (Vacuum Breaker—Atmospheric). A device designed for installation in a water line, without any control valves downstream, to close against its inlet seat and introduce air into its outlet side when water ceases to flow through it.
   B. Pressure Type (Vacuum Breaker—Pressure). A device designed for installation in a water line, to close against its inlet seat and introduce air into its outlet side when inlet water pressure drops below the outlet water pressure.
C. Reduced Pressure Zone Type. An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere.

8. Back-Siphonage. The flowing back of used, contaminated, or polluted water from a plumbing fixture or other sources into a potable water supply pipe due to a negative pressure in the pipe.

9. Closed System. A system which is designed so that the expansion of the water due to temperature changes cannot be accommodated by reverse flow in the water supply system.

10. Connection to Water Supply System. This shall not be construed to include connections to existing faucets.

11. Domestic Appliances. Shall mean any and all apparatus and equipment where the same is connected to a potable water supply system, and which is not connected to a drainage system, or is only indirectly connected to a drainage system as herein defined, and shall include the following:
   A. Clothes washing machines whose capacity does not exceed 20 pounds.
   B. Dishwashing machines used in dwelling units only.
   C. Evaporative coolers of the window and free standing type only.
   D. Humidifiers of the freestanding type only.
   E. Ice making machines used in dwelling units only.
   F. Water conditioning appliances which are provided with a maximum capacity of 120,000 grains. These appliances shall not be directly connected to closed steam or hot water heating systems.
   G. Water heaters not in excess of 100 Mbtu. This term shall not include the gas piping, gas venting, or electrical wiring of the appliance connection.
   H. This definition of Domestic Appliances shall, for the purpose of repair and replacement, include garbage disposal units directly connected to the drainage system.

12. Drainage System. A drainage system means, and includes, all piping within public or private premises which conveys sewage, storm water, or other liquid waste, and includes the building sewer.

13. Effective Opening. The effective opening is the minimum cross-sectional area at the point of water-supply discharge, measured or expressed in terms of: (1) the diameter of a circle, or (2) if the opening is not circular, the diameter of a circle or equivalent cross-area.

14. Flood Level. The flood level in reference to an appliance or fixture means the level at which water begins to overflow from the top or rim of the appliance or fixture.
15. **Flood Level Rim.** The flood level rim is the top edge of the receptacle from which water overflows.

16. **Ice Makers.** Shall mean any type of refrigeration which is connected to the water supply for the purpose of making ice.

17. **Indirect Waste Pipe.** A waste pipe which does not connect directly with a drainage system, but which discharges into the drainage system through an air break or air gap, into a trap, plumbing fixture, receptor, inceptor, or other approved point of disposal.

18. **Repair or Replacement.** Shall include the repair or replacement of domestic appliances as defined in this Chapter. In addition, repair or replacement shall include garbage disposal units and dishwashers where they are connected directly to the sanitary sewer system, including the necessary replacement of tail pipes and traps. This shall not be construed to include the providing of additional openings into, or the relocation of, existing openings to another location in the sanitary drainage system.

19. **Receptor.** A plumbing fixture which is intended to receive the discharge from indirect waste piping, is directly connected to the drainage system, and is properly tapped and vented, and which is installed as provided for in Chapter 50.

20. **Sump.** A sump is a tank or pit which receives the discharge from drains, or other wastes, located below the normal grade of the gravity system, and which must be emptied by mechanical means.

21. **Supports, Hangers and Anchors.** Supports, hangers and anchors are devices for securing pipes, appurtenances and devices to walls, ceilings, or floors.

22. **Used.** Used, when applied to material, or equipment, means removed from previous installations.

23. **Vacuum Breaker.** See Backlow Preventor.

24. **Water Conditioning Appliances.** The term water conditioning appliances shall include equipment which is not connected to a drainage system, or is only indirectly connected to a drainage system, and which is designed to soften or otherwise treat water bypasses.

25. **Water Distributing Pipes.** A water distributing pipe in a building is a pipe which conveys water from the water service pipe to the domestic appliances, plumbing fixture branch or other plumbing outlets.

26. **Water Service Pipe.** Water service pipe is the pipe from the water main, or other source of water supply, to the building served.

27. **Water Heaters.** The term water heater shall include those which provide a Btu input capacity not to exceed 100 Mbtu and is not used primarily for building heating purposes.
28. Water Supply System. The water supply system of a building consists of the water distributing pipes, and the necessary connecting pipes, fittings, control valves, and all appurtenances on a particular premises.

SECTION 4103. GENERAL REQUIREMENTS.
(a) Installation. All appliances shall be installed in a manner to afford access for cleaning, repair, and replacement.
(b) Vertical Pipe Supports. Vertical piping shall be secured at sufficiently close intervals to keep the pipe alignment and carry weight of the pipe and contents, but in no case less than at every story height.
(c) Hangers and Anchors. Hangers and anchors shall be metal of sufficient strength to support the pipe and its contents, and shall be attached to the building construction.
(d) Openings. Openings through walls, floors, and ceilings shall be filled with incombustible materials.

SECTION 4104. JOINTS AND CONNECTIONS.
(a) Watertight. All joints and connections shall be made watertight.
(b) Threaded Joints. All burrs shall be removed. Pipe ends shall be reamed out to the size of the bore, and all chips shall be removed. Pipe joint cement shall be permitted on male threads only.
(c) Soldered or Brazed Joints. Soldered or brazed joints for tubing shall be made with approved fittings. The tubing shall be expanded with a proper flaring tool.
(d) Flared Joints. All flared joints for soft-copper water tubing shall be made with approved fittings. The tubing shall be expanded with a proper flaring tool.
(e) Slip Joints. Slip joints shall not be concealed.
(f) Ground Joints. Ground joint brass connections which allow adjustment of tubing, but provide a rigid joint when made-up, shall be considered as slip joints.

SECTION 4105. AIR GAPS, AIR BREAKS AND PREVENTORS.
(a) Protection of Water Supply. All appliances, except water heaters and water conditioning appliances, shall be supplied with water through an air gap or air break or shall be provided with a backflow preventor conforming to the following:
1. Air Gap. The minimum required air gap shall be measured vertically from the end of the faucets, spout, or supply pipe, down to the flood level rim of the fixtures or vessel.
   A. The minimum required air gap shall be twice the diameter of the effective opening.
2. Backflow Preventor. Atmospheric type backflow preventors, where required, shall be installed between the control valve and the appliance, so the preventor will not be subjected to water pressure except the back pressure incidental to water flowing to the appliance.

A. Backflow preventors shall be constructed of corrosion resistant material of design and proportions which will not deteriorate or deform under reasonable service conditions.

3. Air Break. The water discharge from a portable appliance into a plumbing fixture may be through an air break.

SECTION 4106. WASTE OUTLETS.

(a) General. Waste from appliances shall be discharged into open plumbing fixture or receptor, properly trapped, vented and connected to the drainage system, or if located below the building drain, as defined in Chapter 50, such appliances may discharge to a sump. Discharge from devices, other than plumbing fixtures, supplied with potable water through an air gap or an approved vacuum breaker, or discharge from devices producing condensate and not subject to a vacuum, at times, which could cause back-siphonage, may discharge through an air break. Clear water waste may also discharge to an approved dry well or to other approved points of disposal.

(b) Prohibited Waste. Toxic, corrosive, flammable, or explosive substance, or other liquid, vapor, gas, or substance of any kind harmful to the drainage system, shall not be discharged into a plumbing fixture.

(c) Standpipe for Clothes Washing Machines. A standpipe may be used as a receptor when installed as provided for in Chapter 50.

SECTION 4107. WATER SUPPLY AND DISTRIBUTION.

(a) Protection Against Freezing. All piping, tanks, appliances, and devices, where subject to freezing temperatures, shall be effectively protected.

(b) Water Pipes, Tubing and Fitting. Water supply and discharge piping used for appliances shall consist of brass, copper, lead, cast iron, wrought iron, open-hearth iron, or steel, or NSF approved plastic pipe, with appropriate fittings; provided, however, approved type flexible connections, with a shutoff valve ahead of such connections, shall be permitted for use as water supply and flexible discharge piping shall be permitted, also, for appliances which are portable or subject to vibration. All threaded ferrous pipe and fittings shall be galvanized (zinc-coated), or cement lined.

(c) Drainage of Water Pipes. All water supply pipes for appliances shall be graded or pitched to permit the entire system, or parts thereof, to be drained.

(d) Sizing Water Piping. Water supply pipes for appliances shall be not less in size than the water connection of such units, provided washing machines require not less than 1/2 inch lines, and that the pressure at the appliance connection be not less than 8 psig flowing pressure.
SECTION 4108. TEMPERATURE-PRESSURE RELIEF VALVES.
(a) General. Approved combination temperature-pressure relief valves or separate temperature and pressure relief valves, shall be installed. Combination temperature-pressure, or individual temperature relief valves, shall be of the thermostatic self-closing type. The pressure side of the valve shall be set to relieve at a maximum of 165 pounds per square inch (psi). The temperature side of the valve shall be set to relieve at a maximum of 210 degrees Fahrenheit, and shall be capable of discharging sufficient hot water to prevent any further rise in temperature within the water heater. All temperature relief valves shall provide a relief capacity equal to, or greater than, the rated Btu input of the water heater.
(b) Outlet Waste. The outlet of temperature and pressure relief valve shall not be connected to the drainage system as a direct waste. The discharge pipe from temperature and pressure relief valves shall be piped to drain into a receptor, sump, open fixture, or other disposal location as approved by the Department.
(c) Location. Thermostatic self-closing type combination temperature pressure relief valves shall be placed within 6 inches of the top of the tank, or directly above the tank on the hot water side, and in no case more than 3 inches away from the tank. Required vacuum-relief valves shall be placed as close to the tank as possible. There shall be no check valve or shut-off valve between a relief valve and the heater or tank for which it is installed.

SECTION 4109. USED MATERIALS AND WATER HEATERS.
(a) Approval. Used materials and water heaters shall not be permitted unless approved by the Department.
(b) Potable-Water Piping Material. Material that has been used for other than potable-water supply shall not be used for pipe, tubing, or fittings in a potable-water supply system.

SECTION 4110. MATERIALS. All materials, appliances and heaters shall be approved and used in accordance with the limitations imposed throughout this Building Code, and shall meet established technical standards of quality and strength necessary to produce reasonable, safe, and sanitary installations.

SECTION 4111. STANDARDS. Unless provided for in other portions of this Building Code, the Standards Section of Chapter 50 shall apply.
CHAPTER 42
INTERIOR WALL AND CEILING FINISH

SECTION 4201. GENERAL. Interior wall and ceiling finish shall mean interior wainscoting, paneling, or other finish applied structurally or for decoration, acoustical correction, surface insulation, or similar purposes. Requirements for finishes shall not apply to trim, defined as picture molds, chair rails, baseboards and handrails; to doors and windows or their frames; nor to materials which are less than 1/28 inch in thickness cemented to the surface of walls or ceilings, if these materials have flame-spread characteristics no greater than paper of this thickness cemented to a noncombustible backing.

SECTION 4202. TESTING AND CLASSIFICATION OF MATERIALS.

(a) Testing. Tests shall be made by an approved testing agency to establish flame-spread characteristics and to show that materials, when cemented or otherwise fastened in place, will not readily become detached when subjected to room temperatures of 300 degrees Fahrenheit for 25 minutes. Flame-spread characteristics shall be determined by one of the following methods:

1. The "Tunnel Test", as set forth in ASTM-E-84.
2. Any other recognized method of test procedure for determining the flame-spread characteristics of finish materials that will give comparable results to those specified in Method No. 1 herein.

(b) Classification. The classes of materials, based upon their flame-spread characteristics under the Tunnel Test, shall be as set forth in Table No. 42-A. The smoke density shall be no greater than 450 when tested in accordance with ASTM-E-84 in the manner intended for use. The products of combustion shall be no more toxic than the burning of untreated wood under similar conditions.

SECTION 4203. APPLICATION OF CONTROLLED INTERIOR FINISH.

(a) General. Interior finish materials applied to walls and ceilings shall be tested as specified in Section 4202, and regulated for purposes of limiting flame-spread by the following provisions:

1. When walls and ceilings are required by any provision in this Building Code to be of fire-resistant or noncombustible construction, the finish material of any class shall be applied directly against such fire-resistant construction or to furring strips not exceeding 1 1/2 inches thick applied directly against such surfaces. The intervening spaces between such furring strips shall be filled with inorganic or Class I material, or shall be firestopped not to exceed 8 feet in any direction.
2. Where walls and ceilings are required to be of fire-resistive or noncombustible construction, and walls are set out or ceilings are dropped a distance greater than specified in Paragraph (1) of this Section, Class I finish materials shall be used, except where the finish materials are protected on both sides by automatic fire extinguishing systems, or are attached to a noncombustible backing or to furring strips installed as specified in Paragraph (1). The hangers and assembly members of such dropped ceilings that are below the main ceiling line shall be of noncombustible materials, except that in Types III and V construction fire-retardant wood may be used. The construction of each set out wall shall be of fire resistive construction as required elsewhere in this Building Code. See Chapter 25.

3. Wall and ceiling finish materials of all classes permitted in this Chapter may be installed directly against the wood decking or planking of Heavy-Timber Construction, or to wood furring strips applied directly to the wood decking or planking, installed or firestopped as specified in Paragraph 1 of this Section.

4. All interior wall or ceiling finish, other than Class I material which is less than 1/4 inch thick, shall be applied directly against a noncombustible backing, unless the qualifying tests were made with the material suspended from the noncombustible backing.

SECTION 4204. FINISHES BASED ON OCCUPANCY. The minimum flame-spread classification of interior finish, determined by tests, shall be based on use or occupancy as set forth in Table No. 42-B.

EXCEPTIONS:

1. Except in Group D Occupancy and in enclosed vertical exitways Class III may be used in other exitways and rooms as wainscoting extending not more than 48 inches above the floor, and for tack and bulletin boards covering not more than 5 percent of the gross wall area of the room.

2. Where approved full fire extinguishing system protection is provided, the flame-spread classification rating may be reduced one classification, but in no case shall materials having a classification greater than Class III be used.

3. The exposed faces of Type III-H.T. structural members and Type III-H.T. decking and planking where otherwise permissible under this Building Code, are excluded from flame-spread requirements.

SECTION 4205. DRAPERIES, BLINDS, CARPETS, AND DECORATIONS. Draperies, blinds, tapestries and decorations of all types in buildings housing Group A through D Occupancies, shall be required to be of an approved flameproof or noncombustible material. Carpeting to be installed on walls or ceilings of group A through H Occupancies shall provide a
flame-spread not to exceed 25 and smoke developed not to exceed 50. In addition, the attachment of the carpeting to walls or ceilings shall not rely on adhesives, but shall be installed with mechanical fastenings as approved by the Department prior to installation.

SECTION 4206. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
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<tr>
<td>NFPA</td>
<td>Standards for Flameproofed Textiles, Pamphlet 701-77.</td>
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<tr>
<td>ASTM</td>
<td>Surface Burning Characeristics of Building Materials, E-84-77.</td>
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<td>Methods of Test for Flammability of Treated Paper and Paperboard.</td>
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<td>Surface Flammability of Materials Using a Radiant Heat Source E-162-73, (Carpeting.)</td>
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SECTION 4207. TABLES. Flame-spread classification and minimum interior finish classification shall conform to Tables 42-A and 42-B.
### TABLE NO. 42-A

**FLAME-SPREAD CLASSIFICATION**

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<tr>
<th>CLASS. NO.</th>
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### TABLE NO. 42-B

**MINIMUM INTERIOR FINISH CLASSIFICATION**

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<tr>
<th>Occupancy Group</th>
<th>Enclosed Vertical Exitway</th>
<th>Other Exitways</th>
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*a* Flame-Spread provisions are not applicable to kitchens and bathrooms of Group I Occupancies.
CHAPTER 43

FIRE RESISTIVE STANDARDS

SECTION 4301. GENERAL. This Chapter shall govern the fire-resistant materials and the requirements for fire-resistive construction specified in this Building Code.

SECTION 4302. FIRE RESISTIVE MATERIALS.
(a) General. Materials used for fire-resistive purposes shall be limited to those specified in this Chapter unless accepted under the provisions of Section 4302(b), and shall conform to the Standards of this Chapter.

(b) Tests. For the purpose of determining the degree of fire resistance, the materials of construction listed in this Chapter and the Standards shall be assumed to have the fire resistance ratings indicated. Other materials of construction tested in accordance with ASTM Standard E-119 shall be rated for fire resistance according to the results of this test, provided that they also meet the requirements of Section 111 of this Building Code.

(c) Concrete. Normal weight concrete shall be made with aggregates conforming to ASTM Standard C33 producing structural concrete having a density exceeding 115 pounds per cubic foot. Lightweight concrete shall be made with aggregates conforming to ASTM Standard C330 producing structural concrete having a density of 115 pounds per cubic foot or less.

SECTION 4303. PROTECTION OF STRUCTURAL MEMBERS.
(a) General. Structural members having the fire resistance set forth in Table 43-A or in the Standards shall be assumed to have the fire resistive ratings indicated therein.

(b) Protective Coverings.
   1. Thickness of Protection. The thickness of fire resistive materials required for protection of structural members shall not be less than set forth in Table 43-A or the Standards, except as modified in this Section. The figures shown shall be the net thickness of the protecting materials, and shall not include any hollow space back of the protection.
2. Unit Masonry Protection. Unit masonry protection for metal columns shall have metal ties embedded in transverse joints spaced not more than 16 inches on center. Soffit tile protecting beam and girder flanges shall be secured to the flange with metal ties. Metal ties shall have a minimum cross section area equal to No. 8 wire gauge.

3. Reinforcement for Cast-In-Place Concrete Column Protection. Cast-in-place concrete protection for steel columns shall be reinforced at the edges of the members with wire ties not less than .18 inch in diameter wound spirally around the columns on a pitch of not more than 8 inches or by equivalent reinforcement.

4. Embedment of Pipes. Conduits and pipes may be embedded in the required fire protection of structural members when approved by the Department.

5. Column Jacketing. Fire resistive covering on columns shall be protected from damage due to moving vehicles, the handling of merchandise or other means.

6. Ceiling Protection. When a ceiling forms the protective membrane for fire resistive assemblies, the construction and their supporting horizontal structural members need not be individually fire protected except where the members support directly applied loads from more than one floor or roof. The required fire resistance shall be at least that required for individual protection of members. Ceilings shall form continuous fire resistive membranes, but may have openings for metal plumbing pipes, ducts and electrical outlet boxes provided the areas of the openings through the ceiling are no more than 100 square inches for any 100 square feet of ceiling area. Duct openings shall be protected by fire dampers.

**EXCEPTION:** Larger openings than permitted herein may be installed where the openings and the assemblies in which they are utilized conforms to the testing requirements of Section 4302(b). Individual electrical outlet boxes shall be of steel and not greater than 16 square inches in area. (Rev. 8/86 Ord. No. 521)

7. Plaster Application. Plaster protective coatings may be applied with the finish coat omitted when they comply with
the design mix and thickness requirements of Table 43-A, 43-B, 43-C and the Standards of this Chapter.

(c) **Protected Members.**

1. **Attached Metal Members.** The edges of lugs, brackets, rivets and boltheads attached to structural members may extend to within 1 inch of the surface of the fire protection.

2. **Reinforcing.** Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement except that stirrups and spiral reinforcement ties shall not project more than 1/2 inch into the protection.

3. **Studs and Joists.** Studs and joists are not required to have individual protection when part of an assembly that has a fire resistive rating.

4. **Bonded Prestressed Concrete Tendons.** For members having a single tendon or more than one tendon installed with equal concrete cover measured from the nearest surface, the cover shall be at least that specified in Table 43-A. For members having multiple tendons installed with variable concrete cover, the average tendon cover shall be at least that specified in Table 43-A provided:

   A. The clearance from each tendon to the nearest exposed surface is used to determine the average cover.

   B. In no case shall the clear cover for individual tendons be less than one-half of that specified in Table 43-A. A minimum cover of 3/4 inch for slabs and 1 inch for beams shall be required for concrete of any type aggregate.

   C. For the purpose of establishing a fire resistive rating, tendons having a clear covering at least that specified in Table 43-A shall not contribute more than 50 percent of the required ultimate moment capacity for members less than 350 square inches in cross sectional area and 65 percent for larger members. For structural design purposes, however, tendons having a reduced cover are assumed to be fully effective.

(d) **Fire Protection Omitted.** Fire protection may be omitted from the bottom flange of lintels spanning not over 6 feet, and shelf angles, or plates which are not a part of the structural frame.

**SECTION 4304. HEAVY TIMBER CONSTRUCTION.** Wood members conforming to the requirements of Chapter 20 for heavy timber
construction shall be assumed to have an equivalent fire resistance rating of one hour.

SECTION 4305. FIRE RETARDANT TREATED WOOD. Lumber or plywood impregnated with chemicals, when tested in accordance with ASTM E-84 for a period of 30 minutes, shall have a flame spread not over 25. Materials exposed to the weather shall maintain this fire retardant classification when tested in accordance with the rain and weather tests of UL Standard Specification 790. All materials shall bear the label of an approved testing laboratory showing the fire performance rating and, if intended for exterior use, shall be identified to show suitability for exposure to the weather.

SECTION 4306. WALLS AND PARTITIONS.
(a) General. Fire resistive walls and partitions shall be assumed to have the fire resistance ratings specified in Table 43-B and the Standards.
(b) Combustible Members. Combustible members framed into a wall shall be protected at their ends by at least one-half the required fire resistive thickness of the wall. See Chapter 25 for fire stopping requirements.
(c) Exterior Walls. In fire resistive exterior wall construction, the fire resistive rating shall be maintained for walls enclosing attic areas.

| (d) Penetrations. Penetrations in walls requiring protected openings shall be fire-stopped. Firestopping shall be of an approved material securely installed and capable of maintaining its integrity when subjected to the tests prescribed in Section 4302(b) for the specific wall or partition. Openings in walls or partitions shall be protected as specified in Section 4308. Where fire rated walls and partitions require protected openings, the following penetrations into or through such construction are permitted: |
| 1. Copper or ferrous pipe, conduits or raceways may penetrate the walls or partitions provided the penetrations are sealed with an approved material conforming to the requirements of ASTM E-814. The installation of non-metallic fire sprinkler piping systems is permitted under Section 3803(g). Penetration sealing shall comply with above. |
| 2. Openings for steel electrical outlet boxes not exceeding 16 square inches in area, provided the area of such openings does not aggregate more than 100 square feet of wall or partition area. |
Outlet boxes on opposite sides of walls or partitions shall be separated by a horizontal distance of 24 inches.

3. Where walls are penetrated by other materials or where larger openings are required than permitted in Item No. 2 above, they shall be qualified by tests conducted in accordance with the provisions of Section 4302(b). Duct penetrations shall conform to the requirements of Chapter 17 and 52. (Rev. 8/86 Ord. No. 521)

SECTION 4307. FLOOR-CEILING AND ROOF-CEILING ASSEMBLIES.

(a) General. Fire resistive floor-ceiling and roof-ceiling assemblies shall be assumed to have the fire resistance ratings specified in Table 43-C and the Standards.

(b) Floors. Fire resistive floors shall be continuous, and all openings shall be enclosed as specified in Chapter 17.

EXCEPTION 1. Copper or ferrous pipes, conduits or raceways may penetrate the fire-resistive floor systems, provided the penetrations are sealed with an approved material conforming to the requirements of ASTM E-814. Installation of electrical outlets or communication outlets shall conform to the above or shall be a listed device approved for penetration of fire rated floors.

EXCEPTION 2. The provisions of this Section shall not apply when the openings conform to the testing requirements of Section 4302(b). (Rev. 8/86 Ord. No. 521)

(c) Roofs. Fire resistive roofs may have the same openings permitted for floors, and may contain other openings permitted by this Building Code. See Chapters 54 and 60 for skylight construction.

(d) Unusable Space Above or Below. In one hour fire resistive construction, the ceiling may be omitted above unusable space and flooring may be omitted below unusable space.

(e) Ceiling Protection. When a ceiling approved for one hour fire resistive construction is provided below concrete slabs or concrete structural members not required to be protected by the ceiling, the required thickness of the slab and the fire protection of structural members may be reduced 1/2 inch; but in no case shall the slab
thickness be less than 2 inches and fire protection of structural members less than 3/4 inch.

(f) **Ceiling Panels.** When lay-in panels are used as part of fire resistive floor-ceiling or roof-ceiling assemblies, wire clips or other devices shall be installed to prevent upward displacement of the panels. Clips and devices shall be maintained in place at all times.

(g) **Draft Stops.** See Chapter 32.

**SECTION 4308. FIRE ASSEMBLIES FOR THE PROTECTION OF OPENINGS.**

(a) **General.** When required by this Building Code for the fire protection of openings, fire assemblies shall meet the requirements of this Chapter.

(b) **Definitions.**

1. **Fire Assembly.** The assembly of a fire door, fire window or fire damper including all required hardware, anchorage, frames and sills. Fire dampers shall be fabricated and installed in accordance with the requirements of Chapter 52.

2. **Automatic Closing Fire Assembly.** A fire assembly which may remain in an open position, and will close automatically if activated by a device detecting products of combustion other than heat.

3. **Self Closing Fire Assembly.** A fire assembly maintained in a normally closed position, and is equipped with a device to insure closing and latching after having been open for use.

(c) **Closing Devices.** Type A closing devices shall be self closing door closers without hold open mechanisms. Type B closing devices shall be electromagnetic door holders in combination with Type A closing devices. All devices shall bear the label of an approved testing laboratory.

(d) **Identification of Fire Assemblies.** All fire assemblies having fire protection ratings of 3 hours, 1-1/2 hours, 1 hour and 3/4 hour shall bear a label or other identification showing the fire resistive rating. The label or identification shall be issued by an approved testing agency having a service for inspection of materials and workmanship at the factory.

**EXCEPTION:** In Group A through H Occupancies, a 1-3/4 inch thick solid core wood door shall be acceptable as meeting the requirements for a one hour fire resistive door. See Table 5-B for Group I Occupancies. (Revised 8/80 Ord..No. 393)
(e) **Fire-Resistive Test.** The fire resistive rating of all types of required fire assemblies shall be determined in accordance with ASTM Standard E-152.

(f) **Hardware.** Each fire assembly required to have a 3 hour fire resistive rating shall be automatic closing as defined in Section 4308. Each fire assembly required to have 1-1/2 hours, one hour or 3/4 hour fire resistive rating shall be automatic closing or self closing as defined in Section 4308.

**EXCEPTION:** Exit doors may have closing devices as specified in Chapter 33.

Devices detecting products of combustion other than heat used in automatic fire assemblies shall be installed on each side of the wall opening at the top of the door opening, and at the ceiling when the ceiling is more than 3 feet above the opening. Devices detecting products of combustion shall be approved prior to installation and shall be maintained in operating condition at all times.

(g) **Glazed Openings in Fire Doors.** Glazed openings shall not be permitted in fire doors required to have a 3 hour fire resistive rating. The area of glazed openings in fire doors required to have 1-1/2 hours or 1 hour fire-resistive rating shall not exceed 100 square inches per door. The area of glazed openings in fire doors required to have a 3/4 hour fire resistive rating shall not exceed 1296 square inches per light, with no dimension exceeding 54 inches. One or more lights may be provided.

(h) **Glazed Openings in Fire Windows.** Windows required to have a 3/4 hour fire resistive rating shall not exceed 84 square feet in total area with no dimension exceeding 12 feet. The area of individual lights shall not exceed 1296 square inches with no dimension exceeding 54 inches. Fire window frames shall bear the classification marking of an approved testing laboratory.

(i) **Glazing.** Glazing in required fire assemblies shall be wired glass at least 1/4 inch thick, reinforced with 24 gauge or heavier wire embedded in glass and spaced not to exceed one inch in one or more directions. Wired glass shall be installed with glazing angles or wire clips. When wire clips are used, one shall be installed in each mounting hole.

(j) **Installation.** All fire assemblies shall be installed in accordance with the Standards of this Chapter.

**SECTION 4309. ROOF COVERINGS.** Fire retardant roof coverings shall be as specified in Chapter 32. See Chapter 35 for insulation in roofs.
SECTION 4310. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply: (Revised 5/82 Ordinance No. 245)

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>Spec. for Gypsum Plasters, C-28-76a.</td>
</tr>
<tr>
<td></td>
<td>Spec. for Concrete Aggregates, C33-78.</td>
</tr>
<tr>
<td></td>
<td>Spec. for Gypsum Wallboard C36-78.</td>
</tr>
<tr>
<td></td>
<td>Spec. for Gypsum Lath, C37-76.</td>
</tr>
<tr>
<td></td>
<td>Sampling and Testing Concrete Masonry Units, C140-75.</td>
</tr>
<tr>
<td></td>
<td>Spec. for Portland Cement, C150-78a.</td>
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<td></td>
<td>Spec. for Light Weight Aggregates for Structural Concrete, C330-77.</td>
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<tr>
<td></td>
<td>Fire Tests of Door Assemblies, E152-78.</td>
</tr>
<tr>
<td></td>
<td>Fire Tests of Through-Penetration Fire Stops E814-83</td>
</tr>
<tr>
<td></td>
<td>(Rev. 8/86 Ord. No. 521)</td>
</tr>
<tr>
<td>FM</td>
<td>Approval Guide - 80.</td>
</tr>
<tr>
<td>NFPA</td>
<td>Fire Doors and Windows, No. 80-79.</td>
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LEGEND

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>Factory Mutual System 1151 Boston-Providence Turnpike Norwood, Ma. 02062</td>
</tr>
</tbody>
</table>
SECTION 4311. TABLES.
### TABLE NO. 43-A
### MINIMUM PROTECTION FOR STRUCTURAL PARTS

<table>
<thead>
<tr>
<th>Structural parts to be protected</th>
<th>Item</th>
<th>Insulating Material</th>
<th>Minimum thickness in inches for fire resistive rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 hr.</td>
</tr>
<tr>
<td>Steel columns and all members of primary trusses</td>
<td>1</td>
<td>Normal weight and light weight concrete</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Brick of clay, shale or concrete</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Clay tile or concrete block</td>
<td>4</td>
</tr>
<tr>
<td>Steel beams and girders</td>
<td>4</td>
<td>Normal weight or lightweight concrete</td>
<td>2 1/8</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Brick of clay, shale or concrete</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Clay tile or concrete block</td>
<td>4</td>
</tr>
<tr>
<td>Bonded pretensioned reinforcement in prestressed concrete</td>
<td>7</td>
<td>Normal weight concrete</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slabs</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Lightweight concrete</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slabs</td>
<td>2 1/2</td>
</tr>
<tr>
<td>Bonded or unbonded post-tensioned reinforcement in prestressed concrete</td>
<td>9</td>
<td>Normal weight concrete</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders less than 12&quot; wide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restrained members</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders 12&quot; or wider</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slabs</td>
<td>1 1/4</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Normal weight concrete</td>
<td>4 1/8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders less than 12&quot; wide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restrained members</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders 12&quot; or wider</td>
<td>3 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slabs</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Lightweight concrete</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders less than 12&quot; wide</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Restrained members</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders 12&quot; or wider</td>
<td>1 1/4</td>
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<tr>
<td></td>
<td></td>
<td>Slabs</td>
<td>1 1/8</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Lightweight concrete</td>
<td>3 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders less than 12&quot; wide</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Restrained members</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beams and girders 12&quot; or wider</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slabs</td>
<td>1 1/8</td>
</tr>
<tr>
<td>Reinforcement in concrete columns, beams, girders and trusses</td>
<td>13</td>
<td>Normal weight concrete</td>
<td>2 1/4</td>
</tr>
<tr>
<td>Reinforcement in concrete joists placed monolithically with slab</td>
<td>14</td>
<td>Lightweight concrete</td>
<td>1 1/4</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Normal weight concrete</td>
<td>1 1/4</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Lightweight concrete</td>
<td>1 1/4</td>
</tr>
<tr>
<td>Reinforcement in concrete floor and roof slabs</td>
<td>17</td>
<td>Normal weight concrete</td>
<td>1 1/4</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Lightweight concrete</td>
<td>1 1/4</td>
</tr>
<tr>
<td>Material</td>
<td>Item Number</td>
<td>Construction</td>
<td>Minimum Finished Thickness</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 hr.</td>
</tr>
<tr>
<td>Brick of Clay or Shale</td>
<td>1</td>
<td>Solid units at least 75 percent solid</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Solid units plastered each side with 3/4&quot; gypsum or portland cement plaster</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Hollow brick units at least 71 percent solid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Hollow brick units at least 71 percent solid, plastered each side with 3/4&quot; gypsum or portland cement plaster</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Hollow cavity wall consisting of two 4&quot; nominal clay brick units with air space between</td>
<td></td>
</tr>
<tr>
<td>Hollow Clay Tile</td>
<td>6</td>
<td>Units at least 45 percent solid</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Units at least 45 percent solid, plastered each side with 3/4&quot; gypsum plaster</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Two cells in wall thickness, units at least 40 percent solid</td>
<td>8</td>
</tr>
<tr>
<td>Combination of clay brick and load-bearing hollow clay tile</td>
<td>9</td>
<td>4&quot; brick and 8&quot; tile</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4&quot; brick and 4&quot; tile</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>4&quot; brick and 4&quot; tile, plastered on the tile side with 3/4&quot; gypsum plaster</td>
<td>8 1/4</td>
</tr>
<tr>
<td>Concrete masonry units</td>
<td>12</td>
<td>Lightweight concrete</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Normal weight concrete</td>
<td>12</td>
</tr>
<tr>
<td>Solid Concrete</td>
<td>14</td>
<td>Horizontal reinforcement not less than 0.25 percent and vertical reinforcement not less than 0.15 percent. (Three-fourths as much for welded wire fabric)</td>
<td>Light-weight concrete</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Normal weight concrete</td>
</tr>
<tr>
<td>Hollow (studless) Gypsum wallboard partition non-bearing</td>
<td>15</td>
<td>One full-length layer of 3/4&quot; Type &quot;X&quot; gypsum wallboard attached to both sides of wood or metal top and bottom runners laminated to each side of 1&quot; x 6&quot; full length gypsum coreboard ribs spaced 24&quot; on center with approved laminating compound. Ribs centered at vertical joints of face plies and joints staggered 24&quot; in opposing faces.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>1&quot; regular gypsum &quot;V&quot; edge full-length base layer attached to both sides of 1 3/4&quot; wood or metal runners. Face layer of 1/2&quot; regular full length gypsum wallboard laminated to base layer with approved laminating compound.</td>
<td></td>
</tr>
<tr>
<td>Noncombustible studs - non-bearing partitions</td>
<td>17</td>
<td>3 3/4 No. 16 gauge approved nailable studs spaced 24&quot; on center. 3/4&quot; neat gypsum wood fibered plaster each side over 3/4&quot; rib metal lath nailed to studs at 8&quot; on center.</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Item Number</td>
<td>Construction</td>
<td>Minimum Finished Thickness Face-to-Face (In Inches)</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Noncombustible studs - non-bearing interior partition</td>
<td>18</td>
<td>One layer of 1/2&quot; Type &quot;X&quot; gypsum wallboard applied to each side of 3 1/4&quot; metal studs at 24&quot; o.c.</td>
<td>4 1/4</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>Two layers of 1/2&quot; Type &quot;X&quot; gypsum wallboard applied to each side of 3 1/4&quot; metal studs at 24&quot; o.c. Stagger joints 24&quot; o.c. each layer and side.</td>
<td>6 1/4</td>
</tr>
<tr>
<td>Wood Studs interior partition</td>
<td>20</td>
<td>2&quot; x 4&quot; wood studs 16&quot; on center with two layers 3/8&quot; regular gypsum wallboard applied vertically or horizontally each side. Joints staggered.</td>
<td>5 1/4</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>Wood studs with space filled with insulating bats attached to studs, 1/4&quot; regular gypsum wallboard. Mineral or slag wool bats shall weigh at least 1.0 lb. and glass wool bats at least 0.6 lb. per square foot of wall surface.</td>
<td>4 1/4</td>
</tr>
<tr>
<td>Exterior or interior walls</td>
<td>22</td>
<td>2&quot;x4&quot; wood studs 15&quot; on center with 5/8&quot; Type &quot;X&quot; gypsum wallboard each side.</td>
<td>4 3/4</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>2&quot; x 4&quot; wood studs 16&quot; on center with two layers 1/2&quot; Type &quot;X&quot; gypsum wallboard each side.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1/2&quot; drop siding or 1/4&quot; exterior type plywood over 1/2&quot; gypsum sheathing on 2&quot; x 4&quot; wood studs at 16&quot; on center on exterior surface with interior surface treatment as required for one-hour rated interior wood stud partitions.</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>2&quot; x 4&quot; wood studs 16&quot; on center with metal lath and 1/4&quot; exterior cement plaster on each side.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>2&quot; x 4&quot; wood studs 16&quot; on center with 1/4&quot; exterior cement plaster on the exterior surface with interior surface treatment as required for interior wood stud partitions.</td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>2&quot; x 6&quot; fire-retardant treated wood studs 16&quot; on center. Interior face has two layers of 1/2&quot; Type &quot;X&quot; gypsum wallboard with the base layer placed vertically and face layer placed horizontally.</td>
<td>8 1/4</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>4&quot; No. 18 gauge non-load-bearing metal studs, 16&quot; on center, with 1&quot; portland cement lime plaster on the exterior surface. Interior surface covered with 1&quot; of gypsum plaster on 3.4# expanded metal lath.</td>
<td>6 1/4</td>
</tr>
</tbody>
</table>
### TABLE NO. 43-C

**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS**

<table>
<thead>
<tr>
<th>Floor or Roof Construction</th>
<th>Item No.</th>
<th>Ceiling Construction</th>
<th>Thickness of Floor, or Roof Slab (In Inches)</th>
<th>Minimum Thickness of Ceiling (In Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 hr.</td>
<td>3 hr.</td>
</tr>
<tr>
<td>Normal weight concrete</td>
<td>1</td>
<td>Slab (no ceiling required)</td>
<td>6 1/2</td>
<td>5 1/2</td>
</tr>
<tr>
<td>Lightweight concrete</td>
<td>2</td>
<td>Slab (no ceiling required)</td>
<td>5 1/2</td>
<td>4 1/2</td>
</tr>
<tr>
<td>Reinforced concrete joists</td>
<td>3</td>
<td>Slab with suspended ceiling of vermiculite gypsum plaster over metal lath attached to 1/4&quot; cold-rolled channels spaced 12&quot; on center. Ceiling located 6&quot; below joists.</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Reinforced concrete joists</td>
<td>4</td>
<td>5/8&quot; Type &quot;X&quot; gypsum wallboard attached to hat-shaped galvanized steel channels spaced 24&quot; on center, and supported along their length at 36&quot; intervals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel joist construction with a reinforced concrete slab on top poured on a metal lath form.</td>
<td>5</td>
<td>Gypsum plaster on metal lath attached to the bottom chord.</td>
<td>2 1/2</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Ceiling of Type &quot;X&quot; gypsum wallboard attached to furring channels 12&quot; on center. Channels wire tied to bottom chord of joists or suspended below joists on wire hangers.</td>
<td>2 1/2</td>
<td>2</td>
</tr>
<tr>
<td>3&quot; deep cellular steel deck with concrete slab on top. Slab thickness measured to top cells.</td>
<td>7</td>
<td>Suspended ceiling of 1/4&quot; vermiculite gypsum plaster base coat and 1/4&quot; vermiculite acoustical plaster on metal lath attached at 6&quot; intervals to 1/4&quot; cold-rolled channels spaced 12&quot; on center with No. 16 gauge wire. Beams within envelope and with a 2 1/4&quot; air space between beam soffit and lath have a 4-hour rating.</td>
<td>2 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td>Floor or Roof Construction</td>
<td>Item No</td>
<td>Ceiling Construction</td>
<td>Thickness of Floor or Roof Slab (In Inches)</td>
<td>Minimum Thickness of Ceiling (In Inches)</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>1 1/4&quot; deep steel roof deck on steel framing. Rigid insulation board composed of wood fibers with cement binders of thickness shown bonded to deck with unfinished asphalt adhesives. Covered with a fire-retardant roof covering.</td>
<td>8</td>
<td>Ceiling of gypsum plaster on metal lath. Lath attached to 1/4&quot; furring channels spaced at 12&quot; on center. 1/4&quot; channel saddle tied to 2&quot; channels with doubled No. 16 gauge wire ties. 2&quot; channels spaced 36&quot; on center suspended 2&quot; below steel framing and saddle - tied with No. 8 gauge wire.</td>
<td>1 1/4, 1</td>
<td>1/4, 1/4</td>
</tr>
<tr>
<td>Double wood floor over wood joists spaced 16&quot; on center.</td>
<td>9</td>
<td>Gypsum plaster over 1/4&quot; Type &quot;X&quot; gypsum lath. Nails spaced at 16&quot; on center.</td>
<td>1 1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>Portland cement perlite, vermiculite gypsum or gypsum plaster on metal lath. Nails spaced at 5&quot; on center.</td>
<td>10</td>
<td>1 1/4</td>
<td></td>
<td>1/4</td>
</tr>
<tr>
<td>1/4&quot; Type &quot;X&quot; gypsum wallboard nailed to joists with 6d cooler nails spaced 6&quot; on center. End joints of wallboard centered on joists.</td>
<td>11</td>
<td>1 1/8</td>
<td></td>
<td>1/4</td>
</tr>
<tr>
<td>Plywood stressed skin panels consisting of 1/2&quot; thick interior C-D (exterior glue). Top stressed skin on 2&quot; x 6&quot; nominal (minimum) stringers. Adjacent panel edges joined with 8d common wire nails spaced 6&quot; on center. Stringers spaced 12&quot; maximum on center.</td>
<td>12</td>
<td>1/4&quot; thick wood fiberboard weighing 15 to 18 lbs. per cu. ft. installed with long dimension parallel to stringers or 1/4&quot; standard (exterior) plywood glued and nailed to stringers. Nailing to be with 6d cooler nails spaced 12&quot; on center.</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
TABLE NO. 43-C (cont’d.)
MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS

<table>
<thead>
<tr>
<th>Floor or Roof Construction</th>
<th>Item No.</th>
<th>Ceiling Construction</th>
<th>Thickness of Floor or Roof Slab (In Inches)</th>
<th>Minimum Thickness of Ceiling (In Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 hr.</td>
<td>3 hr.</td>
</tr>
<tr>
<td>Plywood stressed skin panels consisting of 1/4&quot; thick interior C-D (exterior glue) top stressed skin on 2&quot; x 6&quot; nominal (minimum) stringers. Adjacent panel edges joined with 5d common wire nails, spaced 6&quot; on center, stringers spaced 12&quot; maximum on center.</td>
<td>14</td>
<td></td>
<td>1/4&quot; thick wood fiberboard weighing 15 to 18 lbs. per cu. ft. installed with long dimension parallel to stringers or 1/4&quot; standard (exterior glue), plywood glued and nailed to stringers. Nailing to be with 5d cooler nails spaced 12&quot; on center.</td>
<td></td>
</tr>
<tr>
<td>Vermiculite concrete slab proportioned 1:4 (Portland cement to Vermiculite aggregate) on a 1 1/4&quot; deep steel deck supported on individually protected steel framing. Maximum span of deck 6'-10&quot; where deck is No. 26 gauge or greater. Slab reinforced with 4&quot; x 8&quot; No. 12/14 welded wire mesh.</td>
<td>15</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perlite concrete slab proportioned 1:6 (Portland cement to perlite aggregate) on a 1 1/4&quot; deep steel deck supported on individually protected steel framing. Slab reinforced with 4&quot; x 8&quot; No. 12/14 welded wire mesh.</td>
<td>16</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perlite concrete slab proportioned 1:6 (Portland cement to perlite aggregate) on a 1/4&quot; deep steel deck supported by steel joists 4' on center. Maximum span of deck is 6'-10&quot; where deck is less than No. 26 gauge and 8'-0&quot; where deck is No. 26 gauge or greater. Fire-retardant roof covering on top.</td>
<td>17</td>
<td>Perlite gypsum plaster on 1/4&quot; furring channels attached with No. 16 gauge wire ties to lower chord of joists.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor or Roof Construction</td>
<td>Item No.</td>
<td>Ceiling Construction</td>
<td>Thickness of Floor or Roof Slab (In Inches)</td>
<td>Minimum Thickness of Ceiling (In Inches)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>----------------------</td>
<td>---------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Perlite concrete slab proportioned 1:6 (Portland cement to perlite aggregate) on 1 1/4&quot; deep steel deck supported on individually protected steel framing. Maximum span of deck 6'-10&quot; where deck is less than No. 26 gauge and 8'-0&quot; where deck is No. 26 gauge or greater. Slab reinforced with No. 19 gauge hexagonal wire mesh. Fire retardant roof covering on top.</td>
<td>18</td>
<td>None</td>
<td>4 hr. 3 hr. 2 hr. 1 hr.</td>
<td>4 hr. 3 hr. 2 hr. 1 hr.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Floor and beam construction consisting of 3&quot; deep cellular steel floor units mounted on steel members with 1:4 (Portland cement to perlite aggregate) perlite concrete floor slab on top.</td>
<td>19</td>
<td>Suspended envelope ceiling of perlite gypsum plaster on metal lath attached to 5/8&quot; cold rolled channels, secured to 1 1/4&quot; cold rolled channels spaced 42&quot; on center supported by No. 6 wire 36&quot; on center. Beams in envelope with 3&quot; minimum air space between beam soffit and lath have a 4 hour rating.</td>
<td>2 1/4</td>
<td>None</td>
</tr>
</tbody>
</table>
CHAPTER 44

PROTECTION OF THE PUBLIC DURING CONSTRUCTION OR DEMOLITION

SECTION 4401. SCOPE.
(a) General. This Chapter shall establish minimum safety standards for the protection of the public during construction or demolition operations, and the erection and maintenance requirements for barricades, walkways, railings, and fences on private property. For use of public property contact Traffic Engineering Division. (Revised 5/82 Ordinance No. 245)

(b) Loads. Structures required by this Chapter shall not be loaded in excess of the safe carrying capacity of the materials used.

(c) Dust. All dust resulting from construction or demolition operations shall be settled in a manner approved by the Department.

(d) Transportation Approval. Trucks and other equipment used by the contractor shall not interfere with or block either vehicular or pedestrian traffic, except as approved by the Traffic Engineering Division. (Revised 5/82 Ordinance No. 245)

(e) Rubbish and Waste. All adjacent streets, alleys, and public ways and places shall be kept free and clear of rubbish, refuse, and loose material resulting from construction or demolition operations.

(f) Extinguishers. See Fire Code.

SECTION 4402. PUBLIC PROPERTY.
(a) Damage to Public Property. As a condition of obtaining a building permit, the permittee agrees to repair any damage to public property, including any public sidewalks, occasioned by the construction or demolition operations. Failure to make such repairs within 30 days shall be unlawful and grounds for the revocation of the contractor's license. (Revised 5/82 Ordinance No. 245)

(b) Protection of Utilities. Materials used in or equipment required for construction or demolition work shall not be placed or stored so as to obstruct free and convenient approach to any fire hydrant, Fire Department connection, fire or police alarm box, any utility box, any catch basin or manhole, traffic control device, or the free flow of water to any catch basin, alley or any other public drainage areas. Every street lamp, traffic control device, utility box, fire or police alarm box, fire hydrant, and every catch basin and manhole that may be endangered by any work being performed or by the placement or storage of any materials and equipment shall be protected against damage. This protection shall be maintained, as is necessary, and shall be completely removed when the status of work permits. (Revised 5/82 Ordinance No. 245)
SECTION 4403. SITE PREPARATION.
(a) Temporary Utilities. When necessary to maintain power, water, or other utility lines during construction or demolition work, these lines shall be temporarily relocated or protected as approved by the Department and the Utility Company.

SECTION 4404. PUBLIC AND OTHER GROUND LEVEL PROTECTION.
(a) General. A covered walkway shall be provided when the distance from the building, structure or utility to be constructed or demolished is less than 10 feet to the inside edge of the sidewalk or when the height exceeds the horizontal distance from the building, structure or utility to the inside edge of the sidewalk. The construction or demolition of a building, structure or utility shall not commence until the required pedestrian protection structures are in place. The Department may require the permit holder to submit the method and schedule for demolition. Where this is required, work shall not be performed until the method and schedule are approved by the Department.
EXCEPTION: Where Emergency Demolition is necessary to remove a dangerous structure, building or utility, the ground level protection requirements may be waived when approved by the Department.
(b) Obstruction. Throughfares which are open to the public shall be kept clear and unobstructed at all times.
(c) Covered Walkways and Railings. The height of all covered walkways shall be at least 8 feet. The height of all railings shall be at least 4 feet. The width of all covered walkways shall be at least 4 feet (overall minimum width) or as may be required by the Department of Public Works. A railing shall be maintained on the street side of the walkway during construction or demolition work. A splash board, a minimum of 12 inches in height shall be provided where the walk adjoins a traffic lane.
1. The covered walkways shall be provided with lighting from sunset to sunrise. This lighting shall provide a minimum of 60 watt bulbs spaced every 10 feet. In addition to this lighting, flashing amber lights, with a capacity of at least 100 watts, shall be provided on the exterior of the walkway, at both ends and in the center.
2. The outside edge and ends of the roof deck of the covered walkway shall be provided with a bulkhead, at least 42 inches above the roof deck of the walkway.
3. Covered walkway openings for loading or unloading purposes, shall be kept closed at all times except during the actual loading or unloading operations.
4. The flooring of a covered walkway shall consist of planking at least 2 inches in thickness, closely laid, or may be covered with at least 3/4 inch plywood. In either case, the floor shall be smooth. All
members of the covered walkway shall be braced and connected to resist displacement of members or distortion of the framework.

5. The roof of all covered walkways shall be made weather-proof.

6. Solid walls of covered walkways shall be built and placed on the side of the walkway nearest to the construction or demolition and shall extend the entire length of the building site and shall be turned and extended to the building line.

7. The entire structure shall be designed to carry the live and dead loads to be imposed, provided that every structure shall be designed to carry a minimum live load of at least 150 pounds per square foot, uniformly loaded, and 20 pounds per square foot wind load. Uplift forces due to wind shall be included.

(d) **Fences.**

1. **Fences in lieu of covered walkways.** Fences may be used to enclose construction and demolition sites when approved by the Department and the Traffic Engineer.

2. Fences or adequate barricades shall be required where a building or structure is being totally demolished. The minimum height of this fence or barricade shall be 6 foot from grade level.

**EXCEPTION:** In lieu of the above, when approved by the Department, a second person, in addition to the equipment operator, shall be present on the job site to act as a safety watchman to prevent the entry of unauthorized persons.

In addition to the above, when required by the Department, a second person, in addition to the equipment operator, shall be present on the job site to act as a safety watchman to prevent the entry of unauthorized persons. (Revised 4/81 Ordinance No. 175)

(e) **Excavations Abutting Public Property.** Prior to the issuance of a permit by the Department for the construction of any building involving excavation extending within one foot of the angle of repose or natural slope of the soil under any public sidewalk; street, alley or other public property the following shall be provided:

1. The owner of the property or proposed building shall submit to the Manager of the Department of Public Works, an indemnity bond in an amount determined by the Manager in a form approved by the City Attorney.

   A. The City shall be indemnified against any loss or damage to public property, such as paving, curbs, sewers, utilities, sidewalks, etc.; person or individuals, with evidence of bodily injury and property damage.

   B. Public liability insurance naming the City as co-insured in the limits and form as approved by the Manager and City Attorney.
SECTION 4405. WALKWAYS AND BARRICADES FOR EXCAVATIONS.
(a) Required. Walkways or barricades shall be provided for excavations adjacent to the public way in accordance with the applicable portions of this Chapter and of the Revised Municipal Code.
(b) Warning Lights. During sunset and sunrise, flashing amber lights shall be placed on barricades adjacent to the public way.

SECTION 4406. MAINTENANCE AND REMOVAL OF PROTECTIVE DEVICES.
(a) Maintenance. The protection shall be maintained in place and kept in good order for the entire length of time the public may be endangered.
(b) Removal. Every protection fence or barricade shall be removed within 10 days after the protection is no longer required by this Chapter for the protection of the public.
CHAPTER 45
PRIVATE CONSTRUCTION ON PUBLIC PROPERTY

SECTION 4501. GENERAL.
(a) Scope. Except as otherwise permitted in this Chapter, and the Revised Municipal Code, no part of any building, structure, utility addition, alteration or construction hereafter erected shall project onto the Public Right-of-Way. For purposes of this Building Code and Chapter, any projection on private property delegated to the Public Way, shall be treated as the Public Right-of-Way. (Refer also to Article 330 of the Revised Municipal Code.)

(b) Construction.
1. Buildings, structures or utilities, including appendages regulated by this Building Code and Chapter shall be constructed of materials as required by this Chapter and Chapters 17 through 22 of this Building Code. Nothing in this Building Code shall prohibit the construction and use of a structure between buildings and over or under a public way provided the structure complies with all the requirements of this Building Code. See Chapter 17 for Bridges.

2. Balconies, appendages, marquees, canopies, fixed awnings and movable awnings shall be designed and constructed to safely support the load requirements as shown in Chapter 23.

(c) Permits. A revocable permit shall be obtained from the Manager of Public Works prior to the issuance of a permit from the Department.

(d) Projections. Any projection, as regulated by this Chapter shall be the distance measured horizontally from the property line to the outer most point of the projection.

(e) Locations. Every marquee, canopy, fixed awning or movable awning shall be located as not to interfere with the operation of any exterior standpipe or obstruct the clear passage of stairways or exits from the building or the installation or maintenance of overhead electrical equipment.

(f) Ventilation Outlets. Ventilation outlets fronting onto the public way shall provide a minimum height of at least 7 feet from the sidewalls or alley floor.

(g) Horizontal Clearance. All permitted projections shall provide a horizontal clearance of at least 2 feet inside the curb line.

SECTION 4502. PROJECTION INTO ALLEYS.
(a) General. No part of any structure or any appendage shall project into an alley unless a 14 feet clearance above the alley grade is maintained. EXCEPTION: A curb or buffer may project not more than 9 inches and not exceed a height of 9 inches above grade.
SECTION 4503. SPACE BELOW SIDEWALK.
(a) General. The space adjoining a building below a sidewalk on public property may be used and occupied in connection with the building for any purpose consistent with this Building Code. The right to use and occupy space on condition that the right so to use and occupy may be revoked by the City at any time and that the owner of the building shall construct the necessary enclosures for this space from the building and pay all costs and expenses attendant therewith.

SECTION 4504. BALCONIES AND APPENDAGES.
(a) General. Architectural projections may project over the public property of the building site a distance as determined by the clearance of the lowest point of the projection above the grade immediately below, as follows:
1. When the clearance above the public way is less than 8 feet, no projection is permitted.
2. When the clearance above the public way is 8 feet or more, a projection of one inch for each additional one inch of clearance is permitted provided the projection does not exceed a distance of 4 feet.

SECTION 4505. MARQUEES.
(a) Height. All marquees shall be at least 8 feet above the public way.
(b) Construction. A marquee shall be supported entirely from the building and constructed as required by this Chapter and under Types of Construction, Chapters 17 through 22.
(c) Roof Construction.
1. The roof of marquees shall be water-tight and shall have a slope of not more than one inch in 4 feet. Roofs shall drain toward the building or structure and shall be provided with conductors connected with the storm sewer or under the sidewalk to the face of the curb.
2. The roof, or any part thereof, may be a skylight provided that plastic or laminated safety glass shall be used. See Chapters 54 and 60.

SECTION 4506. CANOPIES AND AWNINGS.
(a) Height. A canopy or awning shall be at least 8 feet above the public way. Canvas valances shall be permitted but shall be at least 7 feet above the public way.
(b) Construction. Canopies or awnings shall be constructed as required by this Chapter and Chapters 17 through 22.
EXCEPTION: Where fabrics are used in conjunction with a canopy or awning they shall meet the fire retardant qualities of NFPA Pamphlet No. 701.
(c) Materials. Canopy and awning frames shall be constructed of noncombustible materials except that glass or similar fragile material shall not be permitted in any part of the canopy or awning.

(d) Movable Awnings. Movable awnings shall be supported entirely by the wall of the building or structure to which they are attached and shall have a frame designed to support loads. The covering shall be canvas, cloth or other approved material. All fabrics shall be flame-proof as provided for in NFPA Pamphlet No. 701.

SECTION 4507. DOORS. Doors, when either fully opened or when opening, shall not project beyond the property line. See Chapter 33.

SECTION 4508. STANDARDS. Unless provided for in other portions of this Building Code, the following standards shall apply.

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>LEGEND</th>
<th>ORGANIZATION</th>
</tr>
</thead>
</table>
| NFPA   | National Fire Protection Association  
         Batterymarch Park  
         Quincy, MA. 02269 |
CHAPTER 46
DEMOLITION AND MOVING

SECTION 4601. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, the Revised Municipal Code and the Fire Code, this Chapter shall govern the demolition and moving of buildings, structures and utilities. Any device or equipment such as scaffolds, ladders, derricks, hoists, or similar equipment, used in connection with demolition or moving shall be constructed, installed, maintained, and operated in accordance with the requirements governing the construction, installation, maintenance, and operation of such device or equipment as specified in other portions of this Building Code.

1. Damage to public property. As a condition of obtaining a permit to wreck or move a building, structure or utility, the permittee agrees to repair any damage to public property, including any public sidewalks, occasioned by such moving, demolition, or removal operations. Failure to make such repairs within 30 days shall be unlawful and grounds for the revocation of the contractor's license. (Revised 5/82 Ordinance No. 245)

(b) Loads. Structures, or parts of structures or any floor or temporary support, or scaffold, sidewalk barricade or bridge, or any device or equipment, shall not be loaded in excess of the safe carrying capacity.

(c) Danger Signs. Every demolition project shall be provided with Danger Signs, which shall be posted around the property. See Chapter 1 for the posting of Danger Signs.

(d) Cleaning Brick. The cleaning of brick or lumber at the job site shall be performed only by employees of the demolition contractor.

(e) Dust. All dust resulting from demolition operations shall be settled with water, as approved by the Department.

(f) Transportation Approval. Trucks and other equipment used by the contractor shall not interfere with, or block, either vehicular or pedestrian traffic, except when approved by the Department of Public Works. Where it becomes necessary to transport units of a wrecked building, structure, or utility, upon and through the public streets or alleys, or other public ways and places, permission to do so shall be obtained from the Department of Public Works.

(g) Rubbish and Waste. All adjacent streets, alleys, and other public ways and places shall be kept free and clear of all rubbish, refuse and loose material resulting from the moving, demolition, or demolition removal operations.

(h) Sale of Material on Job Site. The sale of any material on a demolition or moving site is hereby prohibited, except as approved by the Department. See Chapter 1 for violations.
(i) **Sanitary Facilities.** Toilet facilities shall be provided on each demolition or moving site, in accordance with the requirements of Chapter 3 and/or Chapter 50 of this Building Code.

(j) **Extinguishers.** When cutting torches are required on any demolition or moving, approved type extinguishers shall be provided. The approval and number required shall be that as set forth by the Fire Department. See Fire Code.

(k) **Liability Insurance.** Prior to the issuance of a permit by the Department, any person, firm, or corporation demolishing or moving any building, structure, or utility, shall provide insurance to cover bodily injury and property damage to the public or public property. A copy of the certificate of liability insurance shall be provided to the Department, and this insurance shall contain a noncancellation clause and be valid at all times during demolition or moving operations. **EXCEPTION:** Homeowners or the demolition of Group I or J Occupancies when approved by the Department.

1. **Insurance.** The minimum amount of insurance to be provided shall be that indicated herein.

<table>
<thead>
<tr>
<th>CONTRACTOR</th>
<th>INSURANCE COVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A Wrecking</td>
<td>$500,000.00</td>
</tr>
<tr>
<td>Class B Wrecking</td>
<td>300,000.00</td>
</tr>
<tr>
<td>House Moving</td>
<td>300,000.00</td>
</tr>
</tbody>
</table>

2. **Other Permittee.** Whenever any other permittee, except a home owner, performs such work, he shall be required to show proof of insurance in the same amounts as indicated herein.

(l) **Damage to Public Property.** As a condition of obtaining a permit to wreck or move any building, structure, or utility, the permittee assumes liability for any damage to public property occasioned by such moving, demolition, or removal operations.

(m) **Permit.** A permit shall be required for the erection of all covered walkways and railings. See Chapter 3.

(n) **Protection of Utilities.** Materials or equipment used in, or required for, demolition or moving operations shall not be placed or stored so as to obstruct free and convenient approach to any fire hydrant, fire or police alarm box, any utility box, catch basins or manholes, or so as to interfere with the free flow of water in any street or alley gutter. Every street lamp, utility box, fire or police alarm box, fire hydrant, and every catch basin and manhole that might be damaged by any work being performed, or by the placement or storage of any materials or equipment, shall be protected adequately against such damage. This protection shall be maintained only as long as the actual work may require, and shall be completely removed as soon as the work status permits.
SECTION 4602. PREPARATORY OPERATIONS.

(a) **Survey.** Prior to the start of demolition operations, a survey shall be made of the structure to determine the condition of the structure, and to determine the possibility of unplanned collapse of any portion of the building or structure. Any adjacent building or structure shall be similarly surveyed, and the demolition contractor shall possess, in writing, evidence that this survey has been performed. Except as approved by the Department, buildings 4 or more stories in height shall require a professional engineer’s report be filed with the Department prior to any demolition. This report shall contain information as to type of construction, method of demolition, street, sidewalk or other public way closures, method of protecting the public and pertinent data pertaining to adjacent structures. The Department may request an engineer’s report for other demolition operations when deemed necessary. Buildings being demolished containing friable asbestos shall conform to the provisions of the National Emission Standard for asbestos.

(b) **Damage by Fire, Flood, or Other.** When persons are required to work within a structure to be demolished which has been damaged by fire, flood, explosion, or other cause, the structure shall be braced or shored for safety.

(c) **Utility Shut Off.** All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped, or otherwise controlled outside the building line prior to beginning demolition work.

(d) **Relocation of Utilities.** Any power, water, or other utilities required to be maintained during demolition, shall be temporarily relocated and protected.

(e) **Dangerous Utilities.** Determination shall be made by the contractor if any type of hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous substances have been used in any pipes, tanks, or other equipment on the property. When the presence of any such substances is apparent or suspected, testing and purging shall be performed by the demolition contractor, and the hazard eliminated prior to demolition operations.

(f) **Glass Hazard.** Where a hazard exists from the fragmentation of glass, the hazard shall be removed.

(g) **Wall Opening Hazard.** Wall openings shall be protected to a height of approximately 42 inches above the floor.

(h) **Exterior Wall-Floor Demolition.** The demolition of exterior walls and floor construction shall begin at the top of the structure and proceed downward. Each story of exterior wall and floor construction shall be removed and dropped into storage space before commencing the removal of exterior walls and floors in the story next below.

SECTION 4603. STAIRS, PASSAGEWAYS AND LADDERS.

(a) **Access.** Only those stairways, passageways and ladders designated as means of access to the structure of a building shall be used. Other access ways shall be closed at all times.
(b) **Maintenance.** All stairs, passageways, ladders, and incidental equipment thereto shall be periodically inspected and maintained in a clean, safe condition.

(c) **Stairwells.** In a multistory building when a stairwell is being used as access, it shall be properly illuminated by either natural or artificial means, and completely and substantially covered over at a point not less than 2 floors below the floor on which the work is being performed, and access to the floor where the work is in progress shall be through a properly lighted, protected and separate passageway.

(d) **Doorways.** All access doorways or throughfares to the property shall be kept barricaded, except during the actual passage of men or equipment.

**SECTION 4604. CHUTES.**

(a) **Prohibition.** Materials shall not be dropped to any point lying outside the exterior walls of the structure unless the area is protected. Where the distance from the property line or sidewalk is equal to, or greater than, the height of the demolition work, materials may be dropped by gravity to the ground, provided dust control is maintained.

(b) **Enclosure.** All material chutes or sections thereof, at an angle of 45 degrees or more from the horizontal shall be entirely enclosed, except for openings equipped with closures at each floor level for the insertion of materials. The opening shall not exceed 48 inches in height measured along the wall of the chute. At all stories below the top floor, openings shall be kept closed when not in use.

(c) **Gate.** A substantial gate shall be installed in each chute at, or near the discharge end. When chutes are used, a competent employee shall be assigned to control the operation of the gate, and the backing and loading of trucks. When operations are not in progress, the area surrounding the discharge end of the chute shall be securely closed off.

(d) **Guardrail.** Any chute opening into which workmen dump debris shall be protected by a substantial guardrail, approximately 42 inches above the floor or other surface on which the men stand to dump material. Any space between the chute and the edge of the openings in the floors through which it passes shall be solidly covered over.

(e) **Toeboard-Bumper.** Where the material is dumped from motorized equipment or wheel barrows, a securely attached toeboard or bumper not less than 4 inches thick and 6 inches high shall be provided at each chute opening.

**SECTION 4605. REMOVAL OF WALLS, MASONRY SECTIONS AND CHIMNEYS.**

(a) **Floor Loads.** Masonry walls, or other sections of masonry shall not be permitted to fall upon floors of the building in such masses as to exceed the safe carrying capacities of the floors.
(b) **Free Standing Walls.** No wall section which is more than one story in height shall be permitted to stand alone without lateral bracing. All walls shall be left in a stable condition at the end of each shift.

(c) **Cutting Load-Supporting Members.** Structural or load-supporting members on any floor shall not be cut or removed until all stories above such floor have been demolished and removed. This provision shall not prohibit the cutting of floor beams for the disposal of materials, or for the installation of equipment.

(e) **Skeleton Type Buildings.** In buildings of steel or concrete frame construction, the framing may be left in place during the demolition of the masonry. Where this is performed, all beams, girders and similar structural supports shall be cleared of all loose material as the masonry demolition progresses downward.

(f) **Walls Serving as Support.** Walls which serve as retaining walls to support earth or adjoining structures shall not be demolished until the earth has been properly braced, or adjoining structures have been properly supported.

(g) **Walls Serving as Retainers.** Walls which are to serve as retaining walls against which debris will be piled shall not be used unless they are capable of supporting the imposed loads.

**SECTION 4606. CATCH PLATFORMS.**

(a) **General.** During the demolition of the exterior walls of a structure originally more than 70 feet high, catch platforms shall be erected along the exterior faces of these walls.

**EXCEPTION:** Catch platforms shall not be required when the engineer's report as specified in Section 4602 specifically deletes this requirement.

(b) **Height.** The catch platforms shall be constructed and maintained not more than 3 stories below the story from which the exterior walls are being removed. When the demolition has progressed to within 3 stories of ground level, catch platforms shall not be considered necessary.

(c) **Width.** Catch platforms shall be at least 5 feet in width, measured in a horizontal direction from the face of the structure, and shall consist of outriggers and planks. Planks shall be laid tight together and without openings between such planks and the wall.

(d) **Material.** Catch platforms may be constructed of material other than wood provided such material is of equal strength and does not otherwise lessen the security against falling material.

(e) **Loading.** Catch platforms shall be capable of sustaining a live load of at least 125 pounds per square foot.

(f) **Incline.** The catch platforms shall be inclined so that the outer edge is at least 6 inches higher than the inner edge.

(g) **Supports - Outrigger.** Supports shall consist of outriggers of ample strength, secured against turning, and spaced not more than 20 feet apart.

1. Each outrigger shall have ample support against the building or in window openings and shall be properly secured.
(h) **Enclosure.** The outer edge of each catch platform shall be provided with a substantial enclosure constructed at an angle of approximately 45 degrees with the horizontal and having its outer edge at least 48 inches from the platform measured along the slope of the enclosure.

1. The enclosure shall consist of galvanized wire mesh made of at least No. 16 U.S. gauge wire and 1 1/2 inch mesh. The enclosure shall be secured to supports placed not more than 10 feet apart.
2. There shall be no openings between the platform and the enclosure.
3. Supports for the enclosure shall be at least 2 inches by 6 inches in section with the greater dimension at right angles to the enclosure.

**SECTION 4607. STORAGE.** The storage of waste material and debris on any floor shall not endanger the structural stability of the building.

**SECTION 4608. MACHINE DEMOLITION.** Machine demolition shall be subject to approval by the Department.

**SECTION 4609. THE USE OF EXPLOSIVES.** For use of explosives, see Fire Code.

**SECTION 4610. MOVING.**

(a) **Compliance.** Buildings, structures, or utilities which are moved from one location to another, within or from the City, shall conform to all requirements of this Building Code. These buildings, structures, or utilities shall be inspected and approved by the Department prior to moving. See Chapter 3.

(b) **Other Requirements.** During actual moving operations on the public way, one or more men shall be stationed on the roof of the structure being moved to determine that there is no interference with trees, wires, traffic signals, signs, or other obstructions.

(c) **Utilities Disconnect.** See Section 4602.

(d) **Filling Holes and Clearing of Site.** See Section 4612.

(e) **Approvals.** Prior to the issuance of a permit by the Department and the subsequent moving of any building, structure, or utility, approval shall be obtained from the Traffic Engineer.

(f) **Storage of Moved Buildings.** Buildings, structures, or utilities shall not be stored on any property for more than 72 hours, unless approved by the Department.

**SECTION 4611. AFTER REMOVAL.** Upon completion of the removal of a building, structure, or utility, either by demolition or moving, the ground shall be left in a clean, smooth condition. Holes, basements, or cellars shall be filled with an inorganic material; provided, however, the top one foot of fill
shall be clean earth. The filling of such excavations shall not be required when a building permit has been issued for a new building on the site, and construction is to be started within 60 days after completion of the demolition or moving operations. The holder of the building permit shall provide a temporary barricade protecting the excavation on all sides as specified for safety by the Department. The temporary barricade may remain in position for a time not exceeding 3 days, after which a solid barricade or fence shall be provided, or the excavation filled.

SECTION 4612. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
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<tr>
<td>ANSI</td>
<td>Demolition Safety Requirements. A10.6-1969</td>
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<th>ORGANIZATION</th>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
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<td>1430 Broadway</td>
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<td>New York, N.Y. 10018</td>
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CHAPTER 47

LATH, PLASTER AND GYPSUM WALLBOARD

SECTION 4701. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation of lathing, plastering and gypsum wallboard. Where fire resistive construction is required, this Chapter and Chapter 43 shall also apply.
(b) Tests. The Department may require that test holes be made in the wall or ceiling for the purpose of determining the thickness and proportioning of the plaster, lath, or wallboard, provided the permit holder has been notified 24 hours in advance of the time for conducting the test.
(c) Definitions. For the purposes of this Chapter, the definitions as specified in the glossary of Lath and Plaster Specifications and Finishes, Book 9 by the Mountain States Bureau for Lathing and Plastering, Inc., shall apply.

SECTION 4702. MATERIALS. See Section 4713.

SECTION 4703. VERTICAL ASSEMBLIES.
(a) General. In addition to the requirements of this Section, vertical assemblies of plaster or gypsum wallboard shall be designed to resist the loads specified in Chapter 23 of this Building Code. For wood framing see Chapter 25. For metal framing see Chapters 27 and 28.
(b) Wood Framing. Wood framing supports for lath or gypsum wallboard shall be at least 1 1/2 inches in its least dimension. Wood stripping or furring shall be at least 1 1/2 inches thickness in its least dimension, except that furring strips not less than 3/4 by 1 1/2 inch dimension may be used over solid backing.
(c) Studless Partitions. The minimum thickness of vertically erected studless solid plaster partitions of 3/8 inch and 3/4 inch rib metal lath, or 1/2 inch thick long length gypsum lath and gypsum wallboard partitions shall be 2 inches.

SECTION 4704. HORIZONTAL ASSEMBLIES.
(a) General. In addition to the requirements of this Section, supports for horizontal assemblies of plaster or gypsum wallboard shall be designed to support all loads as specified in Chapter 23 of this Building Code. For wood framing, see Chapter 25. For metal framing, see Chapters 27 and 28.
1. Type I, II, and IV Buildings. Ceiling construction shall be of noncombustible or fire retardant treated wood materials, including all supports and covering materials. Where ceilings are required to be fire resistive within a corridor, room, or other area, all

47-1
openings shall be fire-protected in an approved manner. See Chapter 42 for other requirements.


(b) Wood Framing. Wood stripping or suspended wood systems, where used, shall be at least 1 1/2 inches thick in its least dimension, except that furring strips of at least 3/4 by 1 1/2 inch dimension may be used over solid backing.

(c) Hangers, Runners and Furring.

1. Hangers. Hangers for suspended ceilings shall be at least the sizes set forth in Table No. 47-A, fastened to or embedded in the structural framing, masonry, or concrete. Hangers shall be saddle-tied around main runners to develop the full strength of the hangers. Lower ends of flat hangers shall be bolted with 3/8 inch bolts to runner channels, or bent tightly around runners and bolted to the main part of the hanger.

2. Runners and Furring. The main runner and cross-furring shall be at least the sizes set forth in Table No. 47-A, except that other steel sections of equivalent strength may be substituted. Cross-furring shall be securely attached to the main runner by saddle-tying with not less than one strand of No. 16, or 2 strands of No. 18 U.S. gauge tie wire or approved equivalent attachments.

SECTION 4706. EXTERIOR LATH.

(a) General. For projections from buildings required to be fire resistive, see Chapter 17.

(b) Corrosion Resistance. All lath and lath attachments shall be corrosion resistant materials.

(c) Backing. Backing or lath shall provide sufficient rigidity to permit plaster application.

1. Where lath on vertical surfaces extends between rafters or other similar projecting members, solid backing shall be installed to provide support for lath and attachments.

2. Gypsum lath or gypsum board shall not be used, except that on horizontal supports, ceilings, or roof soffits, it may be used as backing for metal lath or wire fabric lath and portland cement plaster.

3. Backing is not required under metal lath or paper backed wire fabric lath.

(d) Weather-Resistive Barriers. Weather-resistive barriers shall be installed as required in Chapter 17 (Weather Protection.) Definition of Weather Exposed Surfaces, See Chapter 4.
(e) **Application of Metal Plaster Bases.** The application of metal lath or wire fabric lath shall be as specified in Section 4705(c), and shall be furred out from vertical supports or backing not less than 1/4 inch, except as set forth in Footnote No. 2, Table No. 47-B.

1. Where no external corner reinforcement is used, lath shall be furred out and carried around corners to at least one support on frame construction.
2. A weep screed shall be provided at the foundation plate line on all exterior stud walls. The screed shall be of a type which will allow trapped water to drain to the exterior of the building.

**SECTION 4707. INTERIOR PLASTER.**

(a) **General.** Plastering with gypsum plaster or portland cement plaster shall be not less than 3 coats when applied over metal lath or wire fabric lath, and shall be not less than 2 coats when applied over other bases permitted by this Chapter. Showers and public toilet walls shall conform to Section 4705.

1. Plaster shall not be applied directly to fiber insulation board. Portland cement plaster shall not be applied directly to gypsum lath, gypsum masonry, or gypsum plaster, except as specified in Section 4706(c).

2. When installed, grounds shall assure the minimum thickness of plaster as set forth in Table No. 47-D. Plaster thickness shall be measured from the face of lath and other bases.

(b) **Base Coat Proportions.** Proportions of aggregate to cementitious materials shall not exceed the volume set forth in Table No. 47-E, for gypsum plaster, and Table No. 47-F, for portland cement and portland cement lime plaster.

(c) **Base Coat Application.** Base coats shall be applied with sufficient material and pressure to form a complete key or bond.

(d) **Interior Masonry or Concrete.** Condition of surfaces shall be as specified in Section 4708(f). Gypsum plaster designed for application to concrete surfaces or approved acoustical plaster may be used. The total thickness of base coat plaster applied to concrete ceilings shall be as set forth in Table No. 47-D. Should ceiling thickness require more than the maximum thickness permitted in Table 47-D, metal lath or wire fabric shall be installed on the surfaces before plastering.

**SECTION 4708. EXTERIOR PLASTER.**

(a) **General.** Plastering with portland cement plaster shall be not less than 3 coats when applied over metal lath or wire fabric lath, and shall be not less than 2 coats when applied over masonry, concrete, or gypsum backing as specified in Section 4706(c). If plaster surface is completely concealed by another wall, plaster application need only be 2 coats, provided the total thickness is as set forth in Table 47-F.

1. On wood frame or metal stud construction with an on-grade concrete floor slab system, exterior plaster shall be applied in a manner to cover, but not extend below, lath and paper.
2. Only approved plasticity agents and amounts may be added to portland cement. When plastic cement is used, additional lime or plasticizers shall not be added. Hydrated lime or the equivalent amount of lime putty used as a plasticizer may be added to portland cement plaster in an amount not to exceed that set forth in Table No. 47-F.

3. For machine placed plasters, asbestos fiber may be added to portland cement plaster in approved amounts. Approved portland cement plaster containing asbestos fiber, blended at the time of manufacture and so labeled, may be used.

4. Gypsum plaster shall not be used on vertical exterior surfaces.

(b) Base Coat Proportions. The proportion of aggregate to cementitious materials shall be as set forth in Table No. 47-F.

(c) Base Coat Application. The first coat shall be applied with material and pressure to fill solidly all openings in the lath. The surface shall be scored horizontally to provide adequate bond to receive the second coat. The second coat shall be brought out to proper thickness, rodded and floated to provide adequate bond for the finish coat.

(d) Curing and Interval. First and second coats of plaster shall be applied and moist-cured as set forth in Table No. 47-F. When applied over gypsum backing as specified in Section 4706(c), or directly to unit masonry surfaces, the second coat may be applied as soon as the first coat has attained sufficient hardness.

(e) Finish Coats. Finish coats shall be proportioned and mixed in accordance with Table No. 47-F. Portland cement and lime finish coats shall be applied over base coats which have been in place for the time periods set forth in Table No. 47-F. The third or finish coat shall be applied with material and pressure to bond to, and to cover, the brown coat.

(f) Preparation of Masonry and Concrete. Surfaces shall be clean, free from efflorescence, damp and rough to assure proper bond. If the surface is inadequate to provide proper bond, agents or a portland cement dash bond coat mixed in the proportions of 1 1/2 cubic feet of sand to one cubic foot of portland cement shall be applied. The dash bond coat shall be moist cured at least 24 hours. When the dash bond is applied, the first coat of base coat plaster may be omitted. See Table No. 47-D for thickness.

SECTION 4709. EXPOSED AGGREGATE PLASTER.

(a) General. Exposed natural or integrally colored aggregate may be partially embedded in a natural or colored bedding coat of portland cement or gypsum plaster subject to the provisions of this Section.

(b) Aggregate. The aggregate may be applied manually or mechanically, and shall consist of marble chips, pebbles, or similar durable, nonreactive materials, moderately hard (3 or more on the MOH scale.)

(c) Bedding Coat Proportions. The exterior bedding coat shall be composed of one part portland cement, one part Type S lime and a maximum 3 parts of graded white or natural sand by volume. The interior
bedding coat shall be composed of 100 pounds neat gypsum plaster and a maximum 200 pounds of graded white sand. Exterior or interior coat may be a factory prepared bedding coat. The exterior bedding coat shall have a minimum compressive strength of 1,000 pounds per square inch.

(d) **Application.** The bedding coat may be applied directly over the first (scratch) coat of plaster, provided the ultimate overall thickness is a minimum of 7/8 inch including lath. Over concrete or masonry surfaces, the overall thickness shall be a minimum of 1/2 inch.

(e) **Bases.** Exposed aggregate plaster may be applied over concrete, masonry, portland cement plaster base coats, or gypsum plaster base coats.

(f) **Preparation of Masonry and Concrete.** Masonry and concrete surfaces shall be prepared in accordance with the provisions of Section 4708 (e).

(g) **Curing.** Portland cement base coats shall be cured in accordance with Table No. 47-F. Portland cement bedding coat shall retain sufficient moisture for hydration (hardening) for 24 hours minimum or, where necessary, shall be kept damp for 24 hours by light water spray.

**SECTION 4710. PNEUMATICALLY PLACED PLASTER.**

(a) **General.** Pneumatically placed portland cement plaster shall be a mixture of portland cement and sand, mixed dry, conveyed by air through a pipe or flexible tube, hydrated at the nozzle at the end of the conveyor, and deposited by air pressure in its final position.

(b) **Rebound Material.** Rebound material may be screened and reused as sand in an amount not greater than 25 percent of the total sand in any batch.

(c) **Consistency.** Pneumatically placed portland cement plaster shall consist of a mixture of one part cement to not more than 5 parts sand. Plasticity agents may be used as specified in Section 4708(a). Except when applied to concrete or masonry, the plaster shall be applied in not less than 2 coats to a minimum total thickness of 7/8 inch. The first coat shall be rodded, as specified in Section 4708(c) in preparation for second coat. The curing period and time interval shall be as set forth in Table No. 47-F.

**SECTION 4711. GYPSUM WALLBOARD.**

(a) **General.** All gypsum wallboard shall be installed in accordance with the provisions of this Section. Gypsum wallboard shall not be installed on surfaces exposed to the weather except weather resistant wallboard may be used as soffits.

1. Gypsum wallboard shall not be installed until weather protection for the installation is provided.

(b) **Supports.** Supports shall be spaced not to exceed the spacing set forth in Table No. 47-G, for single-ply application, and Table No. 47-H, for two-ply application. Vertical assemblies shall comply with Section 4703. Horizontal assemblies shall comply with Section 4704.
(c) **Single-Ply Application.** All edges and ends of gypsum wallboard shall occur on the framing members, except those edges and ends which are perpendicular to the framing members. All edges and ends of gypsum wallboard shall be in contact, except in concealed spaces where fire resistive construction or diaphragm action is not required.

1. The size and spacing of fasteners shall comply with Table No. 47-G, except where modified by fire resistive construction meeting the requirements of Chapter 43. Fasteners shall be spaced not less than 3/8 inch from edges and ends of gypsum wallboard. Fasteners at the top and bottom plates of vertical assemblies, or the edges and ends of horizontal assemblies perpendicular to supports, and at the wall line may be omitted, except on shear-resisting elements or fire resistive assemblies. Fasteners shall be applied to prevent fracture of the face paper with the fastener head.

2. Gypsum wallboard may be applied to wood framing members with an approved adhesive. A continuous bead of the adhesive shall be applied to the face of all framing members, except top and bottom plates, of sufficient size as to spread to an average width of one inch and thickness of 1/16 when the gypsum wallboard is applied. Where the edges or ends of 2 pieces of gypsum wallboard occur on the same framing member, 2 continuous parallel beads of adhesive shall be applied to the framing member. Fasteners shall be used with adhesive application in accordance with Table No. 47-G.

(d) **Two-Ply Application.** The base ply of gypsum wallboard shall be applied with fasteners of the type and size as required for the nonadhesive application of single-ply gypsum wallboard. Fastener spacings shall be in accordance with Table No. 47-H, except where modified by fire resistive construction meeting the requirements as specified in Chapter 43. The face ply of gypsum wallboard may be applied with gypsum wallboard joint compound or approved adhesive furnishing full coverage between the plies, or with fasteners in accordance with Table No. 47-H. When the face ply is installed with joint compound or adhesive, the joints of the face ply need not occur on supports. Temporary nails or shoring shall be used to hold the face ply in position until the joint compound or adhesive develops adequate bond.

(e) **Joint Treatment.** Gypsum wallboard single layer, fire rated assemblies shall have joints treated, except where the wallboard is to receive a decorative finish such as wood paneling, battens, acoustical finishes, or any similar application which would be equivalent to the joint treatment.

**EXCEPTION:** Assemblies tested without joint treatment.

**SECTION 4712. SHEAR RESISTING CONSTRUCTION WITH WOOD FRAME.**

(a) **General.** Gypsum lath and plaster, gypsum sheathing board, and gypsum wallboard may be used on wood studs for vertical diaphragms if applied in accordance with this Section. Shear-resisting values shall not
exceed those set forth in Table No. 47-I. The shear values shall not be cumulative with the shear value of other materials applied to the same wall. The shear values may be doubled when the identical materials applied, as specified in this Section, are applied to both sides of the wall.

(b) Masonry and Concrete Construction. Gypsum lath and plaster, gypsum sheathing board, and gypsum wallboard shall not be used in vertical diaphragms to resist forces imposed by masonry or concrete construction.

(c) Wall Framing. Framing for vertical diaphragms shall comply with Chapter 25, for bearing walls, and studs shall be spaced not further apart than 16 inches center to center. Marginal studs and plates shall be anchored to resist all design forces.

(d) Height to Length Ratio. The maximum allowable height to length ratio for the construction in this Section shall be 1 1/2 to 1.

(e) Application. End joints of adjacent courses of gypsum lath, gypsum sheathing board, or gypsum wallboard sheets shall not occur over the same stud.

1. Where required in Table No. 47-I, blocking having the same cross-sectional dimensions as the studs shall be provided at all joints that are perpendicular to the studs.

2. The size and spacing of nails shall be as set forth in Table No. 47-I. Nails shall be spaced not less than 3/8 inch from edges and ends of gypsum lath, gypsum sheathing board, gypsum wallboard, or sides of studs, blocking, and top and bottom plates.

3. Gypsum lath shall be applied perpendicular to the studs. Maximum allowable shear values shall be as set forth in Table No. 47-I.

4. Four foot wide pieces of gypsum sheathing board may be applied parallel or perpendicular to studs. 2 foot wide pieces shall be applied perpendicular to the studs. Maximum allowable shear values shall be as set forth in Table No. 47-I.

5. Gypsum wallboard may be applied parallel or perpendicular to studs. Maximum allowable shear values shall be as set forth in Table No. 47-I.

SECTION 4713. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply: (Revised 5/82) Ordinance No. 245)

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<th>ORGANIZATION</th>
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<td>ASTM</td>
<td>Adhesive for Fastening Gypsum Wallboard to Wood Framing, C-557-78.</td>
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<td>Gypsum Backing Board, C-442-78.</td>
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<td>Gypsum Base for Veneer Plaster and Gypsum Veneer Plaster, C-587-68 and C-588-80.</td>
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Gypsum Lath C-37-80.
Gypsum Molding Plaster, C-59-76.
Gypsum Plasters, C-28-80.
Gypsum Sheathing Board, C-79-78.
Gypsum Wallboard, C-36-80.
Gypsum Wallboard Tape and Joint Compound,
    C-474-67, C-475-64.
Fire Test of Building Construction and Material,
    E-119-76.
Keene's Cement, C-61-76.
Lime, C-6-49 (1968) and C-206-49 (1968).
Metal Suspension Systems for Acoustical Tile and for
    Lay-in Panel Ceilings, C-635-69 and C-636-69.
Gypsum Drywall Metal Framing, C-754-79.
Perlite, Vermiculite and Sand Aggregates for Gypsum
    Plaster, C-35-76.
Water Resistant Gypsum Backing Board, C-630-78.
USG
GA
Recommended Specifications for the Application and
Door Frames in Steel Stud-Gypsum Board Fire-Rated
    Partitions 219-1978.

LEGEND

ORGANIZATION

ANSI
American National Standards Institute
1430 Broadway
New York, N. Y. 10018

ASTM
American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

USG
U.S. Government Printing Office
Superintendent of Documents
Washington, D.C.

GA
Gypsum Association
1800 North Highland Avenue
Hollywood, CA 90028

SECTION 4714. TABLES.
### TABLE NO. 47-A

**SUSPENDED AND FURRED CEILINGS**
(For Support of Ceilings Weighing Not More than 10 Pounds per Square Foot)

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<th>SIZE AND TYPE</th>
<th>MAXIMUM SPACING OF HANGERS OR SUPPORTS (ALONG RUNNERS)</th>
<th>MAXIMUM SPACING OF RUNNERS (TRANVERSE)</th>
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<tr>
<td>1/4&quot; .3 pound per foot, cold or hot-rolled channel</td>
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<th>SIZE AND TYPE OF CROSS FURRING</th>
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<th>MAXIMUM SPACING OF CROSS FURRING MEMBERS (TRANVERSE)</th>
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</tr>
<tr>
<td>5/8&quot; .410 pound per foot, hot-rolled channel</td>
<td>4'0&quot;</td>
<td>24&quot;</td>
</tr>
</tbody>
</table>

*e Spans are based on webs of channels being erected vertically.
† Other sections of hot or cold-rolled members of equivalent strength may be substituted for those specified.
TABLE NO. 47-A
SUSPENDED AND FURRED CEILINGS
(For Support of Ceilings Weighing Not More than 10 Pounds per Square Foot)

<table>
<thead>
<tr>
<th>SIZE AND TYPE</th>
<th>MAXIMUM AREA SUPPORTED (In Square Feet)</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hangers for Suspended Ceilings</td>
<td>12.5</td>
<td>No. 9 gauge wire</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>No. 8 gauge wire</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>3/16&quot; diameter, mild steel rod&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>7/32&quot; diameter, mild steel rod&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>22.5</td>
<td>1/4&quot; diameter, mild steel rod&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>1&quot; x 3/16&quot; mild steel flats&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Support:</th>
<th>MAXIMUM AREA SUPPORTED (In Square Feet)</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Hangers Between Beams&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8</td>
<td>No. 12 gauge wire</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>No. 10 gauge wire</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>No. 8 gauge wire</td>
</tr>
<tr>
<td>Double Wire Loops at Beams or Joists&lt;sup&gt;d&lt;/sup&gt;</td>
<td>8</td>
<td>No. 14 gauge wire</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>No. 12 gauge wire</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>No. 11 gauge wire</td>
</tr>
</tbody>
</table>

<sup>a</sup> All rod hangers shall be protected with a zinc or cadmium coating or with a rust-inhibitive paint.
<sup>b</sup> All flat hangers shall be protected with a zinc or cadmium coating or with a rust-inhibitive paint.
<sup>c</sup> Inserts, special clips or other devices of equal strength may be substituted for those specified.
<sup>d</sup> Two loops of No. 18 gauge wire may be substituted for each loop of No. 16 gauge wire for attaching steel furring to steel or wood joists.
### TABLE NO. 47-B

**TYPES OF LATH**

**MAXIMUM SPACING OF SUPPORTS**

<table>
<thead>
<tr>
<th>TYPE OF LATH&lt;sup&gt;b&lt;/sup&gt;</th>
<th>MINIMUM WEIGHT (Per Square Yard) GAUGE AND MESH SIZE</th>
<th>VERTICAL (In Inches)</th>
<th>HORIZONTAL (In Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wood</td>
<td>Solid Plaster</td>
</tr>
<tr>
<td>Expanded Metal Lath</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Diamond Mesh)</td>
<td>2.5</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Flat Rib Expanded Metal Lath</td>
<td>2.75</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Stucco Mesh Expanded Metal Lath</td>
<td>1.8 and</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot; Rib Expanded Metal Lath</td>
<td>3.4</td>
<td>24</td>
<td>24&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>24</td>
<td>24&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sheet Lath</td>
<td>4.5</td>
<td>24</td>
<td>d</td>
</tr>
<tr>
<td>3/4&quot; Rib Expanded Metal Lath</td>
<td>5.4</td>
<td>—</td>
<td>d</td>
</tr>
</tbody>
</table>

<sup>a</sup> For Fire-resistive Construction, see Tables No. 43-A, No. 43-B, and No. 43-C. For Shear-resisting Elements, see Table No. 47-I.

<sup>b</sup> Metal lath and wire fabric lath used as reinforcement for portland cement plaster shall be furred out away from verticle supports at least 1/4 inch. Self-furring lath meets furring requirement. Exception: Furring is not required on steel supports having a flange width of 1 inch or less.

<sup>c</sup> Wire backing required on open vertical frame construction except under expanded metal lath and paperbacked wire fabric lath.

<sup>d</sup> May be used for studless solid partitions.

<sup>e</sup> Contact or furred ceilings only. May not be used in suspended ceilings.
**TABLE NO. 47-B (Con't)**

**TYPES OF LATH**

**MAXIMUM SPACING OF SUPPORTS**

<table>
<thead>
<tr>
<th>TYPE OF LATH&lt;sup&gt;b&lt;/sup&gt;</th>
<th>MINIMUM WEIGHT (Per Square Yard)</th>
<th>VERTICAL (In Inches)</th>
<th>HORIZONTAL (In Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GAUGE AND MESH SIZE</td>
<td>Wood</td>
<td>Metal</td>
</tr>
<tr>
<td>Wire Fabric Lath</td>
<td>1.95 lbs., No. 11 gauge, 2&quot; x 2&quot;</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>1.4 lbs., No. 16 gauge, 2&quot; x 2&quot;</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>1.4 lbs., No. 18 gauge, 1&quot; x 1&quot;</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
</tr>
<tr>
<td>Woven&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.4 lbs., No. 17 gauge, 1½&quot; Hexagonal&lt;sup&gt;f&lt;/sup&gt;</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>1.4 lbs., No. 18 gauge, 1&quot; Hexagonal&lt;sup&gt;f&lt;/sup&gt;</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>⅛&quot; Gypsum Lath (perforated)</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>¼&quot; Gypsum Lath (plain)</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>⅛&quot; Gypsum Lath (perforated)</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
<td>16&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>⅛&quot; Gypsum Lath (plain)</td>
<td>24&lt;sup&gt;c&lt;/sup&gt;</td>
<td>—</td>
<td>24&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>f</sup> Woven wire or welded wire fabric lath, not to be used as base for gypsum plaster, without absorbent paper-backed or slot-perforated separator.

<sup>c</sup> Span may be increased to 24 inches on vertical screw or approved nailable assemblies.
<table>
<thead>
<tr>
<th>TYPE OF LATH</th>
<th>NAILS&lt;sup&gt;a,i&lt;/sup&gt;</th>
<th>SCREWS&lt;sup&gt;a,f&lt;/sup&gt;</th>
<th>STAPLES&lt;sup&gt;a,b&lt;/sup&gt;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Spacing&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Vertical</td>
<td>Maximum Spacing&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Vertical</td>
</tr>
<tr>
<td></td>
<td>Type and Size&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(In inches)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diamond Mesh</td>
<td>4d blued smooth</td>
<td>6</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Expanded Metal Lath and Flat</td>
<td>box 1 1/2 No. 14</td>
<td>—</td>
<td>—</td>
<td>1/4</td>
</tr>
<tr>
<td>Rib Metal Lath</td>
<td>gauge 7/16&quot; head</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(clinched)&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1&quot; No. 11 gauge</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7/16&quot; head, barbed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 1/2&quot; No. 11 gauge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/16&quot; head, barbed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot; Rib Metal Lath and Sheet</td>
<td>1 1/2&quot; No. 11 gauge</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Lath</td>
<td>7/16&quot; head, barbed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot; Rib Metal Lath</td>
<td>4d common 1 1/2&quot;</td>
<td>At Ribs</td>
<td>—</td>
<td>At Ribs</td>
</tr>
<tr>
<td></td>
<td>No. 12 1/2 gauge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4&quot; head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2&quot; No. 11 gauge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/16&quot; head, barbed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> For Fire-resistive Construction, see Tables No. 43-B and 43-C. For Shear-resisting Elements, see Table No. 47-l. Approved wire and sheet metal attachment clips may be used.

<sup>b</sup> With divergent points.

<sup>c</sup> When lath and stripping are stapled simultaneously, increase leg length of staple 1/8 inch.

<sup>d</sup> For interiors only.

<sup>e</sup> Attach self-furring wire fabric lath to supports at furring device.

<sup>f</sup> Screws shall be an approved type long enough to penetrate into wood framing not less than 5/8 inch and through metal supports adaptable for screw attachment not less than 1/4 inch.

<sup>g</sup> Three attachments per 16-inch wide lath per bearing. Four attachments per 24-inch wide lath per bearing.

<sup>h</sup> Supports spaced 24 inches o.c. Four attachments per bearing per 16-inch wide lath. Five attachments per 24-inch wide lath per bearing.

<sup>i</sup> For nailable non-load-bearing metal supports use annular threaded nails or approved staples.

<sup>j</sup> Maximum spacing of attachments from longitudinal edges shall not exceed 2 inches.
# Table No. 47-C

## Types of Lath

### Attachment to Wood and Metal Supports

<table>
<thead>
<tr>
<th>Type of Lath</th>
<th>Nails&lt;sup&gt;a, i&lt;/sup&gt;</th>
<th>Screws&lt;sup&gt;a, f&lt;/sup&gt;</th>
<th>Staples&lt;sup&gt;a, b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Spacing&lt;sup&gt;i&lt;/sup&gt;</td>
<td>Vertical</td>
<td>Horizontal</td>
</tr>
<tr>
<td></td>
<td>(In Inches)</td>
<td>(In Inches)</td>
<td>(In Inches)</td>
</tr>
<tr>
<td>Wire Fabric Lath&lt;sup&gt;o&lt;/sup&gt;</td>
<td>4d blued smooth box (clinched)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1&quot; No. 11 gauge</td>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1/8&quot; head, barbed</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1 1/4&quot; No. 11 gauge</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1 1/4&quot; No. 12 gauge</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3/4&quot; head, furring</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1 No. 12 gauge</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>3/4&quot; head</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>3/8&quot; Gypsum Lath</td>
<td>1 1/8&quot; No. 13 gauge</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>1 1/4&quot; head, blued</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>1/4&quot; Gypsum Lath</td>
<td>1 1/8&quot; No. 13 gauge</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>1 1/4&quot; head, blued</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
<td>8&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> For Fire-resistant Construction, see Tables No. 43-B and 43-C. For Shear-resisting Elements, see Table No. 47-1. Approved wire and sheet metal attachment clips may be used.

<sup>b</sup> With divergent points.

<sup>c</sup> When lath and stripping are stapled simultaneously, increase leg length of staple 1/8 inch.

<sup>d</sup> For interiors only.

<sup>e</sup> Attach self-furring wire fabric lath to supports at furring device.

<sup>f</sup> Screws shall be an approved type long enough to penetrate into wood framing not less than 5/8 inch and through metal supports adaptable for screw attachment not less than 1/4 inch.

<sup>g</sup> Three attachments per 16-inch wide lath per bearing. Four attachments per 24-inch wide lath per bearing.

<sup>h</sup> Supports spaced 24 inches o.c. Four attachments per bearing per 16-inch wide lath. Five attachments per 24-inch wide lath per bearing.

<sup>i</sup> For nailable nonload-bearing metal supports use annular threaded nails or approved staples.

<sup>j</sup> Maximum spacing of attachments from longitudinal edges shall not exceed 2 inches.
# TABLE NO. 47-D

**THICKNESS OF PLASTER**

<table>
<thead>
<tr>
<th>PLASTER BASE</th>
<th>FINISHED THICKNESS OF PLASTER FROM FACE OF LATH, MASONRY, CONCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gypsum Plaster</td>
</tr>
<tr>
<td>Expanded Metal Lath</td>
<td>$\frac{5}{8}''$ minimum&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Wire Fabric Lath</td>
<td>$\frac{5}{8}''$ minimum&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gypsum Lath</td>
<td>$\frac{1}{2}''$ minimum</td>
</tr>
<tr>
<td>Masonry Walls&lt;sup&gt;d&lt;/sup&gt;</td>
<td>$\frac{1}{2}''$ minimum</td>
</tr>
<tr>
<td>Monolithic Concrete Walls&lt;sup&gt;d,e&lt;/sup&gt;</td>
<td>$\frac{5}{8}''$ maximum</td>
</tr>
<tr>
<td>Monolithic Concrete Ceilings&lt;sup&gt;d,e&lt;/sup&gt;</td>
<td>$\frac{3}{8}''$ maximum&lt;sup&gt;f,g,h&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> For Fire-resistive Construction, see Tables No. 43-A, No. 43-B, and No. 43-C.

<sup>b</sup> When measured from back plane of expanded metal lath, exclusive of ribs, or self-furring lath plaster thickness shall be $3/4$ inch minimum.

<sup>c</sup> When measured from face of support or backing.

<sup>d</sup> Because masonry and concrete surfaces may vary in plane, thickness of plaster need not be uniform.

<sup>e</sup> When applied over a liquid bonding agent, finish coat may be applied directly to concrete surface.

<sup>f</sup> Approved acoustical plaster may be applied directly to concrete, or over base coat plaster, beyond the maximum plaster thickness shown.

<sup>g</sup> On concrete ceilings, where the base coat plaster thickness exceeds the maximum thickness shown, metal lath or wire fabric lath shall be attached to the concrete.

<sup>h</sup> An approved skim coat plaster $1/16$ inch thick may be applied directly to concrete.
### TABLE NO. 47-E

**GYPSUM PLASTER PROPORTIONS a**

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>COAT</th>
<th>PLASTER BASE OR LATH</th>
<th>MAXIMUM VOLUME AGGREGATE PER 100 POUNDS NEAT PLASTER b,c (Cubic Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Damp Loose Sand d</td>
</tr>
<tr>
<td>Two-coat Work</td>
<td>Base Coat</td>
<td>Gypsum Lath</td>
<td>2 1/2</td>
</tr>
<tr>
<td></td>
<td>Base Coat</td>
<td>Masonry</td>
<td>3</td>
</tr>
<tr>
<td>Three-coat Work</td>
<td>First Coat</td>
<td>Lath</td>
<td>2 e</td>
</tr>
<tr>
<td></td>
<td>Second Coat</td>
<td>Lath</td>
<td>3 e</td>
</tr>
<tr>
<td></td>
<td>First and Second Coats</td>
<td>Masonry</td>
<td>3</td>
</tr>
</tbody>
</table>

a Wood fibered gypsum plaster may be mixed in the proportions of 100 pounds of gypsum to not more than one cubic foot of sand where applied on masonry or concrete.
b For Fire-resistive Construction, see Tables No. 43-A, No. 43-B, and No. 43-C.
c When determining the amount of aggregate in set plaster, a tolerance of 10 percent shall be allowed.
d Combinations of sand and lightweight aggregate may be used provided the volume and weight relationship of the combined aggregate to gypsum plaster is maintained.
e If used for both first and second coats, the volume of aggregate may be two and one-half cubic feet.
f Where plaster is 1 inch or more in total thickness the proportions for the second coat may be increased to three cubic feet.
**TABLE NO. 47-F**

**PORTLAND CEMENT PLASTERS**

<table>
<thead>
<tr>
<th>COAT</th>
<th>PORTLAND CEMENT PLASTER(^b)</th>
<th>PORTLAND CEMENT-LIME PLASTER(^c)</th>
<th>Approx. Minimum Thickness(^d)</th>
<th>Minimum Period Moist Curing</th>
<th>Minimum Interval Between Coats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Volume Aggregate per Volume Cement</td>
<td>Maximum Volume Lime per Volume Cement</td>
<td>Maximum Volume Sand per Volume Cement and Lime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>4</td>
<td>3/4</td>
<td>3 1/4</td>
<td>1/5&quot;e</td>
<td>1 hour</td>
</tr>
<tr>
<td>Second</td>
<td>5</td>
<td>3/4</td>
<td>3 1/4</td>
<td>1st and 2nd Coats 3/4&quot;</td>
<td>1 hour</td>
</tr>
<tr>
<td>Finish</td>
<td>3</td>
<td>—</td>
<td>3</td>
<td>1/4&quot;</td>
<td>8 hours 8 hours</td>
</tr>
</tbody>
</table>

\(^a\) When determining the amount of aggregate in set plaster, a tolerance of 10 percent shall be allowed.

\(^b\) From 10 to 20 pounds of dry hydrated lime (or an equivalent amount of lime putty) may be added as a plasticizing agent to each sack of portland cement, Type I, Regular. Proportions to one sack of cement shall be:

\[
\text{Sand (volume)} \quad \text{Lime (pounds)}
\]

- 2 parts 10
- 3 parts 15
- 4 parts 20

\(^c\) No additions of plasticizing agents shall be made.

\(^d\) Total minimum thickness is 3/4 inch.

\(^e\) Measured from face of support or backing to crest of scored plaster.
### TABLE NO. 47-G
APPLICATION OF SINGLE-PLY GYPSUM WALLBOARD

<table>
<thead>
<tr>
<th>THICKNESS OF GYPSUM WALLBOARD (Inch)</th>
<th>PLANE OF FRAMING SURFACE</th>
<th>LONG DIMENSION OF GYPSUM WALLBOARD SHEETS IN RELATION TO DIRECTION OF FRAMING MEMBERS</th>
<th>MAXIMUM SPACING OF FRAMING MEMBERS* (Center to Center) (In Inches)</th>
<th>MAXIMUM SPACING OF FASTENERS (Center to Center)</th>
<th>NAILSb. TO WOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>Horizontal</td>
<td>Either Direction</td>
<td>16</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>5/8</td>
<td>Horizontal</td>
<td>Either Direction</td>
<td>16</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

Nail or Screw Fastenings With Adhesives (Maximum Center to Center in Inches)

<table>
<thead>
<tr>
<th>(Column headings as above)</th>
<th>End</th>
<th>Edges</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 or 5/8</td>
<td>16</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Horizontal</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Vertical</td>
<td>24</td>
<td>16</td>
<td>24</td>
</tr>
</tbody>
</table>

a For Fire-resistive Construction, see Tables No. 43-B and No. 43-C. Support spacing of 24 inches may be allowed for ceilings only where fire-resistive construction is not required. For Shear-resisting Elements, see Table No. 47-I.
b Where the metal framing has a clinching design formed to receive the nails by two edges of metal, the nails shall be not less than 1/4 inch longer than the wallboard thickness, and shall have ringed shanks. Where the metal framing has a nailing groove formed to receive the nails, the nails shall have barbed shanks or be 5d, No. 13 1/2 gauge, 1 1/4 inch long, 15/64 inch head for 1/8 inch gypsum wallboard, 6d, No. 13 gauge, 1 1/4 inch long, 15/64 inch head for 5/8 inch gypsum wallboard.
c Two nails spaced not less than 2 inches apart, nor more than 2 1/2 inches apart and pairs of nails spaced not more than 12 inches center to center may be used.
d Screws shall be of an approved type long enough to penetrate into wood framing not less than 1/4 inch and through metal framing not less than 1/4 inch.
*e Not required.
## TABLE NO. 47-H

### APPLICATION OF TWO-PLY GYPSUM WALLBOARD

<table>
<thead>
<tr>
<th>Thickness of Gypsum Wallboard (Each Ply) (Inch)</th>
<th>Plane of Framing Surface</th>
<th>Long Dimension of Gypsum Wallboard Sheets</th>
<th>Maximum Spacing of Framing Members (Center to Center) (In Inches)</th>
<th>Maximum Spacing of Fasteners (Center to Center) (In Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16</td>
<td>Horizontal</td>
<td>Perpendicular only</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>1/8</td>
<td>Horizontal</td>
<td>Perpendicular only</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>5/16</td>
<td>Vertical</td>
<td>Perpendicular only</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

### Fasteners and Adhesives

<table>
<thead>
<tr>
<th>Thickness of Gypsum Wallboard (Each Ply) (Inch)</th>
<th>Plane of Framing Surface</th>
<th>Long Dimension of Gypsum Wallboard Sheets</th>
<th>Maximum Spacing of Framing Members (Center to Center) (In Inches)</th>
<th>Maximum Spacing of Fasteners (Center to Center) (In Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16</td>
<td>Horizontal</td>
<td>Perpendicular only</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>1/8</td>
<td>Horizontal</td>
<td>Perpendicular only</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Vertical</td>
<td>Either Direction</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>5/16</td>
<td>Vertical</td>
<td>Perpendicular only</td>
<td>24</td>
<td>7</td>
</tr>
</tbody>
</table>

**Notes:**

- For Fire-resistive Construction, see Tables No. 43-B and 43-C. For Shear-resisting Elements, see Table No. 47-I.
- Nails for wood framing shall be long enough to penetrate into wood members not less than 3/4 inch and the sizes shall comply with the provisions of Table No. 47-G. For nails not included in Table No. 47-G, use the appropriate size cooler nail as set forth in Table No. 25-24-A of U.B.C. Standard No. 25-24. Nails for metal framing shall comply with the provisions of Table No. 47-G.
- Screws shall comply with the provisions of Table No. 47-G.
- Staples shall be not less than No. 16 gauge by 3/4 inch crown width with leg length of 3/8 inch, 1 1/4 inch and 1 3/8 inch for gypsum wallboard thicknesses of 3/4 inch, 1/8 inch and 3/8 inch respectively.
TABLE NO. 47-I
ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES IN POUNDS PER FOOT FOR VERTICAL DIAPHRAGMS OF LATH AND PLASTER, GYPSUM SHEATHING BOARD, AND GYPSUM WALLBOARD WOOD FRAMED WALL ASSEMBLIES

<table>
<thead>
<tr>
<th>Type of Material</th>
<th>Thickness of Material</th>
<th>Wall Construction</th>
<th>Shear Value</th>
<th>Minimum Nail Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woven or Welded Wire Lath and Portland Cement Plaster</td>
<td>3/4&quot;</td>
<td>Unblocked</td>
<td>6</td>
<td>180 No. 11 gauge, 1 1/4&quot; long with 1/4&quot; diameter head nail or No. 16 gauge staples having 1/4&quot; long legs.</td>
</tr>
<tr>
<td>Gypsum Lath, Plain or Perforated</td>
<td>3/8&quot; Lath and 1/2&quot; Plaster</td>
<td>Unblocked</td>
<td>5</td>
<td>100 No. 13 gauge, 1 1/4&quot; long, 1/4&quot; head, plasterboard blued nail</td>
</tr>
<tr>
<td>Gypsum Sheathing Board</td>
<td>1/2&quot; x 2' x 8'</td>
<td>Unblocked</td>
<td>4</td>
<td>75 No. 11 gauge, 1 3/4&quot; long, 1/4&quot; head, diamond point, galvanized</td>
</tr>
<tr>
<td></td>
<td>1/2&quot; x 4'</td>
<td>Blocked</td>
<td>4</td>
<td>175</td>
</tr>
<tr>
<td>Gypsum Wallboard</td>
<td>3/4&quot;</td>
<td>Unblocked</td>
<td>7</td>
<td>100 5d cooler nails</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blocked</td>
<td>7</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blocked</td>
<td>4</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blocked</td>
<td>4</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two-ply</td>
<td>Base Ply 9</td>
<td>250 Base Ply - 6d cooler nails</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Face Ply 7</td>
<td>250 Face Ply - 6d cooler nails</td>
</tr>
</tbody>
</table>

* These vertical diaphragms shall not be used to resist loads imposed by masonry or concrete walls. Values are for short-time loading due to wind or earthquake and must be reduced 25 percent for normal loading.

*b Applies to nailing at all studs, top and bottom plates, and blocking.
### TABLE NO. 47-J

**SOFTWOOD PLYWOOD PANELING**  
(Meeting Requirements of U.B.C. Standard No. 25-9.)

<table>
<thead>
<tr>
<th>Plywood Thickness (Inch)</th>
<th>Max Support Spacing (Inches)</th>
<th>Nail Size and Type</th>
<th>NAIL SPACING (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>16*</td>
<td>4d casing or finish</td>
<td>Panel Edges 6 Intermediate 12</td>
</tr>
<tr>
<td>3/8</td>
<td>24</td>
<td>6d casing or finish</td>
<td>6 12</td>
</tr>
</tbody>
</table>

*Twenty inches if face grain of paneling is across supports.

### TABLE NO. 47-K

**PREFABRICATED STEEL STUDS**

<table>
<thead>
<tr>
<th>Overall Partition Thickness (Inches)</th>
<th>Stud Size (Inches)</th>
<th>Stud Spacing&lt;sup&gt;b&lt;/sup&gt; (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 1/2 or 3 3/8</td>
<td>1 3/4 or 2</td>
<td>24&lt;sup&gt;&quot;&lt;/sup&gt; 19&lt;sup&gt;&quot;&lt;/sup&gt; 16&lt;sup&gt;&quot;&lt;/sup&gt; 12&lt;sup&gt;&quot;&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>2 1/2 or 3 1/4</td>
<td>20&lt;sup&gt;&quot;&lt;/sup&gt; 16&lt;sup&gt;&quot;&lt;/sup&gt; 14&lt;sup&gt;&quot;&lt;/sup&gt; 12&lt;sup&gt;&quot;&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 1/2</td>
<td>4</td>
<td>16&lt;sup&gt;&quot;&lt;/sup&gt; 12&lt;sup&gt;&quot;&lt;/sup&gt; 10&lt;sup&gt;&quot;&lt;/sup&gt; 8&lt;sup&gt;&quot;&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 1/2</td>
<td>6</td>
<td>12&lt;sup&gt;&quot;&lt;/sup&gt; 10&lt;sup&gt;&quot;&lt;/sup&gt; 8&lt;sup&gt;&quot;&lt;/sup&gt; 6&lt;sup&gt;&quot;&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

### TABLE NO. 47-L

**LIMITING HEIGHTS**

<table>
<thead>
<tr>
<th>Stud Width (Inches)</th>
<th>Stud Width (Mm)</th>
<th>Stud Spacing, O.C. (Inches</th>
<th>MM</th>
<th>Feet</th>
<th>M</th>
<th>Single Layer (Each Side)</th>
<th>Feet</th>
<th>M</th>
<th>Double Layer (Each Side)</th>
<th>Feet</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3/4</td>
<td>41.3&lt;sup&gt;*&lt;/sup&gt;</td>
<td>16</td>
<td>406</td>
<td>8</td>
<td>2.44</td>
<td>10</td>
<td>3.05</td>
<td></td>
<td>15</td>
<td>5.79</td>
<td></td>
</tr>
<tr>
<td>2 1/2</td>
<td>63.5</td>
<td>16</td>
<td>406</td>
<td>13</td>
<td>3.86</td>
<td>15</td>
<td>4.57</td>
<td></td>
<td>21</td>
<td>4.27</td>
<td></td>
</tr>
<tr>
<td>3 3/8</td>
<td>92.1</td>
<td>16</td>
<td>406</td>
<td>17</td>
<td>5.18</td>
<td>19</td>
<td>5.79</td>
<td></td>
<td>24</td>
<td>5.49</td>
<td></td>
</tr>
</tbody>
</table>

<sup>*</sup> Where studs are continuous through suspended ceilings to the underside of floor or roof above, and ceiling adds stability to the partition or, studs are adequately braced at or below specified limiting height, the overall partition height may be increased by 50 percent.

**NOTE 2.** Special height limitations or added bracing may be required for framing used for application of water resistant gypsum backing board to receive ceramic tile. Consult the Board manufacturer's recommendations for special installation details.

1 1/4 inch (41.3 mm) studs with single layer of gypsum board recommended for chase walls and closets only.

**o.c.** On center.
# TABLE NO. 47-M

SPANS AND SPACINGS OF FURRING MEMBERS

<table>
<thead>
<tr>
<th>Type of Furring</th>
<th>Maximum Spacing (c to c)(^a)</th>
<th>Maximum Span</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inches</td>
<td>MM</td>
</tr>
<tr>
<td>Furring member (drywall hat shaped)</td>
<td>24</td>
<td>610</td>
</tr>
<tr>
<td>1 1/4 inch (41.3 mm) stud (erected with open side up and against support)</td>
<td>24</td>
<td>610</td>
</tr>
<tr>
<td>2 1/4 inch (63.5 mm) stud (erected with web vertical to support)(^b)</td>
<td>24</td>
<td>610</td>
</tr>
<tr>
<td>3 1/4 inch (92.1 mm) stud (erected with web vertical to support)(^b)</td>
<td>24</td>
<td>610</td>
</tr>
</tbody>
</table>

\(^{c to c}\) Center to Center

\(^{a}\) Consult 6.1.6.3 ASTM C 754 for maximum spacing as determined by gypsum board thickness.

\(^{b}\) A 6 inch (152 mm) length of same size stud shall be nested to form a “box” at each saddle tie.
CHAPTER 48
INCINERATORS, CREMATORIES, FIREPLACES, AND BARBECUES

SECTION 4801. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation, repair, maintenance, and approval of all incinerators, crematories, fireplaces, and barbecues. For purposes of this Building Code, barbecues shall be considered fireplaces and shall meet all the requirements of fireplaces.

(b) Locations Prohibited. Installation of any type incinerator, barbecue (fixed or portable), or fireplace, in garages or in areas containing explosive or flammable liquids or fumes, is expressly prohibited, unless separated therefrom by at least a one-hour fire resistive separation, without any openings to the areas specified herein. See Chapter 17.

(c) Location of Incinerators. All outside incinerators shall be located in accordance with Zoning requirements, and shall be so placed that they will not constitute a fire hazard to adjacent buildings or structures.

(d) Plans. See Chapter 3.

(e) Trash Chute Vent. All trash chutes shall be vented to the outside in an approved manner.

(f) Trash Chute Charging Doors. Trash chute charging doors shall be an approved, self-closing, locking type, and shall provide a one-hour fire resistive rating.

(g) Trash Chute Opening. The opening of a trash chute into the trash room shall be protected by a counter balanced self-closing door, held open by a 135 degree F. fusible link or other approved device. This door shall be in a normally open position.

SECTION 4802. DEFINITIONS.
(a) General. The following words, phrases, terms and their derivatives shall be interpreted as set forth in this Section.

1. Air. All air supplied to the incinerator equipment for combus-
tion, ventilation, cooling, etc. Standard air is air at standard temperature and pressure, namely 60 degrees F., and 29.92 inches mercury.

A. Excess Air. The air remaining after a fuel has been completely burned, or that air supplied in addition to the theoretical quantity.

B. Overfire Area. Air controlled in quantity and direction supplied above the fuel bed.

C. Primary Air. Any air controlled with respect to quantity and direction, forced or induced, supplied through or adjacent to the fuel bed, for the purpose of promoting combustion of the combustible materials in the fuel bed.

D. Secondary Air. Any air controlled with respect to quantity and direction, supplied beyond the fuel bed, as through ports in the walls or bridge wall, or the secondary combustion chamber, for the purpose of completing combustion of combustible materials in the gases from the fuel bed or to reduce operating temperature within the incinerator.

E. Theoretical Air. The exact amount of air required to supply oxygen for complete combustion of a given quantity of a specific fuel.

F. Underfire Air. Air controlled with respect to quantity and direction, forced or induced, supplied beneath the grate that passes through the fuel bed.

2. Air-Setting Bonding Mortars. Air-setting bonding mortars are those which take a rigid set when dried. They are prepared from suitable refractory materials by proper selection and combination. Chemical binders impart air-setting properties and maintain the strength of the bond up to the temperature at which the ceramic bond takes effect. Air-setting mortars form mechanically strong joints with high resistance to abrasion and erosion. They bond the wall from the hot to the cold surface.

3. Auxiliary-Fuel Firing Equipment. Equipment to supply additional heat, by the combustion of an auxiliary fuel, for the purpose of attaining temperatures sufficiently high:
   A. To dry and ignite the waste material.
   B. To maintain ignition thereof.
   C. To promote complete combustion of combustible solids, vapors, and gases.

4. Baffle. Refractory construction intended to change the direction of flow of the products of combustion.

5. Breecching or Flue Connection. A passage for conducting the products of combustion to the stack or chimney.
6. **Bridge Wall.** A partition wall between chambers over which pass the products of combustion.

7. **British Thermal Unit.** The quantity of heat required to raise the temperature of one pound of water from 59 degrees F. to 60 degrees F., usually abbreviated B.T.U., or Btu.

8. **Burning Area.** The horizontal projected area of grate, hearth, or combination thereof, on which active burning takes place.

9. **Burning Rate.** The amount of waste incinerated, usually expressed in pounds per hour per square foot of burning area.

10. **By-Pass.** An arrangement of breechings or flue connections and dampers, to permit the alternate use of 2 or more pieces of equipment by directing, or diverting, the flow of the products of combustion.

11. **Capacity.** The amount of waste incinerated, usually expressed in pounds per hour with the characteristic or type of waste stipulated.

12. **Checkerwork.** A pattern of multiple openings in refractory through which the products of combustion pass to promote turbulent mixing of the gases.

13. **Chimney, Stack, or Flue.** See Chapter 37.

14. **Curtain Wall.** A partition wall between chambers under which pass the products of combustion.

15. **Damper.** A manually or automatically controlled device to regulate draft, or the rate of flow of air or combustion gases.
   
   A. **Barometric.** A hinged or pivoted balanced blade placed to admit air to the breeching, flue connection, or stack, thereby automatically maintaining a constant draft in the incinerator.
   
   B. **Guillotine.** An adjustable blade installed vertically in a breeching or flue connection, arranged to move vertically across the breeching or flue connection.
   
   C. **Butterfly.** A plate or blade installed in a duct, breeching, flue connection, or stack which rotates on its axis.
   
   D. **Sliding.** An adjustable blade installed in a duct, breeching, flue connection, or stack, arranged to move horizontally across the duct, breeching, flue connection or stack.

16. **Destructor.** An incinerator meeting the requirements of Class III, Class VI, or Class VII incinerators.

17. **Down Pass.** A gas passageway placed between 2 chambers to carry the products of combustion in a downward direction.
18. **Draft.** The pressure difference between the incinerator or any component part and the atmosphere, which causes a continuous flow of air and products of combustion through the gas passages of the incinerator to the atmosphere.
   
   A. **Forced Draft.** The pressure difference created by the action of a fan, blower, or ejector which supplies the primary combustion air above atmospheric pressure.
   
   B. **Induced Draft.** The pressure difference created by the action of a fan, blower, or ejector which is located between the incinerator and the stack, or at the stack exit.
   
   C. **Natural Draft.** The pressure difference created by the stack or chimney, due to its height and the temperature difference between the flue gases and the atmosphere.

19. **Drop Arch.** Any vertical refractory wall supported by arch construction.

20. **Drying Hearth.** A surface within the primary chamber upon which wet waste material is deposited for drying prior to burning.

21. **Expansion or Setting Chamber.** A chamber designed to reduce the velocity of the products of combustion to promote the setting of fly ash from the gas stream.

22. **Firebrick, High Heat Duty.** Refractory fireclay brick which meets the Standards of this Building Code.

23. **Fireplace.** A square, rectangular, circular, or oval opening made at the base of a chimney in or against the wall of a room, or free-standing within a room, and surrounded with brick, stone, metal, or other noncombustible material, to hold an open fire.

24. **Flue Connection or Breeching.** See Breeching.

25. **Fly Ash.** Suspended particulate matter in products of combustion.

26. **Fly Ash Collector.** Auxiliary equipment designed to remove fly ash in dry form from the products of combustion.

27. **Gas Washer or Scrubber.** Auxiliary equipment designed to remove pollutants in wet form from the products of combustion.

28. **Grate.** A surface with suitable openings to support the fuel bed and permit passage of air through the burning fuel. It is usually located in the primary combustion chamber, is designed to permit removal of unburned residue and may be horizontal or inclined, stationary or moveable.

29. **Heating Value and Heat of Combustion.** The heat released by combustion of a unit quantity of waste or fuel, measured in British Thermal Units.
30. **Heat Release Rate.** The amount of heat liberated during the process of complete combustion, expressed in Btu per hour per cubic foot of the internal furnace volume in which such combustion takes place.

31. **Hot Drying Hearth.** A surface upon which wet material is placed to dry by the action of hot combustion gases that pass successively over the wet material and under the hearth.

32. **Incineration.** The process of igniting and burning solid, semi-solid, or gaseous combustible waste to carbon dioxide and water vapor.
   - **Commercial and Industrial.** Shall be classified elsewhere in this Chapter. See Section 4815.
   - **Domestic Gas-Fired Type.** An approved direct-fed-gas-fired type, generally located within a building or structure, and designed primarily for use in Group I Occupancies for the burning of ordinary waste material, with a capacity of no more than 4 bushels.
   - **In-Line Type.** A multiple chamber incinerator which when viewed from above, the line of travel of the smoke through the incinerator is a straight line.
   - **Retort Type.** A multiple chamber incinerator which when viewed from above, the line of travel of the smoke through the incinerator incorporates two 90 degree bends and provides a reversal of the direction of flow.

33. **Mixing Chamber.** A chamber, usually placed between the primary combustion chamber and the secondary combustion chamber, where through mixing of the products of combustion is accomplished by turbulence created by increasing velocities of the gases, checkerwork, and/or turns in direction of the gas flow.

34. **P.C.E.** Pyrometric Cone Equivalent.

35. **Primary Combustion Chamber.** A chamber within an incinerator where primary ignition and burning of waste occur.

36. **Rubbish.** See Section 4814(c).

37. **Secondary Combustion Chamber.** A chamber where unburned combustible materials from the primary chamber are completely burned.

38. **Settling or Expansion Chamber.** A chamber designed to reduce the velocity of the products of combustion to promote the settling of fly ash from the gas stream.
39. Trash. See Section 4814(a) and (b).

SECTION 4803. FIREPLACES.

(a) General. Fireplaces, barbecues, and smoke chambers shall be of solid masonry, reinforced concrete, or hollow block when the voids are filled with concrete, and shall conform to the requirements of this Section. (Rev. 3/87 Ord. No. 126)

(b) Fireplace Walls. Structural walls of fireplaces shall be at least 8 inches thick. Firebox walls shall be at least 8 inches in thickness. The firebox shall be 20 inches in depth, and shall be lined with 4 1/2 inches of firebrick. The maximum thickness of joints in firebrick shall be 1/4 inch. A firebox will be permitted to be open on all sides, provided all fireplace openings are located entirely within one room. All firebrick shall be set in air-setting mortar.

(c) Fireplace Hoods. Metal hoods used as a part of a fireplace or barbecue shall be at least No. 18 gauge copper, galvanized steel, or other equivalent corrosion-resistant ferrous metal, with all seams and connections of smokeproof, unsoldered construction. The hoods shall be sloped at an angle of 45 degrees or less from the vertical, and shall extend horizontally at least 6 inches beyond the limits of the firebox. Metal hoods shall be kept a minimum of 18 inches from combustible materials, unless approved for reduced clearance.

(d) Metal Heat Circulators. Approved metal heat circulators may be installed in fireplaces, provided the thickness of the fireplace walls is not reduced.

(e) Smoke Chamber. All walls shall be at least 8 inches in thickness.

(f) Clearance.

1. The distance between a fireplace and combustibles shall be at least 4 inches; and combustibles shall not be placed within 6 inches of the fireplace opening. Wood facings or trim normally placed around the fireplace opening may be permitted when conforming to the requirements of this Section; however, facings or trim shall be furred out from the fireplace wall at least 4 inches, and attached to noncombustible furring strips. The edges of facings or trim shall be covered with a noncombustible material. Where the walls of the fireplace are 12 inches thick, the facing or trim may be directly attached to the fireplace.
2. Parts of metal hoods used as part of a fireplace or barbecue shall be at least 18 inches from combustible material.

(g) **Lining.** The lining shall extend from the throat of the fireplace to a point at least 4 inches above the top of the enclosing masonry walls.

(h) **Areas of Flues, Throats, and Dampers.** The net cross-sectional areas of the flue, and of the throat between the firebox and the smoke chamber of a fireplace shall be at least that required in Chapter 37. When dampers are used, damper openings, when fully opened, shall be at least equal to the required flue area and shall be a minimum of No. 12 gauge metal.

(i) **Lintel.** Masonry over the fireplace opening shall be supported by a noncombustible lintel.

(j) **Hearth.** Every fireplace shall be provided with a brick, concrete, stone, or other approved incombustible hearth slab at least 12 inches wider on each side than the fireplace opening, and projecting at least 18 inches therefrom. This slab shall be at least 4 inches thick, and shall be supported by incombustible materials or reinforced to carry its own weight and all imposed loads. Combustible forms and centering shall be removed.

EXCEPTION: A hearth material shall not be required where the fire pit is depressed at least 6 inches below the rim of the firebox, and the unit is installed at least 30 inches above the floor and designated for cooking purposes only.

(k) **Firestopping.** Firestopping between chimneys and wooden construction shall meet the requirements specified in Chapter 25.

(l) **Support.** Fireplaces shall be supported on foundations designed in conformity with Chapters 23, 24, and 29, or as approved by the Department.

(m) **Screens.** Screens or acceptable protection shall be provided for all fireplace openings.

(n) **Other Type Fireplaces.** Other fireplaces not conforming to the requirements of this Section shall be subject to approval by the Department prior to installation. Imitation fireplaces shall not be used for the burning of gas, solid, or liquid fuel. Factory built fireplaces may be installed when approved by the Department, and shall conform to the applicable portions of this Building Code and Chapter. Factory built fireplaces shall bear the seal of a nationally recognized testing laboratory.
SECTION 4804. DOMESTIC GAS-FIRED INCINERATORS.

(a) General. This Section shall apply to approved gas-fired, freestanding incinerators with a loading capacity of not more than 4 bushels. Gas-fired incinerators shall comply with the following:

1. Clearances to permit access and servicing of the unit shall be provided.

2. When an incinerator is installed in a confined area, and when air is supplied from ventilated adjacent areas to the room housing the incinerator, 2 openings, one near the floor and one near the ceiling, each with a minimum net free area of 100 square inches, shall be provided in the room or walls.

3. When adjacent areas do not have sufficient air infiltration, air shall be supplied from outdoors directly to the room housing the incinerator through an opening, or openings, with a total net free area of 100 square inches.

4. Incinerators shall have a clearance to combustible material of at least 12 inches at sides and rear, at least 30 inches at front and 36 inches above.

EXCEPTIONS:

A. Incinerators approved for installation with a lesser clearance than herein specified may be installed in accordance with the conditions of such approval.

B. Clearance shall not be required when of masonry construction of 4 inches or more thickness, except on the service side where the clearance shall be at least 30 inches.

5. Incinerators shall be mounted on set masonry floors.

EXCEPTION: Incinerators approved for installation on combustible floors may be installed in accordance with the conditions of such approval.

6. All new domestic gas-fired incinerators shall meet the smokeless and odorless requirements of AGA Z-21.6.

SECTION 4805. OTHER TYPES OF INCINERATORS. Incinerators of types other than those herein regulated, and special large capacity incinerators and refuse burners, shall be constructed and installed in a manner approved by the Department.

SECTION 4806. REFUSE CHUTES. Refuse chutes shall not feed directly to the combustion chamber of an incinerator unless otherwise permitted by this Chapter. Chutes shall discharge into a room or bin enclosed and separated from the incinerator room by floors, ceilings and walls of at least 2-hour fire-resistive construction. The opening through which material is transferred from the room or bin to the incinerator shall be
equipped with a 1-1/2-hour fire-resistive door, with an approved self-closing device. Refuse chutes shall rest on an incombustible foundation. The enclosing walls of chutes shall consist of brick or concrete masonry at least 8 inches thick, reinforced concrete at least 6 inches thick, or as approved by the Department.

SECTION 4807. FIXED BARBECUE PITS. Barbecue pits shall conform to the requirements for fireplaces.

SECTION 4808. CREMATORIES.
(a) General. In addition to other requirements of this Building Code, the following shall govern the construction of crematories. For the purposes of this Building Code and Chapter, a crematory shall include any device used to incinerate human bodies, for which permits are required by either the State of Colorado or the City. Pathological incinerators shall be considered as commercial incinerators.

(b) Construction.
1. Firebox.
   A. The firebox of every crematory shall be enclosed with walls, floors, and ceilings with at least 6 inches of super duty firebrick set in super duty refractory mortar, backed with 2 1/2 inches of insulating firebrick conforming to the requirements of Group 20 of the ASTM C-155, or its equivalent. The outside covering for the firebox shall be constructed of at least 12 U.S. Standard Gauge Steel.

2. Other Types of Fireboxes. Other approved firebox construction may be used in lieu of the requirements of this Section, provided the exterior shell temperature does not exceed 160 degrees F.

3. Firebrick.
   A. Firebrick for lining a crematory combustion chamber shall be super duty firebrick, pyrometric cone, equivalent to at least a cone No. 33, conforming to the requirements of ASTM C-64.

   B. Firebrick for lining secondary combustion chambers, connecting passageways and breechings, shall be at least Type A high duty firebrick, pyrometric cone, equivalent to at least a cone No. 31.5, conforming to requirements of ASTM C-64.

   C. Super or high duty firebrick, when used, shall be laid in high temperature mortar; medium duty firebrick, when
used shall be laid in high temperature mortar, all conforming to ASTM C-105.

4. **Castable Refractory.** Fireclay base castable refractory products may be approved in lieu of super or medium duty firebrick, respectively, provided the products are equivalent to super, high, or medium duty fireclay brick, in accordance with Class F, C, or B castable refractory conforming to ASTM C-64.

5. **Chimneys.** Firebrick for the lining of chimneys shall be at least Type F medium duty firebrick, pyrometric cone No. 29, conforming to ASTM C-64.

(c) **Prefabricated Crematories.** Prefabricated crematories shall be approved by the Department when conforming to the requirements of this Chapter, or as an alternate material or method as described in Chapter 1.

(d) **Burners.**

1. **Connections and Installations.** In addition to the requirements of this Chapter, installation of gas or liquid fuel burners, venting, piping, and controls in connection with crematories shall comply with Chapters 37 and 51 of this Building Code.

2. **Air.** Burners for crematories shall be power burners with primary and secondary air supplied by a blower.

   A. Combustion air shall be supplied from outside the building. Air intake shall be designed so that velocity at the louver shall not exceed 300 feet per minute, based on 20 percent excess air.

3. **Pilots.** Burners shall be provided with a gas or liquified petroleum gas pilot, controlled by a flame rod or ultraviolet scanner, or approved electronic controls.

4. **Flame Failure.** Burners shall be provided with 100 percent flame failure protection with manual reset or as approved by the Department.

5. **Oil.** Oil burners shall not use oil heavier than No. 2 fuel oil.

6. **Limiting Controls.** Crematory burners shall be provided with indicating high temperature limiting controls, with thermocouples mounted in both primary and secondary chambers.

7. **Primary and Secondary Chambers.** Burners shall be provided in both the primary and secondary chambers.

8. **Heat Release.** Total heat release within the combustion chamber shall not exceed 40,000 Btu per cubic foot per hour.

9. **Barometric Damper.** A barometric damper shall be provided to control the draft of the crematory in accordance with manufacturer's recommendations.
10. **Induced Draft.** Where an induced draft fan is used, a low draft switch shall be provided and interlocked with all burners.

(e) **Electrical.** Electrical work performed in connection with the installation of a crematory shall be accomplished in accordance with Chapter 53 of this Building Code.

(f) **Location.**

1. **Requirements.** Crematories shall be installed in a room which shall comply to the following:
   A. Walls, floor, and ceiling shall be constructed of at least one-hour fire resistive material, or equivalent to the fire resistive construction of the building itself, whichever is more restrictive.
   B. Fire resistive doors shall be installed equivalent to the type of enclosure required.
   C. Openings into a garage or areas where flammable liquids are used or stored shall not be permitted.

2. **Prefabricated or Other Approved Crematories.** The location of prefabricated or other approved types of crematories shall require approval from the Department.

(g) **Name Plate.** Every crematory shall be provided with a metal plate, or plates, permanently attached to the crematory in a conspicuous location so that it may be easily read. The plate shall bear the manufacturer's name; the trade name of the crematory, if any; the model number; the rated capacity for which it is designed; and the date installed.

(h) **Operating Instructions.** Complete instructions for the proper operation of the crematory and all necessary equipment shall be posted on a card adjacent to the crematory, and shall include at least the following:
   1. Steps required to start and stop burners.
   2. Operation of controls and instruments.
   3. Routine maintenance required.

(i) **Ventilation.** See Chapter 52.

**SECTION 4809. COMMERCIAL AND INDUSTRIAL INCINERATORS.**

(a) **Location.** Inside incinerators, with their waste material bin or containers, shall be located either in a room or compartment used only for that purpose. The room shall be separated from the balance of the building by one-hour fire-resistive walls, floors, and ceilings,
with all openings equipped with a one-hour fire-resistive door, and provided with approved self-closing devices. Access to incinerator rooms shall not be through boiler rooms, air handling or refrigeration equipment rooms, garages or rooms containing flammable liquids. See Chapter 38 for fire protection requirements. (Revised 5/82 Ordinance No. 245)

(b) **Incinerator Room Isolation.** Natural draft incinerators, shall be completely isolated from the effect of any air-conditioning system, boiler room induced draft system, or any other ventilating system.

(c) **Sprinklers.** Every incinerator room shall be provided with automatic fire sprinklers as required in Chapter 38, except when the incinerator burns only Type 4 waste, and is approved in writing by both the Department and the Fire Department.

(d) **Egress.** See Chapter 33.

(e) **Combustion Air and Ventilation.** Combustion air and ventilation shall be provided in accordance with the requirements of Chapter 51. (Revised 5/82 Ordinance No. 245)

(f) **Incinerator for Combination Waste.** Any incinerator which is designed to burn a combination of wastes, and where such combinations do not fall into the category of the “Classification of Incinerators” as set forth herein, the incinerator shall be Class VI or Class VII. In the design, the specific wastes shall be classified into the standard categories for such wastes, and the portion of the incinerator chamber burning this waste shall conform to the minimum and maximum set forth for that category. The total products of combustion, and the total heat release and burner capacities, shall be used in determining the sizes of the down pass, final combustion chamber, flue connection, and stack.

(g) **Pathological Incinerators.** When Type 4 waste is included in mixed waste, the Department may determine the need for a pathological incinerator.

(h) **Operating Instructions.** The incinerator operator shall follow the written operating instructions of the manufacturer. One copy of the instructions shall be posted in the incinerator room.

(i) **Name Plate.** A name plate shall be conspicuously fastened to the incinerator indicating the manufacturer’s name, model number, rated capacity of the unit, the type of waste for which it is designed, and date installed.

(j) **Scrubbers.** Alkaline scrubbers, or other approved devices, shall be required for incinerators burning halogenated compounds.
(k) Prohibitions.
1. It shall be unlawful to burn solid waste in any fireplace or barbecue.
2. In-line incinerators with a burning capacity of less than 750 pounds per hour shall not be installed.
**EXCEPTION:** In existing buildings, where space is not available for a retort type incinerator, in-line incinerators shall be installed only with the written approval of the Department.

**SECTION 4810. DESIGN.** Incinerators shall be designated in accordance with the requirements of this Section.

(a) **Incinerator Volume.** The interior incinerator volume requirements of this Chapter shall be calculated by measuring the inside distance between the side walls and from the front end to the rear wall and from paving to roof, excluding ash pit, interior walls, grates, and hearth. Door openings, chutes, charging hoods, or flue connections, shall not be considered a part of the incinerator volume. The volume of the charging door opening through which the refuse is placed in the incinerator may be considered a part of the furnace volume. Roof height above the grate shall not be less than 4/3 (Ag) 4/11 ± 10 percent where Ag is the grate area, except Class VI incinerator. Total heat release in the entire incinerator shall not exceed 25,000 Btu per cubic foot per hour.

(b) **Settling Chamber.** A chamber shall be provided in which the products of combustion are reduced in velocity to 9 feet per second at 1400 degrees Fahrenheit, while traveling in a vertical plane. The length of gas travel at 9 feet per second shall be a distance at least the square root of the horizontal cross-sectional area of the settling chamber, measured from the top of the opening under the curtain wall to the roof of the incinerator, or to the top of the breeching connection, whichever is lower.

(c) **Flame Port.** The flame port shall be designed to provide a velocity of not less than 50 feet per second, calculated at 1,000 degrees F.
**EXCEPTION:** Domestic gas-fired, Class I and Class IA.

(d) **Down Pass.** All incinerators, except gas-fired domestic, shall include a down pass and/or other means of creating turbulence for the gases of combustion, to assure thorough mixing of the gases prior to their entering the secondary combustion chamber.

(e) **Refractory Lining.**
1. Refractory lining 4-1/2 inches in thickness shall be required, except where the area of any wall exceeds 35 square feet. Every wall over 4 feet in height shall be anchored every 4 feet. Castable and/or plastic refractory shall be anchored every 18 inches.
2. Where the area specified in Item 1 of the Sub-Section is exceeded, the lining of all walls and roof shall be at least 9 inches in thickness.

3. Walls of greater thickness may be required by the Department to provide structural stability.

**EXCEPTION:** This requirement shall not apply to domestic gas-fired and incinerators of Class I and IA.

(f) **Roofs, Arches and Lintels.** All roofs or arches shall be so designed that metal supports or lintels are not directly exposed to heat or flame.

(g) **Barometric Damper.** A barometric damper shall be provided. For natural draft stacks, its free area shall be at least the percentage of the cross-sectional area of the flue connection, breeching, or stack in which it is located as specified in Table. No. 48-C.

(h) **Dampers.**

1. All incinerators, except gas-fired domestic, shall be provided with a guillotine or sliding damper. Design criteria shall provide at least 10 percent free opening when the damper is in the fully closed position.

2. Guillotine dampers provided for draft regulation shall be properly counterbalanced, and sliding dampers shall be arranged for easy operation. The dampers shall be constructed of a steel frame with refractory lining or may be constructed entirely of alloy steel to withstand the high temperature. All dampers shall be provided with a damper box, constructed of No. 12 U.S. Gauge Steel, to completely house the damper when it is in full open position. All guillotine and sliding dampers shall be provided with an approved locking device.

(i) **Mortar.** All firebrick shall be laid in high temperature airsetting refractory mortar, meeting the requirements of ASTM C-64. Mortar shall be the same service as the firebrick.

(j) **Metal Casing.** A metal casing shall be required for all incinerators.

(k) **Insulation.** Insulation shall not be less than 2 inches in thickness, but shall provide a shell temperature not in excess of 90 degrees Fahrenheit above the normal room temperature after the incinerator is fired for the maximum time normal to the user’s operation, but shall not exceed a temperature of 180 degrees Fahrenheit.

(l) **Refuse Charging.** Refuse charging may be direct, side, end, or top. However, the charging chutes shall not exceed 6 feet in length measured from the floor of opening above the incinerator to the outside of the roof of the incinerator. The charging chute shall be constructed
of at least No. 12 U.S. Gauge Steel casing, lined with at least 4-1/2 inches of refractory. Where the incinerator is top charged, an induced draft fan shall be provided.

(m) **Combustion Air.** Air for combustion shall be calculated at 15 pounds per 10,000 Btu total heat release, based on the theoretical air required for complete combustion of liquid and solid fuels of 7 to 7 1/2 pounds of air per 10,000 Btu in these fuels. The requirements shall be 100 percent, or slightly more than 100 percent excess air.

(n) **Underfire Air.** Underfire air shall not exceed 10 percent of the total air.

**SECTION 4811. VENTING.** Venting of all incinerators shall conform to the requirements of Chapter 37 and this Section.

(a) **Chimney Location.**

1. **Height.** Every incinerator chimney, except those for domestic gas-fired incinerators, shall extend above the roof as follows:
   
   A. **Natural Draft Chimneys.** Natural draft chimneys shall extend at least 8 feet above the roof, or above the elevation of any part of the building within 10 feet of the chimney.

   B. **Induced Draft.** Chimneys serving incinerators provided with induced draft, shall extend at least 3 feet above the roof, or above the elevation of any part of the building within 10 feet of the chimney.

   C. **Other Requirements.** When a taller obstruction is within 100 feet of the chimney, an induced draft fan is required unless the chimney extends at least 8 feet above the highest part of the obstruction.

(b) **Chimney Casing.** Incinerator chimneys erected within a building shall be encased in 10 gauge steel. All joints shall be tightly sealed.

(c) **Flue Connections or Breechings.** Flue connections or breechings shall meet the requirements for stacks, except where flue gas temperature reduction is affected. The minimum for unlined breechings shall be 12 gauge Type 316 stainless steel, with clearances as required in Chapter 37 of this Building Code for metal stacks.

(d) **Prohibition.** Incinerators shall not be vented into a chimney or stack serving any other device.

**EXCEPTION:** Gas-fired domestic incinerators.

(e) **Combustion Calculation.** Table No. 48-A includes a column headed “B.T.U. of Aux. Fuel Per Lb. of Waste to be included in Combustion Calculations.” The figures in this column shall be included when determining total heat release within the furnace, and
shall also be included, together with the theoretical air required for
the fuel, when determining the total products of combustion. The
figures in the column headed “Min. Btu/hr. Burner Input per Lb.
Waste” shall be used to determine minimum capacity of the burner
or burners. Secondary burners shall be sized to raise the products
of combustion at least 200 degrees Fahrenheit for Type 00, Type 0,
Type 1, and Type 2 waste, and at least 400 degrees Fahrenheit for
waste containing over 10 percent plastics, wax coated or impregnated
paper, or other dense smoke producing materials.

(f) **Flue Gas Washers.** Where flue gas washers are installed, a pres-
sure switch and flow switch or thermocouple shall be interlocked
with the gas supply to the main burner(s), to interrupt the gas supply
in the event of water failure.

**SECTION 4812. BURNERS.** All burners for incinerators shall be power
type, and the controls shall comply to the requirements of Chapter 51.

(a) **Secondary Burners.** All new incinerators, except gas-fired domes-
tic, shall provide for secondary burner(s). See Section 4811(e). Pri-
mary burners shall be provided as required in Table 48-A.

(b) **Auxiliary Firing.** All auxiliary firing equipment for incinerators
and crematories shall comply with Chapter 51.

**SECTION 4813. PERMITS.**

(a) **Permit to Construct.** A permit shall be required to erect an in-
cinerator. See Chapter 3.

**SECTION 4814. WASTE ANALYSIS.** For purposes of this Chapter, all
types of waste to be destroyed shall be classified as follows:

(a) **Type 00 Waste.** Trash consisting of a mixture of highly combustible
waste such as paper, paper products, cardboard, cartons, wood boxes,
and combustible floor sweepings from commercial and industrial
activities. The mixture contains up to 10 percent by weight of plastic
bags, coated paper, laminated paper, treated corrugated cardboard,
oily rags, and plastic or rubber scrap. This type of waste contains
up to 10 percent moisture, 5 percent noncombustible solids, has a
bulk density of less than 8 pounds per cubic foot, and has a heating
value of 8,500 Btu per pound as fired.

(b) **Type 0 Waste.** Trash consisting of a mixture of highly combustible
waste such as paper, paper products, cardboard, cartons, wood boxes,
and combustible floor sweepings from commercial and industrial
activities. The mixtures contain up to 10 percent by weight of plastic
bags, coated paper, laminated paper, treated corrugated cardboard, oily rags, and plastic or rubber scrap. This type of waste contains up to 10 percent moisture, 5 percent noncombustible solids, has a bulk density of 8 to 10 pounds per cubic foot, and has a heating value of 8,500 Btu per pound as fired.

(c) **Type 1 Waste.** Rubbish consisting of combustible waste such as paper, paper products, cartons, rags, wood scraps, sawdust, foliage, and floor sweepings from domestic, commercial and industrial activities. This type of waste contains up to 25 percent moisture, up to 10 percent noncombustible solids, has a bulk density of 8 to 10 pounds per cubic foot, and has a heating value of 6,500 Btu per pound as fired.

(d) **Type 2 Waste.** Refuse consisting of approximately even mixture of rubbish and garbage by weight. This type of waste consists of up to 50 percent moisture, 7 percent noncombustible solids, has a bulk density of 15 to 20 pounds per cubic foot, and has a heating value of 4,300 Btu per pound as fired.

(e) **Type 3 Waste.** Garbage consisting of animal and vegetable wastes. This type of waste contains up to 70 percent moisture, up to 5 percent noncombustible solids, has a bulk density of 30 to 35 pounds per cubic foot, and has a heating value of 2,500 Btu per pound as fired.

(f) **Type 4 Waste.** Human parts and animal remains consisting of carcasses, organs and solid organic wastes. This type of waste contains up to 85 percent moisture, 5 percent noncombustible solids, has a bulk density of 45 to 55 pounds per cubic foot, and has a heating value of 1,000 Btu per pound as fired.

(g) **Type 5 Waste.** By-product waste, gaseous, liquid, or semi-liquid such as tar, paints, solvents, sludge, fumes, etc. Btu values shall be determined for the individual materials to be incinerated.

(h) **Type 6 Waste.** Solid by-product waste such as rubber, plastics, wood-waste, etc. Btu values shall be determined for the individual materials to be incinerated.

**SECTION 4815. CLASSIFICATION OF INCINERATORS.**

(a) **Class I.** Portable, packaged, or job assembled, direct fed incinerators of 5 cubic feet storage capacity or 25 pounds per hour burning rate for Type 1 or Type 2.

(b) **Class IA.** Portable, packaged, or job assembled, direct fed incinerators of 5 cubic feet to 15 cubic feet primary chamber volume or 25 pounds per hour up to, but not including, 100 pounds per hour burning rate for Type 1, or Type 2 waste.
(c) Class IIA. Flue-fed incinerators shall be served by two flues, one for charging waste and one for carrying the products of combustion.

(d) Class III. Direct-fed incinerators with a burning rate of 100 pounds per hour and over, for Type 00, Type 0, Type 1, or Type 2 waste.

(e) Class IV. Direct-fed incinerators with a burning rate of 75 pounds per hour, or over, for Type 3 waste.

(f) Class V. Municipal incinerators.

(g) Class VI. Crematory and pathological incinerators for Type 4 waste.

(h) Class VII. Incinerators designed for specific by-product wastes for Type 5 or Type 6.

SECTION 4816. REQUIREMENTS FOR INCINERATORS BY CLASSES.

(a) General. These requirements are in addition to the requirements of Section 4809.

(b) Class I. This Class for Type 1 or 2 waste.

1. Incinerators shall have a sufficient thickness of refractory lining and insulation to prevent the shell temperature from exceeding 100 degrees Fahrenheit above normal room temperature, but shall not exceed 180 degrees Fahrenheit. Provisions shall be made for expansion to reduce or eliminate injury to the incinerator.

2. Incinerators shall be constructed to withstand intermittent internal temperatures of 1,800 degrees Fahrenheit, without cracking, warping, or other failure of structural parts, so as to permit flame passage or emission of combustion gases or sparks to the exterior.

(c) Class IA. This Class for Type 1 or Type 2 waste.

1. The design shall be such that when the incinerator is fired with normal waste to be burned at its rated capacity (in pounds per hour of Type 1 waste or Type 2 waste), the shell temperatures at any point shall not exceed 90 degrees Fahrenheit above normal room temperature, but shall not exceed 180 degrees Fahrenheit. The only exception to this maximum temperature shall be at the surface of the doors and frame and/or at the breeching outlet. The minimum construction of the incinerator shall be No. 16 gauge steel, exterior casing one inch in thickness of high temperature block insulation, and 2 1/2 inch thickness of high heat duty firebrick or 2 1/2 inch thickness of castable or plastic refractory. The castable or plastic shall be properly anchored to the exterior steel casing.
2. Incinerators shall be constructed to withstand intermittent internal temperatures of 1,800 degrees Fahrenheit, without cracking, warping, or other failure of structural parts, so as to permit flame passage or emission of combustion gases or sparks to the exterior.

(d) Class IIA. This Class of incinerator is for Type 1 or Type 2 waste, fed in small compact packages from 2 or more floors above the incinerator. This Class of incinerator shall be provided with automatic sequence of operation.

1. Class IIA incinerators shall be served by two flues, one for charging waste and one for carrying the products of combustion. A positive method shall be employed to prevent smoke and fumes from escaping into the charging flue. Provisions shall be made to ensure that the charging flue remains free of vermin and odor.

2. The minimum burning area shall be 0.10 square foot per sleeping room, and combustion calculations based on 3 hours burning per day. Burning area may consist of a combination drying hearth and cast iron grate, but the hearth area shall not exceed 50 percent of the total burning area.

3. The primary chamber shall have a volume of at least 4 cubic feet for each square foot of burning area. The shell temperature shall not exceed 90 degrees Fahrenheit above normal room temperature, but shall not exceed 180 degrees Fahrenheit.

4. Primary (underfire), secondary and overfire air shall be provided through adjustable openings, to meet the minimum requirements set forth in Section 4810(n).

5. Service openings at each floor shall not have a daylight opening that exceeds 1/3 the cross-sectional area of the charging flue. In no case shall the daylight opening exceed 160 square inches. Service opening or other charging device shall be designed with no projection into the flue and with the opening to the flue interior closed off while the service opening door is fully open. This door shall close automatically upon release. Service openings shall be located in an area of the building where ventilating or air conditioning will not create negative pressures, i.e., use the flue as a source of air when the service opening is open.

6. Refractory lining of the incinerators shall meet the requirements of Section 4810(e).

7. Incinerators under this Class shall contain a system to control gas velocities and emissions. This system shall include secon-
primary combustion chambers, burners, settling chambers, and
gas washers or scrubbers.

(e) Class III. This Class of incinerator is for Type 1 or Type 2 waste.
1. When designated to burn Type 1 waste, the incinerator shall
   contain cast iron grates, stationary or dump, or combination
   thereof, with air openings of at least 40 percent of total burning
   area. In lieu of 100 percent grate area, up to 20 percent of the
   total burning area may be solid hearth.
2. When designed to burn Type 2 waste, the incinerator shall
   contain combination drying hearth and cast iron grate area,
   each approximately 50 percent of the total burning area. Where
   step grates or sloping grates are used in lieu of hearth, they
   shall provide at least 50 percent of the grate surface.
3. Maximum burning rate per square foot of primary area shall
   be as indicated in Table 48-B. The areas of grate and hearth
   shall be calculated on a horizontal projected area, and not on
   the line of the slope area of individual steps.

(f) Class IV. This Class of incinerator is for burning Type 3 waste on
a hot drying hearth.
1. Maximum burning rate per square foot of primary area shall
   be as indicated in Table 48-B. The area of the hearth shall be
   calculated on a horizontal projected area, and not on the line
   of the slope or area of individual steps.
2. Gas burners shall be provided as required in Table 48-A. Burn-
   ners shall comply with the provisions of Section 4812.

(g) Class V. Construction of this Class of equipment shall be subject
to special design formulae.
1. The incinerator shall provide for automatic feeding and firing.
   Prior to installation, plans and design criteria shall be submit-
   ted to the Department for review and approval.

(h) Class VI. This Class of incinerator is for Type 4 waste.
1. The incinerator shall be designed to burn the refuse on a hot
   refractor hearth. The maximum burning rate per square foot
   of hearth shall be as indicated in Table 48-13.
2. The incinerator shall have burners in both the primary and
   the secondary chambers, and the Btu inputs shall be as required
   in Table 48-A. Burners shall comply with the requirements of
   Section 4812.
3. The curtain wall shall be designed to direct the hot gasses
   beneath the hearth.
4. The volume of the primary chamber shall not be more than 60 percent of the total incinerator volume.

(i) Class VII. This Class shall be the same as Class III, Class IV, and Class VI, except that heat release, burning rate and velocities shall be determined from an analysis of waste to be incinerated in each instance.

SECTION 4817. INCINERATOR DESIGN.

(a) General. An incinerator deviating from this Chapter as to design and/or construction shall be considered an equal, if tests outlined in Sub-Section (b) of this Section show that emission standards are met. Design criteria and drawings shall be submitted to the Department for approval.

(b) Test Procedures. The ASME (Power Test Code, PTC 27) procedures shall serve as a basis for smoke and fly ash emission tests. All tests shall be conducted as a rated capacity or less for a continuous duration of 3 hours or less. Tests shall be conducted with waste typical of that to be generated by the user.

SECTION 4818. INCINERATOR CONSTRUCTION.

(a) General. Minimum construction requirements shall be as set forth in this Chapter. High temperature block insulation shall be required for its high insulating qualities and resistance to deformation under high temperature. High heat duty refractory shall be required for its resistive qualities to temperature, spalling, abrasion, and disintegration.

(b) Intent. It is not the intent of this Chapter to preclude the use of specialty refractory materials for construction, even though such special refractory does not have all the resistive qualities of the refractories outlined herein. Refractory materials approved by the Department may be used in certain areas where the special characteristics are of particular advantage, provided the materials have all of the resistive qualities required for that area. For example, where weight of the structure is an important factor, insulating firebrick or insulating castable may be used, but shall not be used in any area where they will be subject to abrasion from tools, materials, or high velocity gases.

(c) High Temperature Block. The high temperature block insulation required by this Chapter shall meet Commercial Standards CS-117 and ASTM C-612- Class 2.

(d) Firebrick. The high heat duty firebrick required by this Chapter shall be in accordance with ASTM C-64, Type A.
(e) **Hydraulic Setting Castable Refractory.** The hydraulic setting castable refractory required by this Chapter shall be in accordance with ASTM C-96-Class C.

1. All castable refractory walls shall be installed to form a monolithic structure, and shall be anchored to the exterior shell of the incinerator. The arches of the suspended type shall be constructed so that their weight does not rest on the refractory walls. Alloy steel or refractory anchors shall be spaced not more than 18 inches horizontally and vertically, and in accordance with the refractory manufacturer's instructions.

**SECTION 4819. STANDARDS.** Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
</table>

**LEGEND**

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>ORGANIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGA</td>
<td>American Gas Association 1515 Wilson Blvd. Arlington, Va. 22209</td>
</tr>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers 29 West 39th Street New York, N.Y. 10018</td>
</tr>
</tbody>
</table>
SECTION 4820. TABLES.
<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Principal Components</th>
<th>Approximate Composition % by Weight and Density</th>
<th>Moisture Content %</th>
<th>Incombustible Solids %</th>
<th>B.T.U. Value/Lb. of Refuse as Fired</th>
<th>B.T.U. of Aux. Fuel per Lb. of Waste to be Included in Combustion Calculations</th>
<th>Min. Btu/hr Burner Input/Lb. Waste Primary Chamber unless otherwise Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 and 0*</td>
<td>Trash</td>
<td>Combustible waste, paper, paper products, cartons, rags, wood scraps, floor sweepings; domestic, commercial, industrial sources. The mixture contains up to 10% plastic bags, coated or treated paper products and rubber or plastic scrap.**</td>
<td>Waste containing less than 10% plastic or rubber scrap. Density of 00 trash less than 8 pounds/cubic foot and 0 trash 8 to 10 pounds/cubic foot.</td>
<td>10%</td>
<td>5%</td>
<td>8500</td>
<td>0</td>
</tr>
<tr>
<td>1*</td>
<td>Rubbish</td>
<td>Combustible waste, paper, paper products, cartons, rags, wood scraps, floor sweepings; domestic, commercial, industrial sources. Rubbish 100% (Garbage up to 20%). Density 8-10 lbs/ft^3</td>
<td></td>
<td>25%</td>
<td>10%</td>
<td>6500</td>
<td>0</td>
</tr>
</tbody>
</table>

* The above figures on moisture content, ash and B.T.U. as fired have been determined by analysis of many samples for use in computing heat release, burning rate, velocity and other details of incinerator designs. Any design based on these calculations can accommodate minor variations.

** When trash composition is such that any single charge to the incinerator will contain over 10 percent plastic or rubber scrap by weight, the waste shall be classed Type 6.
<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Principal Components</th>
<th>Approximate Composition % by Weight and Density</th>
<th>Moisture Content %</th>
<th>Incombustible Solids %</th>
<th>B.T.U. Value/lb. of Refuse as Fired</th>
<th>B.T.U. of Aux. Fuel per lb. of Waste to be Included in Combustion Calculations</th>
<th>Min. Btu/hr Burner, Input/lb. Waste Primary Chamber unless otherwise Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>2* Refuse</td>
<td>Rubbish and garbage; residential sources.</td>
<td>Rubbish 50% Garbage 50% Density 15-20 lbs/ft³</td>
<td>50%</td>
<td>7%</td>
<td>4300</td>
<td>0</td>
<td>1500 (See Section 4813(f))</td>
</tr>
<tr>
<td>3* Garbage</td>
<td>Animal and vegetable wastes, restaurants, hotels, markets; institutional, commercial and club sources.</td>
<td>Garbage 100% (rubbish up to 35%) Density 30-35 lbs/ft³</td>
<td>70%</td>
<td>5%</td>
<td>2500</td>
<td>1500</td>
<td>3000</td>
</tr>
<tr>
<td>4 Animal solids and organic wastes</td>
<td>Carcasses, organs, solid organic wastes; hospital, laboratory, abattoirs, animal pounds and similar sources.</td>
<td>100% Animal and Human Tissue Density 45-55 lbs/ft³</td>
<td>85%</td>
<td>5%</td>
<td>1000</td>
<td>3000</td>
<td>5000 Primary 3000 Secondary</td>
</tr>
<tr>
<td>5 Gaseous liquid or semi-liquid wastes</td>
<td>Industrial process wastes.</td>
<td>Variable</td>
<td>Dependent on predominate Components</td>
<td>Variable according to wastes survey</td>
<td>Variable according to wastes survey</td>
<td>Variable according to wastes survey</td>
<td>Variable according to wastes survey</td>
</tr>
<tr>
<td>6 Semi-solid and solid wastes</td>
<td>Combustibles requiring hearth, retort, or grate burning equipment.</td>
<td>Variable</td>
<td>Dependent on predominant components</td>
<td>Variable according to wastes survey</td>
<td>Variable according to wastes survey</td>
<td>Variable according to wastes survey</td>
<td>Variable according to wastes survey</td>
</tr>
</tbody>
</table>

* The above figures on moisture content, ash and B.T.U. as fired have been determined by analysis of many samples for use in computing heat release, burning rate, velocity and other details of incinerator designs. Any design based on these calculations can accommodate minor variations.

** When trash composition is such that any single charge to the incinerator will contain over 10 percent plastic or rubber scrap by weight, the waste shall be classed Type 6.
TABLE NO. 48-B

MAXIMUM BURNING RATE LBS./SQ. FT./HR.
OF VARIOUS TYPES WASTES

<table>
<thead>
<tr>
<th>Capacity Lbs./Hr.</th>
<th>Logarithm</th>
<th>Types 00,0,1, and 2 Waste Factor 10</th>
<th>Type 3 Waste Factor 8</th>
<th>Type 4 Waste No Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>2.0</td>
<td>20</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>200</td>
<td>2.30</td>
<td>23</td>
<td>18</td>
<td>12*</td>
</tr>
<tr>
<td>300</td>
<td>2.48</td>
<td>25</td>
<td>20</td>
<td>14*</td>
</tr>
<tr>
<td>400</td>
<td>2.60</td>
<td>26</td>
<td>21</td>
<td>15*</td>
</tr>
<tr>
<td>500</td>
<td>2.70</td>
<td>27</td>
<td>22</td>
<td>16*</td>
</tr>
<tr>
<td>600</td>
<td>2.78</td>
<td>28</td>
<td>22</td>
<td>17*</td>
</tr>
<tr>
<td>700</td>
<td>2.85</td>
<td>28</td>
<td>23</td>
<td>18*</td>
</tr>
<tr>
<td>800</td>
<td>2.90</td>
<td>29</td>
<td>23</td>
<td>18*</td>
</tr>
<tr>
<td>900</td>
<td>2.95</td>
<td>30</td>
<td>24</td>
<td>18*</td>
</tr>
<tr>
<td>1000</td>
<td>3.00</td>
<td>30</td>
<td>24</td>
<td>18*</td>
</tr>
</tbody>
</table>

* The maximum burning rate in lbs./sq. ft./hr. for Type 4 Waste depends to a great extent on the size of the largest animal to be incinerated. Therefore, whenever the largest animal to be incinerated exceeds one-third the hourly capacity of the incinerator, use a rating of 10 lbs./sq. ft./hr. for the design of the incinerator.

TABLE NO. 48-C

USE TO DETERMINE MINIMUM FREE AREA
OF BAROMETRIC DAMPERS
(For Natural Draft Stacks Only)

[Graph showing the relationship between the free area of the barometric damper and the percentage of cross-sectional area of flue connection or stack vs. the height of the chimney or stack above base of the incinerator.]

HEIGHT OF CHIMNEY OR STACK ABOVE BASE
OF THE INCINERATOR
### TABLE NO. 48-D

**NATURAL DRAFT STACKS OR CHIMNEYS**

<table>
<thead>
<tr>
<th>Incinerator Capacity in lbs per hour</th>
<th>Class III Incinerators</th>
<th>Class IV Incinerators</th>
<th>Class VI Incinerators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type I Waste</td>
<td>Type 2 Waste</td>
<td>Type 3 Waste</td>
</tr>
<tr>
<td></td>
<td>Air** Stack</td>
<td>Stack</td>
<td>Air** Stack</td>
</tr>
<tr>
<td></td>
<td>Supply dia height*</td>
<td>Supply dia height*</td>
<td>Supply dia height*</td>
</tr>
<tr>
<td>50</td>
<td>350 14&quot; 35'</td>
<td>250 12&quot; 30'</td>
<td>200 12&quot; 35'</td>
</tr>
<tr>
<td>100</td>
<td>525 16&quot; 35'</td>
<td>375 14&quot; 35'</td>
<td>300 14&quot; 35'</td>
</tr>
<tr>
<td>150</td>
<td>700 18&quot; 45'</td>
<td>500 16&quot; 35'</td>
<td>400 14&quot; 45'</td>
</tr>
<tr>
<td>200</td>
<td>1050 20&quot; 45'</td>
<td>750 18&quot; 45'</td>
<td>600 16&quot; 50'</td>
</tr>
<tr>
<td>300</td>
<td>1400 22&quot; 50'</td>
<td>1000 20&quot; 50'</td>
<td>800 18&quot; 50'</td>
</tr>
<tr>
<td>400</td>
<td>1750 24&quot; 50'</td>
<td>1250 22&quot; 50'</td>
<td>1000 20&quot; 55'</td>
</tr>
<tr>
<td>500</td>
<td>2100 26&quot; 50'</td>
<td>1500 24&quot; 50'</td>
<td>1200 22&quot; 55'</td>
</tr>
<tr>
<td>600</td>
<td>2450 28&quot; 55'</td>
<td>1750 26&quot; 55'</td>
<td>1400 24&quot; 60'</td>
</tr>
<tr>
<td>700</td>
<td>2800 30&quot; 55'</td>
<td>2000 28&quot; 55'</td>
<td>1600 26&quot; 60'</td>
</tr>
<tr>
<td>800</td>
<td>3150 32&quot; 55'</td>
<td>2250 30&quot; 55'</td>
<td>1800 28&quot; 60'</td>
</tr>
<tr>
<td>900</td>
<td>3500 34&quot; 55'</td>
<td>2500 32&quot; 55'</td>
<td>2000 30&quot; 60'</td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Air supply is given in cfm @ 70° F and is the minimum which shall be available at all times in the incinerator room at atmospheric or a slight positive pressure. The incinerator room or rooms shall not be under a negative or minus pressure. If the incinerator is charged from a room other than the incinerator room, the quantity of air shown shall be available in both rooms.**

The quantity of air shown shall be increased to satisfy the following:

1. If stack or chimney is higher than minimum to satisfy the larger barometric damper involved.
2. If any other equipment requiring air supply is located in the incinerator room or charging room.

* Stack heights are based upon the following:
1. Installation made at or near 5000 ft. above sea level.
2. Stack heights measured from base of the incinerator.
3. Incinerator is side charged.
4. Breaching or flue connection not exceeding 10' in length in a straight run or 3' including not more than 1 - 90° bend or 2 - 45° bends
5. Stack extends as provided for in Section 4813.

Stack heights shall be increased or may be decreased as follows:

1. Decrease height 25% if stack is directly on top of incinerator eliminating any breaching or flue connection.
2. Increase height 15% if incinerator is top charged.
3. Increase height 15% for each additional 10' of straight breaching and 15% for each additional 90° bend.
## Table No. 48-E
### Induced Draft Fans

<table>
<thead>
<tr>
<th>Incinerator</th>
<th>Class III Incinerators</th>
<th>Type 1 Waste</th>
<th>Type 2 Waste</th>
<th>Fan</th>
<th>Fan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity in lbs. per hour</td>
<td></td>
<td>in lbs. per hour</td>
<td></td>
<td>in lbs. per hour</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>1020</td>
<td>1090</td>
<td>2160</td>
<td>1980</td>
<td>.83</td>
</tr>
<tr>
<td>150</td>
<td>1520</td>
<td>1630</td>
<td>3240</td>
<td>2800</td>
<td>.83</td>
</tr>
<tr>
<td>200</td>
<td>2040</td>
<td>2160</td>
<td>4320</td>
<td>3920</td>
<td>.85</td>
</tr>
<tr>
<td>300</td>
<td>3080</td>
<td>3240</td>
<td>6480</td>
<td>5880</td>
<td>.85</td>
</tr>
<tr>
<td>400</td>
<td>4080</td>
<td>4320</td>
<td>8640</td>
<td>7840</td>
<td>.89</td>
</tr>
<tr>
<td>500</td>
<td>5110</td>
<td>5400</td>
<td>10800</td>
<td>9800</td>
<td>.89</td>
</tr>
<tr>
<td>600</td>
<td>6130</td>
<td>6480</td>
<td>12960</td>
<td>11760</td>
<td>.89</td>
</tr>
<tr>
<td>700</td>
<td>7160</td>
<td>7560</td>
<td>15120</td>
<td>13720</td>
<td>.89</td>
</tr>
<tr>
<td>800</td>
<td>8180</td>
<td>8640</td>
<td>17280</td>
<td>15680</td>
<td>.95</td>
</tr>
<tr>
<td>900</td>
<td>9210</td>
<td>9720</td>
<td>19440</td>
<td>17640</td>
<td>.95</td>
</tr>
<tr>
<td>1000</td>
<td>10220</td>
<td>10800</td>
<td>21600</td>
<td>19600</td>
<td>.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incinerator</th>
<th>Class IV Incinerators</th>
<th>Type 3 Waste</th>
<th>Type 4 Waste</th>
<th>Fan</th>
<th>Fan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity in lbs. per hour</td>
<td></td>
<td>in lbs. per hour</td>
<td></td>
<td>in lbs. per hour</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>560</td>
<td>625</td>
<td>1250</td>
<td>1110</td>
<td>.83</td>
</tr>
<tr>
<td>100</td>
<td>580</td>
<td>625</td>
<td>1250</td>
<td>1110</td>
<td>.83</td>
</tr>
<tr>
<td>150</td>
<td>670</td>
<td>735</td>
<td>1875</td>
<td>1660</td>
<td>.83</td>
</tr>
<tr>
<td>200</td>
<td>1180</td>
<td>1250</td>
<td>2500</td>
<td>2220</td>
<td>.85</td>
</tr>
<tr>
<td>300</td>
<td>1740</td>
<td>1875</td>
<td>3750</td>
<td>3330</td>
<td>.89</td>
</tr>
<tr>
<td>400</td>
<td>2230</td>
<td>2500</td>
<td>5000</td>
<td>4440</td>
<td>.89</td>
</tr>
<tr>
<td>500</td>
<td>2890</td>
<td>3125</td>
<td>6250</td>
<td>5540</td>
<td>.95</td>
</tr>
</tbody>
</table>

** Air supply is given in C.F.M. @ 70°F and is the minimum which shall be available at all times in the incinerator room for combustion and fan cooling air. See also notes regarding "air supply" Table 48-D.

1. The total flux gases or total products of combustion are given in lbs. per hour.
2. The cooling air is given in lbs. per hour and is the air required to be bled into and mixed with the flux gases before entering the induced draft fan and unlined breeching section.
3. The fan capacity is given in C.F.M. @ 70°F which is anticipated temperature of the air-gas mixture entering the induced draft fan.
4. The static pressure of the fan is given as the "cold" (70°F) static pressure. The static pressure at 70°F is 45% of the "cold" static pressure.
5. Water sprays or a combination of water and air may be used to cool the flux gases before they enter the fan. The C.F.M. of the fan reduces but the static pressure of the fan increases to overcome the resistance created by the gas washer or scrubber used.
### TABLE NO. 48-F
**CALCULATIONS**
**PRODUCTS OF COMBUSTION - FURNACE VOLUMES**

<table>
<thead>
<tr>
<th>TYPE 0 WASTE</th>
<th>TYPE 1 WASTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1 \times 15 \times 8500)</td>
<td>(1 \times 15 \times 6500)</td>
</tr>
<tr>
<td>(10,000)</td>
<td>(10,000)</td>
</tr>
<tr>
<td>(1 \times .85)</td>
<td>(1 \times .65)</td>
</tr>
<tr>
<td>(1 \times .10 \times 1.6)</td>
<td>(1 \times .25 \times 1.6)</td>
</tr>
<tr>
<td>Products of combustion</td>
<td>Products of combustion</td>
</tr>
<tr>
<td>(= 12.75) lbs. of air</td>
<td>(= 9.75) lbs. of air</td>
</tr>
<tr>
<td>(= 0.85) lbs. of combustibles</td>
<td>(= 0.65) lbs. of combustibles</td>
</tr>
<tr>
<td>(= 0.16) lbs. of water vapor</td>
<td>(= 0.40) lbs. of water vapor</td>
</tr>
<tr>
<td>(= 13.76) lbs./hr. per lb. of waste</td>
<td>(= 10.80) lbs./hr. per lb. of waste,</td>
</tr>
<tr>
<td>or (13.76) lbs./hr. x (46.86)</td>
<td>or (10.80) lbs./hr. x (46.86)</td>
</tr>
<tr>
<td>(3600)</td>
<td>(3600)</td>
</tr>
<tr>
<td>(= 0.179) cu. ft./sec. @ 1400° F.</td>
<td>(= 0.140) cu. ft./sec. @ 1400° F.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE 2 WASTE</th>
<th>TYPE 3 WASTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1 \times 15 \times 4300)</td>
<td>(1 \times 15 \times 2500)</td>
</tr>
<tr>
<td>(10,000)</td>
<td>(10,000)</td>
</tr>
<tr>
<td>(1 \times .43)</td>
<td>(1 \times .25)</td>
</tr>
<tr>
<td>(1 \times .50 \times 1.6)</td>
<td>(1 \times .70 \times 1.6)</td>
</tr>
<tr>
<td>Products of combustion</td>
<td>Products of combustion</td>
</tr>
<tr>
<td>(= 6.45) lbs. of air</td>
<td>(= 3.750) lbs. of air</td>
</tr>
<tr>
<td>(= 0.43) lbs. of combustibles</td>
<td>(= 0.250) lbs. of combustibles</td>
</tr>
<tr>
<td>(= 0.80) lbs. of water vapor</td>
<td>(= 1.120) lbs. of water vapor</td>
</tr>
<tr>
<td>(= 7.68) lbs./hr. per lb. of waste</td>
<td>(= 1.071) lbs. of air for aux. fuel</td>
</tr>
<tr>
<td>or (7.68) lbs./hr. x (46.86)</td>
<td>(1050 \times 13.35)</td>
</tr>
<tr>
<td>(3600)</td>
<td>(1500 \times .044)</td>
</tr>
<tr>
<td>(= 0.099) cu. ft./sec. @ 1400° F.</td>
<td>(= 0.062) lbs. of aux. fuel</td>
</tr>
<tr>
<td>Products of combustion</td>
<td>Products of combustion</td>
</tr>
<tr>
<td>or (6.253) lbs./hr. per lb. of waste,</td>
<td>or (6.253) lbs./hr. per lb. of waste,</td>
</tr>
<tr>
<td>(3600)</td>
<td>(3600)</td>
</tr>
<tr>
<td>(= 0.082) cu.ft./sec. @ 1400° F.</td>
<td>(= 0.082) cu.ft./sec. @ 1400° F.</td>
</tr>
</tbody>
</table>

**NOTE:** The specific gravity of dry air or dry gas is 1.0 and the specific gravity of water vapor is 0.6215. In the above calculations 1.6 is used as a multiplier to correct for the difference in specific gravity between dry air-gas and water vapor. This produces an equivalent weight for water vapor before adding to the other products of combustion. The 1.6 can only be used if it is the intent to convert the total weight of the products of combustion to volume at a given temperature.
### TABLE NO. 48-F

**CALCULATIONS**

**PRODUCTS OF COMBUSTION - FURNACE VOLUMES**

<table>
<thead>
<tr>
<th>TYPE 4 WASTE</th>
<th>MINIMUM INCINERATOR VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Given in cu. ft./lb. of rated capacity per hr.</td>
</tr>
<tr>
<td>1 x 15 x 1000</td>
<td>= 1.50 lbs. of air</td>
</tr>
<tr>
<td>10,000</td>
<td>= 0.10 lbs. of combustibles</td>
</tr>
<tr>
<td>1 x .10</td>
<td>= 1.36 lbs. of water vapor</td>
</tr>
<tr>
<td>3000 x 10</td>
<td>= 2.15 lbs. of air for aux. fuel</td>
</tr>
<tr>
<td>1050 x 13.36</td>
<td>= 0.125 lbs. of aux. fuel</td>
</tr>
<tr>
<td>3000 x .044</td>
<td>= 5.325 lbs./hr. per lb. of waste</td>
</tr>
<tr>
<td>1050</td>
<td>or 5.325 lbs. x 46.86</td>
</tr>
<tr>
<td>Proucts of combustion</td>
<td>= 0.069 cu. ft./sec. @ 1400° F.</td>
</tr>
<tr>
<td>3600</td>
<td></td>
</tr>
<tr>
<td>Type 0 Waste</td>
<td>= 8500</td>
</tr>
<tr>
<td>= 25,000</td>
<td>= 0.34 cu. ft.</td>
</tr>
<tr>
<td>Type 1 Waste</td>
<td>= 6500</td>
</tr>
<tr>
<td>= 25,000</td>
<td>= 0.26 cu. ft.</td>
</tr>
<tr>
<td>Type 2 Waste</td>
<td>= 4300</td>
</tr>
<tr>
<td>= 25,000</td>
<td>= 0.172 cu.ft.</td>
</tr>
<tr>
<td>Type 3 Waste</td>
<td>= 2500 + 1500</td>
</tr>
<tr>
<td>= 25,000</td>
<td>= 0.15 cu. ft.</td>
</tr>
<tr>
<td>Type 4 Waste</td>
<td>= 1000 + 3000</td>
</tr>
<tr>
<td>= 25,000</td>
<td>= 0.15 cu.ft.</td>
</tr>
</tbody>
</table>

**NOTE:** The specific gravity of dry air or dry gas is 1.0 and the specific gravity of water vapor is 0.6215. In the above calculations 1.6 is used as a multiplier to correct for the difference in specific gravity between dry air-gas and water vapor. This produces an equivalent weight for water vapor before adding to the other products of combustion. The 1.6 can only be used if it is the intent to convert the total weight of the products of combustion to volume at a given temperature.
CHAPTER 49

MECHANICAL REFRIGERATION

SECTION 4901 GENERAL.

(a) Required. All mechanical refrigeration systems and equipment, including the replacement of parts and alteration, shall conform to the requirements of this Chapter and Building Code.

(b) Approval. The label of an approved agency attached to the equipment may be accepted by the Department as evidence that the equipment is approved.

(c) Absorption Equipment. Direct fired absorption equipment shall be considered as fuel fired equipment, and shall be subject to the applicable portions of Chapters 37, 51, and 52 of this Building Code.
   1. Absorption equipment utilizing ammonia shall be installed outside the building or structure.
   2. Steam or hot water generated absorption equipment shall be installed in a boiler room, machinery room or as may be approved by the Department.

(d) Supports. Supports for mechanical equipment shall be designed to carry the load imposed in accordance with the requirements of Chapter 23. Where installed on a roof, the equipment shall meet the requirements of Chapter 32.
   1. Compressors or parts of condenser units, when set on the ground shall be placed on a concrete slab at least 3 inches above the adjoining ground level.

(e) Enclosure. Equipment installed on the ground or on the roof of a building accessible to the public shall be enclosed by an approved fence at least 6 feet in height, and provided with a locking gate. See Chapter 36.

(f) Access and Clearances. An unobstructed, lighted, direct access opening or passageway not less than 36 inches in the least dimension shall be provided and maintained to all mechanical equipment. All mechanical equipment shall have access of at least 36 inches on 2 sides, and at least 7 feet in height. The required space or opening to service, repair or replace any component part of the unit shall be maintained.

(g) Guards. Approved metal guards shall be provided around all fly-wheels, fans, pulleys, and belts.
(h) Prohibitions.

1. Refrigerating systems or parts thereof shall not be located in any elevator shaft, nor in any location where the equipment may be subject to mechanical damage.

2. Mechanical equipment shall not be placed in any hazardous location, and not closer than 10 feet to the edge of any roof unless protected by a 4 foot high, rigidly fixed parapet, or approved railing.

(i) (REPEALED) (Rev. 5/87 Ord. No. 251)

SECTION 4902. DEFINITIONS. Except as otherwise provided, terms and symbols used in this Chapter shall be defined as follows:

Absorber. That part of the low side of an absorption system used for absorbing (adsorbing) vapor refrigerant.

Absorption System. See refrigerating system.

Brazed Joint. A gastight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 1000 degrees F. but less than melting temperatures of the joined parts.

Brine. A liquid, used for the transmission of heat without a change in its state, having no flash point or a flash point above 150 degrees F. as determined in an approved manner. See Standards of this Chapter.

Compressor. A specific machine, with or without accessories, for compressing given refrigerant vapor.

Compressor Unit. A condensing unit less the condenser and liquid receiver.

Condenser. A vessel or arrangement of pipe or tubing in which vaporized refrigerant is liquefied by the removal of heat.

Condensing Unit. A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

Container. A vessel for the transportation of refrigerants.

Design Working Pressure. The maximum allowable working pressure for which a specific part of a system is designated.

Duct. A tube or conduit used for conveying or enclosing purposes as specifically defined below.
1. **Air Duct.** A duct used for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

2. **Pipe Duct.** A duct used for encasing pipe.

3. **Wire Duct.** A duct used for encasing either moving or stationary wire, rope, etc.

**Evaporator.** That part of the system in which liquid refrigerant is vaporized to produce refrigeration.

**Expansion Coil.** An evaporator constructed of pipe or tubing.

**Fusible Plug.** A device having a predetermined temperature fusible member for the relief of pressure.

**Generator.** Any device equipped with a heating element used in the refrigerating system to increase the pressure of refrigerant in its gas or vapor state for the purpose of liquefying the refrigerant.

**High Side.** The parts of a refrigerating system under condenser pressure.

**Humanly Occupied Space.** A space normally frequented or occupied by people but excluding machinery rooms and walk-in coolers used primarily for refrigerated storage.

**Liquid Receiver.** A vessel permanently connected to a system by inlet and outlet pipes for storage of a liquid refrigerant.

**Low Side.** The parts of a refrigerating system under evaporator pressure.

**Machinery.** The refrigerating equipment forming a part of the refrigerating system including any or all of the following: compressor, condenser, generator, absorber (adsorber), liquid receiver, connection pipe, or evaporator.

**Machinery Room.** See Section 4906.

**Manufacturer.** The company or organization which evidences its responsibility by affixing its name or nationally registered trademark or trade name to the refrigeration equipment concerned.

**Mechanical Joint.** A gas-tight joint, obtained by the joining of metal parts through a positive holding, mechanical construction.

**Nonpositive Displacement Compressor.** A compressor in which increase in vapor pressure is attained without changing the internal volume of the compression chamber.

**Piping.** The pipe or tube mains for interconnecting the various parts of a refrigerating system.
Positive Displacement Compressor. A compressor in which increase in vapor pressure is attained by changing the internal volume of the compression chamber.

Pressure Imposing Element. Any device or portion of the equipment used for the purpose of increasing the refrigerant vapor pressure.

Pressure Limiting Device. A pressure responsive mechanism designed to automatically stop the operation of the pressure imposing element at a predetermined pressure.

Pressure Relief Device. A pressure actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

Pressure Vessel. Any refrigerant containing receptacle of a refrigerating system other than evaporators, each separate section of which does not exceed 1⁄2 cubic foot of refrigerant containing volume; expansion coils; compressors; controls; headers; pipes; and pipe fittings.

Receiver. See Liquid Receiver.

Refrigerant. A substance used to produce refrigeration by its expansion or vaporization.

Refrigerating System. A combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat.

1. Absorption System. A refrigerating system in which the gas evolved in the evaporator is taken up by an absorber.

2. Sealed Absorption System. A unit system for Group 2 refrigerants only, in which all refrigerant-containing parts are made permanently tight by welding or brazing against refrigerant loss.

3. Self-Contained System. A complete factory made and factory tested system in a suitable frame or enclosure which is fabricated and shipped in one or more sections, and in which no refrigerant-containing parts are connected in the field, other than by companion or block valves.

4. Unit System. A self-contained system which has been assembled and tested prior to its installation and which is installed without connecting any refrigerant-containing parts.

Rupture Member. A device that will rupture at a predetermined pressure.

Sealed Absorption System. See refrigeration system.
Self-Contained System. See refrigeration system.
Soldered Joint. A gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at temperatures below 1000 degrees F. and above 400 degrees F.
Stop Valve. A shutoff for controlling the flow of refrigerant.
Tenant. A person, firm or corporation possessed with the legal right to occupy premises.
Unit System. See Refrigeration System.
Welded Joint. A gas-tight joint, obtained by the joining of metal parts in the plastic or molten state.

SECTION 4903. REFRIGERANT CLASSIFICATION. For purposes of this Chapter refrigerants shall be divided into groups as follows:

GROUP 1

Carbon Dioxide (R 744) ....................... .CO₂
Dichlorodifluoromethane (R 12) .............. .CCl₂F₂
Dichlorodifluoromethane, 73.8 degrees ....... .CCl₂F₂
and Ethylidene Fluoride, 26.2% ............ .CH₃CHF₂
Dichloromethane (R 30)
(Methylene Chloride) ....................... .CH₂Cl₂
Dichloromonofluoromethane (R 21) .......... .CHCl₂F
Dichlorotetrafluoroethane (R 114) .......... .C₂Cl₂F₄
Monochlorodifluoromethane (R 22) .......... .CHClF₂
Trichloromonofluoromethane (R11) .......... .CCl₃F
Trichlorotetrafluoroethane (R113) .......... .C₂Cl₃F₃

GROUP 2 (TOXIC)

Ammonia ..................................... .NH₃
Dichloroethylene ............................. .C₂H₂Cl₂
Ethylchloride ................................. .C₂H₅Cl
Methylchloride ............................... .CH₃Cl
Methylformate ................................ .HCOOCH₃
Sulphur Dioxide .............................. .SO₂

GROUP 3 (FLAMMABLES)

Butane ....................................... .C₄H₁₀
Ethane ....................................... .C₂H₆

08/88 49-5
Ethylene .................................................. \( C_2 H_4 \)
ISO Butane .................................................. \((CH_3)_3 CH\)
Propane ...................................................... \(C_3 H_8\)

SECTION 4904. Group 1 Refrigerants.

(Rev. 5/87 Ord. No. 251)

(a) Machinery Room Required. Refrigeration equipment which either as a single piece of equipment or as multiple, interconnected units having a total charge of 300 lbs. or more of Group 1 refrigerant shall be enclosed in a machinery room:

EXCEPTION: The requirements of this Section shall not apply to:

1. A refrigeration system located outside of a building or on the roof of a building, and not less than 20 feet from any door, window, or air inlet in any building.

2. A refrigerant system required in a building used exclusively for ice making or cold storage, together with the usual accessories in connection therewith.

The refrigeration equipment shall be separated from any air handling units if the quantity of refrigerant exceeds the amount permitted in Table 49A. Entire building volume served by the air handling units may be used to apply Table 49A unless the ventilation system is designed to permit the individual air terminal devices to close below 25% of maximum air flow, in which case the volume of the smallest humanly occupied space within the area being served shall be applicable.

1. Machinery Room Construction. Required machinery rooms shall provide an area of at least 50 sq. ft., and shall be of at least one-hour fire resistive construction, with all interior openings protected with fire assemblies which provide a one-hour fire protection rating. Doors shall be self-closing and tight-fitting. There shall be no openings that will permit passage of escaping refrigerants to other areas of the building. Every machinery room containing any Group 1 refrigerant shall provide at least one exit door at least 3 feet in width and 6' 8" in height. Exit door shall open in the direction of egress. See Section 5201(f) for access limitations.
2. Emergency Refrigeration Shut Down. A readily accessible single emergency refrigeration control switch shall be provided to shut off electrically operated machinery in a machinery room, except the emergency ventilation system required in Section 4904 (a) 3 (c). Such switch shall be controlled from a point outside of, and within 10 feet of, the required exit from the machinery room it serves and the switch shall be labeled “EMERGENCY REFRIGERATION SHUT DOWN SWITCH”, (Sign shall be red in color with contrasting letters at least 1 1/4” in height.)

3. Machinery Room Ventilation. Required machinery rooms shall be continuously ventilated by either:

   A. An independent mechanical ventilation system (mechanical exhaust to the outside-gravity supply from the outside) sized to provide at least 3 air changes per hour and arranged to discharge to the outer atmosphere at a location not less than 20 feet from any exterior door, window, or ventilation air inlets in any building.

   B. Gravity ventilation openings in an outside wall sized in accordance with Table 49C. Gravity openings shall be installed so that approximately one-half of the required area is located within 12” of the ceiling and one-half of the required area is located within 12” of the floor of the room. Wall openings shall be at least 20 feet from any exterior door, window, or ventilation air inlet in any building.

C. Emergency Ventilation. Required machinery rooms shall be equipped with the means to provide emergency ventilation of at least 12 air changes per hour either as a part of the continuous ventilation system required under Section 4904(a)3(A) or as a separate, independent system. The emergency ventilation system shall be controlled by a readily accessible switch within 2 feet of the Emergency Refrigeration Shut Down Switch specified in Section 4904 (a) 2. The switch shall be labeled “EMERGENCY VENTILATION SWITCH”. (Sign shall be red in color with contrasting letters at least 1 1/4” in height) Discharge to the outer atmosphere shall comply with the requirements of Section 4904(a)3(A). (Rev. 6/88 Ord. No. 382)
4. Ventilation of Confined Rooms or Spaces Other than Required Machinery Rooms. Small rooms or spaces which contain refrigeration equipment but are not required machinery rooms as defined in Section 4904(a) shall be ventilated in accordance with Section 4904(a)3 if the cubical contents of the room or space is less than 350 cubic feet per pound of refrigerant charge.

EXCEPTION: Ventilation shall not be required if the space has permanent gravity ventilation openings (minimum 2 square feet total area) to the outside or to adjacent spaces which provide at least 350 cubic feet per pound of refrigerant.

(Rev. 6/88 Ord. No. 382)

(b) Direct Systems. Direct systems are systems which have refrigerant evaporator coils located in occupied spaces or in the airstream of HVAC ductwork. Such systems shall comply with the following requirements.

1. The maximum quantity of a Group 1 refrigerant in a direct system, in all occupancies other than Group D, shall not exceed that set forth in Table 49A. In Group D occupancies, the maximum quantity shall be limited to 50% of the values in Table 49A. A system containing more than the quantity of a Group 1 refrigerant permitted by the foregoing provisions shall be of an indirect type and shall be separated from any air handling units.

2. The following procedures shall be followed when applying Table 49A.

A. When the evaporator coils are located in occupied spaces, the cubical content of the smallest enclosed humanly occupied space where a coil is located, other than the room in which the refrigeration compressor/condenser is located, shall be used to determine the permissible quantity of refrigerant in the system.

B. When the evaporator coils are located in an air-duct system, the cubical content of the smallest humanly occupied enclosed space served by the air-duct system shall be used to determine the permissible quantity of refrigerant in the system.

EXCEPTION: If the duct system is designed so that during normal operation the individual air terminal devices are not allowed to close below 25% of maximum air flow, the cubical content of the smallest enclosed humanly occupied space served by the air-duct system shall be used to determine the permissible quantity of refrigerant in the system.
content of the entire space served by the air-duct system may be used to determine the permissible quantity of refrigerant in the system.

SECTION 4905. GROUP 2 AND GROUP 3 REFRIGERANTS.

(a) General. The use of any Group 2 (toxic) or Group 3 (flammable) refrigerants, other than ammonia as specified herein is prohibited. The use of ammonia in an air conditioning system or ice skating rink is prohibited. The use of ammonia shall be permitted only in a building used exclusively for ice making, cold storage, or for the manufacturing or processing of food or drink, provided the occupant load does not exceed one person per 100 square feet of floor area served by the system. Parts of an ammonia refrigeration system shall not be located in any exit, nor less than 20 feet from any door, window or air inlets when located on the exterior of a building. (REV. 5/87 ORD. NO. 251)

| (b) Machinery Room Required. When ammonia is used in a refrigerating system, all refrigerant-containing parts, except piping and evaporators, and except refrigerant-containing components installed outside the building, shall be installed in a machinery room. See "Section 5201(f) for access limitations. |
| (c) Machinery Room Construction. Required machinery rooms shall provide an area of at least 50 sq. ft., and shall be of at least one-hour fire resistive construction, with all interior openings protected with fire assemblies which provide a one-hour fire protection rating. Doors shall be self-closing and tight-fitting. There shall be no openings that will permit passage of escaping refrigerants to other areas of the building. Every machinery room containing ammonia refrigerant shall provide at least one exit door, at least 3 feet in width and 6'-8" in height, opening directly to the outside. Exit door shall open in the direction of egress. |
| (d) Emergency Refrigeration Shut Down Switch. An accessible single emergency control switch to shut off an ammonia refrigeration machine shall be located outside of and within 10 feet of, the entrance to the space containing the equipment and shall be labeled "EMERGENCY REFRIGERATION SHUT DOWN SWITCH". (Sign shall be red in color with contrasting letters at least 1 1/4" in height) |
(e) **Machinery Room Ventilation.** Ammonia machinery rooms shall be equipped with a mechanical ventilation system (mechanical exhaust to the outside-gravity supply from the outside) sized to provide at least 12 air changes per hour and arranged to discharge to the outer atmosphere at a location not less than 20 feet from any exterior door, window, or ventilation air inlets in any building. Air supply and exhaust ducts shall serve no other area. System shall be operated continuously. (Rev. 6/88 Ord. No. 382)

SECTION 4906. (REPEALED 5/87 ORD. NO. 251)

SECTION 4907. (REPEALED 5/87 ORD. NO. 251)

SECTION 4908. EQUIPMENT IN A MACHINERY ROOM. Combustion equipment or electric resistive heating devices with exposed elements shall not be located in a machinery room.

SECTION 4909. PIPING AND FITTINGS.
(a) **General.** All piping, tubing, fittings, and related parts shall comply with the requirements of the standards listed in Section 4918. They shall have a working pressure of not less than that of the system installed. Welded fittings shall be of the same wall thickness as the piping system in which they are installed.

(b) **Refrigerant Piping.** All materials used in the construction and installation of a refrigeration system shall be suitable for the refrigerant in the system. No equipment or material shall be installed which will deteriorate due to the chemical action of the refrigerant, of the oil, or the combination of both.

1. **Tubing.** Copper tubing shall not be less than Type L, and shall be free from scale and dirt internally. Soft annealed copper tubing shall be limited to sizes not exceeding 7/8 inch outside diameter. Soldered joint fittings for copper tubing shall be wrought copper.

2. **Steel Pipe.** Schedule 80 pipe shall be used on all steel piping subject to working pressures in excess of 300 psi, and for steel liquid lines 1 1/2 inch nominal size or smaller.

(c) **Chilled Water, Condensing Water, Brine, Drain Piping, and Fittings.** Chilled water, condensing water, brine, and drain piping shall be steel or copper. Steel pipe fittings shall be welded, screwed, grooved, or flanged. Copper pipe fittings shall be soldered, brazed, or flared. Ap-
proved plastic pipe and fittings may be used in Type III and V buildings, for drain piping above ground only.

SECTION 4910. ERECTION OF PIPING.

(a) **General.** Piping and tubing shall be installed so as to prevent vibration and strain at joints and connections. It shall be securely supported in a manner to avoid sagging between points of support. The distance between points of support shall not exceed 10 feet. Mechanical joints shall not be made in copper tubing larger than 5/8 inch outside diameter.

**EXCEPTION:** Pre-charged tubing with factory installed quick connects not exceeding 1 1/8 inch outside diameter is permitted.

(b) **Piping on Roof.** Piping across the roof of a building shall be supported directly to the structural portion of the roof, and shall conform to the requirements of Chapters 23 and 32.

(c) **Piping Height.** Piping crossing an open passageway in any building shall be at least 7 1/2 feet above the floor unless against the ceiling of the space.

(d) **Obstructions.** Passageways shall not be obstructed by piping.

(e) **Damage.** All piping systems shall be protected from damage.

(f) **Underground Piping.** All iron and steel piping placed underground shall be coated and wrapped to prevent corrosion. Buried copper piping shall be protected with foamed plastic insulation.

(g) **Solder.** Copper tubing solder joints shall be 95/5 or brazed solder. High gas refrigerant lines, and all buried lines, shall be high temperature solder.

(h) **Penetrations.** All piping penetrations through fire rated enclosures shall be sleeved with minimum 24 gauge steel sleeves, and packed tightly with calcium silicate or asbestos rope.

(i) **Insulation.** Piping and equipment insulation shall conform to the test requirements of ASTM E-84. The insulation shall provide a flame-spread not to exceed 25 and smoke development not to exceed 300.

**EXCEPTION:** Fitting Covers.
SECTION 4911. REFRIGERANT CONTAINING PRESSURE VESSELS.

(a) General. Pressure vessels exceeding 6 inches inside diameter, except those having a maximum internal or external design pressure of 15 psig or less, shall be stamped to be in compliance with the rules of Section VIII of the ASME Boiler and Pressure Vessel Code covering the requirements for the design, fabrication, inspection and testing during construction of unfired vessels.

(b) Approval. Pressure vessels not exceeding 6 inches inside diameter, except those which provide a maximum internal or external design pressure of 15 psig or less, shall be listed either individually or as part of refrigeration equipment by an approved nationally recognized testing laboratory, or shall be constructed according to the preceding paragraph.

(c) Pressure. Pressure vessels which provide a maximum internal or external design pressure of 15 psig or less, except as noted in (a) and (b) of this Section, shall have an ultimate strength to withstand at least 3 times the design pressure and shall be tested by the manufacturer to at least 1 1/3 times the design pressure for which they are rated.

(d) Relief Devices. If a pressure relief device is used to protect a pressure vessel not exceeding 6 inches inside diameter, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand at least 2 1/2 times the pressure setting of the pressure relief device.

(e) Fusible Plug. If a fusible plug is used to protect a pressure vessel which does not exceed 6 inches inside diameter, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand at least 2 1/2 times the refrigerant saturation pressure corresponding to the stamped temperature on the fusible plug, or at least 2 1/2 times the critical pressure of the refrigerant used, whichever is smaller.

SECTION 4912. REFRIGERANT STOP VALVES. A stop valve shall be installed in refrigerant piping at the inlet and discharge of every positive displacement type compressor; the inlets and outlet of every receiver, and the liquid outlet of every condensor where no receiver is used.
SECTION 4913. PRESSURE LIMITING DEVICE.
(a) General. A pressure limiting device shall be installed on every posi-
tive displacement refrigerant compressor, set to stop the action of the
compressor at 90 percent of the labeled working pressure of the sys-
tem.
(b) Shut-Off Valve. A shut-off valve shall not be placed between any pres-
sure limiting device and the compressor it serves.

SECTION 4914. PRESSURE RELIEF VALVES - COMPRESSORS.
Positive displacement compressors of 10 horsepower or more shall be
equipped by the manufacturer with a pressure relief device, of adequate
size and pressure setting to prevent rupture of the compressor, located be-
tween the compressor and stop valve in the discharge side. The discharge
from the relief device may be vented to the atmosphere, or into the low
pressure side of the system.

SECTION 4915. PRESSURE RELIEF DEVICES - PRESSURE VES-
SELS.
(a) General. Every pressure vessel over 6 inches in diameter, which may
be shut-off by valves from other parts of the system, shall be equipped
with a pressure relief device or devices complying with the Standards
of this Chapter.
(b) Type. Pressure vessels of 3 cubic feet or less gross volume containing
liquid refrigerant shall be equipped with a pressure relief valve, fusible
plug, or rupture member; provided, however, that a fusible plug is per-
mitted only on the high side of the refrigerating system. Pressure ves-
sels which provide a gross volume of more than 3 cubic feet shall be
equipped with a pressure valve or rupture member.

SECTION 4916. PRESSURE RELIEF DEVICE REQUIREMENTS.
(a) General. Pressure relief devices shall be set to start function at a pres-
sure not to exceed the design working pressure of the pressure vessel
as determined by the manufacturer and stamped on the pressure ves-
sel. All piping and fittings used for any relief device discharge piping
system shall conform to the Standards of this Chapter.
(b) Discharge Capacity. The minimum required rated discharge cap-
acity of the pressure relief device or fusible plug for a refrigerant con-
taining vessel shall be determined by the following:

\[ C = f \times D \times L \]
Where: \( C \) = Minimum required discharge capacity of the relief device in pounds of air per minute.
\( D \) = Outside diameter of the vessel in feet.
\( L \) = Outside length of the vessel in feet.
\( f \) = Factor depending upon kind of refrigerants as follows:

<table>
<thead>
<tr>
<th>Kind of Refrigerant</th>
<th>Value of ( f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>0.5</td>
</tr>
<tr>
<td>R-12, R-22 and R-500</td>
<td>1.6</td>
</tr>
<tr>
<td>R-502</td>
<td>2.2</td>
</tr>
<tr>
<td>All other refrigerants</td>
<td>1.0</td>
</tr>
</tbody>
</table>

(c) **Size.** The size of the discharge pipe from the pressure relief device shall be at least the size of the relief device outlet. The discharge from more than one relief device may run into a common header, the area of which shall be at least the sum of the area of the pipes connected thereto. Whenever the length of the discharge piping exceeds 50 feet, all piping shall be increased one pipe size in diameter.

(d) **Identification.** Every pressure relief device shall have:

1. The name or trademark of the manufacturer of the device.
2. The discharge or bursting pressure setting of the device expressed in pounds per square inch gauge.
3. The minimum diameter of the discharge outlet or orifice of the valve.
4. The discharge capacity of the pressure relief device in pounds of air per minute.

(e) **Valve Set-Seal.** Every pressure relief valve shall be set and sealed by the manufacturer, or in a laboratory approved by the Department, provided the valve is properly relabeled.

(f) **Discharge.** Pressure relief devices required by this Section for any pressure vessel of 3 cubic feet gross volume or more containing Group 1 refrigerant, or any pressure vessel containing ammonia shall discharge to the atmosphere at a location at least 15 feet above the adjoining ground level, and at least 20 feet from any window, ventilation opening, or exit in any building.

(g) **Valve Location.** Every pressure relief device required by this Section shall be connected as close as practicable to the refrigerant container or evaporator it serves, and above the refrigerant level in the container or evaporator.
(h) **Shut-Off.** A stop or shut-off valve shall not be placed between any pressure relief device required by this Section and the pressure vessel it serves.

**SECTION 4917. LABELS.**

(a) **Labels.** Every condensor or receiver shall be provided with a permanent label which sets forth the type of refrigerant used.

(b) **Power Disconnect.** The main power disconnect for all refrigeration system motors shall be identified with permanent labels with letters at least 1/2 inch in height.

**SECTION 4918. TESTING.**

(a) **General.** All field assembled refrigerating systems which may develop pressures in excess of atmospheric pressure shall be subjected to a test of pressure of at least the pressure set forth in Table No. 49-B for the type of refrigerant in the system.

(b) **Type.** Pressure tests required by this Section shall be at least the lowest setting of any pressure relief device installed on the side of the system it is protecting.

**EXCEPTIONS:**

1. System components which have been factory tested.
2. Pressure vessels constructed in accordance with the Standards of this Chapter.

(c) **Design Working Pressure.** The test pressure applied to any refrigerant container shall be 150 percent of the design working pressure stamped on the container.

(d) **Oxygen.** Oxygen shall not be used for testing.

(e) **Brine, Chilled Water, Water Piping.** All brine, chilled water and condensing water piping which are parts of any refrigerating system shall be tested to a pressure at least the working pressure of the system.

(f) **Drain Piping.** All drain piping shall be water tested and proved leak tight.

(g) **Test Declaration.** A dated declaration, permanently mounted, protected and in sight of the compressor, shall be provided for all systems tested. The declaration shall provide:

1. The name of the installing contractor.
2. The refrigerant used in the system.
3. The test pressures applied to the high and low side of the refrigeration system.
   The declaration shall be signed and mounted by the licensee prior to final inspection by the Department.

SECTION 4919. STORAGE OF REFRIGERANTS.

(a) General. All refrigerants, in excess of the amounts in a refrigeration system, shall be stored in a machinery room in their original containers.

(b) Discharge. Whenever refrigerant is removed or withdrawn from any refrigerating system, it shall be discharged into an approved shipping container or the outside atmosphere.

(c) Portable Refrigerant Container. A portable refrigerant container shall not be connected to any refrigerating system for a period longer than is necessary to charge or discharge the refrigerating system.

SECTION 4920. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flash Point by Means of the Pensky-Martens Closed Tester, Method of Test for, Z11.7-1973.</td>
</tr>
<tr>
<td></td>
<td>Pressure Piping: Refrigerant Piping, Code for B31.5-1968.</td>
</tr>
<tr>
<td></td>
<td>Seamless Copper Tube for Refrigeration Field Service, Specifications for, H23.5-1967.</td>
</tr>
</tbody>
</table>

LEGEND

ORGANIZATION

ANSI  American National Standards Institute
1430 Broadway
New York, N.Y. 10018

ASME  American Society of Mechanical Engineers
29 West 39th Street
New York, N.Y. 10018

ASTM  American Society for Testing and Materials
345 E. 47th Street
New York, N.Y. 10017

SECTION 4921. TABLES.
### TABLE NO. 49-A

**MAXIMUM PERMISSIBLE QUANTITIES OF GROUP I REFRIGERANT FOR DIRECT SYSTEMS**

<table>
<thead>
<tr>
<th>Refrigerant designation</th>
<th>Name</th>
<th>Maximum Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-11</td>
<td>Trichlorofluoromethane</td>
<td>35</td>
</tr>
<tr>
<td>R-12</td>
<td>Dichlorodifluoromethane</td>
<td>31</td>
</tr>
<tr>
<td>R-22</td>
<td>Chlorodifluoromethane</td>
<td>22</td>
</tr>
<tr>
<td>R-113</td>
<td>Trichlorotrifluoroethane</td>
<td>24</td>
</tr>
<tr>
<td>R-500</td>
<td>Dichlorodifluoromethane, 73.8%, and Ethylenedimethanol</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Flouride, 26.2%</td>
<td></td>
</tr>
<tr>
<td>R-502</td>
<td>Chlorodifluoromethane, 48.8%, and Chloropentafluoroethane, 51.2%</td>
<td>30</td>
</tr>
</tbody>
</table>

### TABLE NO. 49-B

**FIELD LEAK TESTPressures in Pounds per Square Inch**

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>High Pressure Test</th>
<th>Low Pressure Test</th>
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<tbody>
<tr>
<td>Ammonia</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>Trichloromonomofluoromethane (Refrigerant 11)</td>
<td>30</td>
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<tr>
<td>Dichlorodifluoromethane (Refrigerant 12)</td>
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<td>140</td>
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<tr>
<td>Monochlorodifluoromethane (Refrigerant 22)</td>
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<td>150</td>
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<tr>
<td>Trichlorotrifluoroethane (Refrigerant 113)</td>
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<td>30</td>
</tr>
<tr>
<td>Refrigerant 500</td>
<td>225</td>
<td>125</td>
</tr>
<tr>
<td>Refrigerant 502</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>TOTAL REFRIGERANT CHARGE IN POUNDS, GROUP 1 REFRIGERANT</td>
<td>TOTAL AREA OF GRAVITY OPENING TO OUTSIDE OF BUILDING (SQUARE FEET)</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>10</td>
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<tr>
<td>9000</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td>90</td>
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</tr>
</tbody>
</table>
CHAPTER 50

PLUMBING

SECTION 5001. GENERAL.

This Chapter shall govern the design, installation or removal of plumbing systems including sanitary and storm drainage, plumbing fixtures and receptacles, water supplies, storm water drainage and sewage disposal within buildings. All plumbing systems, including repairs and additions, hereafter installed shall conform with the provisions of this Chapter. See Chapter 1 for approval of alternate methods and materials.

SECTION 5002. IDENTIFICATION-MARKING.

Each length of pipe and each pipe fitting, trap, fixture, and device used in plumbing systems shall have cast, stamped, or indelibly marked on it the maker's name or mark, the gauge or weight, and be identified as to the Standard(s) met.

SECTION 5003. DEFINITIONS.

(a) General. For purposes of this Chapter, certain terms are defined as follows:

1. **Air Break (Drainage System).** A piping arrangement in which a drain from a fixture, appliance, or device discharges indirectly into another fixture, receptor, or interceptor at a point below the flood level rim, but above the trap seal.

2. **Air Gap (Drainage System).** The unobstructed vertical distance through the free atmosphere between the outlet of waste pipe and the flood level rim of the receptacle into which it is discharging.
   A. **Air Gap (Water Distribution System).** The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the flood level rim of the receptacle.

3. **Anchors.** See Supports.

4. **Approved.** See Chapter 4.

5. **Area Drain.** A drain installed to collect surface or rain water from an open area.
6. Assumed Occupant Load. The number of persons determined in Chapter 5.

7. Backflow. The flow of water or other liquids, mixtures, or substances into the distributing piping system of potable water from any source other than its intended source. Back-siphonage is one type of backflow.

8. Backflow Connection. A connection or condition whereby backflow can occur.

   A. Atmospheric Type (Vacuum Breaker-Atmospheric). A vacuum breaker which is not designed to be subject to static line pressure.
   B. Pressure Type (Vacuum Breaker-Pressure). A vacuum breaker designed to operate under conditions of static line pressure.
   C. Reduced Pressure Type. An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere.

10. Back Siphonage. The flowing back of used, contaminated, or polluted water from a plumbing fixture or other source into a potable water supply pipe due to a negative pressure in the pipe.

11. Branch. Any part of a piping system connected to a riser, main or stack.

12. Branch Interval. A length of waste stack not less than 8 feet in length or height, within which horizontal branches are connected to the stack.

13. Branch Vent. A vent connecting one or more vents with a vent-stack or a stack-vent.


15. Building Drain. That part of the lowest piping of a drainage system which receives the discharge from waste and other drainage pipe inside the walls of the building and conveys it to the building sewer beginning 5 feet outside the building wall.

16. Building Sewer. The horizontal piping of a drainage system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to sewer, sewage disposal system or other approved disposal system.
17. **Building Storm Drain.** That part of the lowest piping of a drainage system used for conveying surface water, or other similar discharge to a building storm sewer or a combined building sewer, 5 feet outside the building wall.

18. **Building Storm Sewer.** The extension from the building storm drain to a storm sewer, combined sewer, or other approved disposal system.

19. **Building Subdrain.** That portion of a drainage system which does not drain by gravity into the building sewer.

20. **Circuit Vent.** A branch vent that serves two or more traps and extends from the downstream side of the highest fixture connection of a horizontal branch to the vent stack.

21. **Closed System.** A system designed so that expansion of the water due to temperature changes cannot be relieved by reverse flow in the water supply system.

22. **Combination Fixture.** A fixture combining two or more sink or lavatory compartments in one unit.

23. **Combined Building Sewer.** A building sewer which also receives storm water or other drainage.

24. **Combination Waste and Vent System.** A specially designed system of waste piping embodying the horizontal wet venting of one or more sinks, lavatories, drinking fountains and floor drains by means of a common waste and vent pipe adequately sized to provide free movement of the air above the flow line of the drain.

25. **Common Vent.** A vertical vent connecting at the junction of two fixture drains and serving as a vent for both fixtures.

26. **Continuous Vent.** A vent which is a continuation of the drain to which it connects.

27. **Continuous Waste.** A waste from 2 or more fixtures connected to a single trap.

28. **Cross-Connection.** Any physical connection or arrangement of pipes between 2 otherwise separate piping systems, one of which contains potable water and the other water or other fluid or gas of unknown or questionable quality, whereby water may flow from one system to the other, the direction of flow depending on the pressure differential between the 2 systems, or the location of potable piping in or near nonpotable or unknown quality liquids whereby
contamination could be introduced into the potable system if back-flow should occur.

29. **Dead End.** A branch leading from a waste, vent, building drain, or building sewer which is terminated at a developed length of 2 feet or more by means of a cap, plug, or other closed fitting.

30. **Department.** See Chapter 4.

31. **Developed Length.** The length of drainage or vent piping measured along the center line of the pipe and fitting.

32. **Diameter.** Unless otherwise specifically stated in this Chapter, diameter means the nominal commercially designated size for pipe or tube.

33. **Downspout.** (Also see Leader). A water conductor which does not connect to a disposal system.

34. **Drainsline.** Any pipe which carries waste water or waterborne wastes in a building drainage system.

35. **Drainage System.** All piping within public or private premises which conveys sewage, storm water, or other liquid waste, and includes the building sewer.

36. **Dwelling Unit.** See Chapter 4.

37. **Effective Opening.** The diameter of a circle or equivalent cross-sectional area.

38. **Fixture Branch-Water Supply Pipe.** The water-supply pipe from the water-distributing pipe to wall or floor line.

39. **Fixture Drain.** The drain pipe from the trap of a fixture to the junction of that drain with any other drain pipe.

40. **Fixture Supply.** The water supply pipe connecting the fixture with the fixture branch.

41. **Fixture Unit.** The design factor selected in order that the load producing values of plumbing fixtures can be expressed approximately as multiples of that factor.

42. **Flood Level.** The level at which water begins to overflow the top or rim of the fixture.

43. **Floor Drain.** An opening in the floor used to drain water from floors into the plumbing system. In homes, floor drains are usually located in the laundry and near the heating boiler, and are fitted with a deep seal trap.

44. **Floor Sink.** A receptor used for the drainage of indirect drains.
45. **Flush Valve.** A device located at the bottom of a tank for flushing water closets and similar fixtures.

46. **Flushometer Valve.** A device designed to discharge a predetermined quantity of water under pressure to fixtures for flushing purposes.

47. **Grease Interceptor.** See Interceptor.

48. **Ground Water.** The water obtained from aquifers beneath the surface of the ground.

49. **Ground Water Supply.** A well, spring, or water pipe used to obtain ground water.

50. **Hangers.** See Supports.

51. **Horizontal Branch.** A branch drain extending laterally from a waste stack or building drain.

52. **Horizontal Pipe.** Any pipe or fitting which is installed in a horizontal position, or an angle of less than 45 degrees from the horizontal.

53. **Indirect Waste Pipe.** A waste pipe which does not connect directly with the drainage system but which discharges into the drainage system through an air break or air gap into a trap, plumbing fixture, receptor, interceptor or other approved point of disposal.

54. **Individual Vent.** A pipe installed to vent a fixture trap and connect to the vent system above the fixture it serves.

55. **Interceptor.** A receptacle designed and constructed to intercept and prevent the passage of oil, grease, sand and other materials into the drainage system to which it is connected.

56. **Leader.** A water conductor from the roof to the building storm drain.

57. **Loop Vent.** Similar to a circuit vent except that it loops back and connects with a stack vent instead of the vent stack.

58. **Main.** The principal artery of any system to which branches are connected.

59. **Municipal Water System.** The system by which water is supplied to the City and its inhabitants.

60. **Offset.** A combination of bends which brings one section of pipe out of line into a line parallel with another section.
61. **Plumbing.** The practice, materials, and fixtures used in the installation, extension, removal, maintenance, and alteration of all piping, fixtures, and appurtenances directly connected to the sanitary or storm drainage, venting system, and public water supply within or immediately adjacent to any building or structure; also, the practice and materials used in the installation, extension, or alteration of storm water, sanitary sewer, and water supply systems of any building or structure to their connection with the public water supply system, sewer system, or acceptable disposal facility. The installation, extension, alteration, or maintenance of domestic appliances equipped with back-flow preventers, domestic water heating appliances, and water conditioning appliances not directly connected to the sewer system shall not be construed to be exclusively plumbing.

62. **Plumbing Fixture.** A receptacle designed to receive and discharge water, liquid, or water carried waste into plumbing or drainage system to which it is connected.

63. **Plumbing System.** The drainage and vent system, the water supply distributing pipes, the fixtures and fixture traps, and storm water drainage, together with their devices, appurtenances, and connections.

64. **Pool.** A water receptacle used for swimming or as a plunge or other bath, designed to accommodate more than one bather at a time.

65. **Potable Water.** Water which is safe for drinking, culinary, and domestic purposes.

66. **Private Water Supply System.** A water supply system from a source other than the municipal water system.

67. **Receptor.** A receptacle directly connected to the drainage system and properly tapped and vented which may receive the drainage from indirect waste piping.

68. **Relief Vents.** A vent pipe to provide circulation of air between drainage and vent systems.

69. **Riser.** A water supply pipe which extends vertically to convey water to branches or fixtures.

70. **Roof Drain.** A drain or receptacle installed to receive water collecting on the surface of a roof and to discharge it to a leader or downspout.
71. **Rough In.** The installation of all portions of the waste, vent and water systems which shall be completed before the plumbing fixtures are installed.

72. **Sand Interceptor.** See Interceptor.

73. **Sanitary Sewer.** A pipe which carries sewage exclusive of storm, surface, and ground water.

74. **Sewage.** A liquid waste containing animal or vegetable matter in suspension or solution, and may include liquids containing chemicals in solution.

75. **Sewage Ejector.** A non-clogging type pump designed for conducting sewage from sanitary plumbing fixtures in the building.

76. **Slope.** The grade of a line in reference to a horizontal plane.

77. **Stack.** The vertical main of a system of waste, or vent piping.

78. **Stack Vent.** The extension of a waste stack above the highest horizontal drain connected to the stack.

79. **Story.** For the purposes of this Chapter, each branch interval shall constitute a story.

80. **Story-Multi.** For purposes of this Chapter, Multi-Story shall include any building or structure with more than 3 branch intervals.

81. **Subsoil Drain.** A drain or pipe which receives only subsurface water and conveys it to a place of disposal.

82. **Sump.** A tank or pit which receives the discharge from drains, or other wastes, located below the normal grade of the gravity system, and which must be emptied by mechanical means.

83. **Sump Pump.** A pump which handles only clear waste or storm water.

84. **Supports - Hangers - Anchors.** Devices for supporting and securing pipes, fixtures and equipment.

85. **Trap.** A fitting or device designed and constructed to provide a liquid seal which will prevent the back passage of sewer gas without materially affecting the flow of sewage or waste.

86. **Trap Seal.** The vertical distance between the weir and the top of the dip of the trap.

87. **Underground Piping.** Piping in contact with the earth.

88. **Vacuum Breaker.** See Backflow Preventer.
89. Vent Stack. A vertical pipe installed for the purpose of providing circulation of air and sewer gas to and from any part of the drainage system.

90. Vent System. Piping installed to provide flow of air or sewer gas from a drainage system to protect trap seals from siphonage and back pressure.

91. Vertical Pipe. Any pipe or fitting installed in a vertical position.

92. Waste Pipe. Any pipe which receives the discharge from a plumbing fixture or fixtures.

93. Water Distribution Pipe. A pipe which conveys water from the water-service pipe to the fixture branch.

94. Water Main. A water-supply pipe for public or community use.

95. Water Service Pipe. The pipe from the water main or other source of water supply to the building.

96. Water Storage Facility. A reservoir, cistern, storage tank, water supply tank, or similar facility utilized to store water in a water supply system.

97. Water Distribution System. The water service pipe, distribution pipes, fixture branches, water storage facilities and related connecting pipes, fittings, valves, and appurtenances on a particular premise.

98. Weir. The level at which water leaves the outlet of a trap.

99. Wet Vent. Any drain pipe which also serves as a vent.

100. Yoke Vent. A pipe connecting upward from the waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.

SECTION 5004. INSTALLATION METHODS AND MATERIALS.

a) Drainage Piping. Horizontal drainage piping shall be run in practical alignment at a uniform slope. See Section 5013(d).

b) Changes in Direction. Changes in direction in drainage piping shall be made by the appropriate use of fittings. Single and double sanitary tees and single and double short quarter 90 degree bends may be used in drainage lines only where the direction of flow is from the horizontal to vertical except that short quarter bends (90 degrees) may be used under floor outlet fixtures.

c) Prohibited Fittings, Connections and Fixtures.
1. **General.** A single or double-tee branch, or a tapped tee branch shall not be used as a drainage system. Drainage piping shall not be drilled or tapped. Branch connections shall not be made to a lead bend or lead stub except for the purpose of a dry vent. Required cleanout openings shall not be used for the installation of fixtures. A heel or side-inlet quarter bend (90 degrees) shall not be used as a vent when the vent inlet is placed in a horizontal position.

2. **Obstruction to Flow-Drainage Piping.** Any fitting or connection which has an enlargement, chamber or recess with a ledge, shoulder or reduction of the pipe area, which offers an obstruction to flow through the drain, or any fitting or connection that offers abnormal obstruction to flow is prohibited. The enlargement of a 3 inch closet bend to 4 inches shall not be considered an obstruction. Back water valves shall not be considered an obstruction.

3. **Protection of Potable Water Supply.**
   A. **Cross Connections.** Potable and nonpotable water supplies shall be distributed through systems entirely independent of each other, and any cross-connection between the supplies is prohibited.
   
   B. **Potable Water Piping Material.** Materials that have been previously used for purposes other than potable water shall not be used for pipe, tubing, or fittings in a potable-water supply system.

4. **Drain Valves and Waste Cocks.** Drain valves and waste cocks shall not be installed in underground potable water piping except when installed in a well for lawn sprinkler use and when approved for this use by the Department.

5. **Special Wastes.** Toxic, corrosive, flammable, or explosive substances or liquid, vapor, gas, or substances harmful to the drainage system or to the public shall not be discharged in to a drain or sewer unless the piping is suitable for the wastes and these wastes are subjected to approved treatment. See Section 5008.

6. **Dead Ends.** In the installation or removal of any part of a drainage system, dead ends shall be avoided except where necessary to extend a cleanout to be accessible.
7. **Prohibited Drainage.** Storm water and subsurface drainage shall not be drained into sewers intended for sewage only, nor shall sewage or special wastes be discharged into storm sewers, unless permitted by the Department.

8. **Types of Vents Prohibited.** Wet venting or stack venting of fixtures shall be prohibited except as permitted in Section 5014. A back vent shall not be installed within 2 pipe diameters of the trap weir.

9. **Type of Traps Prohibited.** A trap which depends for its seal upon the action of movable parts shall not be permitted. A trap with partitions shall not be used, unless the trap is integral with a fixture. A fixture shall not be double-trapped, unless approved by the Department. "S" traps and crown vented "P" traps are prohibited.

10. **Lead solder, flux and pipe prohibited.** After June 19, 1988, the use of lead solder, flux, and pipe is prohibited in new installation or in the repair of existing plumbing systems. This includes the use of lead in drain waste and vents.

   **Exception 1:** Lead as a related material may be used for caulked joints on non-pressure systems, lead pans, and for lead flashings.

   **Exception 2:** Caulked joints for cast iron bell and spigot pipe shall be firmly packed with oakum and filled with one inch deep molten lead; lead shall be caulked. (Rev. 6/88 Ord. No. 381)

(d) **Protection of Pipes.**

1. **Drain Pipes Through and Under Footings; and Pipes Through Foundation Walls.** A waste pipe or building drain passing through a footing or foundation wall shall be installed so that the pipe or wall shall not be weakened. All openings below grade shall be waterproofed by the application of a water-proofing material.

2. **External Corrosion.** Pipes passing through a corrosive environment shall be protected against external corrosion.

3. **Freezing.** Provisions shall be made to protect all plumbing from freezing. All underground pressure water piping outside a building shall be at least 4' 6" below finished grade.
(e) **Individual Sewage Disposal Systems.** When a public sewer is not available for use, a Permit for an individual sewage disposal system shall be obtained from the Department of Health and Hospitals.

(f) **Insulation.** Pipe insulation shall not exceed a flame spread of 25 and smoke development rating of 300. See Chapter 52 for pipe insulation in plenums.

**SECTION 5005. METHODS, MATERIALS AND FIXTURES**

(a) **General.** All methods, materials and fixtures shall meet established technical standards of quality and strength necessary to produce safe and sanitary plumbing installations. See Section 5017.

(b) **Materials - Special Requirements.**

1. **Sheet Lead.** Sheet lead shall weight at least 2-1/2 pounds per square foot.

2. **Flanges.** Flanges shall be required for floor and wall mounted fixtures with integral trap. Flanges shall be firmly supported.

**SECTION 5006. JOINTS AND CONNECTIONS.** All joints and connections shall be made airtight and watertight. See Section 5016.

(a) **Types of Joints.**

1. **Caulked Joints.** Caulked joints for cast iron bell and spigot pipe shall be firmly packed with oakum and filled with one inch deep molten lead. Lead shall be caulked.

2. **Threaded Joints.** All burrs shall be removed. Pipe ends shall be reamed or filed out to size of bore, and all chips shall be removed. Pipe joint compound shall be used only on male threads.

3. **Soldered or Brazed Joints.** Soldered or brazed joints for tubing shall be made with approved manufactured fittings. Surfaces to be soldered or brazed shall be cleaned bright. The joints shall be properly fluxed and made with approved solder.

4. **Swedged Joints.** The depth of swedged joints in tubing on drainage and vent piping or between tube or pipe shall be at least 1/2 the diameter of the tube or pipe.

5. **Flared Joints.** All flared joints for soft-copper tubing shall be made with fittings meeting the Standards. The tubing shall be expanded with a flaring tool.
6. **Hot-Poured Joints.** Materials for hot-poured joints for clay or concrete pipe shall not soften sufficiently to destroy the effectiveness of the joint when subjected to a temperature of 160 degrees F., or be soluble in any of the wastes carried by the drainage system, prior to hot-pouring. The joint shall be caulked tight with oakum.

7. **Mechanical Joints.** Mechanical joints shall be made with a flanged collar, or ring gasket and appropriate number of securing bolts, or with a preformed molded ring secured by pulling the pipe together in a manner to compress the molded ring; or by means of a corrosion-resistant joint and clamp assembly surrounding a sealing sleeve of an elastomeric material in a manner that the sleeve is firmly compressed by the tightening device in the clamp assembly in order to provide a tight joint.

8. **Resilient Joints.** Resilient joints in clay or concrete pipe shall be made by using approved resilient materials.

9. **Lead Burned Joints.** Lead burned (welded) joints shall be lapped and the lead shall be fused together to form a uniform weld at least as thick as the lead being joined.

10. **Asbestos Cement Sewer Pipe Joints.** Joints in asbestos cement pipe shall be of the preformed tapered type or with sleeve coupling sealed with rings of the same composition as the pipe. All joints between asbestos cement pipe and metal pipe shall be made by means of an adapter coupling with an approved joint.

11. **Plastic Pipe Joints.** Joints in plastic piping shall be made with approved fittings by either solvent welded or fusion welded connections, approved insert fittings and metal clamps and screws of corrosion resistant material, all in accordance with the Standards. Connections of plastic pipe to other piping materials shall be made with approved fittings.

12. **Tapped Joints.** The diameter of taps for vent piping or potable water piping shall not exceed 1/2 the diameter of the tapped piping. The tap shall be made by use of a manufactured fitting securely attached.
(b) Types of Joints.
1. Clay Sewer Pipe. All joints in vitrified clay pipe or between clay and metal pipe shall be made with approved hot-poured jointing material as specified in Section 5006 (a) 6 or with resilient joints as specified in Section 5006 (a) 8.
2. Concrete Sewer Pipe. All joints in concrete sewer pipe or between concrete pipe and metal pipe shall be made with approved hot-poured jointing materials as specified in Section 5006(a)6 or resilient joints as provided for in Section 5006 (a) 8.
3. Cast Iron Pipe. Cast iron pipe joints shall be caulked, threaded, resilient or mechanical joints as specified in Section 5006 (a)1, 2, 7 and 8 with approved fittings.
4. Steel Pipe. Joints in steel pipe shall be threaded or mechanical joints in accordance with Sections 5006 (a) 2 and 7.
5. Copper Water Tubing. All concealed joints for copper water tubing within buildings shall be soldered or brazed. Joints installed under ground shall be brazed or flared. Brazing shall be performed at not less than 1000 degrees F.

(c) Special Joints.
1. Slip Joints. Slip joints used for water piping, drain, waste and vent piping shall not be concealed.
2. Expansion Joints. Approved expansion joints may be used where necessary.
3. Ground Joints. Joints which provide a rigid joint when made up shall not be considered as slip joints.

(d) Water Closets and Pedestal Urinals. The connection between flange and water closets or pedestal urinals shall be made by means of an approved gasketing material.

(e) Waterproofing of Openings.
1. Pipes Through Roofs or Walls. When pipes pass through a roof or exterior wall, the openings shall be made watertight.
2. Flashings. Exterior openings exposed to the weather shall be flashed with rust-resistant metal or other approved flashing for water proofing purposes.

SECTION 5007. TRAPS, CLEAN-OUTS.
(a) Traps.
1. **Fixture Traps.** Except when specifically provided in this Building Code, each plumbing fixture, except those having integral traps, shall be separately trapped by a water-seal trap placed as close to the fixture outlet as possible. A combination fixture may be installed with one trap if one compartment is not more than 6 inches deeper than the other(s) and the waste outlets are not more than 36 inches apart.

2. **Integral Traps.** The fixture drain for all fixtures with integral traps shall not be smaller than the fixture outlet. In the case of water closets and pedestal urinals, the drain shall not be less than 3 inches.

3. **Minimum Size.** The size (nominal diameter) of a trap for a given fixture shall be sufficient to drain the fixture rapidly and shall be not less than that given in Table 50-F.

4. **“P” Traps.** Traps and tail pieces, if made of brass, shall be not less in thickness than 17 U.S. Standard Gauge, with the gauge stamped on the trap.

5. **Trap Seal.** Each fixture trap shall have a water seal of not less than 2 inches and not more than 4 inches.

6. **Vertical Distance Between Fixture and Trap.** The trap shall be installed as close to the fixture outlet as practical, but in no case shall the trap weir be more than 24 inches below the fixture outlet. Vertical distance may be increased to 48 inches when approved by the Department.

7. **Trap Levels and Protection.** All traps shall be set true with respect to their water seals.

8. **Running Traps.** Running traps may be used only with advance approval of the Department and shall have an accessible cleanout at the trap on both the upstream and downstream side of the trap.

   (b) **Pipe Clean Outs - General Requirements.**

    1. **Material and Design.** The bodies of clean-out ferrules shall conform in thickness to that required for pipe and fittings of the same material.

    2. **Location of Clean-Outs.** A clean-out shall be provided at or near the foot of each vertical waste stack.
3. **Cleanout Equivalent.** Where the piping is concealed, a fixture trap or a fixture with integral trap readily removable without disturbing concealed roughing work may be accepted as a cleanout equivalent.

4. **Distance of Clean-Outs.** Clean-outs shall be not more than 50 feet apart for horizontal building drains of 4 inch nominal diameter or less and not more than 100 feet apart for larger pipes. Clean-outs shall be not more than 100 feet apart in building sewer lines.

5. **Size.** Clean-outs shall be of the same nominal size as the pipes into which they are installed up to 4 inches, and at least 4 inches for larger pipes.

6. **Clearances.** Clean-outs on 4 inch or larger pipes shall be so installed that there is a clearance of at least 18 inches for rodding. Clearance for smaller piping shall be at least 12 inches.

7. **Accessibility.** Clean-outs concealed underground in walls, floors, or ceilings shall be extended to the surface. Where it is necessary to conceal a clean-out plug, a removable covering plate or access door shall be provided which will permit access to the plug.

**SECTION 5008. INTERCEPTORS.**

(a) **General.** All interceptors shall be designed and installed so that they will not become air-bound or permit siphonage. They shall be located to be readily and easily accessible for cleaning and inspection. All interceptors shall be an approved type.

1. All liquid wastes containing plaster or similar materials shall discharge into an interceptor constructed to intercept these materials prior to entering the drainage system.

2. Interceptors, when required, shall be constructed and installed to separate undesired materials and to prevent them from entering the drainage system. Interceptors shall be located inside the building only when it is impractical to install an outside interceptor, and only when the installation is approved by the Department.

3. A grease interceptor shall be installed on the discharge line of every dishwashing sink, dishwashing machine and every fixed receptacle or plumbing fixture used for the purpose of washing dishes or cooking utensils in a kitchen or food preparation area that serves, or has the capacity to serve, 100 or more meals a day.
4. The discharge from a water wash range hood shall discharge into a drain and continue through a grease interceptor.
5. All floor drains in kitchen areas shall discharge through a grease interceptor.

SECTION 5009. PLUMBING FIXTURES.
(a) General
1. Conservation. All plumbing fixtures in new construction shall meet the following requirements for water use:
   A. Tank type water closets shall not use more than 3.5 gallons per flush.
   B. Flushometer Valves.
      a. Flushometer valves for water closets shall not use more than 3.0 gallons per flush.
      b. Flushometer valves for urinals shall not use more than 1.5 gallons per flush.
   C. Shower heads for the purpose of bathing and washing shall have a maximum flow rate of 3.0 gallons per minute.
   D. Lavatory, kitchen and service faucets shall have a maximum flow of 3.0 gallons per minute.
2. Quality of Fixtures. All plumbing fixtures shall be made of materials with smooth impervious surfaces and shall conform to this Section and Section 5005. (Rev. 6/88 Ord. No. 380)

(b) Installation.
1. Securing Fixtures. All floor-outlet fixtures shall be rigidly secured by screws or bolts. Wall-hung fixtures shall be rigidly supported by approved metal hangers or bolts. Backing shall be provided to receive fixture hold down screws.

(c) Used Materials and Fixtures. Used plumbing fixtures and materials shall not be installed unless they have been inspected by the Department and have been found to meet the requirements of this Chapter and to be in satisfactory physical and sanitary condition.

(d) Water Closet Combinations. Water closet bowls shall be siphon-jet, reverse-trap, washdown, or blow-out type with floor outlet, or siphon-jet or blow-out type with wall outlet. Water-closet bowls and traps shall be made in one piece and shall be provided with integral flushing rim
constructed to flush the entire interior of the bowl. Water-closet bowls for public use shall be of the elongated type.

(e) **Flushometer Valves.** Flushometer valves shall be installed so that they will be accessible for repairing. When the valve is operated, it shall complete the cycle of operation automatically, opening fully and closing positively under the service pressure. At each operation the valve shall deliver water in volume and rate that will thoroughly flush the fixture and refill the fixture trap. Means shall be provided for regulating flushometer valve flow. Not more than one water closet shall be served by a single flushometer valve. Protection against backflow shall be provided as specified in Section 5012(c). Also see Table 50-B.

(f) **Ball Cocks.** Ball cocks shall be antisiphon type and shall be installed with the air inlet ports at least one inch above the overflow level in the tank.

(g) **Urinals.**

1. **Flushing Rim and Trap.** Siphon-jet, blow-out and pedestal urinals shall have integral flushing rims and integral traps except that wash-out and stall urinals may have separate traps. Stall urinals shall have flushing rims or spreaders.

2. **Trough Urinals.** Wall-hung trough urinals shall be permitted only in temporary locations and in buildings not normally used more than 5 hours per day. They shall be not less than 6 inches deep and shall be furnished with one-piece backs and have strainers with outlets at least 1-1/2 inches in diameter. The washdown pipe shall be perforated to flush with an even curtain of water against the back of the urinal and shall be securely clamped as high as practicable to the back of the urinal. Trough urinals shall have automatic flushing tanks with a flushing capacity of not less than 1-1/2 gallons of water for each 2 feet of urinal length.

3. **Flushing.** Urinals shall be provided with a tank and automatically actuated valve, or an approved manually operated, flushing device. All automatic flushing devices shall be adjusted to cause thorough flushing of the urinal at regular intervals to maintain sanitary conditions. No more than 4 urinals shall be flushed with one automatic tank or valve, and only if the flush pipe is sized and graded to insure sufficient pressure, volume, and equal distribu-
tion of the tank contents. Protection against backflow shall be provided as specified in Section 5012 (c).

(h) **Lavatories**. Lavatories shall be provided with waste outlets at least 1-1/4 inches in diameter. Waste outlets shall have open strainers or stoppers. Lavatories for the use of handicapped persons shall be provided and set in accordance with the Standards and Chapter 5.

(i) **Shower Receptacles**. Shower receptacles except those built directly on a slab on the ground or integral with a shower cabinet shall have water-tight pans. The pan shall be turned up 1 inch on each wall side at least one inch above the curb and shall be protected against corrosion.

(j) **Sinks**. Sinks shall be provided with waste lines at least 1-1/2 inches in diameter. Waste outlets shall have open strainers or stoppers.

1. **Commercial Sinks**.
   A. All commercial sinks, "e.g. Bar sinks and dishwashing sinks," used in food preparation areas shall be installed so that any drainage backup is relieved through a floor drain placed next to the fixture.
   B. Sinks used in the direct preparation of foods, "e.g. Salad sinks; frozen food sinks," where food is prepared, stored, or thawed, shall be connected indirectly to a floor sink located as near as possible to the food preparation sink.

(k) **Food Waste Grinder Units**.

1. **Separation Connections**. Domestic and commercial food waste disposal units shall be connected and trapped separately from any other fixture or compartment, except that a continuous waste with flow-directing partition may be used for domestic units. Units may have either automatic or hand operated water supply.

   A. **Food Waste Disposer Mandatory**. New structures arranged or intended to develop food wastes in the direct preparation of food in Group A through I occupancies, shall provide food waste disposal equipment within the premises. Existing structures converted or altered to the uses described above need not meet the requirements of this Section unless the structures are provided with new facilities for food preparation.
2. **Grease Interceptors.** Waste from a food waste grinder shall be discharged by a separate waste line into or through a grease interceptor as required by Wastewater Management Division. This Section shall not apply where a grease interceptor is not required. (Revised 5/82 Ordinance No. 245)

3. **Waste Line.** See Table 50-H.

   (l) **Floor Drains.** Floor drains shall be provided with metal traps with strainers. A floor drain shall not be obstructed by the placement of appliances or equipment. Floor drains in elevator pits shall not be directly connected to a sewer. One floor drain shall be provided at the base of each standpipe at the lowest point of the riser in the building. These drains shall be installed so that water released from the standpipe will drain to the floor drain. Floor drains shall be provided in boiler rooms in locations approved by the Department.

**EXCEPTIONS:**

1. Trench drains, area drains and floor drains discharging into a sand and oil interceptor, shall not be trapped.
2. Waste lines subject to sand, oil or any flammable liquid shall waste through an approved sand and oil interceptor prior to discharging into a sump or ejector device.

   (m) **Laundry Trays.** Each compartment of a laundry tray shall be provided with a waste outlet at least 1-1/2 inches in diameter and with a stopper or strainer.

   (n) **Washing Machines.** Clothes washing machines shall discharge into a smooth finished trough, a standpipe system, a laundry tray, or a service sink.

   (o) **Drinking Fountains.** Drinking Fountains shall be provided with an adjustable angle jet type with guard and shall be of a design so that the nozzle will not be flooded in case of drain blockage.

   (p) **Minimum Toilet Room Facilities.** See Chapter 5.

**SECTION 5010. HANGERS AND SUPPORTS.**

(a) **General.** Piping in a plumbing system shall be installed without undue strains and stresses and with provisions for expansion, contraction, and structural settlement. Hangers and anchors shall be of sufficient strength to support the pipe and its contents. Supports shall be attached to the building construction.
(b) **Vertical Pipe Support.** Vertical piping shall be secured at every story height or at not more than 15 foot intervals. No-hub cast iron soil pipe shall be supported so that the weight is carried from the pipe to the support and not from the joint to the support.

(c) **Horizontal Pipe Support.** Horizontal piping shall be supported to keep it in alignment, prevent sagging, and to provide the required draining slope.

1. Cast iron hub and spigot shall be supported within one foot of each hub. Cast iron no-hub pipe shall have each fitting and each length of pipe of less than 4 feet supported with at least one hanger. Horizontal lengths of pipe longer than 4 feet shall be supported on both sides of each joint.

2. Copper tubing, plastic, steel and glass pipe shall be supported at intervals shown in Table 50-A.

3. Pipes in the ground shall be laid on a firm bed for their entire length.

(d) **Expansion and Contraction.** (Plastic) For plastic drainage and vent systems, restraint and expansion fittings shall be used at each branch interval or each 25 feet, whichever is less, to accommodate movement due to contraction and expansion.

(e) **Base of Stacks.** Bases of stacks above grade shall be supported from the building structure.

(f) **Supports.** Wall-hung fixture supports shall be designed so that no undue strain is transmitted to the fixture.

(g) **Thrust Blocks.** Thrust blocks shall be provided for each change of direction of 45 degrees or greater for water piping having mechanical joints not capable of withstanding the stresses caused by the thrust.

**SECTION 5011. INDIRECT WASTE PIPING.**

(a) **General.** An air gap is required where the indirect waste pipe may at any time be under a vacuum which could cause back siphonage. Where the horizontal length of indirect waste piping required from food preparation equipment exceeds 10 feet, a trap in the indirect waste line shall be provided as near the equipment as practical. Wastes from the following shall discharge through an air gap:
1. Refrigerators, ice makers, steam tables or other receptacles and devices in which food or drink is stored or prepared for commercial purposes.
2. Drains, overflows, or vents from the potable water supply system.
3. Devices or apparatus such as sterilizers and potable water stills.

(b) Pressure Tanks, Boilers and Relief Valves. If the discharge of waste from this type of equipment is connected by piping to the drainage system, it shall be connected as an indirect waste.

(c) Air Gap Requirements. The air gap shall be at least twice the effective diameter of the drain served and shall be provided by extending an indirect waste pipe to an open accessible service sink, floor drain, or other fixture which is properly trapped and vented.

(d) Air Break Usage. Discharge from devices supplied with potable water through an air gap or vacuum breaker may discharge through an air break.

(e) Commercial Dishwashing Machines. Dishwashing machines, except those in dwelling units, shall be indirectly connected except that when a dishwashing machine is located adjacent to a floor drain, may be connected directly on the sewer side of the floor drain trap, provided the drain line from the commercial dishwasher is properly trapped and vented.

(f) Domestic Dishwashers. The discharge line from the dishwashing machine shall be connected to a separate trap, as an indirect waste, to a dishwasher connection of a disposer, or a baffled sink tail piece after going through a looped connection. The looped connection shall be at least as high as the underside of the sink counter.

(g) Clear Water Wastes. Water lifts, expansion tanks, cooling jackets, fire sprinkler systems, or similar devices which waste clear water only shall discharge into a sump or drain into a trapped fixture. Requirements for draining relief outlet wastes, see Section 5011 (b). 1. When drip pans under cooling coils discharge to the sanitary drainage system, the discharge shall be through an air break into an approved trapped receptor. The discharge line from pans under cooling coils shall be at least 3/4 inch in diameter.

(h) Swimming Pools. Pipes carrying waste water from swimming or wading pools including pool drainage, back wash from filters and water from floor drains which serve walks around the pools, shall be installed
as an indirect connection to the building drain or building sewer. Where a recirculation pump is used to discharge waste pool water into the drainage system, the pump discharge shall be installed as an indirect waste to the sewer. See Chapters 57 and 58.

SECTION 5012. WATER SUPPLY AND DISTRIBUTION.

a) Quality of Water Supply.

1. Potable Water. All premises intended for human occupancy shall be provided with potable water.

2. Nonpotable Water. Nonpotable water may be used for irrigation, cooling or industrial uses where it cannot contaminate or pollute water or food products intended for human consumption, for flushing water closets and urinals and for other purposes not requiring potable water; provided, however, that nonpotable water shall be prevented from possible use for drinking, culinary, and other domestic purposes.

b) Identification of Piping. All piping conveying nonpotable water shall be identified by a distinctive green colored paint with one inch white paint banding around pipe at 4 foot intervals so that it is readily distinguished from piping carrying potable water.

c) Protection of Potable Water Supply.

1. Backflow. The water distribution system shall be protected against backflow. Every fixture supply pipe shall be protected from backflow by having the opening from which the water flows spaced a distance above the flood level rim of the receptacle into which the water flows sufficient to provide an air gap of at least twice the diameter of the effective opening. Where it is not possible to provide a minimum air gap, the fixture shall be equipped with an accessibly located back flow preventer complying with Table 50-B.

2. Backflow Preventers. Backflow preventers shall be installed with any supply fixture, such as hose and spray, hose end faucet direct flushing valves, aspirators and under rim water supply connections to a plumbing fixture or receptacle in which the surface of the water in the fixture or the receptacle is exposed at all times to atmospheric pressure and where the outlet end of which may at times be submerged. Atmospheric backflow preventers shall not be
installed on the inlet side of the control valve, unless spring loaded. Backflow preventers shall be made of corrosion resistant material.

(d) Separate Trenches. The underground water service pipe and the building drain or building sewer shall be at least 10 feet apart horizontally and shall be separated by undisturbed or compacted earth except when installed in open utility tunnels. When this condition cannot be met, relief from this Section may be requested from the Department by setting forth in writing the details of the proposed alternate and the reason why these conditions cannot be met.

(e) Pumps and Other Appliances. Water pumps, filters, softeners, and all other appliances and devices shall be connected to prevent contamination of the potable water system.

(f) Water Storage Equipment. Potable water storage equipment shall be designed to prevent contamination of the water supply. The interior of this equipment shall be accessible. See Chapter 58 for hot water tanks.

1. Cleaning, Lining, Painting, or Repairing Water Storage Equipment. Potable water storage equipment used for domestic purposes shall not be lined, painted, or repaired with any material which will affect the potability of the water supply. The equipment shall be disconnected from the system during all maintenance operations to prevent any foreign fluid or substances from entering the distribution piping.

(g) Materials.

1. Water-Distribution pipe, Tubing and Fittings. Materials for water distribution pipes and tubing shall be brass, copper, cast iron, or steel, with approved fittings except that CPVC pipe bearing the NSF seal may be used in buildings of Type III and V construction and in Type IV construction when enclosed in one hour fire resistive construction. All piping used for water distribution shall be capable of withstanding 125 p.s.i. at 180 degrees F. Allowance shall be made to accommodate expansion of pipe. Threaded ferrous pipe and fittings shall be galvanized (zinc-coated) or cement lined. When used underground, ferrous pipe and fittings shall be coal tar enamel coated and the threaded joints shall be coated and wrapped after installation.
2. **Water Service Pipe.** Materials for water service piping between the property line and the building shall be as specified in Table 50-O.

h) **Water-Supply Control.** A main shutoff valve on the water service pipe shall be provided near the meter and an accessible shutoff valve with drain shall be provided inside near the entrance of the water service pipe into the building.

1. **Tank Controls.** Supply lines from pressure or gravity tanks shall be valved at or near their source.
2. **Individual Control Valves.** Accessible individual control valves shall be provided for all fixtures.

i) **Water Distribution System.**

1. **Water Service Pipe.** The water service pipe from the street main to the water distribution system for the building shall be designed to provide an adequate flow of water to meet the requirements of the building at peak demand, but in no case shall be less than 3/4 inch nominal diameter. If water closet flushometer valves or other devices requiring a high rate of water flow are used, the water service pipe shall be designed to supply this flow, but shall be at least 1 inch in diameter.

2. **Demand Load.** The demand load in the building water supply system shall be based upon the number and kind of fixtures installed and the probable simultaneous use of these fixtures. In the absence of a specific design analysis, the demand load and pipe sizing shall be based on Table 50-C.

3. **Size of Fixture-Supply Pipe.** The minimum size fixture supply pipe shall be as set forth in Table 50-D.

j) **Auxiliary Pressure.** If the residual pressure in the system is below the minimum allowable at the highest fixture when the flow in the system is at peak demand, an automatically controlled pressure or gravity tank and/or booster pump shall be installed of capacity to supply sections of the plumbing system which are too high to be supplied directly from the public water main. When a booster pump is used on an auxiliary pressure system, there shall be installed a low pressure cutoff to the booster pump as approved by the Department.
(k) **Street Pressures.** When the street main has a wide fluctuation in pressure during the day, the water distribution system shall be designed for the minimum pressure available. A pressure regulator valve shall be installed to limit the maximum pressure in the system to 90 p.s.i.g.

(l) **Hazard and Noise.** Chargeable air chambers or other approved mechanical devices shall be provided to reduce the hazard to the piping system from water hammer.

(m) **Safety Devices.**

1. **Pressure Relief Valves and Temperature Relief Valves, or Combination Temperature and Pressure Relief Valves.** Pressure relief valves and temperature relief valves, or combination temperature relief valves of the thermostatic self closing type shall be placed on all water heaters. The pressure side shall be set to relieve at a maximum of 165 pounds per square inch. The temperature side shall be set to relieve at a maximum of 210 degrees F., and shall be capable of discharging sufficient hot water to prevent any further rise in temperature.

2. **Approvals.** Pressure relief valves, temperature relief valves, and combination temperature and pressure relief valves which meet the requirements of this Chapter shall be considered acceptable provided each valve has a metallic plate stamped or etched with manufacturer's rated relief capacity. Relief valve capacity shall be equal to or greater than the rated Btu input of the heater or heat exchanger.

3. **Vacuum Relief.** Copper and copper lined tanks shall be provided with vacuum relief valves.

4. **Relief Valve Location.** Extended thermostatic self closing type combination temperature pressure relief valves shall have the element placed in the tank within 6 inches to the top. Valves without extended element shall be placed directly above the tank on the hot water outlet and not more than 3 inches from the tank. Vacuum relief valves shall be placed as close to the tank as possible. There shall be no check or shutoff valve between a relief valve and the heater or tank.
5. Relief Outlet Wastes. The outlet of pressure relief valve, a
temperature relief valve, or a combination temperature and pres-
sure relief valve, shall be piped and turned down to drain into a
sump or into a plumbing fixture as an indirect waste.

6. Size of Relief Outlet Waste. The cross sectional area of the relief
outlet waste shall be equal to or greater than that of the valve out-
let.

(n) Water Used for Cooling. Water used for cooling of equipment or
similar purposes shall not be returned to the potable water distribut-
ing system. When discharged to the building drainage system, the
waste water shall be discharged through an indirect waste pipe or air
gap.

SECTION 5013. DRAINAGE SYSTEM.

(a) Materials.

1. Above Ground Piping Within Buildings. Waste piping for
drainage systems within a building shall be of cast iron, galvanized
steel, lead, brass, copper pipe or copper tube. Plastic pipe bearing
the markings NSF-DWV may be used in buildings of Types III and
V construction. Plastic piping conforming to these requirements
and enclosed within a one hour fire resistive construction may also
be used in Type IV buildings. See Chapter 52 for Air Plenums.

2. Underground Drainage Piping Within Buildings. Under-
ground building drains shall be of hub type cast iron or Type L cop-
per. For special wastes, underground drains may be of the same
material as the above ground drains.

b) Separate Trenches. See Section 5012 (d).

c) Building Sewer. A building sewer may be constructed of cast iron,
Type L copper, vitrified clay with resilient joints, or plastic pipe bear-
ing the mark NSF-DWV. Building sewers shall not be installed in un-
stable soil unless of hub-type cast iron pipe and designed to maintain
a uniform slope.

d) Drainage Piping Installation. Connections to horizontal drainage
branches shall be made with combination Y and 1/8 bends, Y’s, or long
turn TY’s. Horizontal drainage piping shall be installed at a uniform
slope of at least that permitted in Table 50-E, unless designed to give
a minimum velocity of 2 fps.
(e) **Fixture Units.**

1. **Values for Fixtures.** Fixture unit values as given in Table 50-F designate the relative load weight of different kinds of fixtures, and shall be employed in estimating the total load carried by a waste pipe, and shall be used in connection with the Tables of sizes for waste and drain pipes for which the permissible load is given in terms of fixture units.

(f) **Determination of sizes of Waste Piping.**

1. **Maximum Fixture Unit Load.** The maximum number of fixture units that may be connected to a given size of building sewer, building drain, horizontal branch, or vertical waste stack shall be as specified in Tables 50-G, H and I.

2. **Minimum Size of Waste Stacks.** Waste stacks shall not be smaller than the largest horizontal branch connected thereto.

3. **Future Fixtures.** When provision is made for the future installation of fixtures the future fixtures shall be considered in determining the required sizes of drain pipes. Construction to provide for future fixture installation shall be terminated with a plugged fitting or fittings at the stack and shall be vented as required in Section 5014.

4. **Vertical Offsets or Change of Direction.** An offset in a vertical stack, with a change of direction of 45 degrees or less from the vertical, may be sized as a straight vertical stack. In buildings of 10 or more branch intervals, if a horizontal branch connects to the stack within two feet above or below the offset, a relief vent shall be installed in accordance with Section 5014 (l). A stack with an offset of 45 degrees or more shall be sized as follows:

   A. The portion of the stack above the offset shall be sized as for a regular stack.

   B. The offset itself, including fittings, shall be sized as for a building drain. See Table 50-G.

(g) **Sumps, Pumps, Ejectors, and Receiving Tanks.** Building sub drains shall discharge into a sump or receiving tank with a gas tight cover. Sewage shall be lifted and discharged into the building sewer or drain by sump pumps, sewage ejectors, or similar methods. Sumps or tanks shall either be automatically discharged or have a capacity to hold the maximum accumulated sewage and waste for a period of at
least 24 hours, provided that sewage and waste shall be purged from the sump at intervals not exceeding 12 hours. Water operated ejectors are prohibited. An ejector shall be used on sumps serving one or more water closets. The discharge pipe from the sump shall be sized to handle the discharge from the pump, but in no event smaller than the pump discharge. The size and design of a sump pump shall be determined by the capacity of the sump to be served, the discharge head, and the discharge frequency. A check valve shall be installed in each pump discharge line. The discharge pipe from the sump pump or ejector to the drainage system shall be connected through a branch "Y" fitting. The drain into which the sump pump or ejector discharges shall be sized to receive the combined flow from the building sump pump or ejector. For size of vents, see Section 5014(j)6.

SECTION 5014. VENTS AND VENTING.

(a) Materials. Vent pipes shall be cast iron, galvanized steel, lead, brass, copper pipe or copper tube. Plastic piping bearing the markings NSF-DWV may be used in building Types III and V construction. Plastic piping conforming to these requirements and enclosed within one hour resistive construction may also be used in buildings of Type IV construction. See Chapter 52 for air plenums.

(b) Minimum Stack Vent. Any structure on which a building drain is installed shall have at least one stack vent carried undiminished in size through the roof. The minimum size shall be 3 inches in diameter.

(c) Trap Seals. 

1. Protection of Trap Seals. The protection of trap seals from siphonage, aspiration, or back pressure shall be accomplished by the use of waste stacks and adequate venting in accordance with the requirements of this Building Code. Venting systems shall not be subjected at any time to a pneumatic pressure differential of more than one inch of water pressure under design load conditions.

2. Stack Vents. Every waste stack shall be extended vertically as a stack vent to at least 6 inches above the flood level rim of the highest fixture, then to the open air; or the stack vent and vent stack shall be joined within the building at least 6 inches above the flood level rim of the highest fixture, with a single extension from the point of joining to the open air.
(d) **Vent Stacks.** A vent stack or main vent shall be installed with a waste stack whenever back vents, relief vents, or other branch vents are required for 4 or more branch intervals. The vent stack shall terminate in the open air outside the building, or shall be connected with the building venting system and shall connect with the waste stack through, at, or below the lowest horizontal waste branch or with the building drain. A vertical vent stack connection to the drainage system shall be washed with the lowest fixture tied into the vent stack. Vent stacks shall run undiminished in size for their entire length.

1. **Extensions Through Roof.** Extensions of vent pipes through a roof shall be terminated at least 6 inches above the roof and shall be flashed. Where a roof is to be used for occupancy, the extensions shall run at least 6 feet above the roof, and be provided with a vandal proof vent cap.

2. **Location of Vent Terminal.** A vent terminal from a drainage system shall not be located directly beneath any door, window, or other ventilating opening of the building or an adjacent building, nor shall the vent terminal be within 10 feet horizontally of the opening unless it is at least 3 feet above the top of the opening.

3. **Extensions Through Wall.** Vent terminals extending through a wall, when approved by the Department, shall be at least 10 feet horizontally from any lot line and terminate downward. They shall be screened and shall meet the requirements of Section 5014 (d) 2. Vent terminals shall not terminate under the overhang of a building.

(e) **Vent Pipe Grades and Connections.**

1. **Grades.** Vent and branch vent pipes shall be free from drops or sags, and be graded and connected to drip back to the waste pipe or vent stack by gravity.

2. **Venting of Floor Drains.** Floor drains shall be vented by one of the following methods:
   
   A. As specified in Section 5014(e)3.
   
   B. As specified in Section 5014(j).
   
   C. As specified in Section 5014(p).
   
   D. A floor drain shall be considered vented when connected to a vented waste line within a distance not exceeding 48 times the inside diameter of the floor drain.

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E. When structural conditions preclude installation as set forth in Section 5014(e) 3, a vent may be run horizontally before being run vertically, provided there is a cleanout in the vertical portion of the vent to permit washing the horizontal vent line.

F. Unvented floor drains shall not be connected to a horizontal drain within 8 feet of the base of any waste stack.

3. Connections to Waste Pipe. Where vent pipes connect to a horizontal waste pipe, the vent shall be taken off above the center line of the waste pipe, and the vent pipe shall rise vertically, or at an angle not more than 45 degrees from the vertical, to a point at least 6 inches above the flood level rim of the fixture it is venting before offsetting horizontally or before connecting to the branch vent.

4. Connection to Vent Stack. The connection between a vent pipe and a vent stack shall be at least 6 inches above the flood level rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents, relief vents, circuit vents, or loop vents shall be at least 6 inches above the flood level rim of the highest fixture served.

(f) Fixture Vents.

1. Distance of Trap from Vent. Each fixture trap shall have a protecting vent located so that the slope and the developed length of the fixture drain from the trap wire to the vent fitting are within the requirements set forth in Table 50-J.

2. Vent Pipe Level. The vent pipe opening from a waste pipe, except for water closets and similar fixtures, shall not be below the top of the dip of the trap.

(g) Fixture Connected to Stack at Different Levels. A common vent may be used for two fixtures set on the same floor level but connecting at different levels in the stack, provided:

1. The vertical drain is one pipe diameter larger than the upper fixture drain.

2. The vertical drain is not smaller than the lower fixture drain.

3. Both drains conform to Section 5014(f).
(h) **Wet Venting.**

1. **Single Bathroom Group.** A single bathroom group of fixtures may be installed on the top floor with a drain from a vented lavatory, kitchen sink or combination fixture serving a wet vent for a bathtub or shower stall and for the water closet, except blowout type, provided:
   
   A. No more than one fixture unit is drained into a 1 1/2 inch diameter wet vent.
   
   B. No more than four fixture units drain into a 2 inch diameter wet vent.

2. **Bathroom Groups.** Back to back bathroom groups on top floor consisting of two lavatories and two bathtubs or shower stalls located on the top floor, may be installed on the same horizontal branch with a common vent for the lavatories and with no vent for the bathtubs or shower stalls, provided the wet vent is 2 inches or larger in diameter.

3. **Multistory Bathroom Groups.** On the lower floors of a multi-story building, the waste pipe from one or two lavatories may be used as a wet vent for one or two bathtubs or showers provided:
   
   A. The wet vent and its extension to the vent stack is 2 inches in diameter.
   
   B. Each water closet below the top floor is individually vented.
   
   **EXCEPTION:** In any bathroom group wet vented in accordance with Section 5014 (h) 1, 2, and 3, the water closets below the top floor need not be individually vented if the 2 inch waste connects directly into the water closet bend at a 45 degree angle to the horizontal portion of the bend in the direction of flow.

(i) **Stack Venting.**

1. **Single Groups.** A group of fixtures consisting of one bathroom group and a kitchen sink or combination fixture may be installed in a one story building or on the top floor of a building without individual fixture vents, provided:
   
   A. Each fixture drain connects independently to the stack.
   
   B. The water closet and bathtub or shower stall drains enter the stack at the same level.
   
   C. The drains are in accordance with Section 5014 (f) 1.
2. **Multiple Groups.** Groups of fixtures consisting of a water closet, basin, shower or tub and a kitchen sink (with disposal and dishwasher) located back to back to the bathroom, or 2 bathrooms back to back each consisting of one toilet, basin, shower or tub may be installed without individual fixture vents in a one story building or on the top floor of a building, provided:

A. Each fixture drain connects independently to the stack.

B. The water closet and bathtub or shower stall drains enter the stack at the same level.

C. The drains are in accordance with Section 5014 (f) 1.

3. **Lower Floors.** Lower floors may be vented as in Section 5014(i)1 and 5014(i)2, provided a separate wye and upright 1/8 bend is installed above the wye.

(j) **Battery Venting.** A uniformly sized horizontal waste branch, to which one or a maximum of eight floor outlet water closets (except blowout type), floor outlet urinals, fixtures having floor outlets, showers, bathtub, or floor drains that are connected in battery, may be vented by a circuit or loop vent which shall take off between the last two upstream fixture connections.

1. In addition, lower floor branches shall be provided with a relief vent taken off downstream of the first fixture connection. When lavatories or similar fixtures in the same branch interval discharge above lower floor branches, each vertical branch shall be provided with a continuous vent, or shall be connected as follows:

A. Not more than 2 fixture units shall be connected to a 2 inch, or 4 fixture units to a 3 inch loop vent, circuit vent, or to the relief vent used with a loop or circuit vent, provided no other fixture is drained to the vent pipe.

2. Batteries of more than 8 fixtures may be installed, provided a vent as described above is installed for each 8 or fewer fixtures connected.

3. **Dual Relief Vents.** 2 circuit-vented horizontal branches serving not more than 8 water closets in each horizontal branch, as described in Section 5014 (j), in the same branch interval, shall have a dual relief vent. When the vents are joined, the point of joining shall be at least 6 inches above the flood-level rim of the highest
fixture connected to either branch. When other fixtures discharge above these branches, each branch shall be provided with a vent.

4. Vent Connections. When the circuit, loop, or relief vent connection is taken off the horizontal branch, the vent connection shall be taken in a vertical line from the top of the horizontal branch.

5. Fixtures Connected Back to Back or Side by Side in Battery. Fixtures connected to one horizontal branch through a double "Y" or a vertical sanitary cross may be installed on a common vent for each 2 fixtures back to back, side by side, or double connection. The common vent shall be installed in a vertical position. A sanitary cross 2 inches and smaller shall be long turn.

6. Size of Vent. Sumps and receiving tanks, except pneumatic ejectors, into which sewage or other wastes are discharged shall be provided with a vent sized in accordance with Table 50-K and 50-L.

(k) Pneumatic Ejector. The air pressure relief pipe from a pneumatic ejector shall not be connected to the regular venting system, but shall be connected to an independent vent stack terminating as required for a vent extension through roofs. The relief pipe shall be sized to relieve air pressure inside the ejector to atmospheric pressure within 10 seconds, but shall be less than 1-1/4 inches in size.

(l) Relief Vents. Waste stacks in buildings having more than ten branch intervals shall be provided with a relief vent at each tenth interval installed, counting to begin at the top floor. The size of the relief vent shall be equal to the size of the vent stack to which it connects. The lower end of the relief vent shall connect to the waste stack through a Y below the horizontal branch surrounding the floor and the upper end shall connect to the vent stack through a Y not less than 3 feet above the floor level.

(m) Suds Waste and Venting.

1. Where Required. Laundry trays, laundry washing machines, and similar fixtures in which sudsy detergents are normally used shall be wasted and vented in accordance with Section 5014(m)2. This requirement shall not apply to single family dwellings.

2. Method. In buildings of less than 6 branch intervals, a separate waste pipe for the lowest floor fixtures shall be provided. The connection to the lowest horizontal drain shall not be within 5 feet of
the stack. In buildings of 6 or more branch intervals, separate waste and vent stacks for the lower two branch intervals shall be provided.

(n) **Vent Headers.** Stack-vents and vent stacks may be connected into a common vent header at the top of the stacks and then extended to the open air at one location. This header shall be sized in accordance with the requirements of Table 50-K, the number of units being the sum of all units on all stacks connected thereto, and the developed length being the longest vent length from the intersection at the base of the most distant stack to the vent terminal in the open air as a direct extension of one stack.

1. **Size of Circuit or Loop Vent.** The diameter of a circuit or loop vent shall be not less than 1/2 the diameter of the horizontal waste branch. See Table 50-L.

(o) **Size of Vent Piping.** The size of vent piping shall be determined from its length and total of fixture units connected thereto as provided in Table 50-K.

(p) **Combination Waste and Vent System.**

1. **Where Permitted.** Combination waste and vent system shall be permitted only where design conditions preclude the installation of a conventional system in this Building Code.

2. **Limits.** A combination waste and vent system is limited to floor drains, drinking fountains, indirect waste receptors, lavatories, and sinks. It consists of an installation of waste piping in which the trap of the fixture is not individually vented. Every waste pipe in the system shall be at least 2 pipe sizes larger than the size required in Section 5013. The drain to which the connection is made shall be vented in the same branch interval, both upstream and downstream of the connection to the drain, and the vents shall be sized in accordance with Table 50-L.

(q) **Single Stack System.** An engineered single stack system using special fittings designed for systems may be used with prior approval of the Department. See Chapter 1.
SECTION 5015. STORM DRAINS.

(a) Drainage Required. When drainage is piped to a point of discharge off the premises, roofs, paved areas, yards, courts, and court yards shall be drained into a storm sewer system or a combined sewer system, when the systems are available. Storm drainage shall be discharged so as to minimize the creation of a nuisance or a hazard. A building storm drain shall not be connected to a building drain. Roof drains shall form an independent system from any other allowable gravity drains within the building. An interceptor, when required, shall also be provided ahead of any pumping device. See Section 5004(c)7.

1. Traps. Leaders and storm drains, when connected to a combined sewer, shall be trapped and vented. One trap on the storm drain of the building may be used.

2. Expansion Joints. Expansion joints or sleeves shall be provided where necessary to accommodate temperature variations or other building movement.

3. Subsoil Drains. Where subsoil drains are placed under the cellar or basement floor or are used to encircle the building walls, they shall be made of open-jointed, horizontally split, perforated clay tile, perforated bituminized fiber pipe, perforated plastic, or asbestos cement pipe not less than 3 inches in diameter.

(b) Materials.

1. Inside Leaders. Leaders when placed within a building or run in a vent or pipe shaft shall conform to Section 5013(a)1.

2. Outside Leaders. When outside leaders are of sheet metal connected with a building storm drain or storm sewer, they shall be connected to cast iron drain extending above the finish grade and provided with a cleanout.

3. Underground Drains. Building storm drains, when underground, shall conform to Section 5013(a)2.

4. Building Storm Sewer. Building storm sewers shall conform to Section 5013(c).

5. Covers for Roof Drains. All roof drains and overflow drains shall have vandal resistant covers. (Revised 8/80 Ordinance No. 393)

(c) Size of Leaders and Storm Drains.
1. **Vertical Leaders.** The size of vertical leaders shall be based upon the maximum projected roof area in accordance with Table 50-M, unless the runoff is controlled by engineered weir-type drains as provided for in Section 5015(c)3.

2. **Building Storm Drains.** The size of the building storm drain or any of its horizontal branches having a slope of 1/2 inch or less per foot, shall be based upon the maximum projected roof area to be handled, in accordance with Table 50-N, unless the flow is controlled by an engineered system as provided for in Section 5015(c)3.

3. **Controlled Flow Storm Water System.**
   
   **A. Application.** In lieu of sizing the storm drainage system on the basis of actual maximum projected roof areas as previously described in this Chapter, the roof drainage system may be sized on the equivalent or adjusted maximum projected roof areas which result from controlled flow and storage of storm water on the roof provided approved flow control devices are incorporated into a finished roof.

   **B. Roof Drains.** Roof drains and leader piping to individual roof drains shall be sized using tables 50-M and 50-N or using engineered flow rates. If scuppers are used for overflow in lieu of a piped system, then all storm drainage piping may be sized using engineered flow rates. (Revised 8/80 Ordinance No. 393)

   **C. Roof Construction.** See Chapters 23 and 32.

   **D. Installation.** Control of run off from flat roofs may be controlled devices. Height of stones or other granular material above water proofed surface shall be discounted and in no case shall the surface in the vicinity of the drain be recessed to create a reservoir. Control devices shall be protected by strainers.

   **E. Drains Required.** At least 2 drains shall be installed in roof areas 10,000 square feet or less and at least 4 drains in roof areas over 10,000 square feet.

4. **Values for Continuous Flow.** Where a continuous or semicontinuous discharge from a pump, air conditioning plant, or similar device, flows into the building storm drain or building sewer, each gallon per minute of discharge shall be computed as being equivalent to 48 square feet of roof area.

(d) **Overflow Drains.**
1. **Overflow Drains and Scuppers.** When roof drains are installed, overflow drains (one (1) per roof drain) shall be installed with the inlet flow line a maximum of 4 inches above the low point of the roof. Overflow drains shall be sized per tables 50-M and 50-N. In lieu of overflow drains, scuppers shall be installed in adjacent parapet walls. See Chapter 32. No overflow drains or scuppers are required if the maximum water depth cannot exceed 4 inches. **EXCEPTION:** If greater water detention is required, overflow drains and scuppers may extend beyond 4 inch height provided roof loading calculations are submitted and approved by the Department. (See Chapter 23)

2. **Installation.** Overflow drains shall be connected to leader piping after the first 90 degree offset serving a roof drain or be taken independently down through the building and discharged on grade or into storm sewer. When overflow drains and roof drains are combined into a single piping system, all connection to that system must be offset 90 degrees from the vertical prior to connection.  
(Revised 8/80) Ordinance No. 383

**SECTION 5016. TESTS.**

(a) **Material and Labor for Tests.** The equipment, material, power, and labor necessary for the inspections and tests required by this Chapter shall be furnished by the plumbing contractor.

(b) **Tests of Drainage and Vent Systems.** All of the piping of the plumbing system shall be tested with water or air. Test procedures shall not conflict with material manufacturer printed instructions, but in no case shall tests be less than required by this Section.

1. **Water Pressure Test.** The water pressure test shall be applied to drainage system, exclusive of the building sewer, either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water. No section shall be tested with less than a 10 foot head of water. In testing successive sections at least the upper 10 feet of the next preceding section shall be tested, so
that no joint or pipe in the building (except the uppermost 10 feet of the system) shall have been submitted to a test of less than a 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts. The system shall then be tight and without leaks at all points.

2. Air Test. The air test shall be made by attaching an air compressor or testing apparatus to any suitable opening; and, after closing all other inlets and outlets of the system, forcing air into the system until there is a uniform gauge pressure to balance a column of mercury 10 inches in height. This pressure shall be held without introduction of additional air for a period of at least 15 minutes.

i) Test of Water-Supply System. Upon completion of a section or of the entire water supply system, it shall be tested and proved tight under a water pressure of at least the working pressure under which it is to be used. The water used for tests shall be obtained from the normal source of supply.

j) Test of Interior Leaders or Downspouts. Leaders or downspouts and branches within a building shall be tested by water or air in accordance with Section 5016(b)1 or 5016(b)2.

SECTION 5017. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cast Iron Screwed Fittings, 125 and 250 lb., B16.4-1971.</td>
</tr>
<tr>
<td></td>
<td>Threaded Cast Iron Pipe for Drainage Vent, and Waste Services, A40.5-1943.</td>
</tr>
<tr>
<td></td>
<td>Malleable Iron Screwed Fittings, 150 and 300 lb., B16.3-1971.</td>
</tr>
</tbody>
</table>
Seamless Copper Tube, Spec. for, H23.3-1973.
Zinc-Coated (Galvanized) Wrought Iron Sheets, Spec. for, G8.8-1937.

ASTM Seamless and Welded Ferritic Stainless Steel Tubing for General Service, Spec. for, A268.70.
Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses, Spec. for, A120-70.
Seamless Brass Tube, Spec. for B135-71.
Extra Strength Clay Pipe, Spec. for, C700-74.
Concrete Sewer, Storm Drain, and Culvert Pipe, Spec. for, C14-73.
Leaded Brass Plate, Strip, and Rolled Bar, Spec. for, B121-71.
Copper Sheet, Strip Plate and Rolled Bar, Spec. for, B152-74.
Solder Metal, Spec. for, B32-70.
Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, D2852-1974.

AWWA Coal-Tar Enamel. (Protective Coating), 7A.61940.
CISPI Coupling for No-Hub Cast Iron Waste Pipe, 301-78.

LEGEND

ORGANIZATION

ANSI American National Standards Institute
1430 Broadway
New York, N.Y. 10018

ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

AWWA American Water Works Association
6666 W. Quincy Ave.
Denver, CO 80235

CISPI Cast Iron Soil Pipe Institute Standard
2029 K Street, N.W.
Washington, D.C. 20006

SECTION 5018. TABLES AND CHARTS.
<table>
<thead>
<tr>
<th>Material</th>
<th>Pipe Size in Inches</th>
<th>Maximum Spacing in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPPER</td>
<td>( \frac{1}{8} )</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>( \frac{1}{4} ), 1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>( 1 \frac{1}{4}, 1 \frac{1}{2} ), 2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>( 2 \frac{1}{4}, 3 \frac{1}{2}, 4 ), 5</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>6 and Over</td>
<td>14</td>
</tr>
<tr>
<td>STEEL</td>
<td>( \frac{1}{8} )</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>( \frac{1}{4}, 1 \frac{1}{4} )</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>( 1 \frac{1}{4}, 2 \frac{1}{2} )</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>( 3, 3 \frac{1}{2} )</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>5 and Over</td>
<td>16</td>
</tr>
<tr>
<td>GLASS</td>
<td>All Sizes</td>
<td>8</td>
</tr>
<tr>
<td>PLASTIC</td>
<td>( \frac{1}{8}, \frac{1}{4}, 1 ) ( \frac{1}{4}, 1 \frac{1}{2} ), 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( 2 \frac{1}{4}, 3, 4 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 and Over</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hanger Spacing @ Temperature</th>
<th>Below 100° F.</th>
<th>101-130° F.</th>
<th>131-150° F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8, 1/4, 1, 1 1/4, 1 1/2, 2</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2 1/4, 3, 4</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6 and Over</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>TYPE OF CONNECTION</td>
<td>DEGREES OF HAZARD</td>
<td>TYPES OF PROTECTION</td>
<td>DOUBLE CHECK VALVE</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>Moderate</td>
<td>Minor</td>
</tr>
<tr>
<td>Direct Water Connections subject to pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Pumps, tanks, and lines handling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Sewage and lethal substances</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Toxic substances</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Non-toxic substances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Water connection to steam and steam boiler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Boiler or steam connection to toxic substances</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Boiler or steam connection to non-toxic substances</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**TOXIC SUBSTANCE**
Any substance (liquid, solid, or gaseous) which, when introduced into the water supply system, creates a danger to the health and well-being of the consumer.

**NON TOXIC SUBSTANCE**
Any substance of a non-poisonous nature that is potable or edible and that creates a severe, moderate, or minor hazard to the domestic water system.

**EXAMPLES**
1. Connections of food processing lines such as syrups, iod, beer, etc.
2. Connections to steam and steam boilers where the steam does not come in contact with poisonous materials.
3. Steam clean-up connection in food plants, apartment house boilers, or pressing boilers where toxic compounds are not used.
4. Connections to enclosed circulating systems such as radiant heating systems and refrigerated water systems where toxic compounds are not used.
# TABLE NO. 50-B (cont'd.)

**APPLICATION OF BACKFLOW PREVENTION DEVICES IN CROSS-CONNECTIONS AND WHERE CONTAMINATION IS HAZARDOUS TO THE POTABLE WATER SUPPLY**

<table>
<thead>
<tr>
<th>TYPE OF CONNECTION</th>
<th>DEGREES OF HAZARD</th>
<th>TYPES OF PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe</td>
<td>Moderate</td>
</tr>
<tr>
<td>C. Hot water heating boilers, generators or pressure vessels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Connection to toxic substances*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Connection to non-toxic substances*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. Direct or Indirect Water Connections not subject to pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Low inlet to receptacles containing toxic substances*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Low inlet to receptacles containing non-toxic substances*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Lawn sprinkler systems (chemical injection prohibited)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Coils or jackets used as heat exchangers in compressors, degreasers or other equipment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* **TOXIC SUBSTANCE:** Any substance (liquid, solid, or gaseous) which, when introduced into the water supply system, creates a danger to the health and well-being of the consumer.

* **NON-TOXIC SUBSTANCE:** Any substance of a non-poisonous nature that is potable or edible and that creates a severe, moderate, or minor hazard to the domestic water system.

**EXAMPLES:**
1. Connections of food processing lines such as syrup, lard, beer, etc.
2. Connections to steam and steam boilers where the steam does not come in contact with poisonous materials.
3. Steam clean-up connection in food plants, apartment house boilers, or pressing boilers, where toxic compounds are not used.
4. Connections to enclosed circulating systems, such as radiant heating systems and refrigerated water systems, where toxic compounds are not used.
### TABLE NO. 50-B (Con’t)
APPLICATION OF BACKFLOW PREVENTION DEVICES IN CROSS-CONNECTIONS AND WHERE CONTAMINATION IS HAZARDOUS TO THE POTABLE WATER SUPPLY

<table>
<thead>
<tr>
<th>TYPE OF CONNECTION</th>
<th>DEGREES OF HAZARD</th>
<th>TYPES OF PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe</td>
<td>Moderate</td>
</tr>
<tr>
<td>1. In sewer lines</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. In toxic substance(^a)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3. In non-toxic substance(^b)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E. Flushometer valve toilets and urinals</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>F. Toilet and urinal tanks</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G. Valved outlets or fixtures with hose attachments which may constitute a cross connection:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Toxic substances(^a)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. Non-toxic substances(^b)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>H. Water connected into domestic water tanks</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>I. Plumbing drainage lines</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>J. Reclaimed or recycled water</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

\(^a\) **TOXIC SUBSTANCE**

Any substance liquid, solid, or gaseous which, when introduced into the water supply system, creates a danger to the health and well-being of the consumer.

\(^b\) **NON TOXIC SUBSTANCE**

Any substance of a non-poisonous nature that is potable or edible and that creates a severe, moderate, or minor hazard to the domestic water system.

**EXAMPLES:**
1. Connections of food processing lines such as syrup, lard, beer, etc.
2. Connections to steam and steam boilers where the steam does not come in contact with poisonous materials.
3. Steam clean up connection in food plants, apartment house boilers, or pressing boilers, where toxic compounds are not used.
4. Connections to enclosed circulating systems, such as radiant heating systems and refrigerated water systems, where toxic compounds are not used.
1. Rate of Flow and Required Pressures During Flow for Different Fixtures

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Flow Pressure (p.s.i.)</th>
<th>Flow Rate (g.p.m.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary basin faucet</td>
<td>8</td>
<td>3.0</td>
</tr>
<tr>
<td>Self-closing basin faucet</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>Sink faucet, 3/4 inch</td>
<td>10</td>
<td>4.5</td>
</tr>
<tr>
<td>Sink faucet, 1/2 inch</td>
<td>6</td>
<td>4.5</td>
</tr>
<tr>
<td>Bathhtub faucet</td>
<td>5</td>
<td>6.0</td>
</tr>
<tr>
<td>Laundry-tub cock, 1/2 inch</td>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td>Shower</td>
<td>12</td>
<td>5.0</td>
</tr>
<tr>
<td>Ball cock for closet</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>Flushometer valve for urinal</td>
<td>15</td>
<td>15.0</td>
</tr>
<tr>
<td>Garden hose, 50 feet and sill cock</td>
<td>30</td>
<td>6.0</td>
</tr>
<tr>
<td>Flushometer valve for closet</td>
<td>10 to 25</td>
<td>15 to 40a</td>
</tr>
</tbody>
</table>

2. Demand Weight of Fixtures in Fixture Units

<table>
<thead>
<tr>
<th>Fixture or Group</th>
<th>Occupancy</th>
<th>Type of Supply Control</th>
<th>Weight in Fixture Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water closet</td>
<td>Public</td>
<td>Flushometer valve</td>
<td>10</td>
</tr>
<tr>
<td>Water closet</td>
<td>Public</td>
<td>Flushometer valve</td>
<td>10</td>
</tr>
<tr>
<td>Pedestal urinal</td>
<td>Public</td>
<td>Flushometer valve</td>
<td>5</td>
</tr>
<tr>
<td>Stall or wall urinal</td>
<td>Public</td>
<td>Flap tank</td>
<td>3</td>
</tr>
<tr>
<td>Stall or wall urinal</td>
<td>Public</td>
<td>Fauceat</td>
<td>2</td>
</tr>
<tr>
<td>Lavatory</td>
<td>Public</td>
<td>Fauceat</td>
<td>4</td>
</tr>
<tr>
<td>Bathrub</td>
<td>Public</td>
<td>Mixing valve</td>
<td>4</td>
</tr>
<tr>
<td>Shower head</td>
<td>Public</td>
<td>Fauceat</td>
<td>3</td>
</tr>
<tr>
<td>Service sink</td>
<td>Hotel or Rest.</td>
<td>Fauceat</td>
<td>4</td>
</tr>
<tr>
<td>Water closet</td>
<td>Private</td>
<td>Flushometer valve</td>
<td>6</td>
</tr>
<tr>
<td>Water closet</td>
<td>Private</td>
<td>Flap tank</td>
<td>3</td>
</tr>
<tr>
<td>Lavatory</td>
<td>Private</td>
<td>Fauceat</td>
<td>2</td>
</tr>
<tr>
<td>Bathrub</td>
<td>Private</td>
<td>Fauceat</td>
<td>2</td>
</tr>
<tr>
<td>Shower head</td>
<td>Private</td>
<td>Mixing valve</td>
<td>2</td>
</tr>
<tr>
<td>Bathroom group</td>
<td>Private</td>
<td>Flushometer valve for closet</td>
<td>8</td>
</tr>
<tr>
<td>Bathroom group</td>
<td>Private</td>
<td>Flap tank for closet</td>
<td>6</td>
</tr>
<tr>
<td>Separate shower</td>
<td>Private</td>
<td>Mixing valve</td>
<td>2</td>
</tr>
<tr>
<td>Kitchen sink</td>
<td>Private</td>
<td>Fauceat</td>
<td>3</td>
</tr>
<tr>
<td>Laundry tray (1 to 3)</td>
<td>Private</td>
<td>Fauceat</td>
<td>3</td>
</tr>
<tr>
<td>Combination fixture</td>
<td>Private</td>
<td>Fauceat</td>
<td>3</td>
</tr>
</tbody>
</table>

- Flow pressure is the pressure in the pipe at the entrance to the particular fixture considered.
- Wide range due to variation in design and type of flushometer valve closets.
- For supply outlets likely to impose continuous demands, estimate continuous supply separately and add to total demand for fixtures.
- For fixtures not listed, weights may be assumed by comparing the fixture to a listed one using water in similar quantities and at similar rates.
- The given weights are for total demand. For fixtures with both hot and cold water supplies, the weights for maximum separate demands may be taken as 1/4ths the listed demand for supply.

**NOTE 1.** Chart C-1 gives the estimated demand in gallons per minute corresponding to any total number of fixture units. Chart C-2 indicates an enlargement of Chart C-1 for a range up to 360 fixture units.

**NOTE 2.** The estimated demand load for fixtures used intermittently on any supply pipe shall be obtained by multiplying the number of each kind of fixture supplied through that pipe by its weight from Table 50-C (2), adding the products, and then referring to the appropriate curve of Charts C-1 and C-2 to find the demand corresponding to the total fixture units. In using this method, it should be noted that the demand for fixture or supply outlets other than those listed in Table 50-C (2) is not included in the estimate. The demands for outlets (such as hose connections, air-conditioning apparatus, etc.) which are likely to impose continuous demands during times of heavy use of the weighted fixtures, shall be estimated separately and added to the demand for fixtures used intermittently, in order to estimate the total demand.
CHART C-3

Friction Loss in Head in Lbs. per Sq. In. per 100 Ft. Length

Copper Tubing
Smooth Pipe
Type M
Type L
Type K

PIPE SIZING DATA

08/88
STEEL PIPE SIZES

PIPE SIZING DATA
FRICION LOSS IN HEAD IN LBS. PER SQ. IN. PER 100 FT. LENGTH

CPVC

PIPE SIZING DATA
### TABLE NO. 50-D

#### TYPE OF FIXTURE

<table>
<thead>
<tr>
<th>FIXTURE</th>
<th>PIPE SIZE (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathtub</td>
<td>1/8</td>
</tr>
<tr>
<td>Combination sink and tray</td>
<td>1/8</td>
</tr>
<tr>
<td>Drinking fountain</td>
<td>3/8</td>
</tr>
<tr>
<td>Dish washer, domestic</td>
<td>1/8</td>
</tr>
<tr>
<td>Kitchen sink, commercial</td>
<td>1/8</td>
</tr>
<tr>
<td>Kitchen sink, residential</td>
<td>3/8</td>
</tr>
<tr>
<td>Lavatory</td>
<td>1/8</td>
</tr>
<tr>
<td>Laundry tray 1, 2, or 3 compartments</td>
<td>1/8</td>
</tr>
<tr>
<td>Shower (single head)</td>
<td>1/8</td>
</tr>
<tr>
<td>Sinks (service, slop)</td>
<td>1/8</td>
</tr>
<tr>
<td>Sinks, flushing rim with flushometer valve</td>
<td>1/8</td>
</tr>
<tr>
<td>Urinal (flush tank)</td>
<td>1/8</td>
</tr>
<tr>
<td>Urinal (direct flushometer valve operated)</td>
<td>3/8</td>
</tr>
<tr>
<td>Water closet (tank type)</td>
<td>3/8</td>
</tr>
<tr>
<td>Water closet (flushometer valve operated)</td>
<td>1</td>
</tr>
<tr>
<td>Hose bibs and sill cocks</td>
<td>1/8</td>
</tr>
</tbody>
</table>

**NOTE:** For fixtures not listed, the minimum supply branch may be made the same as for comparable fixtures.

### TABLE NO. 50-E

#### MINIMUM SLOPES FOR WASTE PIPING

<table>
<thead>
<tr>
<th>Diameter of Pipe (Inches)</th>
<th>Slope per foot (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4, 1 1/4, 2, 2 1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>3, 4, 5, 8</td>
<td>1/8</td>
</tr>
<tr>
<td>8, 10, 12, 15</td>
<td>1/16</td>
</tr>
</tbody>
</table>
TABLE NO. 50-F
BASIS FOR COMPUTING DRAINAGE FIXTURE UNIT VALUES AND TRAP SIZES

<table>
<thead>
<tr>
<th>Type of Fixture or Group of Fixtures</th>
<th>Drainage Fixture Unit Value (d.f.u.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic clothes washer (2&quot; standpipe)</td>
<td>3</td>
</tr>
<tr>
<td>Bathroom group consisting of a water closet, lavatory and bathtub or shower stall:</td>
<td></td>
</tr>
<tr>
<td>Flushometer valve closet</td>
<td>8</td>
</tr>
<tr>
<td>Tank type closet</td>
<td>6</td>
</tr>
<tr>
<td>Bathhtub* (with or without overhead shower)</td>
<td>2</td>
</tr>
<tr>
<td>Bidet</td>
<td>1</td>
</tr>
<tr>
<td>Clinic sink</td>
<td>6</td>
</tr>
<tr>
<td>Combination sink and tray with food waste grinder</td>
<td>4</td>
</tr>
<tr>
<td>Combination sink and tray with one 1 1/4 inch trap</td>
<td>2</td>
</tr>
<tr>
<td>Combination sink and tray with separate 1 1/4 inch traps</td>
<td>3</td>
</tr>
<tr>
<td>Dental unit or cuspidor</td>
<td>1</td>
</tr>
<tr>
<td>Dental lavatory</td>
<td>1</td>
</tr>
<tr>
<td>Drinking fountain</td>
<td>1/8</td>
</tr>
<tr>
<td>Dishwasher, domestic</td>
<td>2</td>
</tr>
<tr>
<td>Floor drains with 2 inch waste</td>
<td>2</td>
</tr>
<tr>
<td>Kitchen sink, domestic, with food waste grinder</td>
<td>2</td>
</tr>
<tr>
<td>Kitchen sink, domestic, with one 1 1/4 inch trap</td>
<td>2</td>
</tr>
<tr>
<td>Kitchen sink, domestic, with food waste grinder and dishwasher 1 1/4 inch trap</td>
<td>3</td>
</tr>
<tr>
<td>Kitchen sink, domestic, with dishwasher 1 1/4 inch trap</td>
<td>3</td>
</tr>
<tr>
<td>Lavatory with 1 1/4 inch waste</td>
<td>1</td>
</tr>
<tr>
<td>Laundry tray (1 or 2 compartments)</td>
<td>2</td>
</tr>
<tr>
<td>Showers (per head)</td>
<td>2</td>
</tr>
<tr>
<td>Sinks:</td>
<td></td>
</tr>
<tr>
<td>Surgeon’s</td>
<td>3</td>
</tr>
<tr>
<td>Flushing rim (with flushometer valve)</td>
<td>6</td>
</tr>
<tr>
<td>Service (trap standard)</td>
<td>3</td>
</tr>
<tr>
<td>Service (P trap)</td>
<td>2</td>
</tr>
<tr>
<td>Pot, scullery, etc.</td>
<td>4</td>
</tr>
<tr>
<td>Urinal, pedestal, syphon jet blowout</td>
<td>6</td>
</tr>
<tr>
<td>Urinal, wall lip</td>
<td>3</td>
</tr>
<tr>
<td>Urinal, stall, washout</td>
<td>3</td>
</tr>
<tr>
<td>Wash sink (circular or multiple) each set of faucets</td>
<td>2</td>
</tr>
<tr>
<td>Water closet, tank operated</td>
<td>4</td>
</tr>
<tr>
<td>Water closet, flushometer valve operated</td>
<td>6</td>
</tr>
<tr>
<td>All other fixtures*</td>
<td></td>
</tr>
<tr>
<td>Trap size 1 1/4 inch or less</td>
<td>1</td>
</tr>
<tr>
<td>Trap size 1 1/2 inch</td>
<td>2</td>
</tr>
<tr>
<td>Trap size 2 inch</td>
<td>3</td>
</tr>
<tr>
<td>Trap size 2 1/4 inch</td>
<td>4</td>
</tr>
<tr>
<td>Trap size 3 inch</td>
<td>5</td>
</tr>
<tr>
<td>Trap size 4 inch</td>
<td>6</td>
</tr>
</tbody>
</table>

* A shower head over a bathtub does not increase the fixture unit value.

b For a continuous or semi-continuous flow into a drainage system, such as from a pump, sump ejector, air conditioning equipment, or similar device, 2 fixture units shall be permitted for each gallon-per-minute of flow.
### TABLE NO. 50-G

**BUILDING DRAINS AND SEWERS**

**MAXIMUM NUMBER OF FIXTURE UNITS THAT MAY BE CONNECTED TO ANY PORTION* OF THE BUILDING DRAIN OR THE BUILDING SEWER.**

<table>
<thead>
<tr>
<th>Diameter of Pipe (Inches)</th>
<th>SLOPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>⅛ inch</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>2 ⅛</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>390</td>
</tr>
<tr>
<td>5</td>
<td>700</td>
</tr>
<tr>
<td>6</td>
<td>1,400</td>
</tr>
<tr>
<td>10</td>
<td>2,500</td>
</tr>
<tr>
<td>12</td>
<td>3,500</td>
</tr>
</tbody>
</table>

*Includes branches of the building drain.

**TABLE NO. 50-H**

**MAXIMUM LOADS FOR WASTE BRANCH AND STACKS HAVING NOT MORE THAN 3 BRANCH INTERVALS**

<table>
<thead>
<tr>
<th>Diameter of Stack (Inches)</th>
<th>MAXIMUM LOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any Horizontal Fixture Branch (d.f.u.)</td>
</tr>
<tr>
<td>1 ⅛</td>
<td>1</td>
</tr>
<tr>
<td>1 ⅛</td>
<td>4</td>
</tr>
<tr>
<td>2 ⅛</td>
<td>20b</td>
</tr>
<tr>
<td>3 ⅛</td>
<td>100</td>
</tr>
<tr>
<td>4 ⅛</td>
<td>225</td>
</tr>
<tr>
<td>5 ⅛</td>
<td>385</td>
</tr>
<tr>
<td>6 ⅛</td>
<td>875</td>
</tr>
</tbody>
</table>

*Minimum size for food waste grinder is 2 inches.

b Not more than 2 water closets or bathroom groups within each branch interval nor more than 6 water closets or bathroom groups on the stack.

c (d.f.u.) Drain fixture unit.
### TABLE NO. 50-I
MAXIMUM LOADS FOR WASTE STACKS HAVING FOUR OR MORE BRANCH INTERVALS

<table>
<thead>
<tr>
<th>Number of Branch Intervals</th>
<th>Diameter of Stack (in)</th>
<th>2&quot;</th>
<th>2 1/4&quot;</th>
<th>3&quot;a</th>
<th>4&quot;</th>
<th>5&quot;</th>
<th>6&quot;</th>
<th>8&quot;</th>
<th>10&quot;</th>
<th>12&quot;</th>
<th>15&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>one interval</td>
<td>3</td>
<td>7</td>
<td>18a</td>
<td>90</td>
<td>205</td>
<td>350</td>
<td>785</td>
<td>1405</td>
<td>2195</td>
<td>3985</td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>13</td>
<td>27</td>
<td>72a</td>
<td>360</td>
<td>820</td>
<td>1400</td>
<td>3140</td>
<td>6820</td>
<td>8780</td>
<td>16,740</td>
</tr>
<tr>
<td>5</td>
<td>one interval</td>
<td>3</td>
<td>8</td>
<td>17a</td>
<td>84</td>
<td>190</td>
<td>325</td>
<td>735</td>
<td>1310</td>
<td>2045</td>
<td>3675</td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>16</td>
<td>32</td>
<td>85a</td>
<td>420</td>
<td>950</td>
<td>1625</td>
<td>3675</td>
<td>6550</td>
<td>10,225</td>
<td>18,375</td>
</tr>
<tr>
<td>6</td>
<td>one interval</td>
<td>3b</td>
<td>6b</td>
<td>16a</td>
<td>80</td>
<td>180</td>
<td>310</td>
<td>700</td>
<td>1200</td>
<td>1950</td>
<td>3500</td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>18c</td>
<td>36c</td>
<td>96a</td>
<td>480</td>
<td>1080</td>
<td>1860</td>
<td>4200</td>
<td>7500</td>
<td>11,700</td>
<td>21,000</td>
</tr>
<tr>
<td>7</td>
<td>one interval</td>
<td>16a,b</td>
<td>76b</td>
<td>175</td>
<td>299</td>
<td>675</td>
<td>1205</td>
<td>1880</td>
<td>3375</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>102a,c</td>
<td>530c</td>
<td>1215</td>
<td>2090</td>
<td>4725</td>
<td>8435</td>
<td>13,160</td>
<td>23,620</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>one interval</td>
<td>170</td>
<td>290</td>
<td>655</td>
<td>1170</td>
<td>1825</td>
<td>3280</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>1360</td>
<td>2320</td>
<td>5240</td>
<td>9360</td>
<td>14,600</td>
<td>26,240</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>one interval</td>
<td>155b</td>
<td>285</td>
<td>640</td>
<td>1145</td>
<td>1790</td>
<td>3210</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>1400c</td>
<td>2560</td>
<td>5780</td>
<td>10,310</td>
<td>16,090</td>
<td>28,880</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>one interval</td>
<td>290</td>
<td>630</td>
<td>1125</td>
<td>1755</td>
<td>3150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>2800</td>
<td>6300</td>
<td>11,250</td>
<td>17,550</td>
<td>31,500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>one interval</td>
<td>265b</td>
<td>620</td>
<td>1110</td>
<td>1730</td>
<td>3100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on stack</td>
<td>2900c</td>
<td>6830</td>
<td>12,200</td>
<td>19,020</td>
<td>31,160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Not more than two water closets or bathroom groups within any one branch interval and not more than 6 water closets or bathroom groups on the stack.

b Loads on any one branch interval for higher stacks shall not exceed those values, however, this shall not preclude the installation of higher stacks.

c Stack loads for additional branch intervals shall not exceed these values.
**TABLE NO. 50-1**

**MAXIMUM LOADS FOR WASTE STACKS HAVING FOUR OR MORE BRANCH INTERVALS**

<table>
<thead>
<tr>
<th>Number of Branch Intervals</th>
<th>Diameter of Stack (in.) for any:</th>
<th>2&quot;</th>
<th>2 1/4&quot;</th>
<th>3&quot;</th>
<th>4&quot;</th>
<th>5&quot;</th>
<th>6&quot;</th>
<th>8&quot;</th>
<th>10&quot;</th>
<th>12&quot;</th>
<th>16&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>610</td>
<td>1095</td>
<td>1705</td>
<td>3060</td>
</tr>
<tr>
<td>13</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7350</td>
<td>13,100</td>
<td>20,500</td>
<td>38,700</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>565b</td>
<td>1080</td>
<td>1890</td>
<td>3030</td>
</tr>
<tr>
<td>14</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7800c</td>
<td>14,070</td>
<td>21,960</td>
<td>39,390</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1070b</td>
<td>1870</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16,000c</td>
<td>23,410</td>
<td>42,016</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1655</td>
<td>2975</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24,800</td>
<td>44,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>1620b</td>
<td>2955</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26,000c</td>
<td>47,280</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2935</td>
<td>49,870</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>one interval on stack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2780b</td>
<td>50,000c</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a* Not more than two water closets or bathroom groups within any one branch interval and not more than 6 water closets or bathroom groups on the stack.

*b* Loads on any one branch interval for higher stacks shall not exceed these values, however, this shall not preclude the installation of higher stacks.

*c* Stack loads for additional branch intervals shall not exceed these values.
### TABLE NO. 50-J

**DISTANCE OF TRAP WEIR FROM VENT**

<table>
<thead>
<tr>
<th>Size of Fixture Drain (Inches)</th>
<th>Permissible Distance (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4</td>
<td>2.5</td>
</tr>
<tr>
<td>1 1/8</td>
<td>3.5</td>
</tr>
<tr>
<td>2</td>
<td>5.0</td>
</tr>
<tr>
<td>3</td>
<td>6.0</td>
</tr>
<tr>
<td>4</td>
<td>10.0</td>
</tr>
</tbody>
</table>

### TABLE NO. 50-K

**SIZE AND LENGTH OF VENTS**

<table>
<thead>
<tr>
<th>Size of Waste Stack (Inches)</th>
<th>Fixture Units Connected</th>
<th>Diameter of Vent Required (Inches)</th>
<th>Maximum Length of Vent (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 1/4</td>
<td>1 1/2</td>
</tr>
<tr>
<td>1 1/4</td>
<td>2</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>1 1/8</td>
<td>8</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>1 1/2</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2 1/2</td>
<td>36</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>102</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>-</td>
<td>-</td>
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<tr>
<td>4</td>
<td>530</td>
<td>-</td>
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<tr>
<td>5</td>
<td>200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>530</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1400</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>350</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>620</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>960</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>2900</td>
<td>-</td>
<td>-</td>
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<tr>
<td>8</td>
<td>600</td>
<td>-</td>
<td>-</td>
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<tr>
<td>8</td>
<td>1400</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>2200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>7600</td>
<td>-</td>
<td>-</td>
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<tr>
<td>10</td>
<td>1000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>2500</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>3800</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>15,000</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
TABLE NO. 50-L
HORIZONTAL CIRCUIT AND LOOP VENT SIZING TABLE

<table>
<thead>
<tr>
<th>Waste Pipe Diameter (Inches)</th>
<th>Fixture Units: Number not Exceeding</th>
<th>Diameter of Circuit or Loop Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 1/4”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal Length, not Exceeding (Feet)</td>
</tr>
<tr>
<td>1 1/4</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>—</td>
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<tr>
<td>5</td>
<td>200</td>
<td>—</td>
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<tr>
<td>6</td>
<td>500</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>200</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>1100</td>
<td>—</td>
</tr>
</tbody>
</table>

TABLE NO. 50-M
SIZE OF VERTICAL LEADERS AND ROOF DRAINS

<table>
<thead>
<tr>
<th>Diameter of Leader or Conductor* (inches)</th>
<th>Maximum Projected Roof Area (Sq. Ft.)</th>
<th>Flow Rate (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>960</td>
<td>30</td>
</tr>
<tr>
<td>2 1/4</td>
<td>1733</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>2930</td>
<td>91</td>
</tr>
<tr>
<td>4</td>
<td>6130</td>
<td>191</td>
</tr>
<tr>
<td>5</td>
<td>11,530</td>
<td>359</td>
</tr>
<tr>
<td>6</td>
<td>17,995</td>
<td>561</td>
</tr>
<tr>
<td>8</td>
<td>38,660</td>
<td>1205</td>
</tr>
</tbody>
</table>

* Table No. 50-M is based on a 3 inch per hour rainfall.

TABLE NO. 50-N
SIZE OF HORIZONTAL STORM DRAINS

<table>
<thead>
<tr>
<th>Maximum Projected Roof Area in sq. ft. for drains of various slopes (inches per foot)</th>
<th>1/4 Inch</th>
<th>3/8 Inch</th>
<th>1/2 Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of Drain (Inches)</td>
<td>Flow Rate (GPM)</td>
<td>Flow Rate (GPM)</td>
<td>Flow Rate (GPM)</td>
</tr>
<tr>
<td>3</td>
<td>1086</td>
<td>36</td>
<td>1456</td>
</tr>
<tr>
<td>4</td>
<td>2506</td>
<td>78</td>
<td>3533</td>
</tr>
<tr>
<td>5</td>
<td>4453</td>
<td>142</td>
<td>6293</td>
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<tr>
<td>6</td>
<td>7133</td>
<td>231</td>
<td>10,068</td>
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<td>8</td>
<td>15,330</td>
<td>498</td>
<td>21,733</td>
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<tr>
<td>10</td>
<td>27,600</td>
<td>902</td>
<td>38,950</td>
</tr>
<tr>
<td>12</td>
<td>44,400</td>
<td>1467</td>
<td>62,600</td>
</tr>
<tr>
<td>15</td>
<td>72,800</td>
<td>2668</td>
<td>112,000</td>
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</tbody>
</table>
### TABLE NO. 50-O

**PIPING MATERIAL - WATER, DRAINAGE AND VENT**

<table>
<thead>
<tr>
<th>Material</th>
<th>USE</th>
<th>Water Piping Distribution</th>
<th>Interior Drainage and Vent Piping</th>
<th>Exterior Drainage Piping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Service</td>
<td>Under Slab</td>
<td>Above Ground</td>
</tr>
<tr>
<td>CAST IRON</td>
<td></td>
<td>A</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>Hub Type</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>No Hub Pipe &amp; Fitting</td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>COPPER TUBING</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Type K - Hard Temper</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Type L - Hard Temper</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Type M - Hard Temper</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>DWV Hard Temper</td>
<td></td>
<td>NP</td>
<td>NP</td>
<td>A</td>
</tr>
<tr>
<td>GALV. STEEL PIPE</td>
<td></td>
<td>A</td>
<td>NP</td>
<td>A</td>
</tr>
<tr>
<td>Threaded</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>PLASTIC</td>
<td></td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>ABS&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td>NA</td>
<td>NP</td>
<td>A</td>
</tr>
<tr>
<td>CPVC&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>PVC&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

**A = ACCEPTABLE  NP = NOT PERMITTED  NA = NOT APPLICABLE**

---

<sup>a</sup> Minimum sched. 40 pipe size (SDR-13.5).

<sup>b</sup> See Section 5013 (a) 1.

Plastic pipe, where permitted, shall not be installed within 5 feet of any foundation wall. Approved metal pipe shall be used within the 5 feet specified herein.

08/88 50-57
CHAPTER 51

GAS, LIQUID AND SOLID FUEL
(Revised 7/83 Ordinance No. 389)

SECTION 5101. GENERAL.
(a) Scope. In addition to other requirements of this Building Code, this Chapter shall govern the use, installation and repair of gas piping, liquid fuel piping, gas, liquid and solid fuel appliances.

(b) Hazards. No open flame equipment, regardless of the fuel utilized, shall be installed in, or combustion air obtained from, any woodworking establishments, planing mills and box factories; shops and factories where loose combustible materials, fibers or dust is manufactured, processed or generated; locations where flammable liquids or gases are present; grain elevators; flour mills; rubber, plastic, fiberglass or paper processing; rag processing or storage; painting booths or other volatile atmospheres, including occupancies where chlorinated hydrocarbons or other halogenated compounds are utilized or stored.

EXCEPTION: Open flame equipment as permitted in paint spray areas by NFPA 33.

(c) Safety Devices. Boilers, furnaces and water heaters, regardless of the energy source utilized, shall be equipped with approved safety devices arranged to limit high steam pressures, or water temperatures, or air temperatures in warm air furnaces.

(d) Equipment Installation. All appliances or equipment shall be installed with at least minimum clearances from combustible material required by their listing. All appliances or equipment shall be installed to be readily accessible for inspection, maintenance, repair or replacement as defined in this Chapter. Unless specifically listed for mounting on combustible floors, all floor mounted equipment shall be installed on a concrete slab of sufficient thickness (minimum 4 inches) to support the equipment, or other equivalent means of support shall be approved by the Department prior to installation.

(e) Piping Sketch. A fuel piping diagram shall be submitted to the Department for approval prior to installation showing proposed location and size of the piping and the various load demands for all A through H-2 occupancies or as required by the Department.
(f) Field Modifications. Prior to the field modification of any appliance, equipment or appurtenances thereto with an approved listed device(s), approval in writing from the appliance or equipment manufacturer and listed testing agency shall be submitted to and approved by the Department. This written approval shall contain a statement(s) that the safe operation of the appliance or equipment will not be adversely affected by the proposed field modification.

EXCEPTION 1: A listed and approved electric ignition system when the following stipulations are adhered to:

1. The equipment does not utilize oil or heavier than air gas mixtures.
2. Equipment must be listed for use with natural gas and be provided with an approved draft hood and gravity vent.
3. Shall be installed with redundant gas valve.
4. Appliance gas regulator shall be vented to outside atmosphere or equipped with an approved leak limiter.
5. Shall not be used with vent dampers unless specifically designed and tested for such use.
6. Must be installed per manufacturers instructions and the terms of its listing.

EXCEPTION 2: Vent Dampers: When the following stipulations are adhered to:

1. Vent dampers shall be listed.
2. Must be installed immediately after the draft hood and never in a common vent.
3. Equipment shall be a listed appliance with a draft hood and gravity vent.
4. If appliance has an electric ignition, the vent damper shall be listed for use with electric ignition.
5. Shall not be installed on equipment located in unheated areas.
6. Vent dampers shall not be installed on equipment with power burners or induced draft fans.
7. Must be installed per manufacturers instructions and the terms of its listing.

(g) Prohibited Locations. In addition to all other requirements of this Building Code, fuel fired appliances or equipment shall not be installed or used, in any new or existing building, within any of the following locations:
1. **Garages.** Fuel fired appliances or equipment shall not be installed or used in a garage or any other location where flammable vapors may be present except as specifically permitted under other sections of this code.

2. Fuel-fired appliances or equipment shall not be installed or used in a bedroom, bathroom, toilet room, janitor closet, or in any enclosed space with access only through a room mentioned above; or in any surgical operating or medical treatment room; or under any stairway. (Rev. 1/88 Ord. No. 22)

**EXCEPTION:** Appliances or equipment specifically approved for installation and use within these locations by a recognized national testing laboratory and approved by the Department.

3. **Gas ranges and plates.** In addition to other prohibitions of the section, gas ranges or plates shall not be located in any area used for sleeping purposes or in any enclosed area of less than 550 cubic feet and in no case shall be used for heating purposes. Gas ranges or plates shall be installed in areas provided with proper ventilation per this Chapter.

4. **Fuel-fired water heaters.** In addition to other prohibitions of this section, Fuel-fired water heaters shall not be installed in any attic or garage in H and I occupancies. Fuel-fired heaters shall not be installed in any closet used for any purpose, bathroom, toilet room, rooms used for sleeping purposes, residential garages, attic and crawl spaces.

**EXCEPTION:** Commercial garages see Chapter 58.

5. **Gas refrigerators.** The installation and use of gas-fired refrigerators is prohibited.

6. Fuel-fired appliances or equipment shall not be located above false or lay-in ceilings.

7. **LPG appliances or equipment.** In addition to other requirements for fuel-fired equipment, liquid petroleum gas-burning appliances or equipment shall not be installed or located in a pit, cellar, basement, crawl space or other areas located below grade where heavier than air/gas mixtures might tend to collect to form a flammable mixture.

8. **Gas lights.** The installation of gas lights inside of buildings is prohibited.

(Rev. 6/88)
9. **Gas fireplace wood log lighters and open gas torches.** Gas fireplace wood log lighters, and open gas torches are prohibited. (Rev. 3/87 Ord. No. 126)

10. **Power Burners.** Equipment with atmospheric burners and gravity vents shall not be located in the same room with equipment utilizing power burners or induced draft fans. 

   EXCEPTION: Residential appliances installed in Groups H-2, H-3, and I occupancies when approved by the Department.

(h) **Fuel Supply Piping Prohibitions.** In addition to all other requirements of this Building Code, the following prohibitions are applicable to fuel supply piping.

1. Fuel supply piping shall not be strained, stressed or bent and appliances or equipment shall not support or be supported by, or develop any stress or strain on the supply piping.

2. **Non-metallic pipe.** The installation of non-metallic pipe or fittings within all or part of any fuel supply piping system is prohibited.

3. **Cast iron pipe:** The installation of cast iron pipe or fittings within all or part of any fuel supply piping system is prohibited.

4. **Aluminum and copper tubing and pipe:** The use of aluminum and copper tubing or pipe within all or part of any fuel supply piping system is prohibited. 

   EXCEPTION: Type K copper, internally tinned, for outdoor gas lights and gas grills as provided in other sections of this Chapter.

5. **Installation:** Fuel supply piping shall not be installed in or through chimneys, corridors, stairways, hoistways, vents, ventilating ducts or shafts.

6. **Support:** The use of wire to support any fuel supply piping is prohibited.

   EXCEPTION: The use of drive hooks is permitted.

7. **Interconnecting of gas systems:** The installation, use, or maintenance of a gas valve which makes it possible to turn on or otherwise direct the flow of gas from one system of gas piping to another, where the systems are supplied with gas from separate suppliers or meters, is prohibited.

   EXCEPTION: An approved 3 way valve may be used when approved by the Department.
8. **Elevated gas pressures:** Gas supply pressures within Group H, I, and J occupancies shall not exceed 8 inches water column for natural gas and 14 inches water column for liquid petroleum gas.

9. **Soldered Joints:** The use of soldered joints is prohibited.

10. The use of compression type couplings is prohibited.

11. The installation of galvanized pipe in fuel supply piping system is prohibited.

**SECTION 5102. DEFINITIONS.**

(a) **General.** For purposes of this Chapter, the following definitions shall apply:

**Air for Combustion.** The amount of air required for safely and properly burning fuel at 5,000 feet altitude.

**Air Shutter.** An adjustable device for varying the effective opening of an air passage.

**Appliance.** Heating, cooling, cooking or drying equipment utilizing gas, liquid or solid fuel, including but not limited to gas lights, stoves, furnaces, boilers, deep fat fryers, ranges, broilers, smelting pots, incinerators, fireplaces, and any fuel-fired device and/or appurtenances attached thereto.

**Appliance Connector.** An assembly used to convey fuel between a fuel piping outlet and a fuel-fired appliance. This includes alignment and flexible connectors.

**Appliance, Unvented.** An appliance installed so the products of combustion are not conveyed directly to the outside atmosphere.

**Appliance, Vented.** An appliance installed so all the products of combustion are conveyed directly to the outside atmosphere through an approved chimney or venting system.

**Approved (Approval).** See Chapter 4.

**Appurtenance.** Any component, attachment, accessory, addition or other device which is part of any appliance or equipment which can be or is installed, repaired, serviced, or retrofitted to the original manufactured item. These include any item, device, part or section whose designed purpose is to affect the operation of the appliance or equipment by reducing fuel consumption either by fuel use or flue product retardation, including heat reclaimers.

(Rev. 6/88)
Automatically Controlled Fuel Supply. One in which the fuel supply is turned on and off automatically.

Btu. British Thermal Unit.

Burner. A device for the final conveyance of a mixture of fuel and air to the combustion zone.

Burner Valve. A manually or mechanically operated device which controls the flow of fuel to the main burner.

Clearance. The distance between heat-producing appliances or equipment, chimney, chimney connector, vent, vent connector, plenum, fuel supply piping, water or air conditioning piping, and other combustible or non-combustible surface. Clearance shall be sufficient to perform maintenance, remove burners or blowers, or replacement of the equipment or appliance. (See Clearance Table Chapter 52).

Clothes Dryer. An appliance used to dry wet laundry by means of heat derived from the combustion of fuel gases.

Type 1. A factory-built appliance primarily used in H-2, H-3, I and J occupancies.

Type 2. A factory-built appliance not designed for use in individual family units with gas pressures not exceeding 14 inches water column.

Closet. See Confined Space.

Combustible Material. Material made of or surfaced with wood, compressed paper, plant fibers, plastics, cloth or other material that will ignite and burn, whether flameproof or not, or whether plastered or unplastered.

Combustion. The burning of fuel, accompanied by the production of heat, or heat and light.

Combustion Products. Products resulting from the combustion of a fuel with air, including inerts, but excluding excess air.

Condensate. The liquid which separates from a gas, (including flue gases), due to a reduction in temperature.

Confined Space. For the purposes of this chapter, a space whose volume is less than 50 cubic feet per 1,000 Btu per hour of the aggregate input of all appliances installed in that space.

Continuous Pilot. A pilot which operates at all times.
Controls. Devices designed to regulate the fuel, air, water, and/or electrical supply to an appliance. These may be manual, semi-automatic or automatic.

Damper. A device which restricts, retards, or directs the flow of air in any duct, or the products of combustion in any heat-producing equipment, its vent connector, vent or chimney.


Drip Pipe. A vertical pipe installed at a low point in a system of piping to collect and remove condensate or other foreign material.

Elevated Gas Pressure. Gas pressures delivered in excess of 8 inches water column for natural gas and 14 inches water column for Liquid Petroleum Gas.

Flame Safeguard. A device which automatically shuts off the main fuel supply when the means of ignition becomes inoperative.

Field Modifications. Field Modifications are modifications to equipment that are designed to conserve or restrict fuel consumption, draft operation, or a change made to any part of the equipment not specifically designed by the appliance/equipment manufacturer. Field Modifications must be approved per Chapter 1, New Methods and Materials, and installed in strict compliance with manufacturers instructions.

Flexible Metal Connector. An appliance alignment connector consisting of an assembly of flexible metal tubing and fittings or semi-rigid tubing and fittings listed as conforming to ANSI Standard Z21.24 or Z21.45. (See Standards)

Fuel-Fired Equipment. Equipment which utilizes gas, oil or solid fuel as an energy source.

Flue Gases. Products of combustion and excess air.

Fuel Supply Piping System. Any piping system which conveys gas or liquid fuel consisting of all pipe, fittings and valves but shall not include:

1. Piping, valves or fittings integral to the manufactured appliance or equipment.
2. Any piping, valves, fittings or apparatus installed and maintained by the fuel supplier.

Gas. As used in this Chapter, shall include natural, manufactured, mixed gas, or liquefied petroleum products which are used as a fuel in a gaseous state for appliances or equipment.
Gas Control Valve (Automatic). An automatic device for controlling the main gas supply to a gas-fired appliance.

Gas Hose Connector. An appliance connector consisting of an assembly of flexible hose material and fittings listed as conforming to ANSI Z21.2 or Z21.54. (See Standards)

Gas Outlet. A connection in a gas piping system to which a gas-burning appliance may be attached.

Gas Piping System. An arrangement of gas piping supplied by an individual meter or supply source.

Industrial User. Foundries, manufacturing or processing plants or similar industries who utilize gas, liquid or solid fuel to create a product or change raw or unfinished materials into another form or product.

Limit Control. A device responsive to changes in pressure, temperature, or liquid level for turning on or shutting off the fuel supply to an appliance.

Listed and Listing. See Chapter 4.

Liquefied Petroleum Gas (LPG). Includes any material composed predominately of any of the following hydrocarbons or mixtures of them; propane or butane in either the liquid or gaseous state.

Lubricated Plug Valve. A plug-and-barrel type valve with means for maintaining a lubricant between the bearing surfaces.

Manual Main Shutoff Valve. A manually operated valve in the fuel line for the purpose of completely turning on or shutting off the fuel supply to the appliance.

Meter. An instrument installed to measure the quantity of fuel consumed.

Modulating. The action of a control from its maximum to minimum position in either predetermined steps or increments of movements.

Non-Combustible Material. Material meeting requirements of ASTM E-136. (See Chapter 4)

Normal Gas Pressure. Normal gas pressure which is provided by the supplier to gas piping system and does not exceed 8 inches water column for natural gas or 14 inches water column for propane.

Open Flame Equipment. Any fuel burning appliance which does not incorporate in its design a sealed combustion system.
Pilot. Flame utilized to ignite the fuel at the main burner or burners.

Pilot Ignition. A pilot which operates during the lighting cycle and shuts off during main burner operation.

Pilot, Intermittent. A pilot which operates during the ignition cycle and continues during main burner operation, but is shut off at other times.

Purge. To eliminate air, water, or other foreign substances from piping system or combustions zone.

Rating, Input. The amount of fuel, in Btu per hour, that can be safely burned in an appliance derated to 5000 foot altitude. The rating is subject to approval by the Department.

Rated Output. The amount of heat, in Btu per hour, that an appliance will deliver when operating at the input rating.

Readily Accessible. Capable of being reached easily and quickly without obstruction for operation, cleaning, removing burners, replacing motors, controls, air filters, or other working parts, and for adjusting, inspecting and lubricating parts requiring such attention or other maintenance type work.

Regulator, Gas Pressure. A device for controlling and maintaining a uniform gas supply pressure.

Riser. A fuel gas supply pipe which extends vertically.

Sealed Combustion System Appliances. Appliances constructed and installed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged to outdoor atmosphere.

Vent. See Chapter 37.

Vent Connector. See Chapter 37.

SECTION 5103. GAS PIPING SYSTEM.

(a) General. Piping shall be of such size and so installed to provide a supply of fuel sufficient to meet the design maximum requirements of demand and pressure at each point of use. When connecting additional equipment to a fuel piping system, the existing piping shall be checked to determine if it has adequate capacity. If inadequate, the existing piping shall be enlarged as required or separate fuel piping of adequate capacity shall be installed. See Table 51-A

For gas piping systems supplying fuel at elevated pressures, piping shall be sized per tables in NFPA 54 (National Fuel Gas Code) or

(Rev. 6/88)
other approved tables. Fuel supply piping exposed to excessive temperature change shall be installed with sufficient flexibility to allow thermal expansion and contraction of the pipe. Supply piping shall be installed or protected to minimize damage from physical forces. The building structure shall not be weakened by the installation of piping.

(b) **Materials.** Pipe used for the installation, extension, alteration, or repair of any fuel piping shall be at least standard weight wrought black iron or steel.

1. **Used.** Fuel pipe shall either be new or shall previously have been used only for conveying the same fuel. Fuel pipe shall be free from internal obstructions, splits, or other imperfections which would render it unfit for the purpose intended. Burred ends shall be reamed.

2. **Fittings.** Fittings used in connection with fuel piping shall be of malleable iron, steel, or yellow brass (containing not more than 75 percent copper), and shall be at least standard weight.

3. **Valves.** Valves and/or appurtenances used in connection with the piping shall be of a type designed for the fuel used. Globe, gate or needle valves designed only for water or steam shall not be used in gas-piping systems.

(c) **Installation.** All joints in the piping system, unless welded, shall be screwed joints, having NPT threads. Screwed joints shall be made up with pipe joint material, insoluble in the presence of the system fuel, and applied to the male threads only.

1. **Pipe Entrance.** Pipe entrance into the building shall be through the building wall above grade. The opening between the pipe and the wall shall be sealed so as to be rodent and insect proof.

2. **Building Shutoff.** Fuel supply piping systems serving a number of individual buildings shall have separate shutoff valves installed at each building. Each valve shall be located outside the building it supplies and shall be readily accessible so the fuel supply can be turned on or off to each building.

3. **Pipe Embedded.** Pipe shall not be embedded in a slab or in masonry construction, but shall be laid in a channel provided for the pipe. The channel shall be of depth and width to permit removal or repair of the installed pipe. A cover shall be provided to cover the channel and shall be installed so as not to interfere with the smooth surface of the floor.
EXCEPTION: When necessary, due to structural conditions, approved fuel piping may be installed in a pipe sleeve, vented to atmosphere at both ends when approval has first been obtained from the Department.

4. **Running Threads.** Running threads or long-screw joints are prohibited.

5. **Drip Pipes.** Accessible drip pipes, drip tees or dust pockets shall be provided at points where condensation or dirt will tend to collect and at each appliance.

6. **Closing Outlets.** Fuel piping or appliances shall not be removed or disconnected without capping or plugging the outlet from which said pipe or appliance was removed. All outlets to which fuel-fired appliances are not connected shall be left gas tight and exposed on any piping system which has been installed, altered or repaired.

7. **Concealed Piping.** Fuel supply piping shall not be installed in inaccessible concealed locations in A through H occupancies unless specifically approved by the Department. Bushings, unions, valves, and plugged or capped openings shall not be installed within walls, ceilings or other similar concealed locations. All fuel piping which will be concealed shall be air tested prior to being covered. Air tests shall meet the requirements established in this Chapter.

8. **Support.** Fuel piping shall be supported by metal straps of particular size and gauge or drive hooks at intervals not to exceed that shown in Table 51-E. Where fuel piping systems are exposed to temperature change, piping supports shall be designed and installed with sufficient flexibility to allow thermal expansion and contraction of the pipe.

9. **Interconnecting of Gas Systems.** When liquefied petroleum or other standby gas is interconnected with a regular gas piping system, an approved three-way valve shall be installed to prevent backflow into either supply system.

10. **Roof Installation.** See Applicable sections of this Chapter and Chapter 32.

11. **Obstruction.** Gas piping shall not obstruct access to blowers, motors, filters, controls or replacement of other appliances.

12. **Coatings-Wrappings.** When gas piping is installed on the exterior of a building or exposed to unusually damp conditions within a structure, the pipe shall be coated or wrapped with materials tested and approved for the intended application.
13. **Service Piping or Equipment.** Service piping or equipment shall not be covered or made inaccessible by any structural addition, alteration or repair.

14. **Appliance Shutoff Valve.** A readily accessible manual shutoff valve shall be installed in the fuel supply piping upstream of all pilot and burner connections, outside of each appliance enclosure, and ahead of the union or flexible connections thereto. Appliance shutoff valves shall be installed in the same room within 3 feet of the appliance and shall comply with other requirements of this Chapter. Valves shall not be concealed in walls or partitions.

15. **Underground Piping.** Fuel supply piping may be installed underground, but shall not be installed under any buildings or structure: in or under concrete slabs, driveway slabs, or asphalt slabs where gas could collect and migrate into the building. Ferrous piping installed underground shall be protected from corrosion by approved coating or wrapping. If cathodic protection is used, it shall be installed per N.A.C.E. Standard RP-01-69. Pipe protective coatings shall be approved types, machine applied, and conform to recognized standards. Field wrapping shall provide equivalent protection, and is restricted to those short sections and fittings necessarily stripped for threading or welding. Risers shall be wrapped to at least 6 inches above grade. Gas piping installed below grade, shall be installed in an individual trench, be effectively supported at all points on undisturbed or well compacted soil, and shall have at least 15 inches of approved cover. Backfill containing rocks, building materials, ashes or trash shall not be used.

(d) **LPG Piping.** In addition to the requirements of this section for gas piping and the requirements of the Fire Code, the facilities and piping for use with liquefied petroleum gas shall meet the following requirements:

1. Where liquid petroleum gas facilities serve more than one customer through separate piping systems, each system shall be identified in a manner satisfactory to the Department.
2. All liquid petroleum gas facilities shall be placed as to be at all times readily accessible for inspection, testing, and shutting off the gas supply. All main supply shutoff valves shall be outside of the building.
3. All valves and appurtenances used on such piping shall be designed and approved for use with liquefied petroleum gas.
(e) Oil Piping. Oil piping shall meet the following requirements: Also see Fire Code.

1. Pipe Construction. All piping shall be standard weight wrought iron or steel pipe with standard fittings. The use of aluminum or cast iron pipe and fittings is prohibited. **EXCEPTION:** Approved flexible metal hose may be used for reducing the effect of vibration.

2. Pipe Size. Pipe used in the installation of all burners and appliances other than conversion range oil burners shall not be smaller than 3/8 inch iron pipe size or 3/8 inch OD tubing. Copper or brass tubing shall be Type L minimum wall thickness. Flexible metal hose shall be installed in full compliance with its listing.

3. Pipe Joints. Pipe joints and connections shall be made tight with a pipe compound designed for oil. Unions requiring gaskets or packing, running threads or long screw joints, and sweat fittings, shall not be used.

4. Pipe Movement. Allowance shall be provided for expansion, contraction, jarring, and vibration.

5. Pipe Pitch. Oil piping from supply tanks shall be laid to pitch toward the tank, without traps.

6. Shutoff Valves. Accessible manual shutoff valves shall be installed where required to avoid oil spillage during servicing.

(f) Fuel Supply Piping within A through H-2 structures. In addition to all other requirements of this section, fuel supply piping serving appliances or equipment located within A through H-2 structures shall meet the following requirements:

1. Elevated Gas Pressure Piping Systems. Approval of the Department shall be obtained before any piping system can convey gas at an elevated pressure.

2. Pressure Regulators. A gas pressure regulator shall be installed with all equipment. When the actual gas supply pressure exceeds the maximum design operating gas pressure limits of the connected gas equipment, a second gas pressure regulator, conforming to the following requirements, shall be provided:

   A. Prohibited Locations. High pressure gas regulators shall not be installed within any Group H or I occupancy. Gas supply pressures within Group H and I occupancies shall not exceed 8 inches water column for natural gas and 14 inches water column for liquified petroleum gas.
B. Construction. High pressure gas regulators shall be designed to reduce the gas supply pressure to pressures recommended for safe operation of the connected equipment and:

i. The gas pressure regulator shall be of single port valve construction with the orifice properly sized for the maximum gas pressure at the regulator inlet.

ii. The gas pressure regulator valve seat shall be made of resilient material designed to withstand abrasion of the gas, cutting by the valve and to resist permanent deformation when it is pressed against the valve port.

iii. Venting. Each gas pressure regulator, other than the appliance regulator, shall have a properly sized, independent vent piped to a safe location outside of the building. Vents shall terminate with screened openings (1/16“ mesh) and shall face down. Vents shall terminate at a point at least 3 feet from any opening into the building and at least 20 feet from any mechanically induced air intake into the building. Vents shall not be vented into any equipment combustion chamber, any equipment vent or chimney, or into any exhaust system. Material used for vent piping shall be at least standard weight black steel pipe. For roof penetrations see Chapter 32.

3. Pipe Markings. Gas piping delivering fuel at an elevated gas pressure shall be identified at the equipment or immediately upstream of equipment regulators. Such identification shall be a metal tag or other approved markings permanently attached to each regulator or equipment and state:

WARNING - HIGH PRESSURE GAS - DO NOT REMOVE.

4. Concealed Piping. Gas supply piping systems conveying fuel at elevated gas pressures shall not be installed in concealed locations unless specifically approved by the Department prior to installation.

SECTION 5104. CHECKING FOR GAS LEAKS. Leaks in existing gas piping shall be located by applying soapy water to the exterior of the piping.
SECTION 5105. SIZING OF PIPE. Pipe used for the installation, extension, alteration, and repair of any fuel piping system shall be sized to supply all connected appliances and/or equipment with a supply of fuel sufficient to meet the design maximum requirements of demand and pressure at each point of use.

The pressure drop for systems conveying fuel at normal gas pressures shall not exceed 5/10th of one inch water column of gas piping systems. Natural gas piping sizes shall be determined by use of Table 51-A. When supply pressures and gas appliances permit, an engineered gas piping system may be used if approved by the Department.

SECTION 5106. INSPECTIONS AND TESTS BY THE DEPARTMENT.

(a) General. Upon completion of the installation, alteration, or repair of any piping, and prior to use, the Department shall be notified that the piping is ready for inspection.

(b) Rough Piping Inspection. A rough inspection shall be obtained after all gas piping authorized by the Permit has been installed, but before the piping has been covered or concealed, or any fixture or appliance has been attached. This inspection shall consist of an air pressure test of at least 10 pounds per square inch gauge pressure upstream of the appliance connection. Test pressures shall be held for a length of time satisfactory to the Department but in no case for less than 15 minutes with no perceptible drop in pressure. For welded piping, and for piping carrying gas at elevated pressures, the test pressure shall be 1-1/2 times the working pressure, but at least 60 pounds per square inch and shall be continued for a length of time satisfactory to the Department, but in no case for less than 30 minutes.

SECTION 5107. DEFECTIVE PIPE OR FITTINGS. Defective pipe or fittings shall be replaced with approved pipe and fittings, and not repaired. The fuel supply to any system found to be leaking shall be shut off or isolated until permanent repairs are made.

SECTION 5108. AUTHORITY TO RENDER GAS SERVICE. No person shall render gas service, except an authorized agent or employee of a person engaged in the business of supplying gas. It shall be unlawful to turn on or connect gas, in or on any premises, unless all outlets are properly connected to gas appliances or capped.
SECTION 5109. PURGING.
(a) General. All gas piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance.
(b) Discharge. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition.

SECTION 5110. CHIMNEYS AND VENTS. See Chapter 37.

SECTION 5111. FUEL-FIRED APPLIANCES.
(a) General. All fuel-fired appliances shall be listed by an approved testing laboratory or be specifically approved by the Department. The equipment shall be installed in accordance with the terms of its listings and the manufacturer's instructions. Field modifications to listed appliances shall not be permitted.
EXCEPTION: Listed and approved retrofit intermittent pilot gas burner ignition systems and listed automatic vent dampers installed on listed appliances or equipment. (See other sections of this Chapter). Vent dampers shall not be installed for use with unlisted appliances, appliances equipped with barometric draft controls, or solid fuel burning or oil fired equipment.
(b) Readily Accessible. Fuel-fired appliances shall be installed so that burners, orifices, controls, filters, motors, and blowers are readily accessible for observation, inspection and service.
(c) Room Access. Means of access to rooms or spaces, in which fuel-fired equipment is located, shall conform to Chapter 52 of this Building Code.
(d) Clearance. See Chapter 52 and 58.
(e) Replacement. All appliances shall be installed to permit replacement without removing permanent construction, fuel supply piping, or other appliances.

(f) Gas Log. A gas fired decorative log set may be installed in a fireplace suitable for burning solid fuel subject to the following limitations. Installation shall comply with the manufacturer's listing and instructions.
1. Construction shall be in accordance with Los Angeles Standard RGA 2-72 or ANSI Standard Z21.60, and equipment shall be listed.
2. Input rating shall not exceed 90,000 BTUH. Orifices shall be fixed and sized for Denver altitude.

3. A safety pilot is required. The safety shall be protected from mechanical damage and shall not be covered by sand or granules.

4. Thermostatic control valve is not permitted.

5. The use of a flexible gas connector is not permitted.

6. Masonry fireplaces shall comply with Chapter 48. Factory built fireplaces shall be approved for installation of gas logs and provided with a means for installing the gas piping.

7. The chimney serving a masonry fireplace shall comply with Chapter 37. Factory built fireplaces shall be equipped with a listed chimney. Chimney size shall comply with Table 51-F for masonry chimneys and Table 51-G for metal chimneys.

8. The chimney damper shall either be removed or openings shall be cut in the damper to provide minimum amount of opening prescribed in the manufacturers installation instructions.

9. Permanent combustion air opening(s), communicating directly with outside air, shall be provided in the firebox or in an area directly communicating with the room in which the fireplace is located. Openings shall be sized in accordance with Section 5112.

10. Glass doors and fireplace screens shall be required on the fireplace when a gas log appliance is installed.

11. The gas log appliance shall be provided with a permanent label with lettering 1/4" in height stating "NO SOLID FUEL SHALL BE USED IN THIS FIREPLACE". This label shall be visible after installation.

12. Manufacturers instructions: Complete instructions shall be packaged with each set. (Rev. 12/88 Ord. No. 713)

SECTION 5112. REQUIRED VENTILATION AND AIR FOR COMBUSTION. (See Examples on Table 51 at the end of this Chapter.)
(a) **General.** Provisions of this Section shall apply to all fuel-fired appliances installed in buildings. This section does not apply to sealed combustion system appliances. Exterior and interior air intake and air discharge openings shall have a minimum horizontal face opening separation of 5 feet or as approved by the Department. Appliances shall be installed in a location in which the facilities for ventilation permit satisfactory combustion of fuel, proper venting, and the maintenance of ambient temperature at safe limits under normal conditions of use. Appliances shall be located so as not to interfere with proper circulation of air within the space.

(b) **Appliances Located in Unconfined Spaces.** If the unconfined space is within a building of tight construction, air for combustion shall be obtained from outdoors or from spaces freely communicating with the outdoors. Under these conditions, a permanent opening or openings shall have a minimum free area of one square inch for every 5000 Btu per hour of input rating for equipment with atmospheric burners.

For equipment with power burners or induced draft fans, an opening or openings, having a minimum free area of 0.5 square feet per 1,000,000 Btu per hour, shall be provided not more than 12 inches above the floor and an equal opening shall be provided within 12 inches of the ceiling for ventilation air.

Ducts used to convey make-up air from the outside shall be of the same cross-sectional area or larger as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be at least 3 inches.

(c) **Appliances Located in Confined Spaces.** (See definitions of this Chapter)

1. **All Air From Inside Buildings.** (H-3 and I occupancies only)

The confined space shall be provided with 2 separate permanent openings, one within 12 inches of the top of the enclosure and one within 12 inches of the bottom. Each opening shall have a free area of at least one square inch per 1,000 Btu per hour of the total input rating of all appliances in the enclosure, freely communicating with the interior areas having in turn adequate infiltration from the outside.

2. **All Air From Outdoors.** The confined space shall be provided with 2 separate permanent openings, one within 12 inches of the bottom. The openings shall communicate directly, or by means of ducts, with outdoors or to such spaces (crawl or attic...
in H-3 and I occupancies only), that freely communicate with outdoors.

A. When directly communicating with outdoors, or by means of vertical ducts, each opening shall have a free area of at least one square inch per 4,000 Btu per hour of total input rating of all appliances in the enclosure. If horizontal ducts are used each opening shall have a free area of at least one square inch per 2,000 Btu per hour of total input of all appliances in the enclosure.

B. Ducts shall be of the same cross-sectional area or larger as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be at least 3 inches.

C. Fire Dampers shall not be located in Combustion Air ducts.

3. Ventilation Air from Inside Buildings - Combustion Air from Outdoors. The enclosure shall be provided with two separate openings for ventilation, located and sized as described in (c) 1. In addition, there shall be one opening directly communicating with outdoors or to spaces (crawl or attic in H-3 and I occupancies only), that freely communicate with outdoors.

This opening shall have a free area described in (b) for combustion air. A duct used to convey make-up air shall be of the same cross-sectional area as the free area of the opening required. The minimum dimension of rectangular air ducts shall be at least 3 inches.

(d) Louvers and Grilles. In calculating free area in this Section, consideration shall be given to the blocking effect of louvers, grilles, or screens protecting openings. All openings shall be screened. Screens used shall not be smaller than 1/4 inch mesh and readily accessible for cleaning.

(e) Special Conditions Created by Mechanical Exhausting or other fuel burning appliances or equipment. Air for combustion shall be furnished to eliminate negative pressures created by the operation of exhaust fans, kitchen ventilation systems, clothes dryers, or other fuel burning appliances or equipment.

(f) Specially Engineered Installations. The size of combustion air openings specified in (a), (b) and (c) shall not govern when special engineering assures an adequate supply of air for combustion, ventilation, and draft hood dilution. All engineered installations shall be approved by the Department prior to installation.

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(g) **Crawl Space Ventilation.** When fuel-fired appliances are located in a crawl space, within H-3 and I occupancies, ventilation and combustion air shall be provided. Openings shall be sized to requirements established in Chapter 17, or at a ratio of 1 square inch per 2,000 Btu total input ratings of all appliances located within the crawl space, whichever is largest. Ventilation openings which can be closed shall not be used when fuel burning appliances are located in a crawl space.

(h) **Attic Ventilation.** When fuel-fired appliances are located within an attic, ventilation and combustion air shall be provided.

(i) **Roof Termination.** Combustion and or ventilation ducts which terminate above a roof surface shall be faced downward and shall be a minimum of 12 inches above the roof surface. Openings shall be provided with 1/4 inch mesh screen.

**SECTION 5113. APPLIANCE INSTALLATION.**

(a) **General.** Appliances shall be installed in accordance with the terms of its listing and the manufacturers instructions.

(b) **Rigid Connections.** All gas and oil fired equipment shall be connected to the fuel supply piping with rigid connections conforming with other Sections of this Chapter.

**EXCEPTIONS:**

1. Listed flexible connectors not over six (6) feet in length may be used for connecting domestic gas ranges only in H-2, H-3 and I occupancies.

2. Connectors meeting the requirements of ANSI Z21.69-1979 and specifically approved by the Department may be used for connecting commercial cooking equipment.

3. Gas hose connectors listed for outdoor use, specifically approved, and not exceeding fifteen (15) feet in length may be used to connect outdoor portable appliances. Gas hose connectors listed for indoor use with bunsen burners and welding torches, and specifically approved, permanently equipped with union or screw type end connections, and not exceeding six (6) feet in length may be used. No shut-off valve shall be installed after the hose connector.

Gas hose connectors shall not be installed so that they are concealed from view, where the connector is likely to be subjected to temperatures in excess of 125° F, or where the hose connector is subject to repeated or continuous flexing.
4. All connectors, flexible or hose, shall be installed to the following requirements:
   Flexible connectors shall have a diameter not less than that of the inlet connection to the appliance as provided by the manufacturer.
   Connectors shall not be concealed within or extended through any wall, floor ceiling or partition.
   An accessible shutoff valve with a permanent handle not less than the nominal size of the connector shall be installed at the gas piping outlet immediately ahead of the connector.
   Connectors shall not be kinked, twisted or torqued. The connector shall be protected against physical and thermal damage.

   (c) **Flexible Connectors.** Fuel fired equipment, except gas fired dryers, located in Group A through I occupancies subjected to expansive soil conditions or where vibration of oil fired equipment occurs, may be connected to the fuel piping outlet with a flexible connector when the connector and proposed installation is specifically approved by the Department. Thin wall brass range connectors are not approved for these purposes.

   (d) **Low Pressure Cutout Valve.** Pumps or apparatus, capable of producing a vacuum in the gas service pipe, shall not be installed unless a low pressure cutout valve or similar device is provided to prevent the gas pressure at the service outlet from being reduced below the minimum service pressure determined by the serving utility.

   (e) **High Pressure Cutout Valve.** When air or oxygen under pressure is used in conjunction with the gas supply, a high pressure cutout shall be provided to prevent air or oxygen from entering the gas supply line.

   (f) **Approval.** All gas systems shall be approved by the Department prior to installation.

   (g) **Draft Hood and Draft Diverters.** Appliances and equipment designed for operation with approved draft hoods or draft diverters shall not be installed or operated unless the draft hood or draft diverter is installed as specified by the equipment manufacturer and as certified by an approved testing laboratory.

**EXCEPTIONS:**

1. Listed and approved gas-fired equipment designed by the manufacturer to operate without a draft hood or diverter.

2. Incinerators, when specified by equipment manufacturer. Field modifications shall not be permitted.
(h) Two or more draft hoods or diverters shall not be installed in series on any appliance or equipment. (See Chapter 37 for additional requirements).

(i) **Draft Regulator.** When specified by the equipment manufacturer, a barometric draft regulator may be installed. The draft regulators shall not be installed with a Type B vent system.

(j) **Shims.** Appliances or equipment shall be level. Leveling of floor mounted equipment shall be with metal shims only.

(k) **Rating.** The input rating to all appliances shall be that approved by a recognized laboratory and derated at design for 5000 foot altitude operation.

(l) **Instructions.** Appropriate operating instructions shall be supplied by the manufacturer or installer of gas appliances, and posted permanently in a conspicuous location on the appliance.

**SECTION 5114. FUEL FIRED INDUSTRIAL EQUIPMENT.** In addition to other requirements of this chapter, the requirements of the Section shall apply specifically to fuel fired industrial equipment. The location and installation of equipment shall not endanger life, health, and property. Installations shall comply with the Standards of this Chapter and the approval of the Department. All appliances and equipment shall be approved by the Department prior to installation.

(a) **Equipment Suitability.** Before installation it shall be determined that the equipment is suitable for use with the type of fuel and pressures available at the point of utilization.

(b) **Equipment Support.** Industrial equipment shall provide load distributing bases or have a sufficient number of adequate supports to prevent damage to either the building structure or equipment. Equipment which creates excessive vibrations shall be installed to minimize potential damage to the equipment, venting system, building structure, fuel supply piping, or electrical connectors.

(c) **Physical Protection.** Suitable guard rails or other approved protection shall be installed to protect the equipment from damage. Guard rails or other protective apparatus shall not hinder the accessibility for equipment maintenance or servicing.

(d) **Air Requirements.** Sufficient air shall be provided for proper combustion, processing, and ventilation. (See other Sections of this Chapter).

(e) **Draft.** Means for controlling draft shall be installed for each piece of equipment or appliance.
(f) **Dampers.** Adjustable (modulating) dampers, where used for fuel/air ratio control, shall be equipped with a device to establish minimum and maximum operating limits. The minimum operating limits for these dampers shall be fixed to obtain air for complete combustion at the minimum burner input. (See Chapters 48 and 58).

(g) **Burners.** Burners and their component parts shall be installed in accordance with the manufacturer’s instructions and shall be secured to maintain correct alignment in normal use.

1. **Adjustment.** The burners shall be installed and adjusted so that there will be no flame impingement on walls or heating surfaces which will cause incomplete combustion or damage to appliance parts.

2. **Locking Devices.** Burner parts, when adjustable, shall be provided with locking devices to prevent movement or shifting.

3. **Combustion.** Burners shall maintain complete and stable combustion at the minimum rate of firing or during any sudden change in the gas-firing rate between maximum and minimum input.

(h) **Automatic Air Control.** When an automatically operated combustion-air control is provided, the gas shall be shut off in case of failure.

(i) **Mixers.** When air under positive pressure is mixed with the gas supply in a mixer and is automatically controlled, controls shall be provided to prevent air from passing back into the gas line, or gas into the air supply. The gas and air supply shall be equipped with controls to prevent gas from entering the burner until the required amount of air is available, and to shut off the gas supply in the event of air failure.

(j) **Automatic Fire Rate.** On equipment or appliances where the firing rate is automatically changed, the air/gas ratio shall be automatically maintained to produce stable combustion at all firing rates.

(k) **Pilots.** All gas and oil-fired equipment shall be provided with an approved type 100% shut off pilot safeguard, tested and certified by a recognized National Testing Laboratory and acceptable to the equipment manufacturer.

1. **Flame Safeguard.** A flame safeguard shall be constructed and installed so that gas cannot flow to the main burner or burner group unless a proven pilot flame is assured. Fuel to main burners and to intermittent or ignition pilots shall be automatically shut off in case of flame failure.

2. **Response Time.** The response time of the flame safeguard to de-energize the gas shutoff device on flame failure shall not
exceed 5 seconds for appliances having inputs in excess of 2,500,000 Btu per hour. Pilot supervision by the flame safeguard to de-energize the gas shutoff device on flame failure shall not exceed 5 seconds for appliances having inputs in excess of 2,500,000 Btu per hour. Pilot supervision by the flame safeguard shall be only at the point where the flame will ignite the gas at the main burners. The circuit and devices shall be arranged so that the gas will be shut off in case of electrical failure.

**EXCEPTION:** Appliances having an input in excess of 2,500,000 Btu per hour, certified by a recognized testing laboratory and approved by the Department.

3. **Electric Ignition.** Electric ignition systems shall ignite only a pilot. The input to the pilot shall not exceed 3 percent of the maximum input to the main burner as fired. If ignition of the pilot is not obtained within 60 seconds, the pilot gas shall be turned off automatically. Pilots ignited by automatically or remotely controlled ignition systems shall be supervised.

**EXCEPTION:** Equipment or appliances in excess of 2,500,000 Btu per hour, certified by a recognized testing laboratory and approved by the Department.

4. **Supports.** Pilot burners and flame safeguard units shall be supported so that their position relative to each other and to the flame of the main burner, will remain fixed. Means shall be provided to permit observation while firing.

5. **Access and Removal.** Pilot burners and flame safeguard units shall be accessible and removable for servicing. Pilot burners shall be placed so that they may be safely lighted manually, if required.

6. **Pilot Lines.** Pilot lines shall be valved and connected to main fuel supply system upstream from all main fuel control valves.

7. **Start-Up.** After the piping has been thoroughly purged, the pilot burner shall be lighted and adjusted, and the main burner put into operation in accordance with the manufacturer's instructions.

8. **Pilot Effect.** Pilot flames shall ignite the fuel at the main burner or burners within 4 seconds.

9. **Pilot Failure.** Pilot flame shall not be extinguished when the main burner or burners are turned on or off.

10. **Carbon.** Pilot shall not deposit carbon.
11. **Limit Controls.** Limit controls are required per other sections of this Chapter.

(l) **Control Valves.** The control valve assembly shall be as specified by the manufacturer and approved by the Department (See Diagrams at end of this Chapter).

1. **Safety Fuel Shutoff Valve.** Approved main burner safety fuel shutoff valves shall be required on all boilers and industrial type equipment. They shall be a normally closed spring loaded type solenoid or motorized fuel valve. These valves shall not contain a diaphragm in the valve construction, and shall not depend on electricity to shut off the main gas supply. These valves shall respond to safety devices installed to prevent excessive appliance temperature or pressure. This section shall apply to all new and existing installations regardless of equipment input rating.

(m) **Electrical Equipment.** Wiring and controls shall be capable of withstanding the temperatures to which they may be subjected. See Chapter 53.

(n) **Purging.** The flue passages shall be thoroughly purged before lighting of pilots or burners after a shutdown, and also before relighting after an unscheduled extinguishment of burners. This shall be performed by creating air flow through the equipment and by operation of induced and forced draft fans if present.

(o) **Disconnect.** When equipment or appliances are shut down for an extended period, means shall be provided to prevent fuel from leaking into the equipment. This shall be accomplished by blocking off, or disconnecting, the fuel supply pipe.

(p) **Maintenance.** The flame safeguard equipment and all other controls of the unit shall be maintained to assure their safe operation.

**SECTION 5115. FUEL-FIRED RANGES AND PLATES.**

(a) **Prohibitions.** In new or existing buildings, fuel-fired ranges and plates shall not be located in any area of less than 550 cubic feet, rooms used for sleeping purposes, or in any enclosed space with access through a room used for sleeping purposes.

(b) **Clearances.** Gas ranges and plates shall be installed in strict compliance of their listing and/or the manufacturer's recommendations, whichever is more stringent. When installed on combustible floors, ranges and plates shall be set on their own designed bases or legs. The installation and established clearances shall not interfere with appliance ventilation, combustion air flow, or accessibility for oper-
ation and servicing. All fuel burning ranges and plates shall have a minimum vertical clearance above the cooking top of 30 inches.

(c) Ventilation. A mechanical exhaust system meeting the requirements of Chapter 52, shall be installed above gas fired ranges and plates. The discharge from such exhaust system shall terminate to the exterior of the building. The use of ductless fans or hoods is not permitted when gas fired ranges or plates are used. In addition to requirements within this section, range hoods and fans shall comply with the following:

1. Range hoods and fans in individual living occupancies within Group H-2, H-3 and Group I occupancies: See Chapter 52.
2. Commercial cooking appliances, including ranges, fryers and broilers in Groups A through H-2 occupancies: See Chapters 52 and 37.

(d) Level. Fuel fired ranges and plates shall be installed so that the cooking top and/or oven racks are level.

(e) Venting. Space heaters integral with ranges shall be vented in accordance with Chapter 37.

SECTION 5116. FUEL-FIRED STEAM AND HOT WATER BOILERS. Fuel-fired steam and hot water boilers shall comply with the requirements of this Chapter and Chapters 37 and 58 of this Code.

SECTION 5117. FORCED AIR, GRAVITY, FLOOR, UNIT AND WALL-TYPE FURNACES. See Chapters 37 and 52.

SECTION 5118. CONVERSION BURNERS.

(a) General. Conversion burners shall be installed in accordance with Chapters 37, 52 and 58. Burners must be listed by a recognized national testing laboratory and approved by the Department prior to installation. Burners shall be installed so that they will not endanger life, health, or property; and shall be installed in accordance with their listing and approval.

(b) Combustion and Ventilation Air. Combustion and ventilation air shall be supplied per the requirements of this Chapter.

(c) Draft Hood. A listed and approved draft hood, shall be installed on the vent outlet of the appliance when converted to gas. The draft hood shall be located at a point not lower than the top of the highest passageway in the appliance. Appliances of the reversible-flue type shall have the draft hood located at least one foot higher than the top of the highest passageway.
SECTION 5119. FREE STANDING DOMESTIC INCINERATORS.

GAS FIRED. Also, see Chapter 48.

(a) Draft Hoods Prohibited. A draft hood shall not be installed in the chimney connector.

(b) Automatic Draft Regulators (Barometric Dampers). The use of automatic draft regulators is permitted, provided it is specified by the appliance manufacturer. The draft regulator shall be the same size as the incinerator vent and shall be installed according to the manufacturer's instructions.

(c) Over 4 Bushel. Incinerators in excess of 4 bushel capacity, and not of the free standing type, shall conform to the requirements of Chapter 48.

(d) Prohibited Locations. Installation of incinerators in garages or enclosed areas containing explosive or flammable liquids is expressly prohibited, unless separated therefrom by at least a 2-hour fire resistive wall without openings.

(e) Vents. See Chapter 37.

(f) Combustion and Ventilation Air. Combustion and ventilation shall be provided in accordance with the requirements of this Chapter.

SECTION 5120. FUEL-FIRED WATER HEATERS.

(a) General. Water heaters shall be installed in accordance with their listing and approval. See prohibitions this Chapter.

EXCEPTION: Commercial garages. See Chapter 58.

(b) Venting. See Chapter 17.

(c) Fire Rated Enclosures. Water heaters that are 100 Mbtu or more or those that accumulate 100 Mbtu or more, shall be provided with a one hour fire resistive enclosure. See Chapter 17.

(d) Pressure and Temperature relief valves shall be provided per manufacturer's instructions. Piping shall be steel or copper, not reduced not trapped or uphill, and shall terminate a maximum of 12 inches above the floor in close proximity of an approved drain.

(e) Electric water heaters shall not be located in crawl spaces, attic spaces or other unheated areas.

SECTION 5121. MISCELLANEOUS GAS-BURNING EQUIPMENT.

(a) Outdoor Gas Grills. Gas piping shall conform to other sections of this Chapter, except as permitted herein.

(Rev. 6/88) 51-2
1. **Copper Tubing.** Type "K" internally tinned copper tubing, having a nominal diameter of 3/8 inch o.d. or greater, may be used to supply fuel, and only approved flare-type fittings shall be used. Connections from copper to other piping shall be made with an approved dielectric type fittings, where necessary. Tubing need not be wrapped or coated. The depth of the tubing shall be at least 15 inches below the ground level.

2. **Gas Grill Connections.** When gas grill piping is connected to interior gas piping, the piping shall extend through the foundation or wall above grade, and connections made to the copper tubing at a point at least 15 inches below the surface of the ground. Rigid exterior piping above grade shall not be more than 6 inches outside the wall or foundation. The underground portion of steel pipe shall be wrapped or coated. The opening through the wall or foundation shall be sealed to prevent leakage into the building. If the building meter is outside, the extension shall be in the line between the meter and the building, to a point 15 inches below the surface of the ground.

3. **Shutoff Valve.** An approved shutoff valve shall be installed at an accessible point in the rigid pipe, outside the building and above the level of the ground.

4. **Prohibition.** Outdoor type gas grills shall not be installed inside any building or semi-enclosed structure.

5. **Venting** The venting requirements of Chapter 37 do not apply.

6. **Clearance.** Gas lights shall have clearance from combustible materials of at least 6 inches at the sides and at least 12 inches at the top of the light fixture.

7. **Other appliances.** All Appliances or devices not otherwise specified herein shall be subject to Department approval prior to installation.

**SECTION 5122. UNAUTHORIZED DEVICES.** Devices intended to reduce gas consumption by attachment to a gas appliance, or any part thereof, its supply line or vent outlet or vent piping shall not be installed, altered or retrofitted to an appliance, unless specifically approved by the Department.

**SECTION 5123. ELECTRICAL WIRING AND CONTROLS.** See Chapter 53.
SECTION 5124. LIQUID FUEL, LIQUEFIED PETROLEUM GAS AND LIQUEFIED PETROLEUM.

(a) Air-Gas. The installation of liquefied petroleum gas-fired appliances and their appurtenances shall conform with the requirements as set forth in this Chapter and in NFPA Pamphlet No. 58, and Fire Code.

SECTION 5125. GAS EQUIPMENT ON ROOFS.

(a) Gas Equipment on Roofs. In addition to all other requirements in this Chapter, the Chapters 32, 52, 53 and 58, appliances installed on roofs shall comply with the following.

1. Design. Gas appliances shall be listed for rooftop installations and be installed in accordance with the manufacturer’s instructions.

2. Fuel Supply Piping. Except where fuel piping vertically penetrates the roof, all fuel piping shall provide a minimum of 12 inches above the surface of the finished roof and shall be supported on metal stands installed in pitch pans with not more than 10 feet between stands.

SECTION 5126. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply.

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
</table>

(Rev. 6/88) 51-29
Clothes Dryers, Type 1, Gas, Volume I ANSI Z21.5.1-1979 and supplements.
Clothes Dryers, Type 2, Gas, Volume II ANSI Z21.5.2-1979.
Connectors for Other Than All-Metal Construction for Gas Appliances, Flexible ANSI Z21.45-1979.
Counter Appliances, Gas, ANSI Z83.14-1980
Furnaces, Direct Vent Central, ANSI Z21-64-1978 and supplements.
Furnaces, Gas-Fired Duct, ANSI Z83.9-1980 and supplements.
Gas Unit Heaters, ANSI Z83.8-1978 and supplements.
Gas-Fired Gravity and Fan Type Vented Wall Furnaces, ANSI Z21-49-1979 and supplements.
Heaters, Water, Automatic Storage Type with inputs of 75,000 Btu per Hour or Less, Volume 1, ANSI Z21.10.1-1975 and supplements.
Heaters, Water, Circulating Tank, Instantaneous and Large Automatic Storage Type, Volume 111, ANSI Z21.10.3-1975 and supplements.
Hose Connectors for Portable Outdoor Gas-Fired Appliances, ANSI Z21.54-1979
Kettles, Steam Cookers and Steam Generators, Gas-Fired, ANSI Z83.15-1980.
Primary Safety Controls for Gas- and Oil-Fired Appliances, ANSI/UL 372-1976
Ranges and Unit Broilers, Hotel and Restaurant Gas, ANSI Z83.11-1980.


NFPA

Inhalation Anesthetics, 56A-1978.
Respiratory Therapy, 56B-1976.
Labs in Health-Related Institutions, 56C-1980.
Industrial Furnaces, Standard 86B, Volume 8, 1981.
Industrial Furnaces Using a Special Processing Atmosphere, Standard 86C, Volume 8, 1981

LA

Los Angeles Standard RGA 2-72 Standard for Decorative Log Sets for installation in wood-burning fireplace.

(Rev. 6/88)

51-33
SECTION 5127. TABLES AND FIGURES.

INSTRUCTIONS IN THE USE OF TABLE 51-A.

1. Determine the gas demand in cubic feet per hour of each appliance to be attached to the piping system.
2. Measure the length of piping from the gas meter to the outlet farthest from the meter.
3. In Table 51-A, select the vertical column indicating the farthest distance, or the next longer distance if the table does not give the exact distance. The vertical column shall be used in sizing all sections of pipe in the piping system.
4. Starting at the farthest outlet from the meter, find in the vertical column just selected, the gas demand for the outlet as determined in Item 1 of this Section. If the exact gas demand figure is not shown, choose the next largest figure in that column.
5. Opposite this demand figure in the column headed "Nominal Iron Pipe Size Inches", find the correct size of pipe to be used. This pipe size is only for that section of pipe carrying the gas demand for the outlet under consideration.
6. Proceed in a similar manner for each outlet.
7. After each outlet has been sized, then size each section of pipe carrying the gas demand for more than one outlet. This is performed by determining the total gas demand supply by each section and using that figure in the farthest distance vertical column as determined in Item 3 of this Section. (The same distance used in the above calculations).
## TABLE 51-A  
GAS PIPING CAPACITY TABLE  
Maximum Capacity of Pipe in Cubic Feet of Gas Per Hour  
(Based on 0.5 Inch Water Column Pressure Drop)  
(.66 Specific Gravity)  

<table>
<thead>
<tr>
<th>Pipe Length in Feet</th>
<th>Nominal Iron Pipe Size (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2</td>
</tr>
<tr>
<td>10</td>
<td>126</td>
</tr>
<tr>
<td>20</td>
<td>89</td>
</tr>
<tr>
<td>30</td>
<td>73</td>
</tr>
<tr>
<td>40</td>
<td>63</td>
</tr>
<tr>
<td>50</td>
<td>56</td>
</tr>
<tr>
<td>60</td>
<td>51</td>
</tr>
<tr>
<td>70</td>
<td>47</td>
</tr>
<tr>
<td>80</td>
<td>44</td>
</tr>
<tr>
<td>90</td>
<td>42</td>
</tr>
<tr>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>110</td>
<td>38</td>
</tr>
<tr>
<td>120</td>
<td>36</td>
</tr>
<tr>
<td>130</td>
<td>35</td>
</tr>
<tr>
<td>140</td>
<td>33</td>
</tr>
<tr>
<td>150</td>
<td>32</td>
</tr>
<tr>
<td>160</td>
<td>31</td>
</tr>
<tr>
<td>180</td>
<td>29</td>
</tr>
<tr>
<td>190</td>
<td>29</td>
</tr>
<tr>
<td>200</td>
<td>28</td>
</tr>
</tbody>
</table>

**NOTE:** In using this table, no allowance is necessary for an ordinary number of fittings.  
Reference: Spitzglass formula using Base Pressure, PSTA 12.39 and Specific Gravity = 0.65
<table>
<thead>
<tr>
<th>Appliance</th>
<th>Cubic Feet Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small(^a)</td>
</tr>
<tr>
<td>Domestic Range</td>
<td>50</td>
</tr>
<tr>
<td>Domestic Water Heater (Storage Type)</td>
<td>30</td>
</tr>
<tr>
<td>Domestic Space Heaters (Circulating)</td>
<td>20</td>
</tr>
<tr>
<td>Domestic Floor Type Furnace</td>
<td>25</td>
</tr>
<tr>
<td>Domestic Central Type Furnace</td>
<td>75</td>
</tr>
<tr>
<td>Domestic Central Type Boilers (Steam or Hot Water)</td>
<td>75</td>
</tr>
<tr>
<td>Commercial Range (Restaurant)</td>
<td>150</td>
</tr>
<tr>
<td>Commercial Griddle or Hot Plate</td>
<td>20</td>
</tr>
<tr>
<td>Commercial Steam Table, per burner</td>
<td>—</td>
</tr>
<tr>
<td>Commercial Coffee Urn</td>
<td>10</td>
</tr>
<tr>
<td>Steam Boilers, per horsepower</td>
<td>—</td>
</tr>
<tr>
<td>Industrial Appliance</td>
<td>Require Individual Determination</td>
</tr>
</tbody>
</table>

\(^a\) Not to be used for setting appliance gas input.
FIGURE 1
Appliances Located in Confined Spaces. All Air from Inside the Building.

NOTE: Each opening shall have a free area of not less than one square inch per 1,000 BTU per hour of the total input rating of all appliances in the enclosure.

FIGURE 2
Appliances Located in Confined Spaces. All Air from Outdoors.

NOTE: Each air duct opening shall have a free area of not less than one square inch per 2,000 BTU per hour of the total input rating of all appliances in the enclosure.

FIGURE 3
Appliances Located in Confined Spaces. All Air from Outdoors Through Ventilated Attic.

NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 BTU per hour of the total input rating of all appliances in the enclosure.

FIGURE 4
Appliances Located in Confined Spaces. All Air from Outdoors - Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic.

NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 BTU per hour of the total input rating of all appliances in the enclosure.

FIGURE 5

NOTE: Alternate 1, 2 and 3 are locations for air inlets. Free areas shall be not less than 1 square inch per 5,000 BTU per hour of the total input rating of all appliances in the enclosure.

Attic ventilation louvers are required at each end of attic with alternate air inlet No. 1.

Crawl-Space Ventilation louvers for unheated crawl spaces are required with alternate air inlet No. 2.

Each Ventilation Air Opening from inside the building shall have a free area of not less than 1 square inch per 1,000 BTU per hour of the total input rating of all appliances in the enclosure.
<table>
<thead>
<tr>
<th>Size of Pipe (Inches)</th>
<th>Feet</th>
<th>Strap Gauge</th>
<th>Strap Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>¼</td>
<td>6</td>
<td>21</td>
<td>¾&quot;</td>
</tr>
<tr>
<td>¾ or 1</td>
<td>8</td>
<td>21</td>
<td>¾&quot;</td>
</tr>
<tr>
<td>1¼ or Larger (Horn.)</td>
<td>10</td>
<td>18</td>
<td>¾&quot;</td>
</tr>
<tr>
<td>1¼ or Larger (Vert.)</td>
<td></td>
<td></td>
<td>Every Floor - Designed Support</td>
</tr>
</tbody>
</table>
### TABLE 51-F

**MASONARY CHIMNEY SIZING TABLE**

<table>
<thead>
<tr>
<th>Nominal Dimensions (inches)</th>
<th>8 x 8</th>
<th>8 x 12</th>
<th>12 x 12</th>
<th>12 x 16</th>
<th>16 x 16</th>
<th>16 x 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Log Input Rating (BTU/hr)</td>
<td>Chimney Height in ft.</td>
<td>Chimney Height in ft.</td>
<td>Chimney Height in ft.</td>
<td>Chimney Height in ft.</td>
<td>Chimney Height in ft.</td>
<td>Chimney Height in ft.</td>
</tr>
<tr>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
<td>max</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>24,000</td>
<td>6</td>
<td>50</td>
<td>6</td>
<td>43</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>30,000</td>
<td>12</td>
<td>62</td>
<td>6</td>
<td>53</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>36,000</td>
<td>NA</td>
<td>6</td>
<td>64</td>
<td>6</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>48,000</td>
<td>NA</td>
<td>13</td>
<td>88</td>
<td>6</td>
<td>80</td>
<td>6</td>
</tr>
<tr>
<td>60,000</td>
<td>NA</td>
<td>NA</td>
<td>7</td>
<td>101</td>
<td>6</td>
<td>90</td>
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<tr>
<td>72,000</td>
<td>NA</td>
<td>NA</td>
<td>15</td>
<td>121</td>
<td>6</td>
<td>109</td>
</tr>
<tr>
<td>90,000</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>9</td>
<td>136</td>
<td>6</td>
</tr>
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</table>

NA - Not Allowed

(Rev. 3/87 Ord. No. 128)
<table>
<thead>
<tr>
<th>Inside diameter (inches)</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>12</th>
<th>14</th>
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</thead>
<tbody>
<tr>
<td>20,000</td>
<td>11</td>
<td>90</td>
<td>6</td>
<td>90</td>
<td>6</td>
<td>90</td>
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<td>24,000</td>
<td>19</td>
<td>90</td>
<td>7</td>
<td>90</td>
<td>6</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>30,000</td>
<td>54</td>
<td>90</td>
<td>13</td>
<td>90</td>
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<td>NA</td>
<td>24</td>
<td>90</td>
<td>10</td>
<td>90</td>
<td>8</td>
<td>90</td>
</tr>
<tr>
<td>42,000</td>
<td>NA</td>
<td>NA</td>
<td>15</td>
<td>90</td>
<td>8</td>
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<td>NA</td>
<td>NA</td>
<td>23</td>
<td>90</td>
<td>11</td>
<td>90</td>
<td>7</td>
</tr>
<tr>
<td>54,000</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>16</td>
<td>90</td>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>60,000</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>20</td>
<td>90</td>
<td>11</td>
<td>90</td>
</tr>
<tr>
<td>72,000</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>39</td>
<td>90</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>37</td>
<td>90</td>
</tr>
</tbody>
</table>

NA - Not Allowed
CHAPTER 52
HEATING, COOLING AND VENTILATING

SECTION 5201. GENERAL.
(a) Scope. This Chapter shall govern the construction, installation, maintenance and repair of all electrical and fuel-burning equipment for air heating, ventilating, air conditioning, blower and exhaust appliances and systems, domestic and commercial cooking ranges, plates, and hoods.
(b) Equipment. Equipment shall bear the seal of a nationally recognized testing laboratory.
(c) Type of Fuel. Appliances shall not be converted from the fuel specified on the rating plate for use with a different fuel without approval by the Department for the fuel to be used.
(d) Air Plenums. The area above a ceiling may be used for a supply or return air plenum (except in D2, E, and I Occupancies) provided the following restrictions are complied with: (Revised 3/81 Ordinance No. 177)
1. Plastic materials shall not be located in plenums. Combustible materials as defined by ASTM-E136 shall not be located in plenums. EXCEPTIONS:
   A. Insulated flexible ducts shall be permitted in air plenums provided they comply with Section 5203 (d)6 and in addition meet the following conditions:
      1. They shall be constructed of a core material fabricated of solid metal (the use of adhesives or plastic materials as part of the core is prohibited); glass fiber insulation; and an outer jacket made exclusively of metal or approved metalized polyester.
      2. They shall not exceed eight feet in length. (Rev. 5/84 Ord. No. 253)

B. Glass fiber duct board shall be permitted in air plenums provided it includes an outer jacket of aluminum or reinforced aluminum. The duct shall be tested and listed per

(Rev. 6/88)
C. Mineral fiber insulation for duct wrap, pipe insulation and building wall insulation shall be permitted in air plenums as specifically approved by the Department. If it includes a vapor barrier outer jacket, that jacket shall be made of a composite of fiber glass reinforced aluminum foil with or without specially treated kraft paper backing. (Rev. 3/87 Ord. No. 118)

D. Gypsum board shall be permitted in air plenums.

2. Exhaust systems or system components serving commercial range hoods, flammable vapor hoods, or toxic vapor hoods shall not be located in plenums. Exhaust ducts not prohibited by the above restrictions shall be permitted provided all seams and joints are sealed with an approved material.

EXCEPTIONS:
A. Ducts conveying ammonia fumes shall be permitted provided all seams and joints are continuously welded.
B. Range hood exhaust ducts shall be permitted provided they are enclosed in a fire rated enclosure in accordance with Chapter 17.

3. Piping carrying toxic, flammable or combustible gases or liquids shall not be located in plenums.
4. Fuel fired equipment shall not be located in plenums.
5. Clean-outs in sanitary waste lines shall not be located in plenums.
6. Products containing asbestos, in full or in part, shall not be located in plenums.
7. Wood members, including those treated for fire resistance, shall not be located in plenums unless completely covered with gypsum board.
8. All insulated electrical, telephone, and control wiring, located in air plenums, shall be installed in an approved covered metal raceway or conduit.
EXCEPTION:

A. Exposed wiring, where permitted by other sections of this code, will be permitted in plenums provided the wire has been specifically tested by a nationally recognized laboratory for use in plenums and has been approved by the Department. See Chapter 53 and the National Electrical Code NFPA-70.

9. If a material to be used in plenums does not meet ASTM E-136, it must be specifically approved by the Department for use in plenums. Material shall be submitted for approval under Section 111 of the Building Code. (Alternate Materials and Methods of Construction.)

10. The use of ceiling areas as plenums shall be confined to one fire area.

(e) Access. All appliances shall be readily accessible for inspection, repair, or replacement.

(f) Separation of Equipment. Fuel-fired heating equipment shall be separated from refrigeration and air-handling equipment by a fire separation wall of at least one-hour fire resistive construction. Access to refrigeration and air-handling equipment shall not be through boiler room. Access to boiler room shall not be through refrigeration and air-handling room.

EXCEPTIONS:

1. Combination heating and cooling equipment need not comply, provided the heating and cooling equipment is an approved single package or tandem unit.

2. The equipment is approved for exterior installation.

3. In Groups I and J Occupancies.

(g) Furnace Room Construction. See Chapter 17.

(h) Installation or Repairs Affecting Building Structure. Structural supports for equipment shall conform to other portions of this Building Code.

(i) Temporary Heating During Construction. Fuel-fired heaters for temporary heating during construction shall be approved by the Department.

(j) Guards. Pulleys, belts and similar equipment shall be provided with an approved type guard.

(k) Central Heating. Where heating is installed, the heating system or systems shall be of the central type, unless otherwise approved. EXCEPTION: Sealed combustion chamber type (through-the-wall-heaters), when approved by the Department. See Chapter 51.
(l) Openings in Exterior Walls. See Chapter 17.

(m) Smoke Control of all Ventilation Systems in Excess of 2,000 CFM. See Section 1807 for requirements for high rise buildings. All mechanical ventilation systems over 2000 CFM shall be provided with a smoke detector located both at the return side of the unit and at the supply side of the unit. In systems using 100% outside air, a detector shall be provided in the supply side of the unit. Detectors shall be wired to automatically shut down the unit upon detection of smoke.

EXCEPTION: Detectors at the air handling unit may be omitted if the entire area being served by the air handling unit is fully protected with a smoke detection system installed in accordance with NFPA 72E and wired to shut down the air handling unit upon detector activation. (Rev. 6/88 Ord. No. 22)

1. When the supply fan is located in that same smoke or fire zone that it serves, that fan shall be shut down automatically by a product of combustion detection device located in each of the return air systems and the supply air system, after any system filters.

2. When ventilation systems serve more than one smoke or fire zone, the system shall have a product of combustion detection device located in the return or exhaust air stream of each smoke or fire zone which will close a fire damper in the ducts supplying air to that zone. An additional products of combustion detection device shall be located in the supply air system, after the air filters which will stop the supply fan and close all fire dampers in the supply ducts. The dampers shall be located in the required fire partition.

3. The supply air fire control shall not eliminate the need for required fire dampers. (Revised 10/81 Ordinance No. 518)

(n) Heat Exchanger. When more than fifty percent of the air entering the heat exchanger is taken directly from the outside, at winter design temperature, the heat exchanger through which the air passes shall be constructed of an approved non-corrosive material.

(o) Prohibitions.
1. Liquid fuel-burning appliances having an integral or directly attached fuel tank.
2. Used heating equipment, unless approved.
3. Open flame type equipment. (Rev. 3/87 Ord. No. 126)

4. Heating and cooling equipment, ductwork, or piping in elevator shafts, elevator pits, or elevator machine rooms.
5. The repair of heat exchangers. Furnace cement may be used for the resealing of joints, when required, for cast iron furnaces.
6. Gas lines, water lines, sewer lines, or electric lines penetrating any supply, return, or exhaust duct systems.
7. Gas appliances located within 10 feet of the termination of a laundry chute.
8. Access to furnaces, boilers, or to furnace or boiler rooms through any bedroom, bathroom, toilet room, or garage.
9. The installation and use of floor furnaces, pipeless furnaces, and dual-wall floor furnaces.
10. Return air taken from any boiler room, furnace room, kitchen, bathroom, trash room, janitor storage room, toilet room, swimming pool, garage, storage room, or areas containing toxic, flammable, corrosive, radioactive, or pathogenic materials.
11. Fuel-fired unit heaters, suspended furnaces, and duct furnaces in Groups A, B, C, D, and H Occupancies.
12. The use of plastic outer jackets or inner liners in conjunction with flexible ducts to be installed in a plenum is prohibited.

EXCEPTIONS:
A. Electric or solar.
B. Domestic cooking ranges.

SECTION 5202. DEFINITIONS.
(a) For the purposes of this Chapter, the following terms shall be defined as follows:

1. Air Ceiling Plenum. An air chamber formed by the building structure for air supply or return.
2. Air Conditioning. Air conditioning is the process of treating air to control its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space.
3. Air Conditioning System. A ventilating system containing heat exchangers, blowers, filters, supply, exhaust or return ducts, and any apparatus installed in connection therewith.
4. **Appliance.** A fixture or apparatus designed and manufactured to use electricity, natural gas, manufactured gas, liquified petroleum products, solid fuel, oil, or any gas as a medium for developing light, heat, and power.

5. **Appliance, Unvented.** An appliance designed and installed in a manner so that products of combustion are not conveyed directly from the appliance into a vent or chimney and conducted to the outside atmosphere.

6. **Appliance, Vented.** An appliance designed and installed in a manner so that the products of combustion are conveyed directly from the appliance and connected directly into a vent or chimney and conducted to the outside atmosphere.

7. **Boiler or Furnace Room.** See Chapter 4.

8. **Btu.** Abbreviation for British Thermal Unit, or the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit at sea level.

9. **Central Air Heating System.** A heating plant consisting of an air-heating appliance from which the heated air is distributed by means of ducts or pipes, including accessory apparatus and equipment.

10. **Combustion Air.** See Chapter 51.

11. **Combustion Chamber.** The space in a heating appliance for the combustion of fuel.

12. **Commercial Cooking Appliance.** Shall include ranges, ovens, broilers, and other cooking appliances designed for use in restaurants, hotel kitchens, and commercial establishments.

13. **Control, High Limit.** A device responsive to change in temperature, used for interrupting the fuel supply when the bonnet temperature exceeds predetermined settings.

14. **Control, Safety Pilot.** A device to automatically shut off the fuel supply to the main burner when the fuel supply becomes inoperative.

15. **Conversion Burner.** A burner provided to convert a heating appliance from its designed fuel to a different fuel.

16. **Crawl Space.** See Chapter 4.

17. **Direct-Fired Heating Unit.** A unit in which the circulated air comes into direct contact with the flame.

18. **Draft Hood or Draft Diverter.** See Chapter 37.

19. **Duct.** A passageway for conveying air, made of sheet metal or other approved material.
20. **Duct Riser.** A duct which extends vertically.
22. **Exhaust System.** An assembly of connected ducts, plenums, fittings, registers, grilles, and hoods through which air is conducted from the space or spaces and exhausted to the outside atmosphere.
23. **Filter, Air.** A device designed to remove particulates from the heating, cooling, or ventilating air.
24. **Fire Area.** A fire area, as used in this Chapter, shall mean maximum floor areas allowed in Chapter 5.
25. **Fire Damper.** An assembly arranged to restrict the passage of air flow automatically in the event of excessive temperature.
26. **Fire Door.** An approved door, for the protection of an air passage in a Class A opening in a fire wall, installed in accordance with the conditions of its approval and the manufacturer's instruction.
27. **Fire Partition Wall.** See Chapter 4.
28. **Flat-Plate Solar Collector.** A solar collector in which the solid surface area absorbing the solar radiation is essentially flat, without the use of concentration.
29. **Focusing Solar Collector.** A reflective or focusing solar collector which concentrates solar radiation to a thermal receiver.
30. **Furnace.** A self-contained fuel-fired heating unit with burners, combustion chamber, heat exchanger, and casing.
31. **Furnace, Attic.** A forced air furnace designed for installation in an attic.
32. **Furnace, (Counterflow).** A forced air furnace designed with air flow through the furnace in a vertical path downward.
33. **Furnace, (Duct Furnace).** A furnace designed for utilizing a duct distribution system. Air circulation is provided by a blower not furnished as an integral part of the furnace.
34. **Furnace, (Electric).** A furnace designed to utilize electricity as the energy source.
35. **Furnace, (Floor).** A self-contained furnace designed to be suspended from the floor of the space being heated.
36. **Furnace, (Forced Air).** A furnace equipped with a blower to provide the primary means for circulating air.
37. **Furnace, (Gravity).** A furnace which depends upon the difference of the density of warm and cool air for circulation.
38. **Furnace, (Pipeless).** A gravity furnace in which the entire heat output is delivered through one opening directly above
the combustion chamber. Return air enters the unit through grille work around the perimeter of the output grille.

39. **Furnace Room.** See Chapter 4.

40. **Fusible Link.** A device designed to melt, separate, or release at a predetermined temperature.

41. **Gage-Gauge, (Metal).** A standard for measuring the thickness of sheet plate iron and steel.

42. **Gas Ranges and Plates.** Gas-fired units used for domestic and commercial cooking or heating.

43. **Heat Exchanger.** A chamber in which heat is transferred through the walls of the chamber to or from the media entering the exchanger.

44. **Heat Shield.** An automatic heat closing device which limits the transfer of heat radiation across the damper.

45. **Heater, Radiant.** A heater utilizing a ceramic, asbestos, clay or similar material as the radiating media.

46. **Heater, Recessed.** A self-contained heating unit recessed in a wall and located entirely above the floor of the space it is intended to heat.

47. **Heater, Room or Space.** A free-standing heating unit burning solid, gas or liquid fuel for direct-heating of the space in and adjacent to that in which the unit is located, without external heating pipes or ducts.

48. **Heater, Unit.** A suspended, self-contained, vented, heating appliance having integral means of circulation of air. A high-static unit heater is an appliance incorporating integral means of circulating against 2 inch water gauge or greater. A low-static unit heater is an appliance incorporating an integral means of air-circulation, usually a propeller fan, but not intended for duct connection.

49. **Humidifier.** A device used to add moisture to the air.

50. **Incombustible (Non-Combustible).** See Chapter 4.

51. **Infrared Radiant Heater.** A self-contained heater which directs a substantial amount of its energy output in the form of an infrared radiant energy.

52. **Makeup Air.** Outside air required to replace air being exhausted.

53. **Mechanical Equipment Room.** A room or enclosed space housing non-fuel-fired equipment.

54. **Pit.** A depression or excavation below a graded surface.
55. Plenum. An air compartment or chamber to which one or more ducts are connected, and which forms part of either the supply or return systems.

56. Pressure or Velocity Classification of Duct Systems and Plenums. LOW PRESSURE: Static pressure in the duct or plenum up to 2 inches water gauge. HIGH PRESSURE: Static pressure in the duct or plenum 6 inches water gauge or greater.

57. Return System. An assembly of ducts, plenums, fittings, registers, and grilles, through which air from a space or spaces is conducted back to the supply unit.

58. Sealed Combustion Chamber Appliances. Appliances constructed and installed so that all air for combustion is derived from the outside atmosphere, and all flue gases are discharged to the outside atmosphere.

59. Smoke Damper. A louver-type damper arranged to seal off air flow, automatically, in an air passage.

60. Solar Collector. A device designed to collect solar energy.


62. Stock. Material or residue from a manufacturing process that is air-borne.

63. Supply System. An assembly of ducts, plenums, fittings, registers, and grilles through which air is conducted from the supply unit to a space or spaces.

64. Thermal Storage. A device used to store thermal energy.

65. Vent. See Chapter 37.

66. Ventilation. The process of supplying or removing air from any space.

SECTION 5203. AIR HEATING, VENTILATION, AND AIR CONDITIONING SYSTEMS IN BUILDING GROUPS A THROUGH H OCCUPANCIES.

(a) Scope. This Section shall apply to air duct systems employing mechanical means for the movement of air for heating, ventilation, air conditioning systems, and exhaust systems. See other sections of this Chapter for the removal of flammable vapors or residues, or to systems for conveying dust, stock, or refuse by means of air currents.

(b) Equipment.
1. Mechanical refrigeration, when used with air duct systems, shall conform with the requirements of this Chapter and Chapter 49.

2. In Group E Occupancies, heating and exhaust equipment shall be approved prior to installation.

(c) **Installation.** Air conditioning and exhaust systems shall conform to the following:

1. Gas-fired heating equipment shall not be located downstream from a cooling unit unless the equipment is approved for that use.

2. Heating equipment shall not be located upstream from a cooling unit unless the cooling unit is approved for that use.

3. All fuel-fired heating equipment located within Groups A through H Occupancies shall be installed in a furnace or boiler room in accordance with the requirements of Chapter 17. Combustion air shall be directly from the outdoors in Group E Occupancies when corrosive or flammable vapors are present. Access to boiler or furnace rooms shall be from the exterior of the building only.

(d) **Construction of Ducts.** Duct construction shall conform to the following:

1. Ducts shall be constructed entirely of approved materials. See Table 52-A.

2. Ducts shall be constructed to provide structural strength and durability, and shall be at least equal to the thicknesses specified in Table 52-A.

3. Spirally wound ducts under six inches in diameter shall be at least 30 U.S. Gauge Steel.

4. Wire glass or approved plastic may be used for inspection ports or windows. See Chapter 60.

**EXCEPTION:** On range hood exhaust duct systems.

5. Ducts or plenums may be of independent construction, or may be formed by parts of the building structure as approved by the Department. The air passage shall be constructed of approved materials. Where a fire-resistive enclosure is used as a vertical duct extending more than two (2) stories and used for supply air, return air, or smoke control it shall be constructed of masonry, concrete, clay tile, or other material having Class “O” flame spread, smoke developed and fuel contributed ratings and shall be
tested and meet the requirements of Underwriters Laboratories #181 for rigid air duct materials. (See Section 5227 Standards) Any of the above materials shall maintain the fire-resistive requirements for vertical opening enclosures required in Table 17-A and Chapter 43. A fire-resistive vertical enclosure used as a supply air, return air, or smoke control duct shall not be used as an exhaust duct for other than smoke control. (Revised 8/80 Ordinance No. 393)

6. Approved flexible duct connectors used between ducts and air devices in construction Types I, II, III and IV shall be Class 1 in accordance with U.L. 181. The use of flexible ducts is prohibited for use as return air duct and, on gravity furnaces.
   A. Duct connectors shall not pass through any rated wall, floor, or ceiling.
   B. Flexible duct connectors shall be continuous, and shall not exceed 10 feet in length or 16 inches in diameter.

7. Vibration isolation connectors in duct systems shall be made of an approved flame retardant fabric or approved material having a Class 1 rating. Vibration isolation connectors shall not exceed 10 inches in length. Connectors exterior to the building shall be waterproof. Vibration isolation connectors shall not be permitted for range hoods, except when the connectors are located exterior to the building and approved for use.

8. Lining or insulation, when used inside or outside of ducts, shall be of a Class 1 material in accordance with NPFA 90 A.

9. Work involving the use of torches shall not be undertaken on ducts until the system has been made inoperative.

10. Ducts shall have no openings other than those required for the proper operation and maintenance of the system.

11. Tape used for sealing joints shall be of an approved type.

12. The use of non-metallic registers, grills or diffusers is prohibited.

   EXCEPTION: Plastic grills supplied with approved toilet exhaust fans are permitted in H-2 occupancies (Revised 5/82 Ordinance No. 245).

13. As an alternate to duct gauges as required in Section 5203 (d)2 and Table 52-A, duct gauge as specified in SMACNA Low Pressure Duct Construction Standards 1976 (up to 2 inch water gage) or SMACNA High Pressure Duct Construction Standard 1975 (up to 10 inch water gage) may be used provided duct closure and support is installed as specified in the SMACNA...
Standard. Dovetail duct connections are not permitted. (Revised 5/82 Ordinance No. 245)

(e) Installation of Ducts.
1. Ducts shall not impair the effectiveness of the fireproofing surrounding structural members.
2. Ducts which pass through walls, floors, or ceilings required to be of fire-resistive construction shall be enclosed as specified in Chapter 17. If fire resistive enclosures are not provided, approved fire dampers shall be installed at the point where the ducts penetrate the fire resistive walls, floors or ceilings.
3. Approved fire dampers shall be installed in required fire resistive walls, floors, or ceilings at the point of penetration. Dampers shall be installed in accordance with the provisions in Section 5219.
4. Supports and hangers for ducts shall be securely fastened to ducts and attached to structural members at intervals of not more than 8 feet.
5. The use of dual-type stackheads in bathrooms or toilet rooms is prohibited.
6. Electrical fixtures, conduit, piping, ceilings, walls or wall supports shall not be attached to any duct or duct support. Supports shall not penetrate duct-work.

(f) Clearance from Warm Air Ducts, Plenums, or Bonnets.
1. Warm air ducts, plenums, or bonnets shall be installed with clearance to combustible material as follows:
   A. When a metal duct penetrates a partition or enclosure constructed of combustible material, the space around the duct providing the required clearance may be closed with a thimble or collar, or the wall surface may be extended to the duct with noncombustible materials.
   B. In Type I or II buildings, clearance shall not be required for bonnets, plenums or ducts.
   C. In Type III, IV or V buildings, bonnets or plenums shall have a clearance to combustibles as specified in Table 52-E.

(g) Outside Openings.
1. Location.
   A. Outside air intake openings in exterior walls shall be located at least ten feet, measured in any direction from any plumbing vents, flues, vents, chimneys, and gas regulator vents, hazardous, or noxious sources.
2. Mounting Height.
   A. Outside air intake and exhaust openings shall be located at least 12 inches above the outside grade or roof.
   B. Where outside air intake and exhaust openings are located in an areaway below grade, the top of the areaway shall be at least 12 inches above the grade level.

3. Screens. Outside air intake and exhaust openings shall be protected by screens of corrosion-resistant metal of minimum 1/2 inch mesh.

4. Weather Protection. Outside air intake and exhaust openings shall be protected against weather and water with a weather-proof hood or louvers. Outside openings for exhaust air shall be equipped with a backdraft or motorized damper.

5. Accessibility. All outside air intakes shall be accessible for cleaning.

   (h) Controls. Each air handling system shall be equipped with a manual disconnect switch located adjacent to and within sight of the motor for shutting the fan down.

   (i) Negative Pressure from Ventilation Systems. Ventilation systems shall be designed, constructed, and arranged so that negative pressure from the ventilation system cannot affect the air supply for combustion, or draw products of combustion from appliances, vents, or fireplaces.

SECTION 5204. AIR HEATING, VENTILATION, AND AIR CONDITIONING SYSTEMS IN BUILDING OF GROUP I OCCUPANCIES.

(a) Scope. This Section shall apply to central air heating and air conditioning systems in dwelling units.

(b) Supply and Return Ducts and Fittings.

1. Ducts shall be constructed of Incombustible Class 1 material, except as otherwise provided in this Section, and shall be equivalent in structural strength and durability to the requirements of Table 52-B. Flexible duct connectors may be used in forced air supply ducting systems. Flexible ducts or connectors shall be continuous, and shall not exceed 10 feet in length or 16 inches in diameter.

2. Ducts installed in floor slabs shall comply with Section 5212.

3. Joints and seams of supply and return ducts shall be securely fastened and constructed to be substantially airtight. Round pipe slip-joints shall have a lap of at least 1 inch and each joint
shall be individually fastened with a minimum of 3 metal screws or rivets.

4. Supports and hangers for ducts shall consist of strips or rods of metal securely fastened to ducts with sheet metal screws, bolts, or rivets, and attached to joists or other framing members at intervals of not more than 8 feet. Tape used for sealing joints shall be an approved type.

5. The panning of joists for return air ducts shall be of the following gauge metal: At least No. 28 U.S. Gauge galvanized iron, No. 26 U.S. Gauge aluminum or tin. The interior of panned joists shall be lined with metal at points where there would be danger from incandescent particles dropping through the register, such as directly under floor registers, adjacent to outdoor intakes, and at the bottom of vertical ducts.

6. Vertical stacks for return air shall not be connected to registers on more than one floor.

7. The use of dual-type stackheads is prohibited.

8. The use of non-metallic registers, grills or diffusers is prohibited.

   EXCEPTION: Plastic grills supplied with approved toilet exhaust fans are permitted in H-3 and I occupancies. (Revised 5/82 Ordinance No. 245)

9. As an alternate to duct gages as required in Section 5204 (b)1, and Table 52-B, duct gage as specified in SMACNA Low Pressure Duct Construction Standard 1976 may be used, provided duct closure and support is installed as specified in the SMACNA Standard. Dovetail duct connections are not permitted. (Revised 5/82 Ordinance No. 245)

(c) Furnace Settings and Controls. See Table 52-E.

(d) Combustion Air and Venting. See Chapters 51 and 37.

(e) Private Garage Heating. The discharge opening of warm air ducts extending from any dwelling to its attached garage shall be at least 66 inches from the floor of the garage. Outside air shall be supplied to the return air system through a duct having an area 10 percent greater than the area of the garage warm air supply.

(f) Negative Pressure from Exhaust Systems. Exhaust systems shall be constructed and arranged so that negative pressure from the system cannot affect the air supply for combustion, or draw products of combustion from appliances, vents, or fireplaces.

(g) Installation.
1. Gas-fired heating equipment shall not be located downstream from a cooling unit unless the equipment is approved for the use.
2. Heating equipment shall not be located upstream from a cooling unit, unless the cooling unit is approved for that use.
3. Heating equipment installed in parallel with evaporative cooling units shall have an adjustable damper in the circulating air system to direct all of the air through the operating unit. The damper shall be electrically interlocked to insure proper damper position relative to the cycle of operation. In no case shall the cooled air pass over the heat exchanger of the furnace.

SECTION 5205. CLOTHES DRYERS. Make-up air shall be provided from the outside or from other portions of the building. Dryers shall not be permitted in furnace or boiler room except when approved by the Department. See Chapters 37 and 51.

SECTION 5206. RECESSED HEATERS.
(a) General. Recessed heaters shall not be installed as a substitute for a central heating system.
(b) Installation. Recessed heaters shall be installed in accordance with their approval and the manufacturer's instructions.
(c) Access. Panels, grilles, and access doors which must be removed for normal servicing operations shall not be attached to the building construction.
(d) Closed Rooms. Recessed heaters installed in rooms normally kept closed shall be equipped with a safety pilot, and the rooms shall be provided with combustion air.

SECTION 5207. SPACE OR ROOM HEATERS.
(a) Space or Room Heaters.
1. Heaters shall not be installed as a substitute for central heating except when approved by the Department.
2. Space heater locations shall not create a fire hazard to adjacent materials nor impede the movement of persons within the room.
3. Space heaters shall be installed in accordance with their approval.
4. All fuel-fired space heaters shall be vented.
(b) Through-the-Wall Heaters.
1. Through-the-wall heaters shall not be installed as central heating in Groups A through H Occupancies.
2. Combustion air intakes or vent openings shall be located on the exterior of the building. The openings shall be at least 12 inches above the exterior finished grade.

3. Heaters shall not be located in garages or accessory use buildings where motor driven vehicles or devices utilizing volatile liquids are housed or stored.

4. Through-the-wall heaters shall not be located within 12 inches of any window, door, corner, projection or opening into a building.

   EXCEPTION: Heaters may be installed with lesser clearances when approved by a recognized testing laboratory.

5. Through-the-wall heaters shall not extend into any public way or private walkway in a manner that would constitute a hazard.

SECTION 5208. SUSPENDED FUEL-FIRED UNIT HEATERS.

(a) General.

1. Approved unit heaters may be installed in garages, enclosed loading docks, and other occupancies. When heaters are installed in public repair or storage garages, and suspended from the ceiling or roof, they shall be at least 8 feet in height from the floor to the bottom of the unit. In spaces where vehicular equipment in excess of 6 feet in height is present, a minimum of 2 feet clearance shall be provided between the bottom of the unit heaters and the top of the equipment.

2. Unit heaters to be installed in private garages shall be installed with a clearance of at least 66 inches measured from the floor to the bottom of the unit.

3. The location of heaters installed in Group E Occupancies and airplane hangers shall be approved prior to installation.

(b) Clearance. For clearance to combustible materials, see Table 52-E. Heaters approved for lesser clearance may be installed accordingly.

(c) Venting. See Chapter 37.

(d) Supports. Suspended unit heaters shall be securely supported. Hangar brackets and other supports shall be of noncombustible material.

(e) Combustion Air. See Chapter 51.

(f) High-Static Unit Heaters. When heaters are used in conjunction with a duct system, they shall be installed in accordance with the requirements of Section 5203.

(g) Low-Static Unit Heaters.
1. Ducts shall not be used in conjunction with low-static heaters.
2. See Section 5201 (1).

SECTION 5209. HEATING EQUIPMENT IN ATTIC SPACES.
(a) Installation. Heating equipment in attics shall be an approved type.
(b) Access.
1. The space in which an attic furnace is installed shall be accessible by an opening and passageway at least the size required to install or remove the unit without disassembling, and in no case be less than 36 x 30 inches. The access opening to the attic shall be located so that a clearance of 4 feet exists between the top of the ceiling joist and the bottom of the rafters at the point of entrance.
2. The entrance to the passageway shall not be located more than 20 feet from the furnace.
3. There shall be an unobstructed catwalk at least 24 inches wide securely fastened to the ceiling joists, and leading from the access opening to the service side of the furnace.
(c) Furnace Setting.
1. All attic furnaces shall be set on an unobstructed platform, which shall extend at least 12 inches on all sides of the furnace, except that on the control side or other sides where access is necessary for servicing, the platform shall extend from the furnace. The entire platform shall be covered with at least 1/4 inch asbestos millboard or its equivalent.
2. When the platform is supported by the ceiling joists or suspended from the roof construction, the structural integrity of the framing shall not be exceeded. The furnace shall be provided with at least 1 inch ventilated clearances from the bottom of the unit to the asbestos millboard. For clearance to combustible materials, see Table 52-E.
(d) Illumination and Electrical. See Chapter 53.
(e) Filters. See Section 5218.
(f) Ducts. See Section 5203.
(g) Venting and Combustion Air. See Chapters 37 and 51.

SECTION 5210. HEATING EQUIPMENT LOCATED IN CRAWL SPACES.
(a) **Crawl Space.** A minimum height of 36 inches between the ground level and the bottom of the floor joist shall be maintained throughout the entire crawl space area.

(b) **Clearance.** For clearance to combustible materials, see Table 52-E. A minimum distance of 6 inches between the bottom of the floor joist and the top of the equipment shall be maintained unless the equipment is approved for lesser clearance.

(c) **Installation.** Heating equipment shall be placed on a concrete slab at least 4 inches in thickness and such slabs shall be above the level of the surrounding ground in the crawl space. The slab shall extend at least 6 inches on all sides of the furnace.

(d) **Illumination and Electrical.** See Chapter 53.

(e) **Access.** A clear space shall be maintained from the access opening to the service side(s) of the equipment. The access path shall be at least 3 feet in width and the full height of the crawl space.

   1. An exterior access opening shall be provided and the furnace shall be located not more than 20 feet therefrom.

      A. The vertical and horizontal dimensions of the exterior access shall be large enough to remove the heating equipment without disassembly, but shall be at least 36 x 30 inches. The inside of the areaway shall extend at least 54 inches out from the outside face of the access opening. The walls shall be at least 6 inches in thickness of concrete or concrete block and the floor of the access shall be of washed gravel at least 4 inches in depth. The top of the access wall shall be extended to at least 4 inches above the exterior grade and covered in a manner as to be weatherproof.

   2. In Group H-3 and I occupancies, an interior crawl space access opening may be provided. The opening shall not be located in, or access made through garage and it shall not be located where it may be blocked by appliances, floorcovering, fixtures or furniture. The heating equipment shall be located not more than 20 feet from the opening.

      A. If a horizontal access is provided in the floor, the opening shall be a minimum 30 inches by 54 inches, the cover shall be hinged, be level with the floor and provided with an opening device.

      B. If a vertical access is provided, the minimum opening size shall be 30 inches wide by 36 inches high, the door shall be hinged and provided with an opening device.

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(f) In existing buildings where it is impossible to comply with the above requirements, other access openings shall be as approved by the Department.

(g) Crawl spaces over 3 feet in height shall be provided with a ladder.

(h) Flammable or explosive materials shall not be stored in a crawl space.

(i) For combustion air requirements in crawl spaces, see Chapter 51.

(j) Heating equipment shall not be located in a crawl space in Group A through H-2 occupancies. (Revised 7/83 Ordinance No. 389)

SECTION 5211. UNDERGROUND DUCT SYSTEMS.

(a) Installation. Underground duct systems shall have duct joints securely fastened; made air tight and conform to the following:

1. Non-metallic material may be installed in accordance with the requirements of the the approval obtained.

2. Underground duct systems installed in or below concrete floors or slabs shall be fully encased in at least 2 inches of concrete and shall be securely anchored to grade every 6 feet prior to encasement in the concrete. Other systems may be as approved by the Department.

3. Metal duct shall be heavy enough to prevent collapse, but in no case shall be lighter than the weights shown in Table 52-A.

SECTION 5212. GRAVITY HEATING SYSTEMS.

(a) Material. Ducts shall be constructed entirely of noncombustible material equal in structural strength and durability to the requirements of Table 52-B.

(b) Installation. Heating systems shall be installed in the following manner:

1. Ducts and fittings shall be properly secured to the structure with metal lugs or straps.

2. Supply runs in basement shall have a vertical rise of 1 inch for each horizontal run of 1 foot, or where the total rise is taken at the furnace, the rise shall be at least 1-1/2 inches per linear foot of the run.

3. Supply ducts shall afford a clearance of at least 1 inch from any combustibles.

4. Adhesive coverings for aluminum ducts, if used, shall be non-alkaline.
5. Supply ducts shall be provided with locking type dampers which shall be supported on both sides of the pipe, and which shall be located not more than 2 feet from the furnace casing.
6. Supply ducts which pass through combustible walls shall be equipped with a metal ventilated thimble at least 1 inch greater in diameter than that of the pipe.
7. The return air opening shall not extend higher than 14 inches from the bottom of the furnace.
8. Vertical stacks for return air shall not be connected to registers on more than one floor.
9. Gravity furnaces shall not be converted for use as forced air furnaces.

SECTION 5213. APPLIANCES ON ROOFS.
(a) General. Appliances shall be approved for out-door installation and shall be designed to withstand atmospheric and climatic conditions. Roofs on which appliances are to be installed shall be capable of supporting the additional load.

(b) Installation.
1. General. Appliances shall be installed in accordance with their approval.
2. Set Back. At least 6 feet clearance shall be maintained between the appliance and the edge of a roof or other hazard. Otherwise, rigidly fixed rails or guards at least 3 feet in height shall be provided on the exposed side except that parapets at least 3 feet in height may be utilized in lieu of rails or guards.
3. Curbs and Flashings. See Chapter 32.

(c) Access to Appliances.
1. Access to appliances located on roofs or other elevated locations shall be provided.
2. Buildings having an eave height of 20 feet or more, or 2 stories in height where appliances are located on the roof, shall have permanent inside means of access.
3. Permanent lighting shall be provided for the access. See Chapter 53.

SECTION 5214. HEATING AND VENTILATING EQUIPMENT IN HAZARDOUS OCCUPANCIES. Heating and ventilating installation in Group E Occupancies shall be approved by the Department on an individual installation basis.
SECTION 5215. COMMERCIAL COOKING APPLIANCES.
(a) Installation.
  1. All commercial cooking appliances shall be installed in an accessible location with clearances in accordance with their approval, and shall comply with Chapter 51.
  2. The use of liquified petroleum gas or liquid fuel is prohibited.

SECTION 5216. COMMERCIAL COOKING HOODS AND FANS.
(a) Required Locations. Commercial cooking appliances, cooking and industrial appliances in Groups A through H Occupancies shall be provided with ventilating hoods and exhaust ducts. Domestic ranges used for commercial purposes shall meet the requirements of this Section, unless otherwise approved by the Department.
(b) Fire Protection. See Chapter 38.
(c) Electrical Equipment and Control. See Chapter 53.
(d) System Designs.
  1. The hood or other portion of the system designed for primary collection of vapors and residues shall be constructed of steel or stainless steel with welded joints, and shall have a clearance of at least 18 inches to combustible material, unless otherwise approved.
  2. Grease filters shall conform to Section 5218.
  3. Grease filters or other means of grease extraction shall be of noncombustible construction designed for the specific purpose. The height of the lowest edge of grease filters located above the cooking surface shall not be less than:
     A. No exposed flame (grills, french-fryers, etc.) .. 30 inches.
     B. Exposed charcoal and charcoal type fires ...... 48 inches.
     C. Exposed fire other than Item B .................... 42 inches.
(e) Exhaust Ducts and Hoods.
  1. Ducts and hoods, or other primary collection devices, shall be constructed of No. 18 U.S. Gauge or heavier steel, or No. 20 U.S. Gauge stainless steel, with welded joints.
  2. Ducts from grease hoods shall constitute an independent system and shall lead as directly as possible to the outside, and be constructed to provide drainage of grease to a collection point.
  3. Hand-holes for inspection and cleaning purposes, equipped with tight fitting metal doors and latches, shall be provided in horizontal sections of exhaust ducts. Openings shall be at the sides of the horizontal run in order to prevent dripping of residue.
Spacing of openings shall not exceed 20 feet. Openings shall have a minimum dimension of 12 inches.

4. Vertical risers shall be located outside the building, and shall be supported with noncombustible supports. When approved by the Department, a riser may be located inside a building. The riser shall be enclosed in a fire-resistant shaft in accordance with the provisions of Chapter 17. Access openings shall be provided at the base of each vertical riser.

5. Termination of Ducts. Ducts shall extend above the building in which located and shall terminate as follows:
   A. With at least 40 inches clearance from the outlet to the roof surface.
   B. With a minimum of 10 feet of clearance from the outlet to adjacent buildings, property lines, air intakes and adjoining grade levels.
   C. With the direction of flow of exhaust air away from the surface of the roof. If such is not possible, a metal pan shall be provided on the roof surface to catch residues that pass through the system. The pan shall have a minimum one inch lip at all edges to retain residues.

(f) Exhaust Fans.
   1. Exhaust fans shall be located outside the building.
   2. Fans shall be provided with a backward-inclined non-overloading wheel, and the fan motor shall be located outside the air stream.

(g) Ventilation for Commercial Cooking Equipment.
   1. Duct systems shall be designed to create a conveying air velocity in the exhaust ducts of at least 1500 feet per minute.
   2. Hoods shall be equipped with mechanical exhaust blowers which exhaust a minimum of 75 CFM per square foot of hood area when the hood is attached to a wall. When the hood is located with all four sides exposed, a minimum of 100 CFM of air per square foot of hood area shall be exhausted. Minimum overhang shall be 3 inches per foot of height from the top of the appliance, but in no case shall the total be less than 6 inches.
   3. Low sidewall range hoods, when the intake is within 3 feet of the cooking surface, shall have a minimum volume of 300 CFM per lineal foot of cooking surface. The maximum setback from the face of the hood to edge of cooking equipment shall be one foot.
4. Makeup Air.
   A. A positive means of introducing makeup air, equal to 90 percent of the quantity of air being exhausted by all exhaust systems, shall be provided for the space.
   B. The supply of air for exhaust may be makeup air or infiltration, but shall not be dependent upon the opening of windows, doors, etc.
   C. When fuel-burning appliances directly vented to outdoors are located in the same room as the hood, the makeup air quantity shall prevent negative pressures in the room from exceeding 0.02 inches water column.
   D. All systems shall be submitted for approval prior to installation.

SECTION 5217. FILTERS.
(a) Scope. This Section shall apply to filters used for the filtering of air for cooling, heating, ventilating, range hood and exhaust systems. This Section shall not apply to either absorption, ionizing, or collecting type.
(b) Filters. Filters installed in heating, ventilating, or cooling systems shall meet the following requirements:
   1. Air filters shall be readily accessible for inspection and removal for cleaning and replacement. Duct connections shall be constructed to allow even distribution of air over the entire filter bank.
   2. Filters installed near outside air inlets shall be protected from the weather by louvers and 1/2 inch wire mesh screen installed on the inside of the louvers, which shall be accessible for cleaning.
   3. Filters installed near outside air inlets shall be Class 1.
   4. Liquid adhesive coating used on air filters shall have a flash point of at least 325 degrees F., Cleveland Open-Cup Test.
(c) Filters in Commercial Range Hoods. Filters shall meet the following requirements:
   1. Commercial range hoods shall contain a grease retention element or filter placed inside the hood so that all air passing from the hood to the duct shall pass through the element or filter.
   2. Grease retention elements or filters shall be approved by a nationally recognized testing laboratory. There shall be 1 square inch minimum of filter area for each 2.0 CFM exhausted.
3. All filter assemblies shall be accessible for easy removal of the filters for servicing or replacement.
4. The filter media shall be constructed of specially formed metal, and shall be packed for grease retention. The filter media shall be encased in metal channel with drain holes to facilitate servicing. Each filter shall be identified by the manufacturer of the filter, indicating that the filter is suitable for grease retention.
5. Grease filters shall be set at minimum 45 degrees, maximum 60 degrees, from horizontal. A cleanable grease drip-pan shall be provided below the filter bank.

(d) **Filters, Special.** Filters used in conjunction with spray-painting or dipping operations shall be non-flammable.

(e) **Filters, Other.** Filters used for purposes other than provided for in this Section shall be approved by the Department.

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**SECTION 5218. FIRE, SMOKE, COMBINATION FIRE AND SMOKE, CEILING RADIATION DAMPERS.**

(a) **Requirements.** Fire dampers shall be required in air passage openings which penetrate walls or floors having a required fire-resistive rating. Openings in suspended ceilings which are part of a fire rated assembly shall be protected with a ceiling radiation damper that complies with the assembly design as detailed in the U.L. Fire Resistance Directory. Smoke dampers shall be required in air passage openings which penetrate smoke barriers. A combination fire/smoke damper may be used where both a smoke barrier and a fire rated separation are designed to be one and the same. Access shall be provided for the above dampers. Access doors in ductwork shall be painted red and shall be permanently labeled “Fire Damper Access”, “Smoke Damper Access” or “Combination Fire/Smoke Damper Access”.

(b) **Fire Damper Construction.** Fire dampers shall meet the standards of U.L. 555 and shall be listed by an approved testing laboratory.

(c) **Ceiling Radiation Damper Construction.** Ceiling dampers shall meet the standards of U.L. 555 and shall be listed by an approved testing laboratory.
(d) **Smoke Damper Construction.** Smoke dampers shall meet the standards of U.L. 555 S, Class I or Class II and shall be listed by an approved testing laboratory.

(e) **Combination Fire/Smoke Damper Construction.** These dampers must be classified as a fire damper under U.L. 555 and as a leakage rated damper under U.L. 555 S, Class I or Class II.

(f) **Damper Control.** Fire dampers, ceiling radiation dampers and combination fire/smoke dampers shall close automatically upon the operation of a fusible link or other approved and listed heat sensitive device. Smoke dampers and combination fire/smoke dampers shall be equipped with an automatic operator which will open or close the damper in response to smoke detectors located as required in other sections of this code. If fire dampers or combination fire/smoke dampers are located in smoke exhaust paths, the fusible link or heat sensitive device shall be designed and listed for "high" temperature (250 to 300°F). In all other locations, the rating shall be "ordinary" temp (135 to 170°F).

Combination fire/smoke dampers may be equipped for remote override of fire damper closure so that the damper, after closing from heat activation, may be re-opened using controls at the Fire Command Center. However, if combination dampers with this override feature are installed; they shall be so designed, tested and listed so that the remote override feature becomes inoperable at a temperature exceeding 285°F at either side of the damper face.

(g) **Special Requirements.** Listed fire dampers may be used with transfer grills in fire-rated doors provided the grill and fire damper are installed at the door manufacturer’s factory and the door is listed as an assembly with the grill/fire damper in place. (Air transfer openings are not permitted in fire-rated egress corridor walls or doors.)

(h) **Design.** It shall be the responsibility of the building designer to indicate on the design documents the location and rating of all required fire and smoke separations.

(i) **Installation of Fire Dampers.**

1. Fire dampers shall be installed within the fire-rated assembly.  
   EXCEPTION: See paragraph 4 of this section

2. The opening in the fire-rated separation shall be framed and lined with fire-resistive material identical to the facing of the separation assembly. (See Section 1724).
3. A metal sleeve, housing the fire damper, shall be installed in the framed opening. Sleeve shall be 16 ga. for dampers not exceeding 24" in height and 36" in width; 14 ga. for larger sizes. The framed opening in floor or wall shall be a minimum 1/8 inch per foot larger than the overall damper and sleeve assembly size in each dimension unless otherwise specified by the manufacturer and listing. The sleeve may rest on the bottom, or one side, of the opening; and need not be centered. Sleeves shall extend a minimum of 2" and a maximum of 6" beyond the face of the separation.

**EXCEPTION:** When fire dampers are installed at transfer grills, the 2" sleeve extension past the face of the separations shall not be required.

Sleeves shall be retained within the wall or floor assembly by installing angle irons (minimum size 1-1/2" x 1-1/2" x 1/8") on all 4 sides of the sleeve, and on both sides of the wall or floor assembly. Angle irons shall overlap on the face of the separation assembly at least 1". The fire damper shall be secured to the sleeve and the sleeve shall be secured to the retaining angle irons by means of welding (1/2" long welds on 8" centers) or fasteners 1/4" bolts, No. 10 steel screws, or 3/16" min. steel rivets - all on 8" centers). The exterior of the sleeve shall be painted red.

4. If unusual circumstances make it impossible to locate the fire damper within the fire-rated assembly, the fire damper shall then be installed within a 10 ga. sleeve. The extension of the sleeve outside the separation assembly shall be wrapped with fire resistive material that is equal or equivalent to the material that makes up the face of the separation assembly. Wrap shall extend out from the separation assembly to the outer edge of the fire damper. The centerline of the fire damper shall be no more than 12" from the face of the fire-rated assembly.

(j) **Installation of Smoke Dampers.** Smoke dampers shall be installed in accordance with manufacturer's instructions and Section 1807(a)3.

(k) Ceiling radiation dampers, acting as a heat barrier in duct outlets penetrating fire resistive membrane ceilings, and used in lieu of
SECTION 5219. EVAPORATIVE COOLING.
(a) Roofs. For installation on roofs, see Chapter 32.
(b) Water Overflow. Water overflow openings and lines shall be not less than the size of the discharge outlet of the appliance. Lines shall be of galvanized steel, or copper, pitched to drain into a trapped and vented plumbing fixture with a minimum air gap of at least 1 inch.
(c) Wiring. Wiring shall meet the requirements of Chapter 53.
(d) Duct Weights. In addition to the requirements of this Section, duct weights shall conform to Tables 52-A or 52-B.

SECTION 5220. SERVICE STATIONS.
(a) Service Stations Defined. See Chapter 4.
(b) Location of Heating Equipment. Fuel-burning or electric heating equipment shall be located at least 66 inches from the floor to the bottom of the unit, and at least 8 feet in height in lubrication areas. Heating equipment shall not be located below grade.
(c) Clearance. Suspended horizontal furnaces shall be installed with clearances as shown in Table 52-E.
(d) Ducts. Return air and supply air shall be provided to the furnace through approved ducts. Duct weights shall conform to the requirements of Section 5203.
(e) Additional Requirements. In addition to the requirements of this Section, furnaces shall meet the requirements of Section 5203.
SECTION 5221. BLOWER AND EXHAUST SYSTEMS FOR REMOVING DUST, STOCK AND VAPORS. (Excluding paint spray rooms and booths, and Group I Occupancy.)

(a) General. Blower and exhaust systems for dust, stock or vapors shall be constructed and installed in accordance with NFPA Pamphlet 91. Air exhausted shall be replaced with air of equal volume.

(b) Separating and Collecting Equipment.

1. Shall include cyclones, condensers, cloth screen and stocking arrestors, centrifugal collectors, and other devices used for the purpose of separating solid material from the air stream in which it is carried; and hoppers, bins, silos and vaults for collecting the solid material.

2. Separating or collecting equipment shall be designed and constructed to withstand potential explosion pressures.

3. Separating or collecting equipment shall be located to prevent a hazard to adjacent structures. Supports shall be of metal, masonry, or concrete; and the structure shall be securely anchored to resist anticipated loads. Cleanout doors shall be provided. Separating or collecting equipment shall be located at a safe distance from combustible construction, or from unprotected openings.

4. Discharge ducts shall not come in contact with nor expose combustible material. Ducts shall terminate above the roof if within 10 feet of buildings of combustible construction, or unprotected openings.

5. Delivery ducts from cyclone collectors shall not convey refuse directly into the fireboxes of boilers, furnaces (including Dutch oven), refuse burners, incinerators, etc.

(c) Explosion Relief Vents. Explosion relief vents on duct systems shall have a cross-sectional area at least that of the duct vented, and shall lead to the outside of the building. Explosion relief vent openings shall be provided with rupture diaphragms fitted with cutters to accelerate rupture. Other equivalent means of relieving pressure may be used, when approved by the Department.

1. Explosion relief vents shall not be connected to chimneys or duct systems used for other purposes.

2. Ducts other than vertical ducts shall be constructed so that the interior is accessible for other purposes.

3. Cleanout openings shall be provided at a maximum of 20 foot intervals in ducts when the smallest dimension is less than 18
inches. Cleanouts shall be not less than 2 inches smaller in diameter than the smallest dimension of the duct in which they are installed.

SECTION 5222. VENTILATION.

(a) General. In addition to the provisions of other portions of this Building Code, the following ventilation requirements shall apply. See Table 33-A for occupant loads.

(b) Installation.

1. Ventilating requirements shall apply to every room designed, erected, altered, or converted to a different use, regardless of building type.

2. The minimum quantities of air to be supplied and exhausted by mechanical ventilating systems shall be as stated in the minimum required ventilation column of the ASHRAE Standard 62-73. See Section 5227.

3. All rooms which house sources of odors, fumes, noxious gases, smoke, steam, dust, spray, or other contamination shall be ventilated to prevent spreading of the contaminates to other occupied portions of the building.

4. Air exhausted from bath, toilet, locker or coat room, kitchen, boiler room, or rooms of similar use shall not be recirculated and shall be an independent system unless otherwise approved by the Department.

EXCEPTION: Where a building is provided with an exhaust system which operates 24 hours a day and when approved by the Department.

5. When a mechanical ventilation system is provided, supply and exhaust quantities of air shall be equalized.

6. The air removed by mechanical ventilating exhaust systems shall be discharged to the outside at a point where it will not create a nuisance, and from which it cannot again be readily drawn in by a ventilating supply system, except for air to be reused as part of a recirculation system. The minimum separation of discharge and intake openings shall be 10 feet.

7. Ventilating systems shall be of sheet metal or other approved materials. Materials shall be nonabsorbent and moisture and corrosion resistant. The construction of all equipment and duct work shall function under normal conditions without excessive vibration. Ducts and linings shall conform to the Standards.
8. Atrium Ventilation. (See Chapter 17).
(c) **Motion Picture Booth.** This classification shall include all motion picture booths housing projection equipment using carbon arc or xenon lamps.
1. When carbon arc lamps are used, fumes, gases, and other contamination shall be removed and discharged to the outside air by means of an exhaust system. Dampers shall not be installed in systems serving arc lamp projectors and the system shall be independent of any other system serving the building.
2. The capacity of the exhaust system shall be at least 200 cubic feet per minute for each arc lamp, and 300 CFM for each xenon lamp. Provisions shall be made for makeup air equal to the air exhausted. The exhaust air quantity shall be increased, if necessary, to provide a minimum of 20 AC/hr.
(d) **Toilets, Janitor Closets, Sterilizing, and Swimming Rooms.** This Classification shall include all toilet, shower and bathrooms, swimming pool rooms, janitor closets, and similar rooms.
1. When mechanical exhaust systems are used, a negative room pressure shall be maintained for all areas of this classification.
2. Every toilet room, bathroom, shower room, janitors closet, sterilizing and swimming pool room shall be provided with natural or mechanical ventilation. The use of recirculating or ductless fans in lieu of the above requirement is prohibited. Exhaust(s) shall terminate outside of the building a minimum of 5 feet from any operable window, door or air intake into the building. (Revised 5/82 Ordinance No. 245)
(e) **Garages.**
1. Repair garages, service stations, body shops, and all storage garages housing 6 or more vehicles driven by internal combustion engines shall be provided with a supply and exhaust ventilation system. A storage area is defined as any area within a building used for storage of fire trucks, tractors, automobiles, trucks, and other self-propelled vehicles. The outside air supply and exhaust ventilation shall be provided and maintained for all occupied areas during periods of occupancy. In lieu of continuous ventilation system operation, carbon monoxide detectors located as approved by the Department may be used to energize the system at a predetermined maximum carbon monoxide concentration.
2. A mechanical exhaust system shall be provided in all repair areas of 4 vehicle capacity or more to remove the exhaust fumes...
from the internal combustion engines. The duct system shall be designed to provide at least one outlet for each vehicle in the repair area.

(f) Ventilation of Dry Cleaning Plants Utilizing Non-Flammable Solvents. In addition to the requirements of this Chapter, dry cleaning plants utilizing non-flammable solvents shall provide ventilation in accordance with the following:

1. Exhaust System. Dry cleaning equipment shall be provided with an exhaust system capable of maintaining a minimum of 100 feet per minute face velocity through the loading door whenever the door is in fully open position. Ductwork connection of the system shall be sealed (soldered or taped), and the discharge stack shall extend through the roof to a height of at least 6 feet above the roof. The exhaust stack discharge shall be a minimum of 10 feet from a window, opening, fresh air intakes, or adjacent buildings.

2. Coin-operated Plants. Air-flow shall be at least that required by the Standards, with air movement through a separation between the public area and the service area. The direction of air flow shall be from the public area to the service area.
   A. Air flow openings shall be provided in the separation or in the machines at or near the floor level. Additional openings may be provided. If the equipment as installed cannot maintain the required volume, an auxiliary fan shall be provided in the service area.

3. Other Type Cleaning Plants. Air supply shall be provided to the public area and mechanically exhausted from the working or service area. The minimum requirements shall be as required by the Standards.

(g) Range Hoods and Fans in Group H-2, H-3 and Group I Occupancies.

1. When range hoods and fans are provided, air shall be exhausted from kitchens by a range hood or a wall or ceiling fan.
2. Ducts from exhaust fans shall discharge to outdoor air, and shall be designed for the shortest practicable run to the exterior.
3. When the kitchen is not provided with required natural ventilation, mechanical ventilation shall be provided as follows:
   A. In the ceiling or wall close to the range, and not more than 4 feet from the center line of the range to the side or front of the range.
B. In the wall directly above the range, between the bottom of the wall cabinets and the range, with a metal collector installed.

C. Hoods using charcoal for filtering are prohibited.

D. Unvented and electro-static type hoods are prohibited.

4. When the kitchen is provided with required natural ventilation, and a wall or ceiling fan is installed as an optional item of equipment, the fan grilles shall be located in accordance with Item 3 of this Section.

A. Ceiling or high wall fans shall be located not more than 6 feet from center line of range to the side or front of the range.

B. Metal collector hoods for wall fans between the range and the wall cabinets shall not be required.

(h) Spray-Painting and Dipping Rooms and Booths.

1. Spray-painting and dipping rooms and booths shall be provided with ventilation in the following manner:

A. The minimum cross section velocity measured across direction of air-flow for spray-painting and dipping rooms and booths shall be 100 feet per minute. Drive-in or drive-through vehicle spray rooms and booths shall be 100 feet per minute with the vehicle in place. The air supply opening shall be electrically interlocked to prevent operation of spray equipment until the openings are closed. Air exhausted from the room or booth shall be replaced with air of equal volume. If air supply is taken from an adjoining space, the air in the adjoining space shall be replaced with an equal volume. The compressed-air supply to spray-painting equipment shall be interlocked with the ventilating and make-up air equipment, and shall also be interlocked with water-wash equipment, if any, to assure the operation of the ventilation system during spraying operations. The air inlet opening shall be located to provide uniform sweep of air throughout the entire room or booth toward the exhaust opening or openings. When the fan discharge is directed down to the roof, a metal pan 3 inches deep and extending 12 inches on all sides of the outlet shall be installed on the roof. The discharge end shall be not less than 12 inches or more than 36 inches above the
metal pan. The method of exhaust venting shall not constitute a nuisance or hazard to adjoining property or to the public.

B. Freshly sprayed items shall be dried only in spaces provided with ventilation in order to prevent formation of explosive vapors.

SECTION 5223. CLEARANCE AND CONTROLS. See Table 52-E.

SECTION 5224. INFRA-RED SPACE HEATERS (GAS-FIRED); UNVENTED.

(a) Commercial, Industrial.

1. For full building heating, the units shall be mounted as high as practicable and in strict adherence to clearances to combustibles as determined by a nationally recognized laboratory, as indicated on the listing plate, and in accordance with the manufacturer's recommendations. Units for spot heating applications may be at a lower mounting height than that for full building heat.

2. Natural or mechanical ventilation shall be provided for the space to be heated. Provision shall be made for both outside air supply and exhaust.

   A. Natural ventilation shall consist of outlets distributed above the units to provide the capacity as determined by the following formula:

   \[ V = 9.4A \sqrt{H} \text{ (ti-to)} \]

   Where:

   \( V \) = Volume of air exhausted; CFM = 3.8 and 4.55 CFM.
   
   \( V \) = 1000 Btu/hr. for natural gas and propane gas, respectively.
   
   \( A \) = Free area of outlets: square feet.
   
   \( H \) = Height from inlets to outlet: feet.
   
   \( ti \) = Average temperature of indoor air in height \( H \): degrees F.
   
   \( to \) = Outdoor air temperature: degrees F.

   B. Inlet air area shall be fixed, and shall be equal in amount to the outlet area determined in Subsection 2A. Infiltration area may be included in the inlet area.
C. If a negative pressure occurs in the building space (due to other mechanical exhaust equipment) positive mechanical supply of air shall be provided.

D. Mechanical ventilation systems, when used, shall provide a positive pressure in the space. Exhaust area shall be in an amount sufficient to reduce carbon dioxide concentrations to 5000 ppm and carbon monoxide concentrations 50 ppm. The mechanical ventilation system shall be interlocked with the heaters so that the heaters cannot operate unless the ventilation system is operating.

(b) Semi-Hazardous Occupancy (Garages and Aircraft Hangers).
1. Heater units shall be listed for use by a recognized testing laboratory and shall be installed and located in accordance with Standards.
2. The ventilation system shall be mechanical, designed to maintain a positive pressure in the space at all times.
3. Auxiliary positive air supply and fixed exhaust openings in the high point of the space shall be provided in order to reduce the carbon dioxide and carbon monoxide produced by the heaters to 5000 ppm and 100 ppm of air respectively. The auxiliary system shall be interlocked with the main ventilation system so that it will operate only when the main ventilation system is not operating, and the heaters are operating.

SECTION 5225. DIRECT GAS-FIRED MAKE-UP AIR HEATERS.
(a) General. Direct gas-fired make-up air heaters installed in Groups E and G Occupancies only, shall be installed in a separate furnace room, and shall be in accordance with 5203(c)3 unless otherwise approved by the Department.

(b) Discharge. The total discharge of the equipment shall not exceed 110 percent of the capacity of the exhaust system with which it is used.

(c) Air. All air handled by the equipment shall be brought in from the outside.

(d) Controls. Heaters shall be interlocked with its corresponding exhaust system so that it can operate only when the exhaust system is in operation.
   1. Exhaust equipment shall be provided with air-flow sensing devices to shut off the gas burner upon failure of either the main air supply or exhaust air flow.
2. Heating equipment shall be provided with combustion safeguards as required in Chapter 51.
3. Heating equipment shall be provided with both a thermostatic device for normal operation of the gas burner component, and a high temperature limit control. The limit control shall be set at a temperature not to exceed 120 degrees F.

(e) Clearance. Equipment shall be installed with clearances not less than those required in Table 52-E for suspended unit heaters.

(f) Approval. New equipment to be installed in existing buildings shall be examined by the Department prior to installation, with approval granted prior to the issuance of a permit.

SECTION 5226. SOLAR ENERGY SYSTEM.
(a) Solar Energy Collectors. Solar collection systems may be installed as free standing, roof, wall, or deck-supported structures or devices incorporated in or attached to a building construction. Solar collection systems shall conform to ERDA and NBS Standards.

(b) Solar Thermal Components. Open, closed, or sealed vessels, containers, enclosures, spaces, and collectors shall comply with the requirements of this Building Code.

SECTION 5227. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

**ORGANIZATION** | **TITLE OF PUBLICATION**
--- | ---
ACGIH | Industrial Ventilation - 1978.
 | Minimum Required Ventilation Table 62-73.
ASTM | E-136-73 Noncombustibility of Elementary Materials
 | Dust Explosion Prevention in Feed Mills - Pamphlets 61B and 61C - 1973.
 | Air Conditioning and Ventilating Systems - Pamphlet 90A - 1978.

(Rev. 6/88) 52-35
Warm Air Heating and Air Conditioning Systems - 
Pamphlet 90B - 1976.
Blower and Exhaust Systems, Dust, Stock and Vapor 
Removal or Conveying - Pamphlet 91 - 1973.
Vapor Removal from Cooking Equipment - 
Pamphlet 96 - 1978.

SMACNA  Low Velocity Duct Construction Standard - High 
Velocity Systems Duct Manual - Industrial 
Ventilation 1975.

Factory Made Air Duct Materials and Air Duct 
Connectors UL 181-1974

LEGEND  ORGANIZATION
ACGIH  American Conference of Government Industrial 
Hygienists 
P.O. Box 453 
Lansing, Michigan

ASHRAE  American Society of Heating, Refrigeration and Air 
Conditioning Engineers 
345 E. 47th Street 
New York, New York 10017

ASTM  American Society for Testing and Materials 
1916 Race Street 
Philadelphia, PA 19103

NFPA  National Fire Protection Association 
Battery March Park 
Quincy, Mass. 02269

SMACNA  Sheet Metal and Air Conditioning Contractors 
National Association, Inc. 
8224 Old Courthouse Road 
Tysons Corner, Vienna, Va. 22180

UL  Underwriters Laboratories 
333 Pfingsten Road 
Northbrook, Illinois 60062 
(Revised 4/81 Ordinance No. 168)
### TABLE NO. 52-A

**REQUIRED WEIGHTS OF DUCTS FOR A-H OCCUPANCIES**

(This Table Does Not Include Special Exhaust Systems in Table 52-C)

<table>
<thead>
<tr>
<th>Round Ducts Diameter (Inches)</th>
<th>Rectangular Duct Max Side (Inches)</th>
<th>Min. Thickness Steel (U.S. Ga.)</th>
<th>Min. Thickness Aluminum (B &amp; S Ga.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 13</td>
<td>Up to 12</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>14 to 33 1/4</td>
<td>13 to 30</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>34 to 67 1/4</td>
<td>31 to 60</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>61 to 90</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>91 and above</td>
<td>18</td>
<td>16</td>
</tr>
</tbody>
</table>

### TABLE NO. 52-B

**REQUIRED WEIGHTS OF DUCTS FOR I OCCUPANCY**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 12</td>
<td>30</td>
<td>26</td>
<td>IC(112 lb.)</td>
</tr>
<tr>
<td></td>
<td>12 or more</td>
<td>28</td>
<td>26</td>
<td>DX(135 lb.)</td>
</tr>
</tbody>
</table>

| Rectangular Ducts | Width (Inches) | Min. Thickness | |
|-------------------|---------------|----------------|
| Less than 14      | 28            | 28             |
| 14 or more        | 28            | 24             |
### TABLE NO. 52-C

**REQUIRED WEIGHT OF DUCTS FOR BLOWER AND EXHAUST SYSTEMS FOR DUST, STOCK AND VAPORS**

<table>
<thead>
<tr>
<th>Diameter of Duct (Inches)</th>
<th>Non-Abrasive Materials</th>
<th>Abrasive Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 8, inclusive</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Over 8 to 18, inclusive</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>Over 18 to 30, inclusive</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>Over 30</td>
<td>18</td>
<td>14</td>
</tr>
</tbody>
</table>

### TABLE NO. 52-D

<table>
<thead>
<tr>
<th>Duct Gas Temperature</th>
<th>Largest Duct Dimension</th>
<th>Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 600° F., inclusive</td>
<td>8 in.</td>
<td>9 in.</td>
</tr>
<tr>
<td>Over 8 in.</td>
<td>12 in.</td>
<td></td>
</tr>
<tr>
<td>Over 600° F. to 900° F., inc.</td>
<td>8 in.</td>
<td>18 in.</td>
</tr>
<tr>
<td>Over 8 in.</td>
<td>24 in.</td>
<td></td>
</tr>
<tr>
<td>Over 900° F. to 1000° F., inc.</td>
<td>All sizes</td>
<td>24 in.</td>
</tr>
<tr>
<td>Over 1000° F. (Ducts shall be lined with refractory)</td>
<td>All sizes</td>
<td>24 in.</td>
</tr>
<tr>
<td>Type of Furnace</td>
<td>Standard or Reduced Clearance Furnace</td>
<td>Type of Fuel</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Gas</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Gas</td>
</tr>
<tr>
<td>Upflow Forced Air</td>
<td>Standard</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Gas</td>
</tr>
<tr>
<td>Downflow Forced Air</td>
<td>Standard on Non-Combustible Floors</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Gas</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Gas</td>
</tr>
<tr>
<td>Horizontal Forced Air</td>
<td>Standard</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Gas</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Gas</td>
</tr>
<tr>
<td>Type of Furnace</td>
<td>Standard or Reduced Clearance Furnace</td>
<td>Type of Fuel</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Gravity</strong></td>
<td>Standard Standard</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Reduced Reduced</td>
<td>Gas</td>
</tr>
<tr>
<td></td>
<td>Room (Space) Heaters</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gas</td>
</tr>
<tr>
<td><strong>Unit Heater Suspended</strong></td>
<td>Standard Standard</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Gas</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Liquid</td>
</tr>
<tr>
<td><strong>Unit Heater Floor Mounted</strong></td>
<td>Standard Standard</td>
<td>Liquid</td>
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<tr>
<td></td>
<td>Reduced</td>
<td>Gas</td>
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</table>
### TABLE NO. 52-E (cont'd.)

**CLEARANCES AND CONTROLS**

(For Explanatory Notes (a) through (l) see following pages.)

<table>
<thead>
<tr>
<th>Type of Furnace</th>
<th>Standard or Reduced Clearance Furnace</th>
<th>Type of Fuel</th>
<th>High Limit Required</th>
<th>Max. Outlet Air Temp.</th>
<th>High Limit Integral</th>
<th>Minimum Clearance Requirements (Inches to combustibles) for Approved Warm Air Heating Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duct Heaters</td>
<td>Standard</td>
<td>Liquid</td>
<td>Yes</td>
<td>250° F (g)</td>
<td>Yes*</td>
<td>Above and Sides of Bonnet or Plenum above and Sides of Bonnet or Plenum REDUCED</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Gas</td>
<td>Yes</td>
<td>250° F</td>
<td>Yes*</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Liquid</td>
<td>Yes</td>
<td>250° F (g)</td>
<td>Yes*</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Reduced</td>
<td>Gas</td>
<td>Yes</td>
<td>250° F</td>
<td>Yes*</td>
<td>.....</td>
</tr>
</tbody>
</table>

* Furnace may have integral or separate limit control. See Note (a) for requirements.

* The distance may be reduced 1 inch if the limit control to be used has been tested by an approved testing agency and cannot be set higher than 250 degrees F, installed not more than 10 inches above the top of the heat exchanger in a supply plenum that extends at least 12 inches above the top surface of the heat exchanger. The distance shall be increased to 6 inches if the specified distance herein cannot be adhered to.

* A minimum of 6 inches from combustible material shall be maintained for a distance of at least 12 inches from the downstream side of the heat exchanger.

* This clearance may be reduced to zero if 5/8-inch gypsum board is provided over the plenum and extends 6 inches beyond the plenum on all sides.

* Sides and bottom of bonnet or plenum.

* When a door is provided on the service side of the furnace, the clearance on this side may be reduced to 12 inches.

* At least 1-inch ventilated clearance from the bottom of the unit to the asbestos millboard below.

* If connected to the ductwork.

* 18 inches at sides, 12 inches at bottom, 6 inches above top when unit has internal draft hood.

* 1 inch above top of sloping side of a vertical draft hood.

* 6 inches from ell on diverter.

* 6 inches from relief opening of draft hood.

* Back and one side only at least 6 inches.
CHAPTER 53

ELECTRICAL

SECTION 5301. GENERAL REQUIREMENTS.
(a) Scope. In addition to the other requirements of this Building Code, the provisions of this Chapter shall apply to all electrical installations, electrical systems, and their component parts.

(b) Design, Installation and Materials. Design, installation and materials shall conform to the requirements of this Chapter and NFPA Pamphlet 70-1984 of The National Electrical Code. (See Standards)
EXCEPTION: Where a conflict exists between this Chapter and the Standards indicated herein, the requirements of this Chapter will govern. The abbreviation NEC shall mean NFPA 70-1984 and National Electrical Code.
(Revised 6/84 Ordinance No. 280)

(c) Approval. All electrical materials and equipment required or permitted by this Chapter shall be acceptable only if approved and listed by a recognized testing agency (e.g., Underwriters Laboratories, Factory Mutual) or by the Department. See Chapter 4 and 90-6, 110-2 and 110-3 NEC. (Revised 5/82 Ordinance No. 245)

(d) Weather Protection. Electrical equipment and/or conductors shall not be installed inside of any building, structure or utility until the interior has been protected from the weather.

(e) Release. The Public Utility Company shall not provide electrical service to a building, structure, or utility until electrical inspection has been completed; and the building, structure, or utility has been released for electrical service to such agency by the Department.
EXCEPTION: Electrical meters installed in temporary locations for temporary heat and construction purposes may be released by the Department.

(f) Testing. Electrical systems shall be temporarily energized for final inspection or inspection for occupancy.

SECTION 5302. BRANCH CIRCUITS.
(a) Maximum Number of Outlets. In Group I Occupancies, and in the dwelling units of Group II Occupancies, no more than 10 current consuming outlets shall be connected to a 20 ampere branch circuit. No more than 8 current consuming outlets shall be connected to a 15 ampere
branch circuit. All other occupancies shall conform to requirements of Article 220, N.E.C. for calculations of branch circuit loads.

(b) Appliance Outlets. In Group I Occupancies and in dwelling units of Group H Occupancies, appliance branch circuits shall conform to Article 220-3(b), N.E.C. and shall have no more than 3 receptacle outlets per circuit. Each kitchen shall be served by at least two circuits.
EXCEPTION: Family rooms shall comply with Section 5302(a) in regard to the number of outlets.

(c) See Articles 210 and 220, N.E.C.

SECTION 5303. SERVICE

(a) See Article 230, N.E.C.

(b) Service Drop. The method of attachment of electrical services to any building, structure, or utility shall be designated by the Public Utility Company, and shall comply with the requirements of the N.E.C.

(c) Service Masts.

1. Mast Height. Where a mast is required to maintain the required height, (See Art. 230-24 (b), N.E.C.), the mast shall be at least 2 inch galvanized rigid steel conduit or intermediate metal conduit. Masts shall be of sufficient height to maintain a clearance of at least 8 feet above the highest point of the roof over which the service wires pass. All masts over 48 inches in height shall be guyed.

EXCEPTIONS:

A. The verticle clearance shall be a minimum of 3 feet when: the voltage between conductors does not exceed 300 volts, the roof is not accessible by a permanent ladder, stairs or doorways; and the service mast is within 3 feet from the edge of the roof.

B. In Group I and J Occupancies, when the voltage between conductors does not exceed 300 volts and the roof is not accessible by a permanent ladder, stairs, or doorway, clearance shall be a minimum of 3 feet.

C. For remodeling work only, and where it is physically impractical to use 2 inch rigid steel conduit for a service mast, 1 1/4 inch rigid steel conduit may be permitted, provided the mast is securely guyed at the point of attachment of the service wires by 2 backstays of 3/4 inch E.M.T.
or by an approved mast guying kit. All fittings shall be galvanized or equivalent.

(d) Service Size. Service entrance conductors shall be at least number 6 AWG and shall have an ampacity of at least 60 amperes. See Article 230, Part E, N.E.C.

EXCEPTION:

1. For Group I Occupancies with an area of less than 1600 square feet, the service entrance conductors shall have an ampacity of at least 100 amperes, 3 wire. Basements having a bath or kitchen shall be included when computing the areas of the building.

2. For Group I Occupancies with an area in excess of 1600 square feet, the service entrance conductors shall have an ampacity of not less than 125 amperes, 3 wire. Basements having a bath or kitchen shall be included when computing the area of the building.

(e) Disconnecting Means.

1. Service entrance switches or any service distribution equipment, including branch circuit panels, shall not be installed within a bathroom, toilet room, clothes closet, storage closet, bedroom, or furnace or boiler rooms, or under or over stairways.
EXCEPTIONS:
A. Branch circuit panel boards or control centers serving furnace, boiler, or associated mechanical equipment may be installed in furnace or boiler rooms.
B. Furnace or boiler rooms in Group I Occupancies.

SECTION 5304. GROUNDING.
(a) Grounding Electrode. See Article 250

EXCEPTIONS:
1. Gas piping systems shall not be permitted as a grounding electrode.
2. Rod electrodes of iron or steel shall be protected by a conductive coating other than galvanizing or painting.
3. Pipe or conduit electrodes shall not be permitted.
(Revised 5/82 Ordinance No. 245)

(b) Metal Boxes.
1. Metal boxes when used with nonmetallic wiring systems shall be grounded to the grounding conductor by means of separate bonding screw, lug, or clip in box.
2. Grounding screws shall be installed in a tapped hole in the box.
3. When more than one grounding conductor enters metal box, joints shall be made up with approved pressure connectors with a single wire under the bonding screw, lug, or clip.
4. All joints, connections, lugs, screws, or clips shall be accessible after building finish is applied.
5. Connection of grounding conductors to clamp screws, cover screws, or nails is prohibited.
6. All grounding of metal boxes shall be performed prior to a rough-in inspection as required by the Department.

(c) Grounding Connections. Grounding conductors shall not be secured to any plumbing fixture or fitting.

SECTION 5305. TEMPORARY INSTALLATIONS.
(a) Electrical Services. Electrical services and wiring installed for temporary purposes shall comply with all the applicable requirements of this Chapter and Articles 230 and 305 of N.E.C.
(Revised 6/84 Ordinance No. 280)
(b) Group I Occupancies. For Group I Occupancies, one temporary service shall be permitted to serve not more than 3 consecutive sites for construction purposes.

(c) Location. Temporary construction meters shall be located on the same side of the alley, street, or driveway as the construction for which the meter is required.

(d) Outside Wiring. Outside temporary electrical wiring, other than extension cords, shall be installed at a minimum height of 8 feet above ground level. Extension cords rated for hard usage as listed in N.E.C. may be laid upon the ground provided the cords are removed at the end of each working day.

(e) Underground. Temporary conductors installed underground shall be of a type approved for the purpose and use, such as UF and USE. If installed without supplemental protection, such as conduit or duct, minimum burial depth shall be 12 inches. Routes of buried conductors shall be plainly marked with flags or stakes to prevent accidental excavation.

(f) Barricades and Covered Walkways. Covered walkways shall be provided with lighting consisting of a minimum of one 60 watt lamp every 10 feet. In addition, a flashing amber light, with a capacity of at least 100 watts, shall be provided on the exterior of the walkway at both ends and in the center. See Chapter 44.

SECTION 5306. TYPES OF WIRING.

(a) In Group A through H-2 occupancies, except as amended in Section (b) below, the wiring method used shall be metal raceways, cable assemblies with a metallic outer covering, cable trays installed per Article 318 NEC and Flat Conductor Cable, type FCC as approved by the Department.

EXCEPTION: Non-metallic raceways may by installed in earth, or encased in two inches of concrete. Any other use of non-metallic raceways in A through H-2 occupancies will require special permission from the Department. (Revised 7/83 Ordinance No. 389)

(b) The following occupancies or uses shall be permitted to use any wiring method listed in Chapter 3, N.E.C.: 1. Group I Occupancies
2. Group H-3 Occupancies.
3. Group H-2 Occupancies of 3 stories or less. See Section 5310(d) for emergency systems.
4. Temporary buildings.
5. Trailers and mobile units.

53-4
7. Temporary wiring.

SECTION 3307. WIRING METHODS.
(a) Construction of Cable Assemblies. Cables connected to panel boards, junction boxes, outlet boxes, and other enclosures shall enter the enclosures through a separate opening for each cable, and shall be secured to the enclosure by means of an approved fitting, clamp, or connector.

EXCEPTIONS:
1. Exterior Panel Board. Cables shall enter an exterior panel board through a nipple extending completely through the outer wall structure into the hollow space within the wall. The nipple shall be secured to the panel board by locknuts or connector, and insulated bushings shall be provided at each end of the nipple into the panel board.
(b) Box Supports. Outlet boxes shall not be supported by nails alone, unless boxes are specifically designed and approved for the purpose.

(c) Raceway.
1. Raceway installed directly in or on the earth, or in concrete which is placed in or on the earth, shall be one of the following types:
   A. Rigid nonmetallic conduit.
   B. Rigid steel or intermediate metal conduit covered with:
      (1) An approved factory-applied Poly-vinyl Chloride (PVC) or bituminous-base tape. Field-applied tape is not acceptable.
      (2) An approved bonded PVC coating.
      (3) An approved coat of bituminous-base paint.
      An approved “Special” coating, e.g., double galvanizing, etc.
2. Raceway installed in concrete not in contact with the earth may be electrical metallic tubing in addition to the types listed above.
3. Aluminum conduit shall not be installed in or on the earth or embedded in concrete.

(d) Roof Penetrations. Conduits penetrating a roof shall preserve the integrity of the roof as required in Chapter 32.

(e) Conduits on Roofs. When conduits are installed on roofs they shall be as required in Chapter 32.

(f) Conductors in Ducts and Plenums. See Chapter 52 and Article 300, NEC. (Revised 5/82 Ordinance No. 245)

(g) Duct Attachment or Support. Supports or attachment of conduits or fixtures from ducts are prohibited. See Chapter 52.

(h) Clearances. Clearances from bonnets, ducts and plenums. See Chapter 52.

(i) Group H-3 Occupancies. Electrical and telephone wiring and equipment shall not be permitted in two-hour fire resistive wall between units. Electrical installations shall conform to the requirements for Group I Occupancy. See Chapter 13.

(j) Type AC Cable. An approved tool shall be used to cut the armor on type AC cable, metal cutting saws or pliers are not permitted. (Revised 7/83 Ordinance No. 389)

SECTION 5308. APPLIANCES.

(a) General. For general installation refer to Article 422, N.E.C.

(b) Electric Cooking Units. Each wall mounted oven, or countertop cooking unit not grouped to form a single appliance, shall be connected to a separate individual circuit.

(c) Clearances. Minimum distances between electric cooking units and structural materials shall be as defined in Chapter 17.

(d) Electric Fences Prohibited. See Chapter 15.

(e) Electric Water Heaters Prohibited. Electric water heaters shall not be installed in crawl space areas. See Chapter 51.
SECTION 5309. MECHANICAL EQUIPMENT.
(a) General. See Chapter 49 for refrigeration equipment.
(b) Furnaces, Unit Heaters, and Boilers. All motors for furnaces, unit heaters and boilers, either new installations or replacements, shall have a separate overcurrent device which shall open the circuit when the motor current exceeds 125 percent of the rated full-load amperage. A thermal protector integral with the motor is not acceptable as the overcurrent device for motors on furnaces, unit heaters, or boilers. Each motor shall be provided with a disconnecting means located on or adjacent to the unit. All motors for furnaces and boilers, either new installations or replacements, shall be on a separate circuit.
EXCEPTION: In Group I Occupancies, lighting fixtures and receptacles required by 5309 (c) 1 may be installed on the furnace circuit.
(c) General Lighting and Power Requirements. In all rooms containing mechanical equipment adequate lighting and receptacle outlets shall be provided for servicing of the equipment. In addition, when equipment is installed in attics, crawl spaces, or on roofs, the following shall be required:
1. Attics and Crawl Spaces. A lighting fixture shall be installed at the access opening, and a lighting fixture and receptacle shall be installed on the service side of the equipment. Fixtures shall be switched at the access opening.
2. Roofs. A duplex receptacle shall be installed within a 50 foot radius of the equipment.

SECTION 5310. EMERGENCY SYSTEMS.
(a) Scope. Emergency systems shall comply with Article 700 N.E.C. and shall include all required electrical wiring and equipment which is essential to life safety, such as:
1. Emergency Illumination.
   A. Exit Illumination. Exit ways, which are continuous and unobstructed means of egress to a public way, shall be illuminated to an intensity of one foot candle at floor level during all times the building is occupied. See Chapter 33 for definition of required areas.
   B. Exit Signs. An exit sign with illuminated letters at least 5 inches in height shall be provided at each required exit doorway and elsewhere as required to clearly indicate the direction of egress. See Chapter 33 for further location requirements. The letters shall be white on a green field and shall be illuminated with at least 2 lamps.
2. Fire Alarm and Detection Systems.
   A. Systems shall be installed as required by Chapter 38.
   B. Wiring for fire alarm and detection systems shall be separate and distinct from all other wiring and raceway systems.
3. **Sprinkler Alarm Systems.** Audio and visual devices shall be installed on fire sprinkler systems as required by Chapter 38.


5. **Elevators.**
   
   A. When required by Chapter 55, elevators shall be energized from the emergency power source of the building.
   
   B. The ventilation fan and the lighting in each elevator car shall be energized by a separate circuit connected to the emergency power source of the building.

6. **Ventilating Systems.** Mechanical ventilation as may be required by the Department. See Chapter 52.

7. **Communication Systems.** The voice alarm and/or communication system for Fire Department use shall be energized from the emergency power source of the building.

(b) **Emergency Circuits.** All emergency circuits shall be energized from one or more of the following emergency power sources of the building.

(c) **Emergency Power Source.** In occupancies requiring a standby power source, the source shall be one or more of the following: (See Chapters 33 and 38).

   1. Generator driven by an independently powered prime mover
   
   See Chapters 9 and 17 for generator location. See Article 70 of NEC. (Revised 5/82 Ordinance No. 245)
   
   2. Storage batteries approved for emergency use, including unit equipment as defined in Article 701, NEC. In addition to the requirements of 701, NEC, wiring methods shall conform to Section 5310 (d) when supplying remote fixtures from a unit equipment source. (Revised 5/82 Ordinance No. 245)

(d) **Wiring Methods.** Wiring for emergency systems shall be installed in approved metal raceways, type MI cable or type MC cable.

**EXCEPTIONS:** Approved cables may be installed for listed power limited fire protective signalling circuits provided they comply with Article 760-30, N.E.C. and the following requirements:

1. Cables shall have 300 volt insulation rating, and a temperature rating of 105 degrees C.

2. Conductors. See 760-30, N.E.C.

3. Cables shall not penetrate walls, floors, or ceilings required to be fire rated unless enclosed in a metal raceway. Cable passed through a floor or located on a wall within 7 feet of the floor shall be installed in a metal raceway. See Article 300, N.E.C.

4. Cables shall be installed and supported as required for non-metallic sheated cable and shall be protected from mechanical injury.
5. Cables shall be spliced only in equipment enclosures or junction boxes, and junction box covers shall be marked "Fire Alarm" or painted red color.

(e) **Group D Occupancies.**

1. In all Group D Occupancies a standby emergency power source shall be installed. This source shall be a generator having a capacity and rating for the emergency operation of the following equipment:
   A. Heating Equipment.
   B. Emergency Illumination.
   C. Fire Alarm and Detection Systems.
   D. Sprinkler Alarm Systems.
   E. Elevators as required by Chapter 55.

2. The requirements of Article 517 N.E.C. shall apply to all health care facilities.

(f) **Reference.** See Chapters 18, 33 and 36 for other required standby (emergency) power equipment. (Revised 10/81 Ordinance No. 578)

(g) **Testing Standby Power Source.** Tests shall be performed on generator or battery standby source as follows: Group D Occupancies shall be tested on a weekly schedule, all other occupancies shall be tested on a monthly schedule. Tests of generator systems shall be conducted in accordance with Chapter 18. (Revised 10/81 Ordinance No. 518)

**SECTION 5311. Repealed 5/82 Ordinance No. 245.**

**SECTION 5312. SIGNS AND OUTLINE LIGHTING.**

(a) **Disconnect.** The disconnect switch shall be located within 50 feet and within sight of the sign or outline lighting. A switch capable of being locked in an open position shall not be approved as a disconnecting means when over 50 feet or out of sight of the sign.

(b) **Signs.** All signs and outdoor lighting shall be wired to comply with Article 600 of NEC and shall provide an Underwriter's Laboratories label of approval on each sign prior to installation on any building or structure.

1. All new signs and outline lighting shall be inspected by the Department prior to connection to any electrical supply source. Temporary connections shall not be permitted. See Chapter 3.
SECTION 5313. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply: (Revised 5/82 Ordinance No. 245)

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA</td>
<td>National Electric Code; Pamphlet 70-1984</td>
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<tr>
<td></td>
<td>Centrifugal Fire Pumps; Pamphlet 20-1983</td>
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<td>ANSI</td>
<td>National Electrical Safety Code C-2-1984</td>
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**LEGEND**

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<thead>
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<th>ORGANIZATION</th>
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<tr>
<td>NFPA</td>
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<td>Quincy, Mass. 02269</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<td></td>
<td>1430 Broadway</td>
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<td></td>
<td>New York, NY 10018</td>
</tr>
</tbody>
</table>

(Revised 6/84 Ordinance No. 280)
CHAPTER 54
GLASS AND GLAZING

SECTION 5401. GENERAL.
(a) Scope. This Chapter and Standards shall govern glass and glazing installed in buildings or structures as defined herein.

(b) Additional Requirements. For additional glass requirements where openings are required to be fire protected, see Chapters 17, 33, 38 and 43 of this Building Code. See Chapter 60 for openings glazed with plastics.

(c) Solar Collectors. Glass and glazing for solar collectors shall be excluded from the provisions of this Chapter when the installation does not present a hazard.

SECTION 5402. IDENTIFICATION.
(a) General. Each light shall bear the manufacturer's label designating the type and thickness of glass. Each light, with special performance characteristics such as laminated, heat-strengthened, fully tempered, insulated, or coated shall bear the manufacturer's identification showing the special characteristic and thickness by etching or other permanent means, and shall be considered labeled.

EXCEPTION: When approved by the Department, labels may be omitted from other than special performance glass provided an affidavit is furnished to the Department by the installing contractor certifying that each light is glazed in accordance with the approved drawings and specifications.

(b) Safety Glazing. Each light of safety glazing material sold for use in hazardous locations or installed in a hazardous location shall be permanently labeled by means such as etching, sandblasting, firing of ceramic material on the safety glazing material, or by other approved method. The label shall identify the labeler, whether manufacturer, fabricator, or installer; the nominal thickness and the type of safety glazing material; and a statement that the material meets the test requirements of ANSI Z-97.1. Safety glazing labeling shall be legible and visible after installation.

SECTION 5403. AREA LIMITATIONS. Exterior glass and glazing shall be capable of withstanding the loads set forth in Section 2307 (c) of Chapter 23, acting inward and outward. The maximum area of individual lights shall be those set forth in Tables 54-A and 54-B.

EXCEPTION: Where firm support is not provided at 4 edges, the area design and the means of installation shall be submitted to the Department for approval.
SECTION 5404. GLAZING. Glass firmly supported on 4 edges shall be glazed with minimum laps and edge clearances as set forth in Table No. 54-C. Glass supports shall be considered firm when deflection of the support at design load does not exceed 1/175 of the span.

SECTION 5405. JALOUSIES AND LOUVERED WINDOWS. Regular plate, sheet, or patterned glass in jalousies and louvered windows shall not be thinner than nominal 7/32 inch and not more than 36 inches in length. When other types of glass are used, the design shall be submitted to the Department for approval. Exposed glass edges shall be smooth. Wired glass with wire exposed on longitudinal edges shall not be used in jalousies or louvered windows.

SECTION 5406. HAZARDOUS LOCATIONS AND SAFETY GLAZING MATERIALS.
(a) General. Glass lights installed in hazardous locations defined herein shall be glazed with safety glazing materials as specified herein and the Table 54-D and 54-E.
(b) Safety Glazing Defined. Safety glazing material shall mean any glazing material such as tempered glass, laminated glass, wire glass, or rigid plastic which meets the test requirements of ANSI Z-97.1.
(c) Hazardous Locations Defined.
1. Framed or unframed glass entrance doors and fixed glass panels adjacent to entrance and exit doors. For purposes of this Chapter the term adjacent shall mean the edge of the fixed glass panel nearest the door which is 12 inches or less from the inside of the door jamb. Glazing located 12 inches or more from the door jamb and in excess of 6 square feet in area shall be considered to be a fixed glazed panel and shall meet the requirements of Table 54-D and 54-E.
2. Sliding glass doors, storm doors, shower doors, and bathtub enclosures.
3. Fixed glass panels more than 18 inches in width, and over 6 square feet in area, when the bottom edge is less than 18 inches above the adjacent walking surface.
EXCEPTION: Fixed glass panels, glass in corridor walls, and other glass walls, when the bottom edge is 18 inches or more above the adjacent finished walking surface, shall not require horizontal rails or safety glazing material. See Chapters 33 and 43 for the protection of openings in corridors.

SECTION 5407. SKYLIGHTS.
(a) General. Glazing installed at an angle greater than 15 degrees from vertical over lobbies, reception areas, office areas, walkways, and other areas accessible to the public shall be laminated glass, wire glass, rigid plastic, fully tempered glass, or shall be provided with protective wire screens immediately beneath the glass.
(b) Skylight Frames. In other than Type III and Type V buildings, all skylight frames shall be constructed of noncombustible materials, and shall be designed to carry roof loads as specified in Chapter 23. All skylights on any pitched roof shall be mounted on a curb at least 6 inches above the plane of the roof. The curb shall be constructed as required for the frame.

(c) Glazing Installation.

1. Spacing between supports in one direction for flat wired glass in skylights shall not exceed 25 inches. Corrugated wired glass may have supports 5 feet apart perpendicular to corrugation. All glass installed in skylights shall be wire or tempered glass with minimum thickness of 7/32 of an inch.

**EXCEPTION:** Skylights over vertical shafts, including stair enclosures, extending through 2 or more stories, may be glazed with sheet glass as specified in this Section. This glass shall be protected above and below with a wire screen not lighter than No. 12 U.S. gauge with mesh no greater than one inch.

2. Sheet glass may be used in the roofs and skylights for greenhouses, provided the height of the greenhouse at the ridge does not exceed 20 feet above grade. The use of wood frames for skylights shall be permitted in greenhouses outside of Fire Zones No. 1 and No. 2, if the height of the skylight does not exceed 20 feet above the grade; in all other cases, metal frames and metal sash bars will be used.

3. Glass used for the transmission of light, if placed in floors or sidewalks, shall be supported by metal or reinforced concrete frames, and the glass shall be at least 1/2 inch in thickness. Any glass over 16 square inches in area shall be wire glass or shall be provided with a wire screen underneath as specified for skylights in this Section. All portions of the floor lights or sidewalk lights shall be designed for the floor load requirements of Chapter 23, except in cases where the floor is surrounded by a railing at least 3 feet 6 inches in height, in which case the construction shall be designed for not less than roof loads. For additional requirements for plastic skylights, see Chapter 60.

SECTION 5408. STANDARDS. Unless provided for in other portions of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
</table>
LEGEND

ANSI
American National Standards Institute
1430 Broadway
New York, New York 10018

CPSC
Suite 938 - Guaranty Bank Bldg.
817 - 17th Street
Denver, Colorado 80202

SECTION 5409. TABLES.
### TABLE NO. 54-A

**MAXIMUM ALLOWABLE AREA OF GLASS**

(In Square Feet)

<table>
<thead>
<tr>
<th>Plate or Float Glass Thickness (In Inches)</th>
<th>Wind Load (In Pounds per Square Foot)</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
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<th>45</th>
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<table>
<thead>
<tr>
<th>Sheet Glass Thickness (In Inches)</th>
<th>Wind Load (In Pounds per Square Foot)</th>
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<th>15</th>
<th>20</th>
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<td>52</td>
<td>44</td>
<td>39</td>
<td>35</td>
<td>31</td>
</tr>
</tbody>
</table>

*Maximum areas apply for rectangular lights of annealed glass firmly supported on all 4 sides in a vertical position. Glass mounted at a slope not to exceed one horizontal to five verticals may be considered vertical.*
### TABLE NO. 54-B

ADJUSTMENT FACTORS - RELATIVE RESISTANCE TO WIND LOAD

<table>
<thead>
<tr>
<th>GLASS TYPE</th>
<th>Approximate Relationship</th>
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</thead>
<tbody>
<tr>
<td>Laminated</td>
<td>0.6</td>
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<tr>
<td>Wired</td>
<td>0.5</td>
</tr>
<tr>
<td>Heat-Strengthened</td>
<td>2.0</td>
</tr>
<tr>
<td>Fully Tempered</td>
<td>4.0</td>
</tr>
<tr>
<td>Factory-Fabricated Double Glazing</td>
<td>1.5</td>
</tr>
<tr>
<td>Rough Rolled Plate</td>
<td>1.0</td>
</tr>
<tr>
<td>Sandblasted</td>
<td>Varies c</td>
</tr>
<tr>
<td>Regular Plate or Sheet</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*a To determine the maximum allowable area for glass types listed in Table No. 54-B, multiply the allowable area established in Table No. 54-A by the appropriate adjustment factor. Example: For one-fourth inch heat-strengthened glass, determine the maximum allowable area for a 30-pound per square foot wind load requirement. Solution procedure: Use Table No. 54-A to determine the established allowable area for one-fourth inch annealed glass. Answer: 36 square feet, then multiply 36 by 2 — the heat-strengthened glass adjustment factor. Answer: 72.

*b Use thickness of the thinner of the 2 lights, not thickness of the unit.

*c To be approved by the Department, since adjustment factor varies with amount of depreciation and type of glass.
### Minimum Glazing Requirements

#### Fixed and Operable Windows Other Than Horizontal Sliding

<table>
<thead>
<tr>
<th>Glass Area (Square Feet)</th>
<th>Up to 6</th>
<th>6 to 14</th>
<th>14 to 32</th>
<th>32 to 50</th>
<th>Over 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Frame Lap.</td>
<td>$\frac{1}{4}''$</td>
<td>$\frac{1}{4}''$</td>
<td>$\frac{3}{16}''$</td>
<td>$\frac{3}{8}''$</td>
<td>$\frac{1}{2}''$</td>
</tr>
<tr>
<td>Minimum Glass Edge Clearance</td>
<td>$\frac{1}{4}''$</td>
<td>a, b</td>
<td>$\frac{3}{16}''$</td>
<td>a, b</td>
<td>$\frac{1}{4}''$</td>
</tr>
<tr>
<td>Continuous Glazing Rabbet and Glass Retainer</td>
<td>Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilient Setting Material</td>
<td>Not Required</td>
<td>Required</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Sliding Doors and Horizontal Sliding Windows

<table>
<thead>
<tr>
<th>Glass Area (Square Feet)</th>
<th>Up to 14</th>
<th>14 to 32</th>
<th>32 to 50</th>
<th>Over 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Glass Frame Lap.</td>
<td>$\frac{1}{4}''$</td>
<td>$\frac{3}{16}''$</td>
<td>$\frac{1}{16}''$</td>
<td>$\frac{1}{4}''$</td>
</tr>
<tr>
<td>Minimum Glass Edge Clearance</td>
<td>$\frac{1}{4}''$</td>
<td>b</td>
<td>$\frac{3}{16}''$</td>
<td>b</td>
</tr>
<tr>
<td>Continuous Glazing Rabbet and Glass Retainer</td>
<td>Required above third story</td>
<td>Required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilient Setting Material</td>
<td>Not Required</td>
<td>Required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

* Glass edge clearance in fixed openings shall not be less than required to provide for wind and earthquake drift.
* Glass edge clearance at all sides of pane shall be a minimum of $\frac{3}{16}$ inch, where height of glass exceeds 3 feet.
* Glass retainers such as metal, wood, or vinyl face stops, glazing beads, gaskets, glazing clips, and glazing channels shall be of sufficient strength and fixation to serve this purpose.
* Resilient setting material shall include preformed rubber or vinyl plastic gaskets, or other materials which are proved to the satisfaction of the Department to remain resilient.
### TABLE NO. 54-D
**IMPACT LOADS -- GLAZING**

<table>
<thead>
<tr>
<th>Specific Hazardous Locations</th>
<th>Size of Individual Glazed Area</th>
<th>Requirements&lt;sup&gt;a,b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glazing in exit and entrance doors, and fixed glazed panels.</td>
<td>Over 6 Sq. Ft.</td>
<td>Each glazed area shall pass the test requirements of ANSI Z 97.1. If not protected by a protective grill or bar&lt;sup&gt;c&lt;/sup&gt;.</td>
</tr>
<tr>
<td>Glazing in storm doors.</td>
<td>Over 2 Sq. Ft.</td>
<td>Each glazed area shall pass the test requirements of ANSI Z 97.1. If not protected by a protective grill firmly attached to stiles on each exposed side.</td>
</tr>
<tr>
<td>Glazing in sliding doors (both fixed and sliding panels)</td>
<td>Over 6 Sq. Ft.</td>
<td>Each glazed area shall pass the test requirements of ANSI Z 97.1.</td>
</tr>
<tr>
<td>Glass in all unframed doors (swinging).</td>
<td>All Sizes</td>
<td>Shall be fully tempered glass and pass the test requirements of ANSI Z 97.1.</td>
</tr>
<tr>
<td>Glazing in shower doors and tub enclosures</td>
<td>All Sizes</td>
<td>Shall conform to the requirements of Chapter 17 and shall pass the test requirements of ANSI Z 97.1.</td>
</tr>
</tbody>
</table>

<sup>a</sup> Annealed glass less than single strength (SS) in thickness shall not be used.
<sup>b</sup> If short dimension is larger than 24 inches, annealed glass must be double strength (DS) or thicker.
<sup>c</sup> Bar or push-bar shall be constructed with a rail 36 to 42 inches above the adjacent walking surface. The rails shall be 4 inches in width and shall be securely fastened to the stiles on each exposed side of the glass so as to limit or prevent human impact from being delivered to the glass surface.
<table>
<thead>
<tr>
<th>Glazing Materials</th>
<th>Size of Individual Glazed Area</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annealed glass (regular plate, float, sheet, rolled, or obscure).</td>
<td>Over 6 Sq. Ft.</td>
<td>Not less than ( \frac{3}{16} ) inch nominal thickness. Each glazed area shall be protected by a protective grill or bar.(^a)</td>
</tr>
<tr>
<td>Annealed glass (regular plate, float, sheet, rolled, or obscure), face sandblasted, etched, or otherwise depreciated.</td>
<td>Over 6 Sq. Ft.</td>
<td>Not less than ( \frac{3}{16} ) inch nominal thickness. Each glazed area shall be protected by a protective grill or bar.(^a)</td>
</tr>
<tr>
<td>Fully tempered glass. laminated glass. Wired glass, obscure, patterned, or transparent. Transparent rigid plastic.</td>
<td>All Sizes</td>
<td>Shall pass the test requirements of ANSI Z 97.1.</td>
</tr>
</tbody>
</table>

\(^a\) See note c, Table No. 54-D.
CHAPTER 55

VERTICAL AND HORIZONTAL TRANSPORTATION

SECTION 5501. GENERAL.
(a) Scope. In addition to other requirements of this Building Code, this Chapter shall govern the design, construction, installation, testing, inspection, maintenance, alteration, repair and approval of all vertical and horizontal transportation as defined in this Chapter.
(b) Vertical and Horizontal Transportation Defined. For purposes of this Chapter and Building Code, vertical and horizontal transportation shall include the following:
1. Elevators
2. Escalators
3. Moving Walks
4. Dumbwaiters
5. Private Residence Elevators
6. Material Transport System Lifts (MTS Lifts)
7. Stage Lifts
8. Man Lifts
9. Inclined Passenger Lifts
10. Personnel Hoists
11. Powered Platforms and Powered Scaffolds
(c) Prohibitions.
1. The equipment included in this Chapter shall not be operated until inspected and approved by the Department.
2. Mast tower cantilevered platform type automatic hoists are prohibited when the height exceeds 25 feet unless operated by a certified operator. The tower shall be guyed and provided with safety barricades and gates approved by the Department.
3. Stacking machines shall not be used as an elevator.
4. The installation or use of private residence elevators or inclined lifts is prohibited in all buildings except Group I and H-3 Occupancies.
5. Hand powered elevators are prohibited in new construction.
6. Man lifts are prohibited. Existing man lifts may be permitted to operate when controlled by the owner for operating personnel only.
7. Sidewalk elevators are prohibited on public property.
(d) Accidents and Reports.
1. Any accident involving a person or damages to the transportation equipment or its enclosures shall be reported to the Department within 24 hours after the accident, by the owner or operator of this equipment. (See Chapters 1 and 2).
2. When an accident involves injury to a person or damage to any portion of the equipment, the equipment shall not be operated until approved by the Department. The Department may order the discontinuance of service until a new Certificate has been issued.

3. Portions of the damaged construction or operating mechanism shall not be removed from the premises until approval has been granted by the Department.

(e) **Emergency Side Exits.** Except in hospitals and in blind hoistways, emergency side exits shall not be required for elevators equipped with safety devices which do not require resetting from the car.

(f) **Emergency Top Exits.** Emergency top exits, when required by this Chapter or the Department for new and existing elevators, shall be arranged so that they can be opened from the top of the car only.

(g) **Ventilation and Lighting.** In addition to requirements of ANSI A17, 1, all passenger elevators shall be equipped with an exhaust fan or blower and a minimum rating of 450 cubic feet per minute. The ventilation fan and elevator cab lighting shall be energized by a separate circuit connected to the emergency power source of the building.

**EXCEPTION:** Enclosures designed with top and bottom louvered openings which permit natural ventilation.

(h) **Power Source.** See Chapter 18, 38 and 53 for standby (emergency) power requirements. (Revised 10/81 Ordinance No. 518)

**EXCEPTION:** Elevators connected to the building emergency power system.

(i) **Test and Inspections.**

1. Elevator operation shall be inspected as required in Chapter 3. A metal plaque indicating the location within the building of the current Certificate may be mounted in the car in lieu of the Current Certificate of Inspection.

2. In lieu of Rule 1001.6b, of ANSI 17.1, pressure relief valves shall be tested, sealed and tagged at 5 year intervals by an elevator contractor. Tag shall indicate testing company, relief valve setting and date of test.

3. The elevator contractor shall notify the Department, at least one day in advance, of all 5 year safety, governor, and buffer tests, and 1 or 2 year reshackling of drum machine cables, and shall metal tag the equipment tested or reshackled indicating the date when work was accomplished and company accomplishing the work.

4. Full load, full speed safety tests for elevators with wooden guide rails shall be performed at 5 year intervals. Damaged rail sections shall be replaced and an appropriate tag furnished by the contractor affixed to the equipment.

(j) **Special Provisions.**

1. Sump pumps shall not be installed in an elevator pit.

2. Carpeting may be installed only on the floor of the cab and may be covered to extend not more than 8 inches on the wall of the cab.
3. At least one elevator car in each bank of elevators in buildings 4 stories or greater, serving all floors, shall accommodate an ambulance stretcher in its horizontal position.

4. An approved legible sign to read, "In Case of Fire or Fire Alarm Use the Stairway" shall be installed on every floor at each elevator call button. See Chapter 18 for signing requirements in high rise buildings. (Revised 10/81 Ordinance No. 518)

5. See Chapter 64 for special requirements for handicapped people. (Revised 5/83 Ordinance No. 259)

SECTION 5502. DEFINITIONS.

(a) Elevator, Emergency Operation. An elevator or bank of elevators designated beforehand or at the time of the emergency as "Emergency Elevators" and placed under the control of the Fire Department. These elevators shall be capable of being connected to the building electrical standby power source as required by Chapters 18, 38 and 53. (Revised 10/81 Ordinance No. 518)

(b) Elevator, Freight. See ANSI A.17.1. (Revised 10/81 Ordinance No. 518)

(c) Elevator, Passenger. See ANSI A.17.1. (Revised 10/81 Ordinance No. 518)

(d) Powered Platform. Equipment permanently installed for extended use to provide access to the exterior of a building for maintenance or window washing, consisting of a suspended power operated working platform, a roof car or other suspension means and the required operating and controlling devices.

(e) Power Scaffold. Similar to a powered platform but not affixed or stored on a building roof for extended use, and without a roof car.

(f) Stage Lift. Powered stage used for performing arts so it can be positioned for use at various elevations.

SECTION 5503. OPERATION OF ELEVATORS UNDER EMERGENCY CONDITIONS.

(a) New Elevators. Elevators in new high rise buildings shall conform to the emergency operation requirements in Chapter 18. New elevators not covered by the above shall conform to the requirements of this Chapter. (Revised 10/81 Ordinance No. 518)

(b) Existing Elevators. Existing elevators located in buildings exceeding travel of 75 feet in height above the main floor, shall conform to the Emergency Operation Requirements of this Chapter on or before January 1, 1980. See Item (c) 4, of this Section.

(c) Revisions to Standards. The following changes or additions to the Standards shall apply: See Section 5505.

1. All requirements applicable to heights of 70 feet shall be changed to 75 feet.

2. When the return switch, located at the main floor is in the "bypass" position, it shall render the sensing devices inoperative and restore normal operation except that it shall not affect the operation of elevators that are operating on emergency service.
3. Emergency operation switches located on the elevator shall have 2 positions only (off and on). Delete all references to "by-pass" position. Elevators shall be removed from emergency service by moving the emergency service key-operated switch in the car to the "off" position with the car at the main floor.

4. Automatic elevator recall equipment, actuated by fire detection systems or fire extinguishing systems shall conform to the requirements of Chapter 18 for new high rise buildings. Detector actuated automatic elevator recall equipment shall not be required in other new or existing buildings. See ANSI A17.1, 211.3a (1)(b). (Revised 7/83 Ordinance No. 389)

5. Hoistway door unlocking devices conforming to Rule 111.9(e)-1 and 111.9(e)-3 of the American National Safety Code for Elevators A17.1-1971, shall be provided for hoistway doors at the top landing, lowest landing, and at the first accessible landing above an express hoistway.

(d) Emergency Keys and Cabinet.

1. Emergency Key Cabinet. A cabinet shall be provided to contain the keys furnished by the elevator manufacturer and the fire protection contractor used to activate the operation of the elevators and master fire alarm panel and manual pull station during emergency conditions. The cabinet shall be located directly below and separate from the main call button fixture for each single elevator or group of elevators. The cabinet shall be provided with a tamper-proof door, equipped with a lock approved by the Fire Department which is keyed to a Fire Department issue key. All keys shall be identified to correspond to the instructions for use. The cabinet door shall be engraved "Fire Department" in letters at least 1/4 inch in height.

2. Instructions. Instructions for the operation of the elevator(s) shall be typed on a plastic encased card and attached to the inside of the fire control key cabinet. Instructions for use of the hoistway door unlocking device keys and the use of the key(s) for the main fire alarm panel shall be incorporated as separate numbered items on the instruction card.

SECTION 5504. PERMITS, DRAWINGS AND CERTIFICATES OF INSPECTION.

(a) General. Permits shall not be required for repairs, replacement and testing for maintenance with parts of equivalent materials, strength and design unless correctional work is ordered by the Department. See Chapter 3 for Permit requirements.

(b) Elevator Permit Information. The elevator contractor shall submit the following information for approval prior to issuance of an elevator permit: shop drawings including hoistway plan and elevation; machine
room plan locating all major equipment; clearances; and reactions on the building structure.

(c) Certificate of Inspection. See Chapter 3.

SECTION 5505. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

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<th>ORGANIZATION</th>
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<td>Safety Requirements for Personnel Hoists, A10.4-1981.</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<td>1430 Broadway</td>
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<td>New York, New York 10018</td>
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CHAPTER 56
SIGNS AND SIGN STRUCTURES

SECTION 5601. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter and the Revised Municipal Code shall govern the installation, repair, maintenance, unsafe conditions and approval of all signs.

(b) Purpose. The purpose of this chapter is to provide the minimum standards to safeguard life, health, property, and public welfare by regulating and controlling the design, quality of materials, construction, location, electrification and maintenance of all signs, billboards, and marquees not located within buildings. For interior signs and outline lighting see chapter 53.

(c) Identification and Marking. Each sign hereafter erected or remodeled shall bear in a prominent position thereon a clearly legible identification plate stating the name of the person, firm, or corporation, responsible for its construction and erection. Electrical signs shall be marked per Chapter 53.

(d) Maintenance. Every sign shall be maintained in good structural condition. Signs shall be kept painted, including all metal parts and supports thereof that are not galvanized or of rust resisting metals. The owner of the sign shall maintain the premises in a clean and sanitary condition, free and clear of all rubbish. The Department shall inspect and shall have the authority to order the painting, repair, alteration, or removal of a sign which constitutes a hazard to safety, health or public welfare by reason of inadequate maintenance or design.

(Rev. 3/87 Ord. No. 117)

SECTION 5602. PROHIBITED SIGNS. See Zoning Ordinances.

SECTION 5603. OVER PUBLIC PROPERTY. Prior to the issuance of a Building Permit for a sign which is located over public property or
which may require work over public property, the erector shall furnish proof that a revocable permit has been obtained from the Department of Public Works. See Revised Municipal Code.

SECTION 5604. PERMITS, FEES AND INSPECTIONS. Permits, fees and inspections shall be as required in Chapter 3.

EXCEPTION: The following signs shall not require a building permit. These exemptions shall not be construed as relieving the owner of the sign from the responsibility of its erection and maintenance and its compliance with the provisions of this code or any other law or ordinance regulating the same.

1. Any sign specifically exempted from permit by the Zoning Code.
2. Any sign directly painted on a building or structure wall.
3. Any sign advertising a property for sale or lease and which is not more than 16 square feet in area and is less than 6 feet in height above grade. (Rev. 3/87 Ord. No. 117)

SECTION 5605. DESIGN AND CONSTRUCTION. Signs and structures shall be designed and constructed in conformance with Chapters 23, 25, 26, 27, 28 and 60.

SECTION 5606. GROUND AND WALL SIGNS.
(a) General. Ground and wall signs may be constructed of any material meeting the requirements of this Building Code.
(b) Design. Supports for ground signs shall not be placed upon the public right-of-way or public easements.

SECTION 5607. ELECTRIC SIGNS.
(a) Erection. Electrical signs shall be erected and maintained in compliance with Chapter 53.
(b) Prohibition. No combustible material other than approved plastics shall be used in the construction of electrical signs. See Chapter 60 for plastics.
CHAPTER 57
SWIMMING POOLS

SECTION 5701. SCOPE. In addition to other requirements of this Building Code, the design and installation of swimming pools shall comply with the requirements of this Chapter. Where a conflict exists between this Chapter and other portions of this Building Code, this Chapter shall supercede.

SECTION 5702. GENERAL.
(a) Compliance. All swimming pools, including repairs, shall comply with the provisions of this Chapter and other provisions of this Building Code.
(b) Engineer Required. All swimming pool plans shall be required to carry the seal and signature of a registered Colorado Professional Engineer, unless otherwise approved by the Department. For additional requirements see the Revised Municipal Code and the Department of Health and Hospitals Rules and Regulations.
(c) Pipe Marking. Each length of pipe fitting and device used in the installation of swimming pools shall have cast, stamped or indelibly marked on it the maker's name or mark, the gauge or weight and shall be identified as to the Standards met.
(d) Plot Plans. A plot plan shall be required showing the location of property lines, existing structures, proposed pool, equipment and utilities locations. See Chapter 3.

SECTION 5703. DEFINITIONS. For purposes of this Chapter certain terms are defined as follows:
(a) Swimming Pool. The term swimming pool or pools include all bodies of water sufficiently deep for complete immersion of the body and used collectively by two or more persons for swimming or recreational bathing, together with the supports, building equipment and appurtenances pertaining to these bathing areas.
   EXCEPTION: Swimming pool or pools installed above ground in Group I and J Occupancies when utilities are not provided.
(b) Private Residential Pool. A swimming pool constructed in or on the property of any single family dwelling (Group I and J Occupancies).
(c) Commercial Pool. A swimming pool constructed to be used by 3 or more families.
(d) Pool Heater. A device through which pool water is circulated to increase the temperature of the water.
(e) Pool Filter. A device through which pool water is circulated to remove impurities.
(f) Pool Pump. A pump that is used to recirculate pool water.
(g) Pool Chlorinator. A device used to feed chlorine into pool water.
(h) Recirculating Piping. Pool piping used to recirculate pool water that does not connect to City sewer or water distribution piping.
SECTION 5704. CONSTRUCTION.
(a) Design. All pools installed shall be designed in accordance with Chapter 23 and shall comply with Section 5702 of this Chapter.
(b) Equipment Rooms. Equipment Rooms shall also meet the requirements of all other applicable portions of the Building Code. See Chapter 17.
1. Private residential equipment rooms containing pool heaters may contain all equipment except chlorination equipment or chlorine.
2. Commercial equipment rooms containing pool heaters or boilers may contain all equipment except chlorination equipment and chlorine. Boiler rooms to be equipped with adequate floor drains and service access.
3. All equipment rooms shall provide access doors and maintenance openings of adequate size to repair or replace enclosed equipment.

SECTION 5705. ELECTRICAL.
(a) Bonding. All pool electrical wiring and bonding shall comply with the National Electric Code and Chapter 53 of this Building Code. EXCEPTION: The panel bolts on prefabricated metal wall pools with sections that bolt together are approved for bonding conductor.
(b) Underground Power Lines. Pools shall not be installed closer than 5 feet from the underground power lines.
(c) Overhead Power Lines. Pools shall not be installed under overhead power lines. See N.E.C.
(d) Other Electrical Requirements. See Chapter 53 and N.E.C.

SECTION 5706. MECHANICAL.
(a) Safety Controls. All pool heaters shall be equipped with approved safety controls and as approved by the Department.
(b) Licenses. All pool heaters, heater vents and gas lines shall be installed by a properly licensed contractor. See Chapter 2.
(c) Commercial Pool Heaters. Pool heaters in Group A through H Occupancies shall meet the requirements of Chapter 17, 37, 50, 51, and 58.
(d) Private Residential Pool Heaters. Pool heaters for residential installation need not be enclosed. When enclosed, no chlorination equipment nor chlorine shall be permitted. When not enclosed, pool heaters shall be placed on a concrete slab 6 inches above grade.

SECTION 5707. PLUMBING.
(a) General. All pool recirculation piping shall comply with this Chapter and other applicable sections of the Code. See Chapters 50 and 58.
(b) Private Residential Pool Piping.
1. Swimming pools shall not be connected directly to the water distribution system. The water distribution system shall be protected from backflow by providing an air gap of at least twice the diameter of the effective opening.
2. The drainage system of a swimming pool shall not be connected to the waste water piping. The drainage system shall only be connected by indirect waste piping.
3. Schedule 40 plastic pipe with cemented or threaded fittings, when approved by the Department, may be installed underground.
4. C.P.V.C. Schedule 40 piping with cemented or threaded fittings may be installed above ground.
5. All outdoor equipment installations shall be installed on a concrete slab 6 inches above grade, with all piping above or through the slab to be 12 inches or more from the outside edge of concrete slab.
6. All pool recirculation piping on pools except connections to pool heater may be done by a licensed pool contractor.
7. The installation of gas lines, water distribution piping to the air gap, waste water piping from the indirect drain to the sewer vents, pool heaters and boilers shall be installed by a properly licensed contractor and shall comply with Chapters 37, 50, 51 and 58.

(c) Commercial Pools.
1. Schedule 40 plastic pipe with cemented or threaded fittings when approved by the Department may be used underground.
2. Metal Piping is required in all boiler rooms and other fire rated rooms to 6 inches below the floor and to 6" outside the walls. All connections between plastic and metal pipes shall be made accessible by use of a service panel.
3. All pool circulation piping for enclosed pools shall be installed by a licensed plumbing contractor and all recirculating piping or pools that are not enclosed may be installed by a licensed pool contractor.
4. The installation of gas lines, water distribution piping to the air gap, waste water piping from the indirect drain to the sewer vents, pool heaters and boilers shall be installed by a properly licensed contractor and shall comply with Chapters 37, 50, 51, and 58.
5. All commercial pools shall be in accordance with requirements of revised Municipal Code and the Department of Health and Hospitals Rules and Regulations.

SECTION 5708. TESTS.
(a) Material and Labor for Tests. The equipment, material, power, and labor necessary for the inspections and tests required by this Chapter shall be furnished by the plumbing or swimming pool contractor.
(b) Tests of Drainage or Recirculating Systems. All of the piping of the plumbing system shall be tested with water or air. Test procedures shall not conflict with material manufacturer printed instructions, but in no case shall tests be less than required by this Section.
1. Water Pressure Test. The water pressure test shall be applied to the recirculating and drainage system, exclusive of the City sewer, either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening under test, and each section shall be filled with water. No section shall be tested with less than 30 p.s.i. pressure. The water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. The system shall then be tight and without leaks at all points.

2. Air Test. The air test shall be made by attaching an air compressor or testing apparatus to any suitable opening and after closing all other inlets and outlets of the system, forcing air into the system until there is a uniform gage pressure of 30 p.s.i. This pressure shall be held without introduction of additional air for a period of at least 15 minutes. (Revised 4/80 Ordinance No. 240)

SECTION 5709. STANDARDS. Unless provided for in other portions of this Building Code, the following standards shall apply:

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<td>ASTM</td>
<td>Rigid Poly Vinyl Chloride Compounds and Chlorinated Poly Vinyl Chloride Compounds, D1784-69.</td>
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<td>Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120, D1785-73.</td>
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<td>Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR), D2241-73.</td>
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<td>Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80, D2464-73.</td>
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<td>Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80, D2467-73.</td>
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<td>Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings, D2564-73A.</td>
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(Revised 4/80 Ordinance No. 240)
SECTION 5801. GENERAL

(a) Scope. In addition to other requirements of this Building Code, this Chapter shall govern the construction, installation, alteration, operation, repair, maintenance, and inspection of all boilers, pressure vessels, steam and hot water heating and process piping systems.

(b) Equipment. All equipment used for steam or water heating systems and related process piping shall be designed for its specific application and bear the seal of a recognized testing laboratory.

(c) Boilers. All boilers used for space, water or process heating shall be so certified and stamped that their design and construction are acceptable to ASME Boiler Codes. Cast iron boilers and cast iron radiators shall not be permitted on steam or hot water heating systems operating at pressures in excess of 15 psig for steam or 30 psig for water unless such boilers or radiation are designed and tested for higher working pressures and so certified by the manufacturer and testing laboratory.

(d) Type of Energy. Gas or oil fired equipment shall not be converted from the fuel specified on the rating plate for use to a different fuel without consulting the manufacturer for complete instructions and be approved by the Department prior to conversion. For gas, oil, or solid fuel fired conversions, see requirements specified in this chapter and chapter 37 and chapter 51. For electric fired appliances, see chapter 53 and for Solar Equipment also see chapter 65.

(e) Installation. The installation of systems governed by this Chapter shall conform to the manufacturer's instructions in addition to the requirements of this Code.
The contractor shall attach operating instructions of a permanent type to the appliance or system. The manufacturers' rating data and the name plate shall also be attached.

(f) The installation and repair of equipment covered in this Chapter shall be performed specifically by licensed steam and hot water heating contractors, or hot water heating contractors in I occupancies only. The erection or repairing of boilers may be performed by a boiler maker contractor.

(g) Access. Irrespective of other provisions of this Code, clearances shall be maintained around all boilers, generators, heaters, tanks and all other equipment so as to permit inspection, servicing, repair or replacement of burners or tubes, and normal visibility of all gauges. A minimum of 24" shall be provided on all service sides.

(h) Boiler Room Required. For boilers located in Group A through H-2 occupancies, a boiler room shall be required and shall meet the construction requirements of Chapter 17, except as provided herein. The boiler room enclosure may be waived when in the opinion of the Department, the enclosure is not necessary or would tend to increase the hazard.

EXCEPTION: Boiler rooms located in dry cleaning plants, white rooms, chemical rooms or similar, and Group D and E occupancies, shall provide a 2 hour fire separation. Access to this room shall be from the exterior of the building.

(i) Combustion and Ventilation Air. Combustion and ventilation air shall be provided in accordance with Chapter 51.

(j) Venting. See Chapter 37.

(k) Connection to Water Supply. See Chapter 50.

(l) Gas Piping. See Chapter 51.

(m) Steam and Hot Water Heating Systems. All equipment, piping, fittings, valves, traps, pumps or other equipment to be installed shall be fabricated of approved materials suitable for the pressure and temperatures the material may be subjected to.
(n) Field Modifications. Field modifications to boilers shall be approved by the boiler manufacturer, Listing Agency, and the Department prior to installation. See Chapter 51.

(o) Valves on Boilers. All equipment shall have suitable type shut off valves installed as close to the equipment as possible, on both supply and return piping. Such valves shall be of the material suitable to the service, pressures and temperatures of the systems. No valves shall be installed between the boiler and safety, relief valves or discharge piping.

(p) Roof Mounted Equipment. See Chapters 32 and 52.

(q) Temporary Heating and Process Equipment. All heating and process equipment used during construction shall be approved types and be installed per current Code and used in accordance with their approval. All boilers shall be operated when required per Chapter 2 by certified operators or stationary engineers.

(r) Exits and Access. See Chapters 32, 33, and 52.

(s) Solar and Geothermal Energy. All solar and geothermal energy systems shall be submitted to the Department for approval prior to installation. Also see Chapter 65.

(t) Burners. See Chapter 51.

(u) Separation of Equipment. Direct or indirect fired heating or cooling equipment in Group A through H-2 Occupancies shall be separated from air handling or refrigeration equipment by a fire separation of at least one-hour fire-resistive construction. Access to refrigeration or air handling equipment rooms shall not be through boiler rooms.
SECTION 5802. DEFINITIONS: The following definitions are in addition to those contained in Chapters 4, 37, 51, 52 and as defined in the ASME Boiler Codes.

(See Standards Section.)

Allowable Working Pressure - The maximum pressure for which the boiler was designed and constructed.

Atmospheric Burner - A burner in which the air at atmospheric pressure is injected into the burner by a jet of gas.

Boiler - A closed vessel used for heating water or liquid, or for generating steam or vapor by direct application of heat from combustible fuels or electricity.

Boiler Horsepower - The evaporation of 34.5 lb. of water per hour from a temperature of 212°F into dry saturated steam at the same temperature. Equivalent to 33, 472 Btu/Hr. or 10 KW/Hr.

Boiler Trim - Piping on or near the boiler which is used for safety, limit, and operating controls, gages, water column, etc.

Condensate - Condensed water resulting from the removal of latent heat from steam or flue gases.

Design Pressure - The maximum allowable working pressure permitted under the rules of the ASME Construction Code.

Dry Return - A return pipe in a steam heating system which carries condensate and air and is above the water level of the boiler.

External Header - Connection between sections of a cast iron boiler to effect circulation of the steam or heated water.

External Inspection - An inspection made when a boiler is in operation.

Firetube - A tube in a boiler having water on the outside and carrying the products of combustion on the inside.

Fired Pressure Vessel - A vessel containing a fluid under pressure exposed to heat from the combustion of fuel.

Flue - A passage for products of combustion.

Furnace Draft - The draft in a furnace, measured at a point immediately in front of the highest point at which the combustion gases leave the furnace.
Gage Pressure - The pressure above atmospheric pressure.

Header - Piping which connects two or more boilers together.

    It may be either supply or return piping.

Heat Exchanger - A vessel in which heat is transferred from one medium to another.

Heating Surface - That surface which is exposed to the heating medium for absorption and transfer of heat to the heated medium.

High Pressure Boiler - A boiler furnishing steam at pressures in excess of 15 psig or hot water at temperatures in excess of 250°F or at pressures in excess of 160 psig.

Hydrostatic Test - A strength and tightness test of a closed pressure vessel by water pressure.

Internal Inspection - An inspection made when a boiler is shut down with all handholes and/or manholes opened for inspection of its interior and appurtenances.

Limit Control - Any device which shuts down the burner when operating limits are reached.

Low Pressure Hot-Water Heating Boiler - A boiler operated at pressures not exceeding 160 psig and temperatures not exceeding 250°F for water.

Low Water Fuel Cutoff - A float operated device which shuts down the fuel burner when the water level in the boiler drops below its operating level.

Manifold - A pipe or header for collecting a fluid from, or the distributing of a fluid to, a number of pipes or tubes.

Miniature Boiler - Fired pressure vessels which do not exceed the following limits: 16 in. inside diameter of shell; 42 in. overall length to outside of heads at center; 20 sq. ft water heating surface; or 100 psi maximum allowable working pressure.

Modulation of Burner - Control of fuel and air to a burner to match fluctuations of the load on the boiler.

National Board Inspection Code - The manual for boiler and pressure vessel inspections published by the National Board of Boiler and Pressure Vessel Inspectors.
Nipple, Push - A short length of pipe tapered at both ends, used to hold sections of cast boilers together.

Operating Control - Any device which controls the operation of a fuel burner to maintain the desired condition.

Operating Water Level - In a steam boiler, the maintained water level which is above the lowest safe water level.

Pneumatic Control - Any control which uses compressed air as the actuating means.

Portable Boiler - An internally fired boiler which is intended for temporary locational use.

Power Boiler - Any boiler which generates steam or vapor at a pressure of more than 15 PSIG or any high temperature water boilers intended for operation at pressures exceeding 160 PSIG and/or temperatures exceeding 250°F.

Power Burner - A burner in which either gas or air, or both, are supplied at pressures exceeding for gas, the line pressure, and for air, atmospheric pressure.

Pressure Relief Valve - A valve designed to open when pressures exceed a predetermined set point.

Pressure Vessel - A closed vessel or container designed to confine a fluid at a pressure above atmospheric.

Rated Capacity - The manufacturer's stated capacity rating for mechanical equipment, for example, the maximum continuous capacity in pounds of steam per hour for which a boiler is designed.

Receiver - The tank portion of a condensate or vacuum return pump where condensate accumulates.

Safety Control - Devices incorporated in the burner control circuitry and on the burner to allow flow of the fuel only if required steps and conditions are met.

Safety Valve - An automatic pressure relieving device actuated by the static pressure upstream of the valve and characterized by full-opening pop action. It is used for gas or vapor service.

Safety Relief Valve - An automatic pressure relieving device actuated by the pressure upstream of the valve and characterized by opening pop action with further increase in lift with an increase in pressure over popping pressure.
Steam-Heating Boiler - A boiler operated at pressures not exceeding 15 psig for steam.

Stop Valve - Valve (usually gage type) which is used to isolate a part of a heating system or a boiler from the other parts.

Tube Plug - A solid plug driven into the end of a tube.

Unfired Pressure Vessel - A vessel designed to withstand internal pressure, neither subjected to heat from products of combustion nor an integral part of a fired pressure vessel system.

Used Boiler - A boiler in which the location has been changed after primary use.

Water Column - A vertical tubular meter connected at its top and bottom to the steam and water space respectively of a boiler, to which the water gate, gage cocks, and high and low level alarms may be connected.

Water Heater - A closed vessel of either instantaneous or storage type used to heat water for domestic or sanitary purposes.

Water Level - The elevation of the surface of the water in a boiler.
SECTION 5803. INSPECTION AND TESTING BY THE DEPARTMENT.

(a) Testing and Inspection Responsibility. The testing of boilers and pressure vessels shall be performed by the Permit holder and the inspection of boilers and pressure vessels shall be performed by the Department, in addition to the inspections required in Chapter 3.

(b) Owners to Provide Facilities. Every person owning or having possession or control of any such equipment subject to inspection as aforesaid shall provide, at his own expense, proper arrangements and facilities for attaching the instruments of inspection. Immediately before the time set for such inspection, every such person shall remove all scale, dirt, soot, and sediment in, beneath and around the equipment. When directed by the Department, a hydrostatic test shall be performed by a licensed steam and hot water heat contractor or boiler maker contractor and be witnessed by the Department. The minimum test pressure shall be 1 1/2 times the working pressure of the Boiler.

(c) Equipment Tests. When leaks occur which prevent a successful test, the Department shall make a second test upon receiving notice that all leaks have been repaired. If, upon making a second test, such equipment is still defective, the owner or user thereof shall, for each subsequent test pay an additional inspection fee as herein provided per Chapter 3. In no case shall the Department give an order for a certificate until fully satisfied of the safety of the equipment.

(d) Hydrostatic Pressure. When hydrostatic pressure tests are deemed necessary by the Department, an internal examination shall be performed prior to the hydrostatic pressure test. The hydrostatic pressure used in tests shall not exceed the maximum working pressure of said equipment by more than fifty (50) per cent.

(e) Piping Systems. Piping systems shall be pressure tested to a minimum of one and one-half times working pressure or 100 psig; whichever is greater.
(f) Inspection Fees. See Chapter 3.

SECTION 5804. PROHIBITIONS

(a) General. The following prohibitions shall apply to installation and location of equipment.

1. In addition to equipment location prohibitions in Chapter 51, Gas, Oil or Solid fuel-fired equipment or appliances including but not limited to steam generators, boilers, or water heaters shall not be installed or maintained in any garage, wash rack, auto wash or building where gasoline or L.P.G. equipment can be operated. Boilers of any type shall not be located in elevator equipment rooms.

   EXCEPTION: Steam generators, water heaters or other open-flame devices may be located in auto washes or commercial garages if installed at least 5 feet, 6 inches above the floor, on a noncombustible stand, structurally sufficient to support the equipment.

2. In addition to access requirements covered in Chapter 51, access to rooms containing gas, liquid, or solid fuel fired steam generators, boilers, or water heaters shall not be through any garage, wash rack, auto wash, or any area where flammable vapors may be present.

3. Boilers or water heaters shall not be installed in dry cleaning plants except as permitted in Chapters 10 and 17.

4. The installation of compressors or the storage of materials of any kind, combustible or non-combustible, shall not be permitted in boiler rooms.

5. The installation or use of gaseous chlorinators or chlorine piping in boiler rooms or rooms where fuel fired equipment is located is prohibited.

6. The installation of any device that will create a pressure less than atmospheric in the boiler room containing gas, oil, or solid fuel-fired equipment is prohibited.
EXCEPTION: Equipment designed, listed, and approved with power burners or induced draft fans.

7. The installation of piping shall not be permitted in the shaft, pit, or penthouses of elevators.
   EXCEPTION: Piping necessary for the installation of heating equipment for penthouses shall be permitted in the penthouses.

8. The use of internal float type low-water cutoff as a primary control is prohibited.

9. Refrigeration equipment, forced air or gravity furnaces or air handlers, shall not be located in or access made to same through boiler rooms.
   EXCEPTION: H₃ and I occupancies.

10. Fuel-fired equipment with atmospheric burners shall not be installed in the same room with equipment provided with power burners or induced draft fans.
    EXCEPTION: Engineered systems specifically approved by the Department.

11. Cast iron boilers and cast iron radiation shall not be permitted on steam systems operating at pressures in excess of 15 psig for steam or 30 psig for water, unless such boilers or radiation are designed and tested for higher working pressures and so certified by the manufacturer, Listing Agency and approved for use by the Department.

A. In A through H₂ occupancies, no tanks or piping constructed of non-metallic materials shall be permitted in boiler rooms.
   EXCEPTION: Tanks and piping utilized for feedwater treatment when specifically approved by the Department.

12. Potable water shall not be circulated through any piping system, appurtenances or equipment utilized for space heating.

13. Single wall exchangers, where process water and potable water are interfaced are prohibited. See Chapter 50.
14. Incinerators or access to incinerators shall not be located in boiler rooms. See Chapter 48.
15. Boilers shall not be located in crawl spaces or attics.
16. The use of sealants introduced into boilers and piping systems is prohibited.
17. Piping utilized for plumbing or waste constructed of non-metallic materials shall not pass through boiler rooms unless enclosed with one hour construction.
18. The plugging of boiler tubes is prohibited.
19. The use of non-metallic materials in piping on heating or process systems.
   EXCEPTION: On process systems where non-metallic products only can withstand corrosion problems, approval may be granted by the Department on an individual basis, provided the non-metallic material is designed for the intended application and is capable of withstanding temperature, pressures and corrosion of the product conveyed.
20. Water heaters shall not be used for space heating purposes.
21. Galvanized pipe shall not be used on steam, space heating or process piping systems.

SECTION 5805. CONDEMNATION

(a) Hazard. Any boiler or pressure vessel piping or appurtenances thereto which is found to constitute a hazard, shall be shut off and appropriately tagged and condemned in accordance with the provisions of Chapter 1 of this Building Code.

SECTION 5806. EQUIPMENT AND MATERIALS.

(a) Equipment Standards. Specifications, design, materials and fabrication of equipment governed by this Chapter shall be in accordance with the Standards and this section.

(b) Piping for Steam and Water Heating Systems. For all steam systems with a pressure of 15 psig and less, and all water heating systems with a pressure no greater than 125 psig or 250 degrees F, the following shall apply:
1. Steam Piping. Shall be standard weight schedule 40 steel pipe or Type K and L copper.

2. Condensate Piping. Shall be standard weight schedule 40 steel pipe or Type K copper.

3. Water Heating Piping. Shall be standard weight schedule steel pipe or Type K, L or M copper.

   EXCEPTIONS: If copper is used:
   1. Type K and L copper shall be used for heating water lines above 30 psig working pressure.
   2. Type K and L copper shall be used for hot water lines embedded in concrete or buried and shall be provided with brazed copper fittings.

4. Fittings for copper tube shall be wrought copper, wrought bronze, or cast brass. Fittings for steel pipe shall be screwed cast iron, malleable iron, or forged steel welding fittings.

5. The system operating pressure shall not exceed the materials rated working pressure. For pressures above those listed herein, see Standards.

6. Steel and wrought iron pipe shall be minimum schedule 40 pipe or tubing, or pipe or tubing of equivalent working pressure and tensile strength per standards.

   (c) Approved Materials.

1. Required gaskets shall be constructed of materials approved for the pressure and temperature to which they are to be subjected.

2. All piping fittings, flanges and valves shall have pressure ratings for the pressures and temperatures of the installation.

3. When utilized for non-pressure applications and not part of a piping system used for heating applications, non-metallic pipe or tubing specifically designed, tested, listed and approved by the Department for the intended application may be approved by the Department on an individual job basis.
(d) Safety or Relief Valves.

1. General. Safety or relief valves shall be installed on all boilers, pressure vessels, hot water storage tanks, closed piping systems, and other systems shall meet the requirements of the Standards, modified as follows:

A. The requirements for temperature relief valves shall be the same as required for pressure relief valves, except that temperature relief valves shall be an approved type, and bear the seal of the ASME.

2. An approved pressure relief valve shall be provided on all closed heating systems. The capacity and size of the relief valve shall be in accord with the Btu generating capacity of the heat exchanger or boiler. Relief valves less than one-half (½) inch pipe size shall not be installed in any closed system or on a large system, where the Btu capacity of the system is greater than the capacity of any one relief valve to provide adequate protection, two or more valves shall be provided to meet the Btu generating capacity.

A. Fuel fired boilers of over 100 horsepower or 500 square feet of heating surface or electric boilers of more than 1100 kilowatts shall be provided with two safety valves or safety relief valves. Each valve shall be capable of relieving the full firing capacity of the boiler.

B. Repair or re-setting of safety or relief valves shall be performed by an authorized A.S.M.E. National Board Certified VR stamp holder only.

(e) Discharge. Safety or relief valve discharge openings shall be independently piped the full size of the relief opening to a location where the discharge cannot be injurious to the plant, the building, or to personnel. If the discharge pipe from the safety valve from steam equipment is piped to the outside of the building, provisions shall be made to secure proper drainage, prevent freeze-up and be
discharged where no hazard will be created. Discharge pipe from the relief valve, piped to the inside of the building shall be piped to within six (6) inches of the boiler room floor, or to an approved plumbing receptacle. The boiler room floor shall be provided with a drain or an approved plumbing receptacle connected to the sewer and the drain pipe size larger than the drain outlet of the relief valve. The discharge end of the pipe from any relief valve shall be open to the atmosphere so as to provide a minimum air gap between the overflow rim to the receptacle of the sewer opening or floor drain of twice the inside pipe diameter of the relief valve discharge pipe.

(f) Pressure and Limit Control. All new and existing steam and hot water boilers will have pressure and limit controls as per the following.

1. Steam Boilers.

Each automatically fired steam boiler shall be protected from overpressure by two pressure-operated controls.

A. Each individual automatically fuel fired and electric steam boiler shall have a limit control that will cut off the fuel or electric supply to prevent steam pressure from exceeding the maximum allowable working pressure of the boiler.

B. Each individual steam boiler shall have a safety control that will cut off the fuel supply when the pressure reaches an operating limit, which shall be less than the maximum allowable pressure.

C. Shutoff valves of any type shall not be placed in the steam pressure connection between the controls described in A & B above. These controls shall be protected with a syphon or equivalent means of maintaining a water seal that will prevent steam from entering the control.
The minimum size of a syphon shall be ¼ inch standard pipe size or 3/8 inch O.D. non-ferrous tubing. The use of aluminum tubing is prohibited. This requirement is for new and existing installations.

   A. The pressure differential between the pressure relief valve set pressure and the boiler operating pressure shall be at least 10 psi or 25 percent of the boiler operating pressure whichever is greater.
   B. On steam heating boilers a pressure differential of at least 10% between the safety valve set pressure and the boiler operating pressure shall be maintained.
   C. For power boilers, hot water supply boilers, pressure vessels and other equipment requiring pressure relief valves, the requirements specified by the A.S.H.E. Boiler Code shall apply and be approved by the Department.

3. Feed valve pressure rating to be 25% above set pressure of safety or relief valve(s) on power boilers.

(g) Low Water Cut-Offs Controls -- Water Feeders.

1. An external low water cut-off control shall be installed on all fuel fired and electric steam boilers or generators and all hot water boilers over 400,000 Btu in such a manner so that the fuel firing device will shut off when the level of the water is within one inch of the bottom of the gauge glass. On hot water boilers, the low water cut-off control shall be installed per boiler manufacturers instructions. The use of an internal type low water cut-off control is prohibited unless part of a listed boiler or as approved by the Department.
   A. A water feeder may be installed to operate and maintain the water at the operating level in steam boilers. A water feeder shall not be installed on any boiler which is not equipped with a low water
cut-off control. Combination feeders and low water cut-offs are permitted.

B. The quick hook-up type of low water cut-off or combination feeder and cut-off that are attached or connected to the gauge glass connection of a steam boiler are permitted on steam boilers not in excess of 300,000 Btu or the equivalent in boiler horsepower. All boilers larger in size shall use the type of low water cut-off or feeder combination that is attached directly to the boiler by means of separate pipe connection, one above the water line of the boiler, the other at least 12 inches below the normal operating water line of the boiler. The connecting pipe to the boiler shall not be less than one inch iron pipe size. Such pipe shall have a blow-off valve installed at the lower connection.

C. Each type of low water control and combination type feeder and control shall be equipped with a flushing valve, gate valve, or quick opening valve. This valve shall be the full size of the opening provided at the bottom of the control. Flushing valves shall be provided with permanently marked tags carrying instructions to the operator to flush the low water control at least once a week.

D. New and Existing Power Boilers shall be provided with two low water cutoff controls per boiler.

1. Special Types. Special types of low water cut-offs and water feeders that are supplied by the manufacturers of boilers as part of the listed boiler equipment and built into the boiler, if approved, are acceptable.

(h) Control Valves. Approved main burner safety shut-off valves shall be required on all boilers in excess of 400,000 Btu/hr input. (See Chapter 51)
(i) Pressure Valves. On all closed building heating systems,
in addition to the expansion tank, an approved type of
pressure reducing valve and separate pressure relief valve
shall be installed. The reducing valve shall be capable
of reducing the water supply pressure to the safe operating
requirements of the heating system. This valve shall be of
at least one-half (½) inch nominal iron pipe size and shall
be installed in the makeup water supply line. Combination
pressure reducing and relief valves are prohibited.

(j) Water Level & Steam Pressure Gauges and Try-Cocks.
1. General. Each steam boiler shall be equipped with:
   A. A water level gauge glass mounted so that the mid-
      point of the glass is at the normal water level of
      the boiler.
   B. At least two hand operated try-cocks mounted one
      and one-half (1 ½) inches above and one and one-
      half (1 ½) inches below the normal water level of
      the boiler.
   C. A steam pressure gauge mounted on or at the top of
      the boiler.
2. Gauge Glass and Try-Cocks. The gauge glass and try-cocks
   may be mounted directly onto the boiler, independent of
   all other connections. If the boiler is equipped with
   a separate water column on which the gauge glass and
   try-cocks are installed, and this water column is
   connected to the boiler by means of pipe and fittings,
   the bottom of the water column shall be provided with
   proper size blow down valve. The size of such valve
   shall be at least the size of piping connection of the
   water column to the boiler and shall be of the gate valve
   type. Wherever separate water columns are to be connected
   to boilers, the water columns shall be piped to the boiler
   using plugged crosses for all 90° bends in such piping.
3. Steam Gauge. A steam gauge shall be provided so as to be clearly visible from the operating floor or normal access area at all times. It shall be the low pressure type with easily read numerals, at least four and one-half (4 ½) inches in diameter and with a maximum rating of one and one-half (1 ¼) times the maximum operating pressure of the boiler. Such gauge may be mounted directly on the boiler or at the top of the water column and shall have a syphon loop, between the gauge and the boiler connection.

(k) Blow-Off Valves.

1. General. Each steam boiler shall be provided with a proper size blow-off or drain valve or valves of the quick opening or one-fourth (¼) turn type. Such blow-off or drain valves shall be installed in the opening of the boiler provided by the manufacturer or in the return header at the boiler and shall be so installed that the boiler will completely drain. The blow-off or drain valve shall be at least three fourth (3/4) inch size for boilers of up to 150,000 Btu capacity; one (1) inch for boilers up to 450,000 Btu capacity; and one and one-fourth (1 ¼) inches for boilers up to 1,200,000 Btu capacity; and one and one-half (1 ½) inches for boilers in excess of 1,200,000 Btu capacity. Maximum blow-off or drain size will not exceed ASME requirements. The blow-off or drain valve shall not be connected directly to any sanitary sewer system. When drained to a sewer, it shall drain to an open floor drain, approved receptor, or to a regular blow-off tank or sump. The temperature of the discharge water shall not exceed 180°F. when it enters the sanitary sewer system.
1. Blow-off and Sump Tanks.

A. Blow-off or sump tanks shall be installed where either are necessary to properly blow down or drain the boiler or where the boiler is set or pitted below the level of the boiler room or below the low point of any floor drain connected to the sewer.

B. Where sump or blow-off tanks are installed below the level of sewer piping and it is necessary to raise the water so that it can be properly drained into the sewer, an automatic power driven pump shall be provided to lift the water, and such pump shall operate by means of a float in the sump or tank when the water reaches a pre-determined height and temperature.

C. All piping between blow-off and drain valves and connecting to sump or flash tank shall be connected directly to the tank and shall be at least the size piping of the blow-off or drain valve. Such pipe and fittings shall be capable of withstanding the full pressure of the boiler.

(1) Heat Exchangers. When heat exchangers are interfaced between boiler or process heating fluids and potable water, a double wall exchanger vented to atmosphere shall be provided. The vent shall be located at the lowest part of the heat exchanger.

(n) Backflow Prevention. Whenever a solid connection is made to a system containing boiler or process fluids and potable water, a double check vented to atmosphere type backflow preventer shall be installed.

(n) Return or Vacuum Pumps.

1. Where boiler return pumps or vacuum pumps are used as a means of returning condensate to the boiler instead of gravity return, the size of the pipe connecting to a Hartford connection shall be one size larger than the outlet or discharge connection of the pump. If the distance between the pump and the boiler is over thirty
(30) feet, the size of the pipe shall be increased to compensate for increased pressure loss. Check valves shall be installed in this pipe between the pump and the boiler to prevent a backflow.

2. Where boiler return pumps or combination return and vacuum pumps are used to return condensate to the boiler, they may be connected through a Hartford Tee and Loop Connection or direct to boiler return piping. Pipe from pump to boiler shall be run up in a vertical position from pump to height not less than three (3) feet above the water line of the boiler, or to ceiling if ceiling is less than three (3) feet, carried across to the boiler at that height, then dropped to below water line of the boiler and connected to a Hartford Tee or direct to boiler return piping with necessary check valves installed to prevent a backflow.

SECTION 5807. INSTALLATION AND ERECTION.

(a) Installation and Erection. The installation or erection of new or used equipment shall be performed under a license issued by the Department. See Chapter 2. The installation of systems governed by this Chapter shall conform to the manufacturer's instructions in addition to the requirements of this Chapter.

(b) Clearances.

1. Irrespective of other provisions of this Building Code, clearances shall be maintained around all equipment to permit inspection, servicing, repair or replacement, repair or replacement of burners or boiler tubes, and normal visibility of all gauges and controls. Every boiler or appurtenance thereof, shall be installed in a space which allows a minimum clearance of 24 inches on all service sides.

2. All steam and water heating appliances shall provide a clearance to combustible material as specified in this Chapter and in NFPA Pamphlet 89M and Table 58-A.
EXCEPTIONS:

A. Boilers listed specifically for installation with clearance less than specified in NFPA 89M may be installed in accordance with the conditions of the listing.

B. Boilers shall not be installed in confined spaces, alcoves, or closets unless the equipment has been listed and approved specifically for the installation, and is installed in accordance with the conditions of the approval. See Chapter 51 for other prohibited locations.

3. Steam and hot water pipes shall be installed with a clearance required by NFPA 89M. Steam pipes and hot water pipes passing through shelving shall be covered with approved insulation at least 1 inch in thickness.

(c) Existing Buildings. The Permit holder shall be responsible for arranging for a professional determination of the adequacy of an existing building structure; or the structural modifications necessary to accommodate equipment to be installed. Proof of the adequacy shall be furnished by the Department upon request.

(d) Foundations.

1. All boilers or generators shall be set or erected on a concrete foundation or other approved foundation capable of properly supporting the weight of the boiler or generator under full operating load.

2. Brick foundations for boilers or generators may be acceptable if the construction is of hardpressed brick and cement mortar. If the brick foundation forms part of the combustion chamber or is exposed to extreme heat, proper provision shall be made for the expansion and insulation of the brick work.

EXCEPTION: Horizontal return tubular boilers.
(e) Headers and Connections on Steam Boilers.

1. Sectional Boilers.

A. Steam Headers. Steam outlets or openings in all cast iron sectional type steam boilers shall be connected into a common steam header. The size of such header, for boilers having not more than two steam outlets shall be not less in nominal diameter than the nominal diameter of the larger of such outlets. The size of such header for boilers having more than two steam openings shall be increased one pipe size for each additional two steam outlets. Reducing the size of the openings between boiler and header is prohibited. All steam headers shall be installed so as to permit expansion of the boiler. Rigid type headers having the steam openings connected directly into a header pipe placed directly over such openings without the use of any fittings are prohibited. Offset headers shall be placed or installed to the right or left side of the steam openings of the boiler by use of 90° fittings. The riser pipes from the steam openings shall be connected into the horizontal header by the use of elbows and flanges placed either in the riser pipe or in the horizontal pipe running from the riser to the header. The final connections to the header may be made by welding or with screw type fittings.

B. Return Headers. Return openings in all cast iron section type steam boilers shall be connected into a common return header. The size of the return header shall be not less in area than one-half (\(\frac{1}{2}\)) the area of steam header. Total area of connections from return openings to header shall be equal to the area of the return header. Where more than two return openings are provided on a boiler, the openings selected to connect into the return header
shall be those at either end of the boiler so that complete circulation through the boiler may be attained. If the return opening or openings selected on the boiler are larger in area than is required for a return header, such opening or openings may be reduced so that the total area will be not less than the area required for a return header. Where return openings of boilers are reduced, eccentric bushing or eccentric fittings shall be used. Where return headers connect to boiler return openings, the use of ells is prohibited. Tees shall be used and so installed that one opening of the tee is in line with the opening of the boiler. This opening shall be capped-off full size.

2. Steel Boilers. A header is not required of firebox type steam generators or other types having only one steam opening and one return opening. Piping connections shall be offset to provide for expansion.

(f) Boilers in parallel batteries on gravity return steam systems. Where boilers are installed in batteries of two or more, with cross-connected steam and return headers, such boilers shall be installed so that the operating water line or level of all boilers to be operated as a unit will be at the same level.

(g) Sectional Type Boilers. All sectional type boilers used in series or in batteries with other sectional type boilers shall have separate headers for steam and return connections as provided for individual boilers. Each boiler shall have valves on the supply and return piping so that it may be shut off from other boilers operating in same battery without interfering or affecting operation of such other boilers. The steam supply to the common header or main steam supply piping shall be taken from the individual header of each boiler. The return to each boiler shall connect to a common header that in turn is connected to each boiler return header.
On steel boilers, the steam outlet may be connected directly to main steam header on main steam supply but an equalizing pipe and Hartford Connection shall be installed on gravity return systems where the boiler is used for low pressure service. Boilers shall also be valved so they can operate as individual units.

(h) Piping. Piping for low pressure steam and water heating systems shall comply with the following:

1. All pipe or tubing shall be reamed, after cutting, to at least full internal dimensions.

2. Steel piping shall be joined by welding or by the use of screwed or flanged fittings. Copper tubing shall be joined by the use of manufactured fittings or brazed or soldered. Manufactured mechanical joint fittings may be used for joining pipe or tubing when approved by the Department.

3. Pipe and piping shall be properly hung and supported from the structure to carry weight of the pipe and contents and to permit expansion and contraction.
   A. The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings, valves or equipment and so that sagging will not occur in the pipe between points of suspension under normal operating conditions. Vertical piping shall be secured not less than every other story height or by an engineered support system, submitted to and approved by the Department.

4. Piping passing through walls, ceilings, floors, beams or any portion of the building structure, shall be installed in a manner to maintain the specified fire resistive requirement of the structure.

5. Buried Piping. All piping buried below ground shall be installed as follows:
   A. Steel piping shall be joined by welding.
   B. Copper tubing shall be joined with manufacturer's fittings and brazed having a minimum melting point of 800 degrees F.
C. All piping shall be installed with approved wrapping or by a manufactured system to protect against corrosion.

D. All piping outside of buildings shall be buried with a minimum of 25" cover. When subject to vehicular traffic; depth is to be determined by calculation to carry the wheel load and calculations shall be submitted to the Department upon request.

6. Approved Materials:
   A. All threads shall conform to Standards in this Chapter.
   B. Threaded joints shall be made with thread compound or lubricant suitable for the service intended.

7. Pitch of Piping:
   A. All piping shall be pitched or graded for proper venting. Wherever practical, water pipe shall be so pitched that the air or gases flowing to a high point or vent point will flow in the same direction as the water.
   B. All steam mains shall be pitched down in the direction of the flow of steam from the boiler. The grade or pitch shall be at least one inch per each 20 feet of horizontal pipe run. Risers and the ends of the steam mains shall be dripped and connected into the return piping of the system so that the condensate will be carried back to the boiler directly or to a boiler return pump or return trap.
   C. All branches to radiators or to supply risers on steam heating systems shall pitch up from the point of connection to main or return piping at least one inch per each 4 feet of horizontal run. If the horizontal run from the main to the radiator or riser on the steam system is over 8 feet in length, the run shall be increased one pipe size or pitched down and trapped at riser. If the building or structural conditions are such that the branches
cannot be pitched up from the connection point and must be pitched down to the point where they rise to connect into the radiator or riser, the branch shall be dripped to a steam trap at the low point and trap connected to the return piping.

D. Where necessary, due to structural conditions, to regrade or elevate the steam main or mains; and where the change in grade or level causes the formation of pockets in which condensate can collect, a drip pocket and steam trap shall be installed at the low point and connected to the return piping. The size of the drip leg and trap connection shall be adequate to drain the amount of condensate anticipated, but in no case shall the drip connection be less than %4 inch iron pipe size. Where the steam main cannot be pitched so that the steam and condensate will flow in the same direction, the main shall be sized in accordance with the Standards.

8. Where pipes or tubing are embedded in the structure of the building, all steel pipe shall be joined together by welding and all copper tubing shall be joined together with manufactured fittings and copper brazing rods having a melting point of 800 degrees F. or higher. The use of screwed fittings, compression fittings, flared fittings, or other means of joining the pipes or tubing together shall not be permitted.

(i) Cleaning.

1. Steam boilers or steam generators shall be "boiled-out" prior to being put into service in accordance with the recommendations of Section VI or VII of the ASME Boiler Pressure Vessel Code.

2. Before final connections are made in the piping systems, all piping shall be cleansed for the removal of all foreign materials.
(j) Boiler Mounting or Setting. Unless approved for other mounting or setting, boilers shall be mounted on an approved non-combustible base. The construction shall extend not less than 12 inches beyond the boiler on all sides. Where solid fuel is used it shall extend not less than 48 inches at the front or sides where ashes are removed.

(k) Insulation. Piping and equipment insulation installed in all types of buildings shall conform to the test requirements of ASTM E-84 and the insulation shall provide a flame-spread not to exceed 25 and smoke-developed not to exceed 300, and be approved by the Department. Insulation located in plenums shall be specifically approved by the Department.

EXCEPTION: Fitting covers if not located in air plenums.

(l) Floor Drains. See Chapter 50 for required floor drains in boiler rooms.

(m) Hartford Tee and Equalizing Pipe Requirements.

1. General on gravity return systems. An equalizing pipe shall be connected between the steam header and the return header. The size of such pipe shall be the same as the steam header to a point not less than six (6) inches below the water line of the boiler. Reduction may be made at this point to the same size as the return header or piping. A tee or welded connection shall be installed in the equalizing pipe, prior to reduction in size, and located at a point to the same size as the return header or piping. A tee or welded connection shall be installed in the equalizing pipe, prior to reduction in size; and located at a point two (2) inches below the operating water line of the boiler. The two (2) inches below water line shall be measured from the top of the side opening of the tee or top of the side weld connection. The use of "Y" lateral type fittings or weld are also permitted in place of straight type tees. When "Y" fittings are used, the branch of side outlet of "Y" shall be installed to run down, or in an inverted position. If threaded tee is used, a close
nipple shall be used between tee and an elbow and such
ei shall point downward. From the inverted "Y" or the
elbow; a pipe shall be run downward and parallel to the
equalizing pipe to a point near the floor line. All
direct return piping from the system shall be connected
to this pipe and the size of such pipe shall be not
less in internal cross sectional area than the total
cross sectional area of the connected return piping.

All piping systems shall be tested to a minimum 1½
times their working pressure.
EXCEPTION: Piping systems concealed in buildings,
installed in slabs or underground shall be pressure
tested to a minimum of 100 psig or 1½ times their
working pressure, whichever is greater.

3. Return Pumps. Where boiler return pumps are used as a
means of returning condensate to the boiler instead of
a gravity return, check valves (2) and a globe valve
shall be installed in this pipe between the pump and
the boiler. One check valve shall be on the discharge.

(n) Test Lever. All safety and relief valves shall be provided
with a suitable type hand test lever. A chain shall be
provided when the safety relief valve cannot be raised when
standing on the boiler room floor.

SECTION 5808. USED EQUIPMENT.

(a) General. This Section shall not be construed to prevent
the use, or reinstallation of a boiler or pressure vessel
provided it has been made to conform to the requirements of
this Chapter governing new or existing installations.

(b) Working Pressure. The maximum allowable working pressure
of a boiler or pressure vessel carrying the ASME Code
symbol shall be determined by the applicable Sections of
the ASME Code under which it was constructed and stamped.

(c) Non-Standard Working Pressure. The maximum allowable
working pressure of a boiler or pressure vessel which does
not carry the ASME Code symbol shall be computed in accord-
ance with the Inspection Code of the National Board of
Boiler and Pressure Vessel Inspectors.

(d) Used Equipment. Before a used boiler or pressure vessel may be installed, an inspection shall be made by a Denver licensed Steam and Hot Water Heating or Boilermaker contractor.

EXCEPTION: For equipment to be installed in I occupancies the boiler may be checked by a Hot Water Heating Contractor.

(e) Used boilers and pressure vessels shall be hydrostatically tested. Test results and written certification of the boiler condition shall be submitted by the licensed contractor to the Department and approved prior to installation.

(f) Re-Installation. Where a stationary boiler or pressure vessel is moved and reinstalled, the fittings and appurtenances shall comply with the requirements for new installations.

SECTION 5810. CENTRAL UTILITY STEAM.

(a) General. Steam piping from any central utility heating system entering into an individual building shall be provided with a steam shut off valve of the same size as the supply pipe to the building and shall be installed near the entrance of the pipe and the building. Connections to the steam supply of building piping shall be made on the building or load side of the valve.

(b) Reducing Valve Required.

1. Where the steam pressure supplied from such systems is of greater pressure than the design pressure of the heating equipment or other equipment used in the building, an approved reducing valve shall be installed to regulate the steam pressure to this equipment.

2. If a bypass line is installed around the pressure reducing valve, this bypass shall be at least $\frac{1}{2}$ the size of the reducing valve and shall be controlled by a globe type stop valve.
3. On the downstream side or low pressure side of the reducing valve, a steam gauge and low pressure relief or safety valve shall be installed, set at maximum pressure at which the low pressure heating system is designed to be operated. The relief or safety valve shall be installed in compliance with Section 5802 (d) and the Standards herein.

(c) Return Condensate. The return condensate from a building heated by a central steam supply may be discharged either into a return condensate system or wasted into a sewer drain connection or approved leaching well. This condensate when discharging into a sanitary sewer system shall be sufficiently cooled so that the temperature of the discharge water shall not be in excess of 180°F, and the discharge cannot be directly connected to any sanitary sewer system. The discharge shall be to an open floor drain or a special drain connection or approved receptor. If the floor drain or drain connection to the sewer is above the level of the return piping so that it cannot flow by gravity, an automatic sump pump shall be installed into which the condensate can be discharged and pumped from the sump to the sewer drain.

SECTION 5811. Standards. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
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<tbody>
<tr>
<td>AISI</td>
<td>American Iron and Steel Institute C-140 Flow Chart and Sizing tables.</td>
</tr>
<tr>
<td>ASTM</td>
<td>Surface Burning Characteristics of Building Materials, E84-77.</td>
</tr>
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<td>ORGANIZATION</td>
<td>TITLE OF PUBLICATION</td>
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<tr>
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<tr>
<td>NBBI</td>
<td>National Board Inspection Code, 1981.</td>
</tr>
<tr>
<td></td>
<td>1984 Systems</td>
</tr>
<tr>
<td></td>
<td>1981 Handbook of Fundamentals</td>
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<td></td>
<td>1982 Applications</td>
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<td></td>
<td>1983 Equipment Volume.</td>
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**LEGEND**

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<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
</tr>
<tr>
<td></td>
<td>1000 16th Street N.W.</td>
</tr>
<tr>
<td></td>
<td>Washington, D.C. 20036</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td></td>
<td>1430 Broadway</td>
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<tr>
<td></td>
<td>New York, NY 10018</td>
</tr>
<tr>
<td>API</td>
<td>American Petroleum Institute</td>
</tr>
<tr>
<td></td>
<td>1801 K Street N.W.</td>
</tr>
<tr>
<td></td>
<td>Washington, D.C. 20006</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>American Society of Heating, Refrigeration and Air Conditioning Engineers</td>
</tr>
<tr>
<td></td>
<td>1791 Tullie Cir. N.E.</td>
</tr>
<tr>
<td></td>
<td>Atlanta, GA 30329</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td></td>
<td>1916 Race Street</td>
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<td>Philadelphia, PA 19103</td>
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<tr>
<td>NBBI</td>
<td>National Board of Boiler and Pressure Vessel Inspectors</td>
</tr>
<tr>
<td></td>
<td>1055 Crupper Avenue</td>
</tr>
<tr>
<td></td>
<td>Columbus, OH 43229</td>
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</tbody>
</table>
### TABLE NO. 58-A

CLEARANCES (Inches)

<table>
<thead>
<tr>
<th>RESIDENTIAL TYPE APPLIANCES FOR INSTALLATION IN ROOMS WHICH ARE LARGE*</th>
<th>APPLIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fuel</td>
</tr>
<tr>
<td><strong>BOILERS AND WATER HEATERS</strong></td>
<td></td>
</tr>
<tr>
<td>Steam Boilers - 15 p.s.i.</td>
<td>Automatic Oil or Comb. Gas-Oil</td>
</tr>
<tr>
<td>Water Boilers - 250° F.</td>
<td>Automatic Gas</td>
</tr>
<tr>
<td>Water Heaters - 200° F.</td>
<td>Solid</td>
</tr>
<tr>
<td>All Water Walled or Jacketed</td>
<td></td>
</tr>
<tr>
<td><strong>HEAT EXCHANGER</strong></td>
<td></td>
</tr>
<tr>
<td>Steam - 15 p.s.i. Max.</td>
<td></td>
</tr>
<tr>
<td>Hot Water - 200° F. Max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RADIATORS</strong></td>
<td></td>
</tr>
<tr>
<td>Steam or Hot Water(^*)</td>
<td>Gas</td>
</tr>
<tr>
<td><strong>COMMERCIAL INDUSTRIAL TYPE LOW-HEAT APPLIANCES ANY AND ALL PHYSICAL SIZES EXCEPT AS NOTED</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BOILERS AND WATER HEATERS</strong></td>
<td></td>
</tr>
<tr>
<td>100 cu. ft. or less</td>
<td>All Fuels</td>
</tr>
<tr>
<td>Any p.s.i. Steam</td>
<td>All Fuels</td>
</tr>
<tr>
<td>50 p.s.i. or Less</td>
<td>All Fuels</td>
</tr>
<tr>
<td>Any Size</td>
<td></td>
</tr>
<tr>
<td><strong>UNIT HEATERS</strong></td>
<td></td>
</tr>
<tr>
<td>Floor Mounted or Suspended - Any Size</td>
<td>Steam or Hot Water</td>
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TABLE NO. 58-A
CLEARANCES (Inches)

<table>
<thead>
<tr>
<th>COMMERCIAL INDUSTRIAL TYPE MEDIUM-HEAT APPLIANCES</th>
<th>APPLIANCE</th>
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<tbody>
<tr>
<td></td>
<td>Above</td>
</tr>
<tr>
<td></td>
<td>Top of</td>
</tr>
<tr>
<td></td>
<td>Casing or</td>
</tr>
<tr>
<td></td>
<td>Appliance</td>
</tr>
<tr>
<td></td>
<td>Fuel</td>
</tr>
<tr>
<td>BOILERS AND WATER HEATERS</td>
<td>All Fuels</td>
</tr>
<tr>
<td>Over 50 p.s.i.</td>
<td></td>
</tr>
<tr>
<td>Over 100 cu. ft.</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 feet, the volume of a room shall be figured in the basis of a ceiling height of 8 feet.

<sup>b</sup> The minimum dimension should be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

<sup>c</sup> If the appliance is incased in brick, the 18-inch clearance above and at sides and rear may be reduced to not less than 12 inches.

<sup>d</sup> If the appliance is encased in brick, the clearance above may be not less than 36 inches and at sides and sides may be not less than 18 inches.

<sup>e</sup> Steam pipes and hot-water heating pipes shall be installed with a clearance of at least 1 inch to all combustible construction or material, except that at the points where pipes carry steam or hot water at not over 15 pounds gage pressure emerge from a floor, wall, or ceiling the clearance at the opening through the finish floor boards or wall ceiling boards may be reduced to not less than ½ inch. Each such opening shall be covered with a plate of noncombustible material.

Such pipes passing through stock shelving shall be covered with not less than 1 inch of approved insulation.

Wood boxes or casings enclosing uninsulated steam or hot-water heating pipes, or wooden covers to recesses in walls in which such uninsulated pipes are placed, shall be lined with metal or asbestos millboard.

Where the temperature of the boiler piping does not exceed 160°F., the provisions of this table shall not apply.

Coverings or insulation used on steam or hot-water pipes shall be of materials suitable for the operation temperature of the system. The insulation or jackets shall be of noncombustible materials, or the insulation of jackets and lap-seal adhesives shall be tested as a composite product. Such composite product shall have a flame spread of not more than 25 and smoke developed not to exceed 300 when tested in accordance with ASTM E-84.

NOTES:
1. When appliances are installed in large rooms these standard clearances may be reduced by affording protection to combustible material in accordance with Footnote C.

2. An appliance may be mounted on a combustible floor if the appliance is listed for installation on a combustible floor, or if the floor is protected in an approved manner.
CHAPTER 59

HOISTS, DERRICKS AND CRANES

SECTION 5901. GENERAL.

(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation, repair, maintenance and approval of all hoists, derricks, and cranes, when used in conjunction with the construction or demolition of any building, structure, or utility.

(b) Permit. Prior to the erection or use of any hoist, derrick, or crane, a Permit shall be required and the fee shall be that indicated in Table 3-A.

(c) Hoist Operator License. See Chapter 2.

(d) Prohibitions.

1. Hoist shall not be operated until it has been inspected and approved by the Department.

2. Belted hoisting machines are prohibited.

3. Platform hoists with more than 1 point suspension are prohibited.

(e) Unsafe. For installations found to be unsafe, See Chapter 1.

(f) Accident Reports. In the event of an accident involving a hoist, derrick or crane, the requirements pertaining to accidents in Chapter 55 shall apply.

(g) Safety Barricades. All hoistways shall be provided with safety barricades. Hoistway door or gate shall be provided and locking devices shall be installed.

SECTION 5902. DEFINITIONS. The following definitions shall apply.

1. Hoist. A hoist is any apparatus by which a pulling and releasing action can be transmitted through ropes, wire ropes, or chains to bring about the raising or lowering of loads.

2. Belt Driven Hoist. A belt driven hoist is one in which the driving mechanism is connected to a prime mover by single or multiple belts, and where belts are used, the direction of the hoist car is changed without the reversal of the prime mover.

3. Locking Device. A device which secures a hoistway door or gate in the closed position and prevents opening from the landing side except under specific conditions.

4. Mast Tower Platform. A single vertical member on which a cantilevered platform suitable for carrying material, may be moved up and down.

5. Hoistway Enclosure. The fixed structure consisting of framing which isolate the hoistway from all portions of the building or from adjacent hoistway and in which the hoistway doors and assemblies are installed.

6. Crane. A boom-type machine for lifting, lowering, or swinging a load and moving it laterally, in which the hoisting mechanism is
an integral part of the machine. This may be driven manually or by power and may be a fixed or mobile machine.

7. **Derrick.** An apparatus for hoisting or swinging loads, consisting of a mast supported by guys or braces. Derricks generally are provided with a boom, hinged at the lower end, for carrying the load and may be power or hand operated.

**SECTION 5903. CONSTRUCTION TOWERS.**

(a) **General.** Towers shall rest upon solid foundations. Towers constructed of material other than wood shall provide strength, stability, and durability at least equivalent to those built in accordance with Section 5903 (c).

(b) **Hoppers.** The hopper brackets on all towers shall be designed and constructed with a safety factor of at least 6. Bolts, or equivalent, shall be used for attaching all large hoppers or critical load bearing members, including all horizontal supporting members that are in contact with the hopper. For purposes of this Chapter, a large hopper is one having a capacity of 1/2 cubic yard or more.

(c) **Wooden Towers.** Wooden members for tower corner posts may be built up of 2 inch laminated material pursuant to Table 59-A. The wooden members, such as splice pads, braces, etc., shall be bolted. Bolts, less than 1/2 inch in diameter, shall not be permitted.

1. **Lumber.** Lumber for tower construction shall be the equivalent of Douglas fir "selected lumber."

2. **Sizes.** The nominal sizes of the various members in wooden towers shall be as specified in Table 59-A, or larger.

3. **Braces (Diagonal).** Not more than 2 diagonal braces may be omitted or removed from a panel point in the tower, but if this is accomplished, braces are not to be omitted from the next panel above or below.

4. **Braces (Cross).** The diagonal cross bracing shall be placed on each of the 4 sides of the tower and between horizontal cross-ties, except at loading and unloading stations.

5. **Post Splices.** The splices of corner posts, if one piece material, shall be provided with square butt joints and with at least 2 pads or scabs on the adjacent sides. The pads or scabs shall be of the same width as the corner posts and at least 2 inches in thickness, and shall extend at least 2 feet on each side of the joint.

6. **Guys.** Whenever wooden towers are independent of the building, they shall be guyed at each corner post every 32 feet in height, by at least a 3/8 inch wire rope or galvanized steel strand. The anchor shall be designed to develop the strength of the guy.

7. **Extra Loads.** Where spouting equipment or other load, in addition to that of loaded cage or bucket, is supported by the tower, the tower shall be built as to safely withstand any and all stresses.
8. **Tower Booms.** Whenever a boom is supported by the tower, the boom anchor shall be located at a level where guy lines are attached; and the upper fastening of the falls which rise and lower the boom, shall be placed at a distance of at least 1/2 the length of the boom above the boom anchor and at a level supported by the guys. The guy lines and anchors supporting these 2 points shall be designed to carry the extra load caused by the boom and its load.

9. **Access.** A safe means of access shall be provided to the top of each wooden tower. These may normally be accomplished by means of an attached side rail ladder, however, if a safe means of approach is provided from some point on the building or a ladder landing, the tower ladder need not extend below that point.

(d) **Metal Construction Towers.**

1. **Design.** All metal construction hoisting towers, masts, etc., shall be substantially constructed, and of such design that expected loads will not stress any members beyond the limits established by applicable engineering formula. The design shall also provide ample strength for loads imposed by the use of booms attached to a tower or mast. The maximum load, as specified by the manufacturers, shall not be exceeded.

2. **Foundation and Anchorage.** All metal construction hoisting towers, masts, etc., shall be placed on firm and substantial foundations and securely guyed or braced against swaying or tipping. Particular attention shall be given to the need for anchorage at the top of the towers and also at the bucket dumping positions, where this equipment is used.

3. **Guying.** Metal construction hoisting towers, masts, etc., shall be supported by guys or anchored to a building or structure in accordance with manufacturer's recommendations, provided, however, that such support or anchorage shall be installed at vertical intervals not exceeding 40 feet with at least 3/8 inch wire rope or equivalent. This interval of spacing may be increased and the number of guys reduced only if the design and method of construction provide adequate strength to resist all lateral forces.

4. **Assembled Towers.** Positive connections, as those made with bolts or pins, shall join the various segments from which assembled towers are constructed.

5. **Removal of Bracing.** When necessary to remove diagonal bracing from 2 or more adjacent panels of the tower, other type bracing or reinforcement of equivalent strength shall be provided.

**SECTION 5904. CONSTRUCTION ELEVATORS.**

(a) **Elevator Landing Gates and Barriers.** Standard railings and toeboards shall be placed on the open sides of runways connecting the elevator tower to the structure. If a gate is not required by this Chapter, a bar 42 inches high and set back at least 18 inches from the tower shall be installed at all openings into the tower.
(b) **Enclosures.** Except for entrance, towers shall be enclosed on all sides adjacent to or within 3 feet of any floor, landing, scaffold, or walkway to a height of at least 6 feet. The enclosure shall be by means of wire mesh, slatted partitions, planks or plywood. Wire mesh shall be at least No. 18 gauge, with openings not exceeding 1/2 inch in thickness and spaced not more than 2 inches apart.

(c) **Landing Gates.** Construction elevators with 3 or more landings (including the bottom one), shall have a slatted or solid gate at least 6 feet high at all landings. Vertical sliding gates shall be counterweighted. Hinged gates are acceptable. (See Section 5905 (d) for requirement).

(d) **Inside Building.** If cages are to be used in an elevator shaft inside a building, the shaft opening shall be enclosed with a solid partition.

1. If one elevator in a shaft is put into service before the others are completed, that part of the shaft in which it operates shall be separated from the other part of the shaft by a continuous partition of solid material or wire screen with 2 inch or smaller mesh.

SECTION 5905. CONSTRUCTION MATERIAL ELEVATORS.

(a) **General.** No employer shall permit any person to ride in an elevator provided for hoisting material, except when oiling or repairing guides, unless such elevator is in compliance with the requirements of Section 5906.

**EXCEPTION:** Permanent elevators being used temporarily for hoisting shall have a Department certified operator in the car.

(b) **Cage Construction.** The cage sling frame shall be made of Douglas Fir “Selected Lumber”, or of structural steel and designed in accordance with accepted engineering practice to provide a factor of safety not less than 4. Main members shall be bolted or welded.

1. The cage platform shall be a solid floor built of wood at least 2 inches thick, or equivalent, and shall be securely attached to the frame.

(c) **Hoisting Loose Materials.** Cages for hoisting brick, tile or loose material shall have the unused sides enclosed to a height of 42 inches with boards or the equivalent of No. 16 U.S. Standard wire gauge screen, 2 inch or smaller mesh to protect workmen from falling material.

1. When construction buggies or wheelbarrows are hoisted on the cage, provisions shall be made to prevent their movement on the cage, and if buggies or wheelbarrows are loaded with loose material, all unused open sides of the cage shall be enclosed at least to a height of 42 inches.

(d) **Signaling Device.** In addition to the signal arrangements called for in this Chapter, the following shall be provided to prevent unexpected movement of any cage that a worker could board at a landing: Each landing gate on construction material elevators with 3 or more landings
shall be equipped with an adequate latching
device and electrical contract so designed and installed that a circuit
which lights a green bulb is closed whenever all gates are closed. This
bulb is to be in clear view of the operator, and the cage is not to be
moved unless the bulb is glowing.

1. The following sign shall be placed on all cages or platforms of in-
stallations not designed for handling men and shall state as
follows: 'BUILDING DEPARTMENT OF THE CITY AND COUN-
TY OF DENVER PROHIBITS RIDING THIS CAGE OR PLATFORM.' Size of letters shall be not less than 2 inches in height.

(e) Sheave Beams and Bearings. The overhead sheave beams shall be of
sufficient size and strength to safely carry 4 times the maximum
weight of cage and contents. They shall be Douglas Fir “Selected Lum-
ber,” or equivalent. They shall be bolted together. In all cases the
sheave bearings shall be mounted on top of beams and securely bolted.
Open bearings shall not be permitted.

1. All sheave bearings shall be lined with babbit, or other equivalent
bearing metal, or have ball or roller bearings, and shall be pro-
vided with adequate means for lubrication.

(f) Sheave Dimensions. The minimum dimensions for all material eleva-
tor sheaves shall be as given in Table 59-B. Axles shall provide a
minimum factor of safety of 8 based on the static load, a condition that
will be fulfilled by following listed sizes indicated in Table 59-B, if the
wire rope is not over loaded and the bearings abut against the sheave hub.

(g) Wire Rope. Hoisting rope shall be wire rope, plow steel, or equivalent,
providing flexibility at least equal to that of standard plow steel hoisting
rope composed of 6 strands of 19 wires each.

1. All hoisting rope used in normal construction elevator service
shall be wire rope providing a factor of safety of at least 5, when
new; which shall be calculated by dividing the breaking strength
of the rope, as given in the manufacturer’s published tables, by the
total load to be hoisted, including the weight of the wire rope when
fully let out.

2. Defective or badly worn wire ropes shall not be permitted, and no
rope shall be used in which more than 10 percent of the total wires
are broken in any running foot of the rope.

(h) Wire Rope Clips. Rope fastenings shall be substantially and securely
made and maintained. The minimum number of clips for wire rope and
attachments shall be as indicated in the manufacturer’s tables, but in
no case shall less than 3 such clips be permitted. All clips shall have the
“U” side placed on the dead end of the rope. The clips shall be spaced at
a distance equal to at least 6 times the diameter of the rope. All sharp
edges shall be prevented from coming into contact with the rope.
(i) **Hoist Brake.** Every hoist shall be equipped with a brake capable of sustaining the maximum load in any position.

(j) **Hoist Operator.** Each hoist operator shall be provided with a covering as protection from falling material.

(k) **Hoisting Ropes.** Wire hoisting ropes in exposed locations within 7 feet of floor or ground shall be guarded by enclosure or fenced with standard railing.

(l) **Inspection and Maintenance.** Hoisting machinery shall be throughly inspected each day it is to be used, with special attention given to brakes and other safety appliances. All hazardous defects found shall be corrected prior to further use of the equipment.

(m) **Rope Marking.** Hoisting ropes shall be accurately marked, or equivalent steps taken, to indicate when the load has reached certain important positions, including top and bottom landings.

SECTION 5906. CONSTRUCTION ELEVATORS FOR HOISTING MEN (Other than permanent elevators on a temporary basis). Construction elevators on which people ride shall comply with the provisions of this Section and all of Section 5905 except for those parts of Section 5905 (c), (c-1), (d), and (d-1) which are inconsistent with this Section.

(a) **Car Attendant.** Each elevator on which people ride shall be controlled by a Department approved attendant in the cage.

(b) **Dead-man Control.** Every machine used to hoist men shall be equipped with a control that will return to the “stop” position when the hand of the hoist operator is removed from the control lever. The brakes shall be automatically applied and the power from the machine cut off whenever the control lever is in the “stop” position.

(c) **Brakes.** The hoist machine shall be equipped with 2 brakes, either of which is capable of stopping and holding a fully loaded cage. One shall be an automatic brake that will be applied whenever the power fails, is shut off, or when the power control lever is in the “off” position. The other brake shall be a hand or foot brake that operates on the hoist drum.

(d) **Broken-Rope Safety Device.** The car shall be equipped with a broken-rope safety device, or equivalent, that will hold the car and capacity load in its guides in the event the rope separates. This safety device shall be tested on every installation. If the hoisting rope is so long and heavy that, in the event of breakage near the hoist drum, its inertia would interfere with the proper operation of a broken rope safety device, a governor-actuated, or equivalent, safety device shall be installed as a substitute.

1. Rope shall not be used for the purpose of raising or lowering men, when more than 10 percent of the total wires are broken in any running foot of said rope, or when the wires on the crown of the
strands are worn down to less than 60 percent of their original area, or when, by superficial inspection, the rope shows serious defects, such as marked reduction in diameter or excessive corrosion.

2. All hoists shall be provided with an efficient device which will bring the cage to a stop at the top and bottom limits of travel.

3. The speed of the "cage" shall not exceed 200 feet per minute.

(e) **Drum flanges.** The drums of construction hoists used for hoisting men shall have flanges which extend at least 2 inches radially beyond the last layer of rope when all the rope is coiled on the drum.

1. Sheave and drum diameters shall not be less than the minimum recommended for this service by the manufacturer of the wire rope being used. The following table lists diameter dimensions that will not vary greatly from minimum values normally recommended.

   - 6-strand 19-wire rope: 40 times rope diameter.
   - 6-strand 27-wire rope: 27 times rope diameter.
   - 8-strand 19-wire rope: 32 times rope diameter.

2. Cages shall have the top covered with boards not less than 2 inches thick and the 3 sides enclosed to a height of 6 feet with 3/4 inch plywood, or some equivalent such as one inch boards or No. 16 U.S. Standard gauge wire screen, not over 2 inch mesh, fastened in a secure and substantial manner.

3. In lieu of a construction elevator, installations complying with the requirements for elevators may be used as construction elevators for hoisting men or materials, provided that such have car tops equivalent to that required by item 2 of this Sub-Section. Incomplete elevators in this category may also be used for construction service, provided that the major part of the installation is ready for service and the hazards that result from the incomplete items are controlled by measures at least equivalent to those in this Chapter.

**SECTION 5907. HOISTING.**

(a) **Operator.** Hoisting machines shall be operated only by regularly assigned and City certified operators.

(b) **Hoisting Operations.** Only those persons whose duties require their services shall be in the hoist room or station.

1. There shall be no conversation involving the hoist operator while the hoist is in motion, or while he is attending to signals, except to receive orders or instructions.

2. The hoist shall be operated with extreme caution when workmen are being hoisted or lowered.

3. The hoist operator shall be kept fully informed on any changes in conditions of the work that affect hoisting operations.

4. The hoist shall not be operated during oiling of parts.
(c) Construction Hoisting Signals. Bell, whistle, or electric signals shall be provided on all hoists, except hoists where the hoist operator has a clear and unobstructed view of the load or signal man, in which case a manual system (see Fig. 1) of signaling may be used. Wiring for electrical signal systems shall be so arranged that an electrical failure will not result in a false signal to move the load.

(d) Posting Signals. The employer shall post a copy of the hoisting signals in a conspicuous place at the operator's place of duty and all landing levels of all elevators.

(e) Bell Signals. The following signals shall be used on all elevators and hoisting machines, unless manual signals (See Figure 1) or telephone are used:

   One bell or whistle, to stop.
   Two bells or whistles, to go up.
   Three Bells or whistles, to go down.
   Four bells or whistles, to go slow.

(f) Derrick Signals. Whenever derricks are used for hoisting materials, the following signals shall be used unless manual signals are used. (See Figure 1).

   NOTE: The signals are given with 2 different sounding bells.

   One Sounding Bell
   Sound One Bell, to hoist
   Bell
   Different Sounding Bell
   One bell, to stop (if in motion)
   2 bells, to lower
   One bell, to raise boom
   2 bells, to lower boom

   If swing lines are used on booms:
   2 bells or whistles, to the right.
   3 bells or whistles, to stop.
   4 bells or whistles, to the left.

(g) Crane Signals. Manual signals shall be used where signals are needed for safe crane operation, unless for special reasons a bell or telephone system is appropriately used.

SECTION 5908. MOBILE TOWERS, HOISTS, AND SIMILAR EQUIPMENT. (Does not include cranes or earth moving machines).

(a) General. High lift truck, mobile hoist, or similar self-propelled equipment used in delivering materials to elevated platforms more than 12 feet high, shall not be in motion while the load is being hoisted. Hoisting shall not proceed beyond the height needed for ground clearance until travel is completed, except for the final, lateral motion of a few feet needed in placing the elevated load in its final position just above platforms.

(b) Soil. A substantial plank or steel matting shall be provided where the ground is uneven, loose, soft, or filled, and shall extend far enough beyond the width and length of the wheel base to provide a substantial foundation.
(c) **Transport.** The platform of a mobile hoist unit used to transport any rolling equipment, such as wheelbarrows, concrete buggies, etc., shall be provided with an adequate means to hold such equipment and its load securely in place.

(d) **Other Requirements.** All mobile towers, hoists, and similar equipment shall comply with applicable provisions of this Chapter.

(e) **Canopy Guard.** The Department may require lift trucks, mobile hoists, or similar units to be equipped with canopy guards of strength adequate to withstand, without undue deformation, the impact of falling objects which are normally handled or stored.

**SECTION 5909. MAST TOWERS AND HOISTS.**

(a) **General.** Any mast tower that has a cantilevered hoisting platform operating on a vertical mast or mastlike structure shall be stationary when in use. They shall conform to Section 5905.

1. The area on the ground or bottom landing that is under the cantilevered platform shall be surrounded on at least 3 sides by the equivalent of a standard railing.

**SECTION 5910. GIN POLES.**

(a) **General.** Gin poles shall be of high quality, defect-free material, such as selected timber, structural metal, or steel pipe. The pole and all component parts shall provide a factor of safety of at least 4.

1. Gin poles shall be held as nearly perpendicular as possible, with only enough slope to clear the load to be lifted. At least 3 guy wires or ropes shall be provided.

2. If a winding drum is provided such shall be equipped with a friction brake and positive pawl or dog.

3. Every gin pole shall be securely fastened at the bottom to prevent it from kicking out during operation.

**SECTION 5911. SLINGS.**

(a) **Material.** The slings used with derricks, or other hoisting apparatus, shall be made of wire rope, certified alloy steel chains, manila or sisal rope of sufficient strength to carry the imposed loads, with a safety factor of at least 6. The factor of safety, based upon the sling's original strength, shall be increased to 8 or more if the sling is not reasonably new.

(b) **Size.** Slings shall be of proper size and type to handle the load without overstress or slipping. Double choker slings shall be provided on all horizontal loads over 12 feet in length that include 2 or more pieces of material.

**SECTION 5912. RAILINGS AND TOEBOARDS.** (See Standards).

**SECTION 5913. SUSPENDED, POWER-DRIVEN SCAFFOLDS.** (See Standards).
SECTION 5914. BOATSWAIN'S CHAIRS. (See Standards).

SECTION 5915. DERRICKS AND CRANES.

(a) Derricks and Cranes. Derricks shall be constructed of metal or select structural Douglas fir, with proper metal braces and fittings. Derricks shall be of proper strength and size for the work to be performed, and shall be anchored so as to prevent them from tipping or collapsing. Guyed derricks shall have at least 6 guys. This number shall not be reduced, unless a study by the Department determines that the proposed guy arrangement will provide a safety factor at least 3-1/2 under all circumstances.

1. Reinforcing steel shall not be permitted for guy line anchors.

(b) Brakes. The hoisting drum of all handpower hoists shall be equipped with an effective brake, and shall be provided with a safety dog of sufficient strength to hold the load in any position.

1. All ropes, chains, and blocks shall be of sufficient size and strength to safely raise, lower, or sustain the load under all circumstances.

2. The maximum allowable working load of new chains and ropes shall be based on manufacturer's tables.

3. Ropes shall be attached to drums in a manner that will not interfere with proper winding.

(c) Wire Rope Clips. Wire rope fastenings shall be substantially and securely made and maintained. The minimum number of clips for wire rope end attachments shall be as indicated in manufacturer's tables, but in no case shall less than 3 clips be used. All clips shall have the "U" side placed on the dead end of the rope. The clips shall be spaced at a distance equal to at least 6 times the diameter of the rope. All sharp edges shall be prevented from coming into contact with the rope.

(d) Moving Rope Guards. Wire hoisting ropes and similar moving ropes in exposed locations within 7 feet of ground or floor, except for free end section, shall be guarded by an enclosure or fenced with standard railings.

(e) Safe Derrick Load. The load on any boom or extension to a boom on any derrick shall not exceed the safe load indicated by the manufacturer.

1. Every derrick shall be plainly marked on the length of the boom, the rated load, and the corresponding radius.

(f) Crane Capacity. Every boom-type mobile crane shall have a legible capacity chart or data plate, conveniently located on or in the crane, containing manufacturer's rated loads at the maximum and minimum radius and at least 2 other points for the various boom length, counterweight, and outrigger arrangements. This information shall be given for boom positions, both parallel and transverse to the line of travel.
1. Any boom or extension to a boom, designed by other than a recognized manufacturer or structural engineer, shall be tested before use, and at any other time requested by the Department with a vertical load at least 25 percent greater than the load which it is intended to lift, and with a lateral load equal to 1/2 the load it is intended to lift vertically, or with a lateral load equal to the maximum efforts of the swinging device, if of a swing type.

(g) **Crane Boom Stops.** Devices to prevent the boom from falling over backward shall be provided on cranes and on other equipment with booms that present similar hazards.

(h) **Boom Dog.** Any crane boom that depends upon a dog and ratchet arrangement to hold it in position shall have the dog readily visible to the operator, or shall be provided with a visible, directly connected, positive telltale device.

(i) **Oiling Platform.** Crane booms with outrig blocks or similar equipment, requiring a man to climb out onto the boom for oiling or other regular service, shall be equipped with an oiler’s walkway, or platform and grab irons for safe access, except for those booms that can be and are safely lowered to the ground for this purpose.

(j) **Safety Glass.** All glass in the cabs of cranes or derricks shall be of a shatterproof type. Wire glass or equivalent is acceptable except for those sections, like windshields, through which the operator must frequently view his operations.

**SECTION 5916. STANDARDS.** Unless provided for in other portions of this Building Code, the following Standards shall apply:

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<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
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<tbody>
<tr>
<td>ANSI</td>
<td>Safety Requirements for Workmen’s Hoists, A 10.4-1963.</td>
</tr>
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**LEGEND**

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<tr>
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| American National Standards Institute |
| 1430 Broadway |
| New York, New York 10018 |

**SECTION 5917. TABLES.**
<table>
<thead>
<tr>
<th>Cage or Bucket Capacity Up to</th>
<th>Vertical Distance Measured From Top Down</th>
<th>Post Sizes</th>
<th>Guide Sizes S 4 S</th>
<th>Horizontal Tie Sizes</th>
<th>Diagonal Brace Sizes</th>
<th>Maximum Tie Spacing</th>
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<tr>
<td>500 lb.</td>
<td>Top to 72'</td>
<td>4x4</td>
<td>2 1/2 x 3 1/4</td>
<td>1x6</td>
<td>1x6</td>
<td>6'</td>
</tr>
<tr>
<td>500 lb.</td>
<td>72 to 198'</td>
<td>4x6</td>
<td>2 1/2 x 3 1/4</td>
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<td>1x6</td>
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<td>1,000 lb. or 1/4 cu. yd.</td>
<td>Top to 72'</td>
<td>4x4</td>
<td>3 1/2 x 3 1/4</td>
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<td>1x6</td>
<td>6'</td>
</tr>
<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>72 to 128'</td>
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<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>126 to 198'</td>
<td>6x6</td>
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<td>1x6</td>
<td>6'</td>
</tr>
<tr>
<td>2,000 lb. or 1/4 cu. yd.</td>
<td>Top to 80'</td>
<td>4x6</td>
<td>3 1/2 x 3 1/4</td>
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<td>1x6</td>
<td>8'</td>
</tr>
<tr>
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<td>80 to 128'</td>
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<td>1x8</td>
<td>8'</td>
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<tr>
<td>2,000 lb. or 1/4 cu. yd.</td>
<td>128 to 208'</td>
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<tr>
<td>4,000 lb. or 1 cu. yd.</td>
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<td>3 1/2 x 3 1/4</td>
<td>2x6</td>
<td>2x6</td>
<td>8'</td>
</tr>
<tr>
<td>4,000 lb. or 1 cu. yd.</td>
<td>80 to 128'</td>
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<td>3 1/2 x 3 1/4</td>
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<td>2x6</td>
<td>8'</td>
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<tr>
<td>4,000 lb. or 1 cu. yd.</td>
<td>128 to 208'</td>
<td>6x8</td>
<td>3 1/2 x 3 1/4</td>
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<td>2x6</td>
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TABLE NO. 59-B

<table>
<thead>
<tr>
<th>Diameter of Hoisting Rope (in inches)</th>
<th>Diameter of Sheave (in inches)</th>
<th>Axle Diameter, inches (see Sub-Section (f) for information)</th>
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<tr>
<td>5/32</td>
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</tr>
<tr>
<td>3/16</td>
<td>9</td>
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<td>1 13/16</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>2 1/16</td>
</tr>
</tbody>
</table>

NOTE: Diameter of sheaves shall be measured at bottom of groove.

1. All sheaves shall be of iron or steel, and of sufficient strength to support the loads to which they will be subjected.
2. The grooves of all sheaves shall be matched and shall be concentric with the axis.
3. All sheaves shall have axles of a grade at least equal to cold rolled shafting.

FIGURE 1
STANDARD HAND SIGNALS FOR CRANES AND DERRICKS

1. HOIST
2. LOWER
3. STOP
4. SWING
5. BOOM UP
6. BOOM DOWN
7. TRAVEL
8. MAKE MOVEMENT SLOWLY
9. EMERGENCY STOP
CHAPTER 60
PLASTICS

SECTION 6001. GENERAL.

(a) Scope. The use of combustible plastic materials on interiors or exteriors of buildings shall conform to the flame spread and smoke contribution requirements of this Building Code, except as permitted by this Chapter. Refer to Chapters 5 and 16 through 22 for exterior uses, and Chapter 42 for interior uses. Plastic materials are classified: incombustible, approved plastics, and plastics.

(b) Approval for Use. The Department shall require that technical data be submitted to substantiate the proposed use of any plastic material and, if it is determined that the evidence submitted is satisfactory for the use intended, it may approve its use subject to the requirements of this Chapter. This approval shall not be construed as meeting the access requirements of Chapter 38. Approval by the Department and the Fire Department shall be secured to meet the access requirements.

(c) Identification. Each full sheet, roll, or piece of plastic for which a permit is required shall be identified with a mark or decal indicating its intended use.

SECTION 6002. APPROVED PLASTICS DEFINED. Approved plastic materials shall be those which provide a flame spread rating of 225 or less when tested in accordance with ASTM E-84 in the manner intended for use; and a smoke density rating no greater than 75 when tested in the thickness intended for use by the chamber method of test under ASTM D-2843. The products of combustion shall be no more toxic than those of untreated wood when burned under similar conditions.

SECTION 6003. INSTALLATION.

(a) General. Plastics shall be approved and those used as interior finish and trim shall comply with the requirements specified in Chapter 42. EXCEPTION: Approved plastics are not required to be used in occupancies not restricted by Table No. 42-B.

(b) Structural Requirements. All plastic materials and their assemblies and fastenings shall withstand the design loads as prescribed in Chapter 23. Technical data shall be submitted to the Department by an approved testing agency to establish stresses, maximum unsupported spans and other information as may be deemed necessary by the Department for the various thicknesses and forms used.

(c) Fastenings. Fastenings shall withstand design loads as prescribed in this Building Code. Provision shall be made for the expansion and contraction of plastic material and any material in conjunction with which it is employed.
SECTION 6004. GLAZING OF UNPROTECTED OPENINGS.

(a) Definition.

1. Exterior Plastic Light Transmitting Panels. Light transmitting material glazed, set in frame or sash, or held by mechanical fasteners which pass through the material.

(b) General. In Type V-N construction, doors, sash, and framed openings not required to be fire protected may be glazed or equipped with approved plastic materials. In all types of construction having occupancies other than Groups A, B, Divisions 1 and 2; E. Divisions 1 and 2, and in all buildings equipped with an approved automatic fire sprinkler system, openings not required to be fire protected may be glazed or equipped with approved plastic materials, subject to the following requirements:

1. The aggregate area of plastic light shall not exceed 30 percent of the area of any wall face of the story in which they are installed.

2. In stories above the first story, the area of a pane of glazing shall not exceed 12 square feet, and the vertical dimension of a unit or pane shall not exceed 3 feet. When the light transmitting panel is mechanically fastened, the maximum height of each panel shall not exceed 10 feet in buildings over one story in height.

3. Assemblies of transmitting materials shall be separated vertically by noncombustible wall surfacing material to a height of at least 4 feet, or a height equal to at least 50 percent of the height of the highest panel of the next lower assembly or run, whichever is greater.

4. Installations above the first story shall be of material easily broken to permit venting of a fire or entry by firemen, i.e., acrylic sheet or fiberglass materials. Polycarbonate material may be used when approved by both the Department and Fire Department.

EXCEPTIONS:

A. Installation of approved plastic materials which will automatically vent a fire in the occupancy prior to ignition of the plastic materials may occupy a maximum of 50 percent of the area of the wall face and the story when installed in the first 3 stories. The area of the materials above the 3rd story shall not exceed 30 percent of the area of the wall face and story of which it is installed. These materials shall be subject to the installation requirements specified in Item 2 of this Section.

B. Plastic materials qualifying under Exception 1 of this Section may be installed in areas up to 50 percent of the wall area of each story in structures less than 150 feet in height which are provided, on each floor above the first floor, with continuous architectural projections meeting the requirements of Chapter 17, and extending at least 3 feet from the surface of the wall in which the light transmitting material is installed. The size and dimensions of individual units or panes
shall not be limited to the installations, except as required to meet loading requirements.

SECTION 6005. SKYLIGHTS.
(a) General. Approved plastics may be used in skylights installed on roofs in accordance with the following provisions:
   1. The plastic shall be mounted at least 9 inches above the plane of the roof on a curb constructed with materials consistent with the construction of the roof upon which the skylight is mounted. The curb may be omitted in buildings of Types IV-N and V-N construction which is approved by the Department.
   2. Flat or corrugated plastic lights shall slope at least 4:12 when mounted above the plane of the roof on a curb.
   3. Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome, but not less than 5 inches.
   4. The edges of the plastic lights or dome shall be protected by metal or noncombustible material.
   5. Each skylight unit may have a maximum area, within the curb, of 100 square feet.
   6. The aggregate area of skylights and plastic roof panels shall not exceed 25 percent of floor area of the room or space sheltered by the roof in which they are installed.
   7. Skylight units shall be installed on the roof with a minimum distance of 4 feet between units and, except for Group H and I Occupancies, at least 4 feet from any exterior wall. Skylights shall not extend into yards beyond a vertical plane where fire protection of wall openings is required.

EXCEPTIONS:
   A. Provision 5, of Section 6005 (a), need not be applied if the building on which the skylights are located is not more than one story in height; the building has an exterior separation from other buildings of at least 30 feet; the room or space sheltered by the roof is not classified in a Group D Occupancy, or as a required means of egress or the plastic material meets the fire retardant requirements of the roof.
   B. Except for Groups A, B, Division 1, D, and E Occupancies, approved plastic materials may be used beyond the limitations specified in provisions 5 and 7, of Section 6005 (a), if serving as an approved fire venting system, or if used in a building equipped with an approved fire sprinkler system.

(b) Combinations of Roof Panels and Skylights. Combinations of approved plastic used in roofs and skylights shall not exceed 25 percent of the floor area of the roof or occupancy sheltered.
SECTION 6006. MONITORS AND SAWTOOTH ROOFS.

(a) General. Where a fire resistive rating is not required for the roof structure, and in all buildings provided with an approved automatic fire sprinkler system, approved plastics may be used with or without sash as the light transmitting medium in monitors and sawtooth roofs.

EXCEPTION: Plastics used in monitors or sawtooth roofs of Type IV-N buildings shall be of Class I or II material as set forth in Table No. 42-A

(b) Allowable Areas. The area of individual plastic glazing used in monitor and sawtooth glazing shall not exceed 200 square feet. The total aggregate area of plastics used in skylights, monitors and sawtooth glazing shall not exceed 30 percent of the floor area of the room or occupancy sheltered.

(c) Area Separations. The areas of the plastic panels shall be separated from each other by a section of noncombustible material or by a section of the roofing material of the structure not less than 4 feet in length.

SECTION 6007. PLASTIC LIGHT DIFFUSERS IN CEILINGS.

(a) Luminous Ceilings. For the purpose of this Section, a luminous ceiling shall be defined as any light diffusing or light transmitting ceiling consisting of transparent, translucent, louvered, egg-crated, mesh, or similar materials suspended from a ceiling or structural framework by means of hangers, and which may include a supporting grid on which the material rests.

1. Where ceilings are required to be fire resistive or of noncombustible construction and are dropped greater than the distance specified in Chapter 42, plastics conforming to the requirements of a Class I finish material shall be used, except where they are protected on both sides by an automatic fire sprinkler system.

EXCEPTIONS: Ceiling light diffusers of approved plastics shall not be required to conform to the above requirement, provided the installation meets the following requirements:

   A. The ceiling light diffusers, as installed, will fall from their mountings at an ambient temperature of at least 200 degrees Fahrenheit below the ignition temperature of the plastic material as measured by ASTM D-1929.

   B. The plastic light diffusers are mounted in the ceiling in a manner so they will remain in place at an ambient room temperature of 175 degrees Fahrenheit for a period of at least 15 minutes.

   C. The maximum length of any single plastic light transmitting panel shall not exceed 10 feet.

2. Luminous ceilings installed below sprinkler heads shall be installed so they will not interfere with the effective operation of the sprinkler system in the area to be protected, and shall provide a ready means of access to all valves and sprinkler heads of the system.
(b) Use of Approved Plastics with Electrical Lighting Fixtures. Light transmitting and light diffusing panels made from plastic materials installed in approved electric lighting fixtures shall be exempt from the requirements of Chapter 42 and Section 6007 (a), and shall meet the following requirements:
   1. The light diffusers shall meet the requirements of Section 6007 (a), Exceptions A and B.
   2. Unless the occupancy is protected by an approved automatic sprinkler system, the area of approved plastic materials when used in exitways, exit passages, or corridors, or in Groups A, B, Division 1, and D Occupancies, shall not exceed 30 percent of the aggregate area of the ceiling in which they are installed.
   3. The maximum area of any single plastic light diffuser shall not exceed 30 feet.

SECTION 6008. PARTITIONS. When partitions are not required to be of fire resistive or noncombustible construction, approved plastics conforming to the requirements of Chapters 42 and 17, may be used.

SECTION 6009. EXTERIOR VENEER.
   (a) General. Exterior veneer shall be of approved plastic materials, and shall conform to the provisions of this Section.
   (b) Limitations. Exterior plastic veneer which meets the requirements for noncombustibility as defined in Chapter 4, shall be unlimited as to height and length of veneered area, except as limited by Chapter 30. All other approved plastic materials shall conform to the following provisions:
       1. Height. The plastic veneer shall not be attached to any exterior wall above 20 feet.

SECTION 6010. AWNINGS AND PATIO COVERS. Approved plastic may be used in awnings and patio covers. All the awnings shall be constructed in accordance with the provisions governing projections and appendages as specified in Chapter 45.

SECTION 6011. GREENHOUSES. Approved plastics may be used in lieu of plain glass in greenhouses in Fire Zone No. 3.

SECTION 6012. CANOPIES. Plastic panels shall not be installed in canopies erected over motor vehicle service station pumps.
SECTION 6013. STANDARDS. Unless provided for in other portions of this Building Code, the following standards shall apply:

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<tr>
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<tr>
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<tbody>
<tr>
<td>ASTM</td>
<td>American Society for Testing Materials 1916 Race Street Philadelphia, Penn. 19103</td>
</tr>
<tr>
<td>MCA</td>
<td>Manufacturing Chemists Association, Inc. 1825 Connecticut Avenue, N.W. Washington, D.C.</td>
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CHAPTER 61

LAWN SPRINKLER SYSTEMS

SECTION 6101. GENERAL.
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the design, construction, and installation of lawn sprinkler systems connected to the potable water supply. For pressure lines, See Chapter 50.
(b) Lawn Sprinkler System. Shall include apparatus and equipment affixed permanently to the property in the lawn, ground, flower beds, or fence, connected to the potable water supply, and normally used for the purpose of irrigation. Connection to the water supply shall also mean connections to the hose bibs, as well as permanent connections to the water supply line.

SECTION 6102. DEFINITIONS. Also See Chapter 50.
(a) Approved. See Chapter 4.
(b) Back Flow. The reverse flow of water into the pipes of a potable supply of water. Back siphonage is one type of back flow.
(c) Back Flow Preventor. A device or means to check or stop water from flowing into a potable supply of water from the sprinkler system. See Table 50-B.
(d) Sprinkler Distribution Pipe. A water line not under continuous pressure conveying water from the control valves to the sprinkler heads.
(e) Control Valves. The valves controlling distribution of water from the sprinkler supply line to sprinkler distribution pipes. The valves may be installed singly or in a manifold.
(f) Pressure Lines. A water line designed or intended to contain water under continuous working pressure.
(g) Service Line. A pipe or pipes conveying water from the water main into the building.

SECTION 6103. CONSTRUCTION AND INSTALLATION.
(a) Design and Installation. Design and installation of sprinkler systems shall, under calm wind conditions, prevent spray of water onto sidewalks, streets, or other public ways.
(b) Drainage of Sprinkler Distribution Pipe. Pipes shall be sloped to drain. Drain valves shall drain into a sump or gravel pocket.
(c) Cross Connections. Cross connections shall not be made between the potable water supply and any other source of water.
(d) Connection to Water Supply. Connection to the potable water supply may be made either to the service line or to the water distribution line. In either case, the connection shall be made at least 5 feet downstream from water meter. Provisions shall be made to protect the sprinkler supply line from freezing.
(e) **Installation of Back-Flow Preventor.** An approved back-flow preventor shall be installed in all lawn sprinkler systems. The back-flow preventor, unless of the reduced pressure type, shall be installed at least 6 inches above the highest sprinkler head.

(f) **Material for Pressure Lines.** In addition to meeting the requirements specified in Chapter 50, tubing under pressure from the back-flow preventor to remote control valves shall be capable of withstanding a minimum of 125 p.s.i.

(g) **Materials for Sprinkler Distribution Pipe.** All sprinkler distribution pipe and fittings shall be capable of withstanding a continuous working pressure of 80 pounds per square inch.

(h) **Identification Marking.** Each pipe fitting, sprinkler head, valve or device used in a lawn sprinkler system shall have the manufacturer’s name and type of classification cast, stamped, or indelibly marked on it. Each length of pipe shall be marked continuously on its length showing the manufacturer’s mark and type or classification of piping.

**SECTION 6104. STANDARDS.** Unless provided for in other portions of this Building Code, the following Standards shall apply. For additional Standards, see Chapter 50.

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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td></td>
<td>1916 Race Street</td>
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<td></td>
<td>Philadelphia, Pa. 19103</td>
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CHAPTER 62
ENERGY CONServation

DIVISION I
SCOPE AND GENERAL REQUIREMENTS

SECTION 6201. SCOPE.
(a) Nonresidential Buildings, Group A Through G Occupancy. This Chapter, except for Section 6201 (b), sets forth minimum Energy Conservation requirements for the design of new nonresidential buildings and structures or portions thereof and additions to existing nonresidential buildings when required by Chapter 1. These buildings, primarily for human occupancy, are designed by regulating their exterior envelopes; selection of their HVAC; service water heating; electrical distribution and illuminating systems and equipment, all for effective use of energy. These buildings shall be designed to comply with the requirements of either Division IV, V, VI of this Chapter. Where the term nonresidential is used in this Chapter, this shall mean any Group A through G Occupancy. Buildings or portions of buildings used primarily for the storage of materials and uninhabited except for the handling of those materials shall be excluded from the provisions of this Chapter. For exception to this, see Section 6202 (c).

(b) Residential Buildings. The design of new residential buildings and structures or portion thereof and additions to existing residential buildings, when required by Chapter 1, shall comply with this Section but are exempt from the requirements of other Sections in this Chapter. These residential buildings are designed primarily for human occupancy. Residential buildings includes Group I and J-1 Occupancy if not more than 2 stories or Group H Occupancy not to exceed 3 stories above grade. Private garages, carports and buildings that are not mechanically heated or cooled are exempt from this Section.

1. Minimum insulation standards for Residential Buildings shall be as follows:
   A. Insulation having a minimum R-value of 11 shall be used in all exterior walls contiguous to unheated areas above grade.
   B. Insulation having a minimum R-value of 19 shall be used in all exterior ceilings of heated areas above grade.
   C. All windows above grade shall be double glazed.
   D. All exterior doors and interior doors leading to unheated areas above grade shall be weather stripped and sliding glass doors shall be double glazed.
E. Computations submitted by a licensed architect or engineer that the total energy required in a residential building, through design or otherwise, equals or is less than the total energy used if the dwelling is built or renovated according to standards contained in Subsection (1) of this Section shall be considered an acceptable alternative for conformance with the prescriptive standards set forth in Subsection (1) of this Section. The total energy required shall be computed as the annual estimated Btu's necessary to heat, cool, and light the proposed residential building. For purposes of this calculation, the exterior walls shall consist of no more than the equivalent of 20 percent doors and windows.

SECTION 6202. INTENT AND COMPLIANCE.
(a) Design Requirements. The requirements of this Chapter shall regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, electrical, and illumination systems and equipment which will enable the effective use of energy in new building construction.
(b) Design Paths. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of energy. These provisions are structured to permit compliance with the intent of this Chapter by any of the 3 paths for design:
   1. Division IV. Building design by systems analysis and design of buildings utilizing nondepletable energy sources.
   2. Division V. A component performance approach for various building elements and mechanical systems and components.
   3. Division VI. A specified acceptable practice. Compliance with any one of these paths meets the intent of this Chapter.
(c) Exempt Buildings.
   1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than 3.4 Btu/h per square foot of floor area or 1.0 watt per square foot of floor area for all purposes.
   2. Buildings and structures or portions thereof which are neither heated nor cooled by fuel or electrical energy.
   3. Buildings or portions of buildings used primarily for the storage of materials and are uninhabited, except for the handling of those materials, and are not heated to 50 degrees or higher.
   4. Historic buildings which are deliberately preserved beyond their normal term of use because of historic associations, architectural interest, or public policy. See Chapter 31.
   5. Buildings which are not air-conditioned by refrigeration and which are associated with heat producing industries, processes and operations, provided the basic building heat is derived from
these heat generating processes and the supplemental energy expended for heating does not exceed 3.4 Btu/h per square foot of floor area, or the supplemental energy provided for heating is not intended for use except to protect the equipment or processes during down time. In which event, the supplemental energy required for heating shall not exceed that required if the building had a complying envelope.

(d) **Additions to Existing Buildings.** Additions to existing buildings or structures may be made to such buildings or structures without making the entire building or structure comply, except as hereafter provided. The new addition shall conform to the provisions of this Code as they relate to the new construction only. For renovations, alterations or repairs see Chapter 1.

e) **Change of Occupancy.** Any change in occupancy or use of any building or structure constructed under this Chapter which would require an increase in demand for either fossil fuel or electrical energy supply shall not be permitted unless such building or structure is made to comply with the requirements of this Chapter. This Section supercedes Chapter 5 of this Code. See Chapter 1.

**SECTION 6203. MATERIALS AND EQUIPMENT.**

(a) **General.** All materials and equipment shall be identified in order to show compliance with this Chapter.

(b) **Alternate Materials and Methods.** The provisions of this Chapter are not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that this construction, design or insulating system has been approved by the Department as meeting the intent of this Chapter. See Chapter 1.

(c) **Maintenance Information.** Required regular maintenance actions shall be clearly stated and incorporated in a readily accessible label. This label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of project. Maintenance instructions shall be furnished for any equipment which requires preventative maintenance for efficient operation.

**SECTION 6204. PLANS AND SPECIFICATIONS.**

(a) **General.** With each application for a building permit, and when required by the Department, plans, specifications and a statement of design compliance with this Chapter shall be submitted. Where design is required to be by an architect or engineer, the statement of compliance shall be prepared by the architect or engineer.

(b) **Review for Design Compliance.** Review for design compliance with this Chapter may be required by the Department. See Chapter 3.
(c) **Details.** The plans and specifications shall show in sufficient detail all pertinent data and features of the buildings and the equipment and systems as herein governed including but not limited to, design criteria, exterior envelope component materials, U values of the envelope elements, R values of insulating material, size and type of apparatus and equipment, equipment and system controls and other pertinent data to indicate conformance with the requirements of this Chapter.

**DIVISION II**

**DEFINITIONS**

**SECTION 6205.**

(a) **General.** For purposes of this Chapter the following definitions shall apply:

1. **Accessible.** (As applied to equipment) Admitting close approach not guarded by locked doors, elevation or other effective means. (See readily accessible).

2. **Air Conditioning.** The process of treating air so as to control its temperature, humidity, cleanliness and distribution to meet requirements of the conditioned space.

3. **Air Transport Factor.** The ratio of the rate of useful sensible heat removal from the conditioned space to the energy input to the supply and return fan motor(s), expressed in consistent units and under the designated operating conditions.

4. **Automatic.** Self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature or mechanical configuration. (See Standards).

5. **Boiler Capacity.** The rate of heat output in Btu/h measured at the boiler outlet, at the design pressure and/or temperature, and rated fuel input at site elevation.

6. **Building Envelope.** The elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior.

7. **Building Project.** A building or group of buildings, including on-site energy conversion or electric generating facilities which utilize a single submittal for a construction permit or are within the boundary of a contiguous area under one ownership.

8. **Coefficient of Beam Utilization (CBU).** The ratio of the luminous flux (lumens) reaching a specified area directly from a floodlight or projector to the total beam luminous flux.

9. **Coefficient of Performance (COP).** See the following paragraphs in Division V for the definitions of COP as appropriate:
A. Heat Pumps, Heating - 6215 (b).
B. Electrically Operated HVAC Systems Equipment, Cooling - 6215 (d).
C. Electrically Operated HVAC Systems Components, Cooling - 6215 (e).

10. Coefficient of Utilization (CU). The ratio of the luminous flux (lumens) from a luminaire received on the work plane to the lumens emitted by the luminaire's lamps alone.


12. Comfort Envelope. The area on a psychrometric chart enclosing all those conditions described in Std. 3 as being comfortable.

13. Conditioned Floor Area. The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy using system.

14. Degree Day, Heating. A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65 degrees F. there exist as many Degree Days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65 degrees F.

15. Efficiency, Overall System. The ratio of useful energy (at the point of use) to the thermal energy input for a designated time period, expressed in percent.

16. Energy. The capacity for doing work; taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical and chemical; in customary units, measured in kilowatt hours (kwh) or British thermal units (Btu).

17. Energy Efficiency Ratio (EER). The ratio of net cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions.

18. Energy, Recovered. (See recovered energy).

19. Equivalent Sphere Illumination (ESI). The level of sphere illumination which would produce task visibility equivalent to that produced by a specific lighting environment.

20. Exterior Envelope. (See building envelope).

21. Floodlighting. A lighting system designed to light an area using projector type luminaires usually capable of being pointed in any direction.

22. Fuel. A substance which may be burned to give heat or generate electricity; a nuclear substance used to generate electricity.
23. **Glazing.** The non-opaque portion of the building envelope.

24. **Gross Floor Area.**
   A. The sum of areas of the several floors of the building, including basements, cellars, mezzanine and intermediate floored tiers and penthouses of headroom height, measured from the exterior faces of exterior walls or from the centerline of walls separating buildings.
   B. Covered walkways, open roofed-over areas, porches and similar spaces shall be excluded.
   C. The gross floor area does not include such features as pipe trenches, exterior terraces or steps, chimneys, roof overhangs, etc.

25. **Gross Wall Area.** The vertical projection of the exterior wall area bounding interior space which is conditioned by an energy using system; includes opaque wall, window and door areas. The gross area of exterior walls consists of all opaque wall areas, including foundation walls to a point 2 feet below grade, between floor spandrels, peripheral edges of floors, window areas including sash, and door areas, where these surfaces are exposed to outdoor air and enclose a heated or mechanically cooled space, including interstitial areas between 2 such spaces.

26. **Heat.** The form of energy that is transferred by virtue of a temperature difference.

27. **Heated Space.** Space within a building which is provided with a positive heat supply to maintain air temperature of 50 degrees F. or higher.

28. **Historic Buildings.** Those buildings which have been designated as historic by the State Historical Society, or the governing body of a county or municipality, or are listed in the National Register of Historic Places.

29. **Humidistat.** An instrument which measures changes in humidity and controls a device(s) for maintaining a desired humidity.

30. **HVAC.** Heating, ventilating and air conditioning.

31. **HVAC System.** A system that provides either collectively or individually the processes of comfort heating, ventilating and/or air conditioning within, or associated with, a building.

32. **Illumination.** The density of the luminous flux incident on a surface; it is the quotient of the luminous flux by the area of the surface when the latter is uniformly illuminated.

33. **Infiltration.** The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.
34. **Light Loss Factor (LLF).** A factor used in calculating the level of illumination after a given period of time and under given conditions. It takes into account temperature and voltage variations, dirt accumulation on luminaire and room surfaces, lamp depreciation, maintenance procedures and atmospheric conditions.

35. **Luminaire.** A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

36. **Manual.** Capable of being operated by personal intervention. (See automatic.)

37. **Nondepletable Energy Sources.** Sources of energy (excluding minerals) derived from incoming solar radiation including photosynthetic processes; from phenomena resulting therefrom including wind waves and tides, lake or pond thermal differences; and energy derived from the internal heat of the earth, including nocturnal thermal exchanges.

38. **Nonresidential Building.** Structures, or portions thereof, and additions to existing buildings that comply with occupancy types other than Group H, I or J as defined in this Building Code.

39. **Opaque Areas.** All exposed areas of a building envelope which encloses conditioned space, except openings for windows, skylights, doors and building service systems.

40. **Overall Thermal Transfer Value (OTTV).** An overall coefficient of heat gain expressed in units of Btu per hour per square foot per degree F.

41. **Outside Air.** Air taken from the outdoors and, therefore, not previously circulated through the system.

42. **Packaged Thermal Air Conditioner.** A factory-selected combination of heating and cooling components, assemblies or sections, intended to serve a room or zone. (For the complete technical definition, see Std. 15.)

43. **Positive Heat Supply.** Heat supplied to a space by design or by heat losses occurring from energy consuming systems or components associated with that space.

44. **Power.** In connection with machines, power is the time rate of doing work. In connection with the transmission of energy of all types, power refers to the rate at which energy is transmitted; in customary unit, it is measured in watts (W) or British thermal units per hour (Btu/h).

45. **R-Value.** The reciprocal of the thermal transmittance value (U-Value). The term is applied to usual combinations of building materials, as generally recognized and accepted in the building construction industry.
46. **Readily Accessible.** Capable of being reached quickly for operation, renewal or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc. (See accessible).

47. **Recovered Energy.** Energy utilized which would otherwise be wasted from an energy utilization system.

48. **Reflectance.** The ratio of the light reflected by a surface to the light falling upon it.

49. **Renovation.** Any structural alteration or repair to a building which results in, or is likely to result in a 50 percent or greater increase in the replacement value of the existing structure as determined by the Office of the Assessor.

50. **Reheat.** The application of sensible heat to supply air that has been previously cooled below the temperature of the conditioned space by either mechanical refrigeration or the introduction of outdoor air to provide cooling.

51. **Reset.** Adjustment of the set point of a control instrument to a higher or lower value automatically or manually to conserve energy.

52. **Residential Building.** Includes Group I and J-1 Occupancies of not more than 2 stories and Group H Occupancies not exceeding 3 stories above grade, except for private garages and carports.

53. **Roof Assembly.**
   A. A roof assembly shall be considered as all components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.
   B. The gross area of a roof assembly consists of the total interior surface of such assembly, including skylights exposed to the heated or mechanically cooled space.
   C. When return air ceiling plenums are employed, the roof/ceiling assembly shall:
      --For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly; and,
      --For gross area purposes, be based upon the interior face of the upper plenum surface.

54. **Room Air Conditioner.** An encased assembly designed as a unit primarily for mounting in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and may also include means for ventilating and heating.

55. **Room Cavity Ratio (RCR).** A number related to room dimensions used in average illumination calculations.
56. **R-Value.** The reciprocal of the average overall coefficient of heat transmission in Btu's (British thermal units) per hour. The term is applied to usual combinations of insulation materials, as generally recognized and accepted in the building construction industry.

57. **Sequence.** A consecutive series of operations.

58. **Service Systems.** All energy using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering or similar functions.

59. **Service Voltage.** Utilization voltage from the utility source to the service entrance of the building.

60. **Service Water Heating.** Supply of hot water for domestic or commercial purposes other than comfort heating.

61. **Service Water Heating Demand.** The maximum design rate of energy withdrawal from a service water heating system in a designated period of time (usually an hour or a day).

62. **Shading Coefficient (SC).**

\[
SC = \frac{\text{Solar Heat Gain of Fenestration (West Elev. at 4 P.M. Sun Time 9/21)}}{\text{Solar Heat Gain Unshaded DSB (West Elev. at 4 P.M. Sun Time 9/21)}}
\]

where:
- DS means double strength
- B means grade class

63. **Solar Energy Source.** Source of thermal, chemical or electrical energy derived from conversion of incident solar radiation.

64. **System.** A combination of central or terminal equipment or components and/or controls, accessories, interconnecting means and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, service water heating or illumination.

65. **Terminal Device.** The means by which the transformed energy from a system is finally delivered; i.e., registers, diffuser, lighting fixtures, faucets and similar elements.

66. **Thermostat.** An instrument which measures changes in temperature and controls device(s) for maintaining a desired temperature.

67. **Thermal Transmittance (U).** Overall coefficient of heat transmission (air to air) expressed in units of Btu per hour per square foot per degree F. It is the time rate of heat flow. The U value applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity air spaces, and surface air films on both sides of a building element.
68. Thermal Transmittance \( (U_o) \) 
   A. Overall (average) heat transmission of a gross area of the exterior building envelope, expressed in units of Btu per hour per square foot per degree F.
   B. The \( U_o \) value applies to the combined effect of the time rate of heat flows through the various parallel paths, such as windows, doors, and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceiling.

69. Unitary Cooling and Heating Equipment. One or more factory made assemblies which include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

70. Unitary Heat Pump. One or more factory made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant to water heat exchanger, including means to provide both heating and cooling functions. It is designed to provide the functions of air circulating, air cleaning, cooling and heating with controlled temperature; and dehumidifying, and may optionally include the function of humidifying. When such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

71. Utilization Equipment. The motor components of equipment which utilizes electric energy for mechanical, chemical, heating, lighting or similar purposes.

72. Veiling Reflections. Regular reflections superimposed upon diffuse reflections from an object that partially or totally obscures the details to be seen by reducing the contrast. This sometimes is called reflected glare.

73. Ventilation Air. That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See Std. 2 and Sections 6206 and 6207 of this Chapter.)

74. Work Plane. The plane at which work usually is done and at which the illumination is specified and measured. Unless otherwise indicated, this is assumed to be a horizontal plane 30 inches above the floor.

75. Zone. Space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.
DIVISION III
DESIGN CONDITIONS

SECTION 6206. DESIGN CRITERIA.
(a) General. The criteria of this section establishes the minimum requirements for thermal design of the exterior envelope of buildings and establishes criteria for design of the HVAC systems and their parts.
(b) More Stringent Requirements. A building that is designed to be both heated and cooled shall meet the more stringent of the heating or cooling requirements as provided in this Chapter when requirements of the exterior envelope differ.
(c) Mixed Occupancy. See Chapter 5.
(d) Deterioration by Design. The design of buildings for energy conservation shall not create conditions of accelerated deterioration from moisture condensation.

SECTION 6207. DESIGN PARAMETERS.
(a) General. The following design parameters shall be used for calculations required under this Section. Adjustments may be made to reflect local climates which differ from the tabulated temperature when approved by the Department.
(b) Exterior Design Conditions.

Outdoor Design Temperature

<table>
<thead>
<tr>
<th>Winter</th>
<th>Design Dry-Bulb</th>
<th>1°F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Design Dry Bulb</td>
<td>91°F</td>
</tr>
<tr>
<td>Summer</td>
<td>Design Wet-Bulb</td>
<td>63°F</td>
</tr>
<tr>
<td>Degree Days Heating</td>
<td>5505</td>
<td></td>
</tr>
<tr>
<td>Degrees North Latitude</td>
<td>39° 5'</td>
<td></td>
</tr>
</tbody>
</table>

(c) Interior Design Conditions.
1. Indoor Design Temperature. Indoor design temperature shall be 72 degrees F for heating and 78 degrees F for cooling. Other design temperatures may be used for equipment selection if they result in lower energy usage.
2. Humidification. If humidification is provided during heating, it shall be designed for a maximum relative humidity of 30 percent. When comfort air conditioning is provided, the actual design relative humidity within the comfort envelope as defined in Std. 3 shall be selected for minimum total HVAC system energy use.
EXCEPTION: Special applications including, but not limited to, hospitals, laboratories, thermally sensitive equipment rooms, computer rooms and facilities with open refrigerated display cases may be exempted from the requirements of this section when approved by the Department.

(d) Mechanical Ventilation. Ventilation air shall conform to Std. 2. The minimum column value of Std. 2 for each type of occupancy shall be used for design. The ventilation quantities specified are for 100 percent outdoor air ventilating systems. Reductions to 33 percent but not less than 5 CFM per human occupant of the specified minimum outdoor air requirement in Section 6 of Std. 2 for recirculating HVAC systems are permitted.

EXCEPTION: If outdoor air quantities other than those specified in Std. 2 are used or required because of special occupancy or process requirements, source control of air contamination, health and safety or other standards, the required outdoor air quantities shall be used as the basis for calculating the heating and cooling design loads.

DIVISION IV

BUILDING DESIGN BY SYSTEMS ANALYSIS AND DESIGN OF BUILDINGS UTILIZING NONDEPLETABLE ENERGY SOURCES

SECTION 6208. DESIGN CRITERIA.

(a) General. This Section establishes design criteria in terms of total energy use by a building including all of its systems.

(b) Energy Analysis. Compliance with this Section will require an annual energy analysis. Division V and VI of this Chapter establish criteria for different energy consuming and enclosure elements of the building which, if followed, will eliminate the requirement for an annual energy analysis while meeting the intent of this Chapter.

1. A building designed in accordance with this section will be deemed as complying with this Chapter if the calculated annual energy consumption is not greater than a similar building (defined as a "standard design") whose enclosure elements and energy consuming systems are designed in accordance with Division V.

2. For an alternate building design to be considered similar to a "standard design," it shall utilize the same energy source(s) for the same functions and have equal floor area, environmental requirements, occupancy, climate data and usage operational schedule.
3. The standard design, conforming to the criteria of Division V or Division VI, and the proposed alternative design shall be designed on a common basis as specified herein. The comparison shall be expressed as Btu input per square foot of gross floor area per year.

4. In lieu of requiring that a “standard design” be calculated each time that an alternate design is proposed, the Department may establish standard performance criteria on a building occupancy basis for comparative evaluation of alternate building designs. Such performance criteria shall be equal to or more stringent than performance criteria calculated in accordance with Division V or as set forth in Division VI.

5. If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source (even though similar sources are used for similar purposes), the difference in each energy source shall be converted to equivalent energy units for purposes of comparing the total energy used.

SECTION 6209. ANALYSIS PROCEDURE.

(a) Analysis. The analysis of the annual energy usage of the standard and the proposed alternative building and system design shall meet the following criteria:

1. Calculation Procedure. The building heating/cooling load calculation procedure used for annual energy consumption analysis shall be detailed to permit the evaluation of effect of factors specified in Section 6209 (b).

2. Evaluation. The calculation procedure used to simulate the operation of the building and its service systems through a full year operating period shall be detailed to permit the evaluation of the effect of system design, climatic factors, operational characteristics and mechanical equipment on annual energy usage. Manufacturer’s data or comparable field test data shall be used when available in the simulation of all systems and equipment. The calculation procedure shall be based upon 8760 hours of operation of the building and its service systems and shall utilize the design method specified in Standards 1, 5, 7 and 8.

(b) Calculation Procedure. The calculation procedure shall cover the following items:

1. Design Requirements. Environmental requirements as required in Division III.

2. Climatic Data. Coincident hourly data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation.

3. Building Data. Orientation, size, shape, mass, air, moisture and heat transfer characteristics.
4. Operational Characteristics. Temperature, humidity, ventilation, illumination and control mode for occupied and unoccupied hours.

c) Documentation. Proposed alternative designs, submitted as requests for exception to the standard design criteria, shall be accompanied by an energy analysis comparison report. The report shall provide technical detail on the building and systems designs and on the comparative analysis to verify that both the analysis and the designs meet the criteria of Division IV of this Chapter.

EXCEPTION: Proposed alternative designs for commercial and industrial structures having an area of 5,000 square feet or less and having the indoor temperature controlled from a single point are exempted from the full year energy analysis described in Section 6209 (a) 2. A comparison of energy consumption between the alternative design and the standard design shall be provided.

SECTION 6210. BUILDINGS UTILIZING NONDEPLETABLE ENERGY SOURCES.

(a) General. Any proposed building utilizing solar, geothermal, wind or other nondepletable energy sources for all or part of its energy source shall meet the requirements of Section 6208 of this Chapter, except such nondepletable energy may be excluded from the total annual energy consumption allowed for the building by that Section. To qualify for this exclusion, this energy shall be derived from a specific collection, storage and distribution system.

(b) Solar Processes. The solar energy passing through glazing shall also be considered as qualifying if the glazing is provided with:
1. Operable insulating shutters or other devices which, when drawn or closed, shall cause the glazing area to reduce maximum outward heat flows to those in accordance with Section 6212 (b) 1 and Section 6212 (c).
2. The glazing areas are shaded or otherwise protected from the direct rays of the sun during periods when cooling is required.

(c) Nocturnal processes. This provision shall also apply to nocturnal cooling processes in lieu of energy consuming processes. The exclusion of Section 6210 shall also apply to nocturnal cooling processes used in lieu of energy consuming mechanical cooling equipment.

(d) Other Criteria. All other criteria covered in Sections 6208 and 6209 shall apply to the proposed alternative designs, utilizing nondepletable sources of energy.

(e) Documentation.
1. Proposed alternative designs, submitted as requests for exception to the standard design criteria shall be accompanied by an energy
analysis, as specified in Section 6209. The report shall provide technical detail on the alternative building and system designs and on the data employed in and resulting from the comparative analysis as to verify that both the analysis and the designs meet the criteria of Sections 6208, 6209 and 6210 of this Chapter.

2. The energy derived from nondepletable sources and the reductor in conventional energy requirements derived from nocturnal cooling, shall be separately identified from the overall building energy use. Supporting documentation, on the basis of the performance estimates for the aforementioned nondepletable energy sources or nocturnal cooling means, shall be submitted.

3. Energy usage must be calculated in accordance with the design conditions and methods specified in this Chapter.

**EXCEPTION:** Proposed alternative designs for all structures of less than 20,000 ft.$^2$ that derive a minimum of 30 percent of their total annual energy usage from nondepletable sources or from nocturnal cooling, shall be exempt from the requirement of a full year energy system analysis providing that the annual input of such nondepletable sources, or the extent of such nocturnal cooling can be expected to meet the demands imposed by the proposed alternative design. Other commercial, institutional and industrial structures that derive over 50 percent of their annual thermal requirements (heating, cooling, service water heating) or over 30 percent of their annual total energy requirements from nondepletable sources shall be exempted from comparing the proposed design to a standard design which follows the provisions of Section 6209 (b). Documentation verifying the percentage of annual energy use derived from such nondepletable sources shall be required as provided in Section 6210(e).

DIVISION V

BUILDING DESIGN BY COMPONENT

PERFORMANCE APPROACH

SECTION 6211. GENERAL REQUIREMENTS.

(a) **Heating or Cooling.** All buildings that are heated or mechanically cooled shall be constructed so as to provide the required thermal performance of the various components.

(b) **More Stringent Requirements.** A building that is designed to be both heated and cooled shall meet the more stringent of the heating or cooling requirements as provided in this Chapter when requirements of the exterior envelope differ.
SECTION 6212. BUILDING ENVELOPE REQUIREMENTS.

(a) Design Criteria.

1. The stated $U_0$ value of any assembly, such as roof/ceiling, wall or floor, may be increased and the $U_0$ value for other components decreased provided that the total heat gain or loss for the entire building envelope does not exceed the total resulting from conformance to the $U_0$ values specified in Table 62-A. Complying $U_0$ for building envelope shall be determined as follows:

$$\text{Value Line 1 or 3} \times \text{Gross Wall Area} + \text{Value Line 5} \times \text{Roof Area} + \text{Value Line 7} \times \text{Floor Area}$$

$$\text{Gross Wall Area} + \text{Roof Area} + \text{Floor Area}$$

2. In addition to the criteria set forth in this Section, the proposed design may take into consideration the thermal mass, orientation and exterior color of the building components, using verified criteria developed by a recognized research organization, in considering energy conservation when approved by the Department.

(b) Heating and Cooling Criteria.

   A. General. Buildings that are heated shall have a combined thermal transmittance value ($U_0$) of the gross area of the elements of the exterior building envelope not exceeding the resultant by using the values in Table 62-A. Equation 1 shall be used to determine acceptable combinations of building components and thermal properties to meet the resultant $U_0$ found by the procedure set forth in Section 6212 (a) 1.

   B. Floors Over Unheated Spaces. For floors of heated spaces over unheated spaces, the $U_0$ value shall not exceed the value given in Table 62-A.

   C. Slab on Grade Floors. For slab on grade floors the thermal resistance of the insulation around the perimeter of the floor shall not be less than the value given in Table 62-A. The insulation shall extend downward from the top of the slab for a minimum distance of 24 inches, or downward to the bottom of the slab then horizontally beneath the slab for a minimum total distance of 24 inches and shall be an approved type.

(c) Air Leakage. The requirements of this Section shall apply to all buildings and structures, or portions thereof, and apply to those locations separating outdoor ambient conditions from interior spaces that are heated or mechanically cooled and are not applicable to the separation of interior conditioned spaces from each other.

1. Exterior joints around windows and door frames; openings between walls and foundations, between walls and roof/ceilings and between wall panels; openings at penetrations of utility services
through walls, floors and roofs; and all other such openings in the building envelope shall be caulked, gasketed, weatherstripped or otherwise sealed in an approved manner.

2. All exterior doors and windows shall be designed to limit air leakage into or from the building envelope, and shall have air infiltration rates not exceeding those shown in Table 62-B.

SECTION 6213. BUILDING MECHANICAL SYSTEMS.

(a) General. Sections 6213 through 6217 cover the determination of heating and cooling loads, design requirements, system and component performance, insulation of HVAC systems and duct construction. Utilization equipment in these systems shall be in accordance with section 6219 (b).

EXCEPTION: Special applications, including but not limited to, hospitals, laboratories, thermally sensitive equipment rooms, computer rooms and facilities with open refrigerated display cases may be exempted from these requirements when approved by the Department.

(b) Calculations of Heating and Cooling Loads.

1. The design parameters specified in Division III shall apply for all computations. Heating and cooling design loads for the purpose of sizing HVAC systems shall be determined in accordance with one of the procedures described in Chapters 21 or 22 of Standard 1 or an equivalent computation procedure.

2. Infiltration for heating and cooling design loads shall be calculated for nonresidential building by the procedures in Chapters 19, 21 and 22 of Standard 1.

SECTION 6214. DESIGN OF MECHANICAL SYSTEMS.

(a) Energy Recovery. Consideration shall be given to the use of recovery systems which will conserve energy provided the amount expended is less than the amount recovered when the energy transfers potential and the operating hours are considered.

(b) Controls.

1. Temperature Control. Each HVAC system shall be provided with at least one thermostat for the regulation of temperature. Each thermostat shall be limited as follows:

A. Where used to control heating only, a maximum temperature of 75 degrees F.

B. Where used to control cooling only, a minimum temperature of 70 degrees F.

C. Where used to control both heating and cooling, it shall have a maximum high temperature setting of 85 degrees F and a minimum low temperature setting of 55 degrees F and shall be capable of operating the system heating and cooling in sequence. It shall be adjustable to provide a temperature range of up to 10 degrees F between full heating and full cooling, except as allowed in Section 6214 (g) 1C (2).
2. **Humidity Control.** If an HVAC system is equipped with a means for adding moisture to maintain specific selected relative humidities in spaces or zones, a humidistat shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 30 percent relative humidity. Where a humidistat is used in an HVAC system for controlling moisture removal to maintain specific selected relative humidities in spaces or zones, it shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 60 percent relative humidity.

**EXCEPTION:** Special occupancies requiring different relative humidities may be permitted by the Department.

3. **Zoning for Temperature Control in Nonresidential Buildings.**
   
   A. Each separate HVAC system.
   
   B. Each separate zone as defined in Division II. As a minimum each floor of a building shall be considered as a separate zone. In a multi-story building where the perimeter system offsets only the transmission losses of the exterior wall, an entire side of uniform exposure may be zoned separately. A readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each floor.

4. **Control Setback and Shut-Off in Nonresidential Buildings.**

   Each HVAC system shall be equipped with a readily accessible means of shutting off or reducing the energy used for HVAC during period of non use or alternate uses of the building spaces or zones served by the system. The following are examples that meet this requirement:

   A. Manually adjustable automatic timing devices.
   
   B. Manual devices for use by operating personnel.
   
   C. Automatic control systems.

(c) **Balancing.** The HVAC system design shall provide means for balancing the air and water systems including, but not limited to, dampers, temperature and pressure test connections and balancing valves.

(d) **Energy for Air Delivery.** The air transport factor for each all-air HVAC systems shall not be less than 4.0. The factor shall be based on design system air flow for constant volume system. The factor for variable air volume systems may be based on average conditions of operation. Energy for transfer of air through heat recovery devices shall not be included in determining the factor; however, such energy shall be included in the evaluation of the effectiveness of the heat recovery system.

\[
\text{Air Transport Factor} = \frac{\text{Space Sensible Heat Removal}^*}{\text{Supply plus Return Fan(s) Power Input}^*}
\]

*Expressed in Btu/h.
(e) **Mechanical Ventilation.** Each mechanical supply and exhaust ventilation system shall be equipped with a readily accessible means for either shut-off or volume reduction and shut-off when ventilation is not required.

(f) **Cooling with Outdoor Air (Economizer Cycle).** Each fan system shall be designed to use up to and including 100 percent of the fan system capacity for cooling with outdoor air automatically whenever its use will result in lower usage of new energy. Activation of economizer cycle shall be controlled by sensing outdoor air enthalpy and dry bulb temperature jointly or outdoor air dry bulb temperature alone or alternate means approved by the Department.

**EXCEPTIONS:** Cooling with outdoor air is not required under any one or more of the following conditions:

1. Fan system capacity less than 5,000 ft.\(^3\)/min or 134,000 Btu/h total cooling capacity.
2. The quality of the outdoor air is so poor as to require extensive treatment of the air and approval by the Department.
3. The need for humidification or dehumidification requires the use of more energy than is conserved by the outdoor air cooling.
4. The use of outdoor air cooling may affect the operation of other systems so as to increase the overall energy consumption of the building.
5. Internal/external zone heat recovery or other energy recovery is used.
6. When all space cooling is accomplished by a circulating liquid which transfers space heat directly or indirectly to a heat rejection device such as a cooling tower without the use of a refrigeration system.

(g) **Simultaneous Heating and Cooling.** Simultaneous heating and cooling by reheating or recooling supply air or by concurrent operation of independent heating and cooling systems serving a common zone shall be restricted as delineated below.

1. **General Requirements.**
   A. Recovered energy, provided the new energy expended in the recovery process is less than the amount recovered, may be used for control of temperature and humidity. (New energy is defined as energy, other than recovered energy, utilized for the purpose of heating or cooling).

   B. New energy may be used to prevent relative humidity from rising above 60 percent for comfort control or to prevent condensation on terminal units or outlets, or functioning of special equipment. New energy may be used for temperature control if minimized in accordance with Section 6214 (g) 1 C through 6214 (g) 4.

   C. Concurrent operation of independent heating and cooling systems serving common spaces and requiring the use of new
energy for heating or cooling shall be minimized by one or both of the following:

(1) By providing sequential temperature control of both heating and cooling capacity in each zone.

(2) By limiting the heating energy input through automatic reset control of the heating medium temperature (or energy input rate) to only that necessary to offset heat loss due to transmission and infiltration and where applicable, to heat the ventilation air supply to the space.

EXCEPTION: A multiple zone HVAC system that employs reheating or recouling for control of not more than 5,000 ft.\(^3\)/min, or 20 percent of the total supply air of the system, whichever is less, shall be exempt from the supply air temperature reset requirement of Section 6214 (g) 2 through 4.

2. Reheat Systems. Systems employing reheating and serving multiple zones, other than those employing variable air volume for temperature control, shall be provided with control that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the coolest air. Single zone reheating systems shall be controlled to sequence reheating and cooling.

3. Recouling Systems. Systems in which heated air is recouled, directly or indirectly, to maintain space temperature shall be provided with control that will automatically reset the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the warmest air.

4. Dual Duct and Multi-Zone Systems. For systems with multiple zones, one or more zones may be chosen to represent a number of zones with similar heating/cooling characteristics. Dual duct and multi-zone systems shall be provided with control that will automatically reset:

A. The cold deck air supply to the highest temperature that will satisfy the zone requiring the coolest air; and

B. The hot deck air supply to the lowest temperature that will satisfy the zone requiring the warmest air.

SECTION 6215. HVAC EQUIPMENT PERFORMANCE REQUIREMENTS.

(a) General. The requirements of this Section apply to equipment and mechanical component performance for heating, ventilating and air conditioning systems. Where equipment efficiency levels and Standard Rating Conditions are specified, data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure shall be used to satisfy these requirements. Where components from more than one manufacturer are assembled into systems regulated under this section, compliance shall be shown as specified in Sections 6215 (b) through 6215 (f).
(b) Heat Pumps, Heating Mode.

1. **Definitions.** Coefficient of Performance (COP) Heating is the ratio of the rate of net heat output to the rate of total energy input, expressed in consistent units and under designated rating conditions. Rate of net heat output shall be defined as the change in the total heat content of the air entering and leaving the equipment (not including supplementary heat). Total energy input shall be determined by combining the energy inputs to all elements, except supplementary heaters, of the heat pump, including, but not limited to, compressor(s), pump(s), supply-air fan(s), return-air fan(s), outdoor-air fan(s), cooling-tower fan(s), and the HVAC system equipment control circuit.

2. **Requirements.** Heat pumps whose energy input is entirely electric shall show a Coefficient of Performance (COP) Heating not less than the values shown in Table 62-C. These Requirements apply to, but are not limited to, unitary heat pumps (air source and water source) in the heating mode and to heat pumps in the packaged terminal air-conditioner and room air-conditioner forms in the heating mode.

3. **Supplementary Heater.**
   A. The heat pump shall be installed with a control to prevent supplementary heater operation when the heating load can be met by the heat pump alone.
   B. Supplementary heater operation is permitted during transient periods such as start-ups, following room thermostat set point advance, and during defrost.
   C. A two-stage thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement. The cut-on temperature for the compression heating shall be higher than the cut-on temperature for the supplementary heat, and the cut-off temperature for the supplementary heat. Supplementary heat may be derived from any source of electric resistance heating or combustion heating.

(c) Combustion Heating Equipment.

1. **Definitions.** Combustion efficiency is defined as 100 percent minus stack losses in percent of heat input. Stack losses are:
   A. Loss due to sensible heat in dry fuel gas.
   B. Loss due to incomplete combustion.
   C. Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the flue.

2. **Requirements.** All gas and oil fired comfort heating equipment shall show a minimum combustion efficiency of 75 percent at maximum rated output.

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(d) Electrically Operated Systems Equipment, Cooling Mode.

1. Definitions. Coefficient of Performance (COP) Cooling is the ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated rating conditions. Rate of net heat removal shall be defined as the change in the total heat content of the air entering and leaving the equipment (without reheat).

   A. Total energy input shall be determined by combining the energy inputs to all elements of the equipment, including, but not limited to, compressor(s), pump(s), supply-air fan(s), cooling-tower fan(s), and pump(s), and the HVAC system equipment control circuit.

2. Requirements. HVAC system equipment as listed below whose energy input in the cooling mode is entirely electric, shall show a Coefficient of Performance (COP) Cooling not less than values shown in Section 6215. These requirements apply to, but are not limited to, unitary cooling equipment (air-cooled, water-cooled, and evaporatively-cooled), the cooling mode of unitary heat pumps (air source and water source), packaged terminal air conditioners, and room air conditions.

   EXCEPTION: These requirements do not apply to equipment used in areas having open refrigerated food display cases.

(e) Electrically Operated Systems Components, Cooling Mode.

1. Definitions. Coefficient of Performance (COP) Cooling is the ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated rating conditions. Rate of net heat removal is defined as the difference in total heat contents of the water or refrigerant entering and leaving the component.

   A. Total energy input shall be determined by combining the energy inputs to all elements and accessories of the component, including, but not limited to, compressor(s), internal circulating pump(s), condenser-air fan(s), purge, and the HVAC system component control circuit.

2. Requirements. HVAC system components, as indicated in Section 6215, whose energy input is entirely electric, shall show a Coefficient of Performance (COP) Cooling not less than the values shown in Section 6215.

(f) Heat Operated Systems Equipment, Cooling Mode.

1. Definitions. Coefficient of Performance (COP) Cooling is the ratio of the total net cooling output to the total heating input (electrical auxiliary inputs excluded).

2. Requirements. Heat operated cooling equipment shall show a COP Cooling not less than the values shown in Section 6215. The requirements apply to, but are not limited to, absorption equipment, engine driven equipment and turbine driven equipment.
SECTION 6216. INSULATION OF HVAC SYSTEMS.
(a) Air Handling Duct Systems. All ducts, plenums and enclosures installed in or on buildings shall be thermally insulated as follows:

1. All duct systems, or portions thereof, shall be insulated to provide a thermal resistance, excluding film resistances of:

\[ R = \frac{\Delta t \cdot h \cdot (F \cdot ft^2) / Btu}{15} \]

where \( \Delta t \) = the design temperature differential between the air in the duct and the surrounding air in F.

2. Additional insulation with vapor barriers shall be provided to prevent condensation, unless it can be shown that condensation is not a problem.

**EXCEPTION:** Duct insulation (except where required to prevent condensation) is not required in any of the following cases:

A. Where \( \Delta t \) is 25 degrees F or less.
B. Supply or return air ducts installed in unventilated crawl spaces with insulated walls.
C. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.
D. Within HVAC equipment.
E. Exhaust air ducts.

(b) Piping.

1. Standard Insulation. All piping installed to service buildings and within buildings shall be thermally insulated in accordance within Table 62-D, except as stated herein (for service water heating systems see Section 6218). Insulation thicknesses in Table 62-D are based on insulation having thermal resistance in the range of 4.0 h F ft^2/Btu to 4.6 h F ft^2/Btu per inch of thickness on a flat surface at a mean temperature of 75 degrees F.

2. Optional Insulation. Minimum insulation thickness shall be increased for materials having R values less than 4.0 or may be reduced for materials having R values greater than 4.6 as follows: For materials with thermal resistance greater than R = 4.6, the minimum insulation thickness may be reduced as follows:

\[ \frac{4.6 \times \text{Table 62-D Thickness}}{\text{Actual R}} = \text{New Minimum Thickness} \]

For materials with thermal resistance less than R = 4.0, the minimum insulation thickness shall be increased as follows:

\[ \frac{4.0 \times \text{Table 62-D Thickness}}{\text{Actual R}} = \text{New Minimum Thickness} \]

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3. **Vapor Barriers.** Insulation with vapor barriers shall be provided to prevent condensation, unless it can be shown that condensation is not a problem.

**EXCEPTION:** Piping insulation is not required in any of the following cases:

A. Piping installed within HVAC equipment.

B. Piping at temperatures between 55 degrees F and 120 degrees F when not required for energy conservation purposes.

C. When the heat loss and/or heat gain of the piping, without insulation, does not increase the energy requirements of the building.

**SECTION 6217. DUCT CONSTRUCTION.**

(a) **General.** All duct work shall be constructed and erected in accordance with Standards 6, 16, 19, 20, 21 and 22 as applicable to Chapters 49, 52 and 58 of this Building Code.

1. High-pressure and medium-pressure ducts shall be leak tested in accordance with the applicable reference standards in Division VII with the rate of air leakage not to exceed the maximum rate specified in that standard.

2. When low-pressure supply air ducts are located outside of the conditioned space, all transverse joints shall be sealed using mastic or mastic-plus tape. All longitudinal seams, except Pittsburgh-lock type, shall be sealed using mastic. For fibrous glass ductwork, heat activated or pressure sensitive tape may be used.

3. Automatic or manual dampers installed for the purpose of shutting off outside air intakes for ventilation air shall be designed with tight shut-off characteristics to minimize air leakage.

**SECTION 6218. SERVICE WATER HEATING.**

(a) **General.** Hot water for domestic, sanitary and swimming pool purposes shall be generated and delivered in a manner conducive to saving heat energy. The purpose of this Section is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating.

(b) **Performance Efficiency of Water Heaters, Storage Tanks, Boilers and Piping.**

1. **Electric Storage Water Heaters.** All automatic electric storage water heater(s) shall have a stand-by loss not exceeding 4 W/ft\(^2\) of tank surface area when tested in accordance with Std. 12.

2. **Gas and Oil Fired Storage Water Heaters.** All gas and oil fired automatic storage water heaters shall have a recovery efficiency (Er) not less than 75 percent and the exterior storage tank loss shall not exceed that set forth in Section 6218 (b) 3.

where:
\[ V = \text{rated volume in gallons} \]
when tested in accordance with Std. 13.

**EXCEPTION:** In utilizing Std. 13 to test oil-fired units \( CF = 1.0 \); \( Q \) equals total gallons of oil consumed; and \( H \) equals total heating value of oil in Btu/gal.

3. **Insulation.** Heat loss from unfired hot water storage tanks shall be limited to a maximum of 15 Btu/h ft\(^2\) of external tank surface area. The design ambient temperature shall be no higher than 65 degrees F.

4. **Combination Service Water Heating/Space Heating Boilers.** Service water heating equipment shall not be dependent on year round operation of space heating boilers (that is, boilers that have as another function winter space heating).

**EXCEPTION:** Exempt from these requirements are systems with service/space heating boilers having a stand-by loss Btu/h less than:

\[ 13.3 \text{ pmd} + 400 \]

\[ \frac{n}{\text{pmd}} = \text{probable maximum demand in gallons/hour as determined in accordance with Chapter 11 of Std. 5.} \]
\[ n = \text{fraction of year when outdoor daily mean temperature exceeds 64.9 degrees F.} \]

The stand-by loss is to be determined for a test period of 24 h duration while maintaining a boiler water temperature of 90 degrees F above ambient.

(c) **Temperature Controls.**

1. Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use.

2. A separate shutdown switch shall be provided to permit turning off the energy supplied to electric service water heating systems. A separate valve shall be provided to permit turning off the energy supplied to the main burner(s) of all other types of service water heating systems.

(d) **Swimming Pools that are Integral Components of Buildings.**

1. Heated swimming pools shall be equipped with controls to limit heating water temperatures to no more than 80 degrees F.

**EXCEPTION:** Pools used for therapeutic purposes are exempt from this requirement when approved by the Department.

2. Uncovered (unenclosed) heated pools shall be controlled so that the electric or fossil-fueled pool water heating systems are inoperative whenever the outdoor air temperature is below 60 degrees F.
(e) **Pump Operation.** Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

(f) **Pipe Insulation.** For recirculation systems, piping heat loss shall be limited to a maximum of 25 Btu/h ft\(^2\) of external pipe surface for above ground piping and a maximum of 35 Btu/h ft\(^2\) of external pipe surface for underground piping. Maximum heat loss shall be determined at a \(\Delta t\) equal to the maximum water temperature minus a design ambient temperature no higher than 65 degrees F.

(g) **Conservation of Hot Water.**

1. Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.

2. Lavatories in restrooms of public facilities shall:
   A. Be equipped with outlet devices which limit the flow of hot water to a maximum of 0.5 gpm.
   B. Be equipped with devices which limit the outlet temperature to a maximum of 110 degrees F, or the water temperature delivered from the hot water source to the lavatory to a maximum of 110 degrees F.
   C. Be equipped with self-closing valves that limit delivery to a maximum of 0.25 gallons of hot water.

SECTION 6219. ELECTRICAL DISTRIBUTION SYSTEMS.

(a) **General.** Electrical distribution systems shall be designed for efficient distribution of electrical energy from the service entrance to the points of use.

(b) **Power Factor.** Utilization equipment, with a labeled rating greater than 1,000 W and lighting equipment greater than 15 W, with an inductive reactance load component, shall have a power factor of not less than 85 percent under rated nameplate conditions. Power factor of less than 85 percent shall be corrected to at least 90 percent under rated nameplate conditions. Power factor corrective devices, installed to comply with this Chapter, shall be switched with the utilization equipment, except where this results in an unsafe condition or interferes with the intended operation of the equipment.

(c) **Service Voltage.** Where a choice of service voltages is available from the power supplier, a computation shall be made to determine which service voltage would produce the least energy loss, and that voltage shall be selected.

(d) **Voltage Drop.** In any building, the maximum total voltage drop shall not exceed 3 percent in branch circuits or feeders, for a total of 5 percent to the furthest outlet based on steady state design load conditions.

(e) **Lighting Switching.** Local switching and or other approved control devices shall be provided for each lighting circuit, or for portions of
each circuit, so that the partial lighting required for custodial or for effective complementary use with natural lighting may be operated selectively.

SECTION 6220. LIGHTING POWER BUDGET.
(a) General. The lighting power budget for the building shall be the sum of the power limits computed for all lighted interior and exterior spaces and shall be determined in accordance with the procedures specified in this Section.
(b) Definitions. A lighting power budget is the upper limit of the power to be available to provide the lighting needs in accordance with a given set of criteria and given calculation procedure.
(c) Criteria for Calculations.
1. The criteria specified below will be utilized for computation of the lighting power budget. All calculations shall be in accordance with Section 6220 (f).
2. When insufficient information is known about the specific use of the building space (e.g. number of occupants, space function, location of partitions), the budget shall be based on the apparent intended use of the building space.
(d) Building Interiors. The allowable electric power for lighting shall be established by using the criteria and the calculation procedures specified in Section 6220 (f). The value shall be based on the use for which the space within the building is intended and on efficient energy utilization.
1. Illumination Level Criteria. For the purpose of establishing a budget, levels of illumination shall be those listed in Std. 18. Those levels shall be used as follows:
   A. Task Lighting. In most cases, the levels of illumination listed are for specific tasks. These levels are for the task areas defined in Std. 18, or, where not defined, at all usable portions of task surfaces. In some cases, the levels of illumination are listed for location. These levels are to be considered as average levels.
   B. General Lighting. In areas surrounding task locations, the average level of general lighting, for budget purposes only, shall be one-third the level for the tasks performed in the area but in no case less than 20 foot-candles. Where more than one task level occurs in a space, the general level shall be one-third the weighted average of the specific task levels.
   C. Non-Critical Lighting. In circulation and seating areas where no specific visual tasks occur, the average level of illumination shall be one-third of the average general lighting in the adjacent task spaces but in no case less than 10 foot candles.
2. Lighting System Criteria. For the purpose of establishing a power budget, only lamp efficiencies and Coefficients of Utilization (CU), specified in Tables 62-H, I, and J shall be assumed.

EXCEPTIONS:

1. The criteria of Section 6220 (d) shall not apply to the following areas when calculating the load:
   A. Theater auditoriums, entertainment, audiovisual presentations and motion picture and television studios where the lighting is an essential technical element for the function performed.
   B. Public spaces including lobbies, halls, stairways, basement areas and utility rooms.

2. The criteria of 6220 (d) shall not apply to the following lamps and luminaires; however, their use shall be accounted for in the calculation of task lighting loads for specific tasks. The allowable load shall be based on the luminaire wattage to achieve the levels of illumination as covered in 6220 (d) using a point calculating method given in Std. 18.
   A. Luminaires for medical and dental purposes.
   B. Luminaires for highlighting applications, such as sculpture exhibits, art exhibits and individual items of display merchandise.
   C. Luminaires for specialized lighting applications (color matching, where electrical interference cannot be tolerated, etc.).

3. The criteria of Table 62-J shall apply in spaces where it is impractical to control reflectance and where a dirty atmosphere cannot be avoided. Where this condition exists, the values for reflectances and light loss factors shall be those expected to be found and shall be approved by the Department. The calculation shall make note of this deviation.

(e) Building Exteriors. In exterior spaces, the lighting power budget shall be based on the use for which the space is intended (for task performance, safety or security) and on efficient energy utilization.

1. Criteria. The same criteria as those for interior spaces apply for illumination levels and lighting systems with the addition of luminaires for floodlighting. For power budget purposes luminaires shall have a greater percentage of their beam lumens restricted to the area to be lighted and have minimum efficiencies at least as great as those listed in Std. 18.

2. Facade Lighting. Facade lighting for budget purposes shall be no greater than 2 percent of the total interior lighting load of the building.

3. Calculation Procedure. In establishing a lighting power budget the following procedures shall be used:
A. **Overhead Lighting.** The procedure specified in Section 6220 (d) shall be followed for overhead lighting, but using reflectances as found.

B. **Floodlighting.** The beam lumen method as shown in Std. 18 and a Coefficient of Beam Utilization (CBU) of 0.75 shall be used for floodlighting calculations.

(f) **Calculation Procedure.** To establish a lighting power budget, the following procedure shall be used:

1. **Determining Illumination Levels and Areas.**
   A. Determine the visual tasks that are expected to be performed in each space (the commonly found tasks at each work station) and the number of planned work locations where tasks will be performed. If assumptions are made, their bases shall be indicated.
   B. Select the illumination level in foot candles for those expected tasks in accordance with Section 6220 (d) 1A.
   C. Calculate total task areas to be illuminated to the same level by multiplying the number of work locations by 50 ft² per work location. (Total task area shall not exceed actual total space area). If actual task area is greater than 50 ft², the actual area shall be used. If special task lighting or localized lighting is to be employed, use the actual task areas and point calculation procedures.
   D. Calculate the level of general lighting by multiplying the task lighting level by one-third, where there is only one task level, or by taking one-third of the sum of the products of the task levels (B) and their areas (C) divided by the total task areas in accordance with Section 6220 (d) 1B.
   E. Calculate the level of noncritical lighting in accordance with Section 6220 (d) 1C.
   F. For area determinations of general and noncritical lighting, calculations shall be based on Std. 18.

2. **Determining Lighting System Data.**
   A. Determine light source and luminaire types to use.
   B. Determine lamp lumens per watt and luminaire coefficients of utilization for room and luminaire mounting height dimensions. Luminaire CU's shall be selected from Std. 18 or manufacturers data for types not found in Std. 18. In all cases, no luminaire shall have a CU for RCR = 1 or less than that given Table 62-I. Lamp efficacies shall be those listed in Table 62-H.

3. **Determining Allowable Wattage.**
   A. Using data form (b) above, the illumination levels and areas determined in 1, and the criteria of Table 62-K, calculate the allowable wattages using the lumen method.
B. Calculate the total space wattage by adding the task, general and noncritical lighting loads.
C. Add the wattage of luminaires allowed in Section 6220 (d)2, Exception 2.

DIVISION VI
BUILDING DESIGN BY ACCEPTABLE PRACTICE

SECTION 6221. SCOPE.
(a) Group A through G Occupancy. The requirements contained in this section are applicable only to buildings less than 5,000 square feet in gross floor area and 3 stories or less in height. The provisions of this Section are limited to nonresidential buildings that are heated only. Buildings constructed in accordance with this Section are deemed to comply with this Chapter.

SECTION 6222. BUILDING ENVELOPE REQUIREMENTS.
(a) Design Criteria.
1. The various wall, roof and floor assemblies in the Appendix are typical and are not intended to be all inclusive. Other assemblies may be used provided documentation is submitted indicating the thermal transmittance value of the opaque section. Such documentation shall be in accordance with accepted engineering practice.
2. The proposed design may take into consideration the thermal mass, orientation and exterior color of the building components, using verified criteria developed by a recognized research organization in considering energy conservation when approved by the Department.
(b) Thermal Transmittance Values. This Section applies to nonresidential buildings.
1. Walls. The opaque above grade exterior wall section shall be selected from Figures 1, 2 or 3 for the combined thermal transmittance value, not exceeding the value specified for walls in Table 62-A. The $U_w$ value for the opaque wall shall be determined by the use of Charts 62-1 and 62-2 and Figure 1 based upon the glazing area of the wall.
2. Roof/Ceiling. The roof/ceiling assembly shall be selected from Figure 4 for the thermal transmittance value not exceeding the value specified for roof/ceiling in Table 62-A.
3. Floors Over Unheated Spaces. The floor section over an unheated space shall be selected from Figure 5 for the thermal transmittance value ($U_o$ value) not exceeding the value specified for floors in Table 62-A.
4. Slab on Grade Floors. For slab on grade floors, thermal resistance (R) of the insulation around the perimeter of the floor shall be at least the value given in Table 62-A. The insulation shall extend downward from the top of the slab for a minimum distance of 24 inches or downward from the top of the slab then horizontally beneath the slab for a minimum total distance of 24 inches.

(c) Air Leakage.

1. Windows and Doors. All windows and doors shall be labeled as conforming to the air infiltration rates specified in Section 6212 (c) 2 and Standard 2.

2. Caulking. Exterior joints around windows and door frames; openings between walls and foundations, between walls and roof and between wall panels; openings at penetrations of utility service through walls, floors and roofs; and all other such openings in the building envelope shall be caulked, gasketed, weatherstripped or otherwise sealed in an approved manner.

SECTION 622: BUILDING MECHANICAL SYSTEMS.

(a) Design Requirements.

1. All HVAC devices, components and their elements shall conform to the requirements of this Section.

2. Systems other than combustion heating equipment regulated from a single point of control shall be designed in accordance with the requirements of Division V of this Chapter.

(b) Performance Requirements.

1. Heating Equipment. The requirements of this Section apply to equipment and component performance. Equipment shall be rated in accordance with Section 6215.

2. Combustion Heating Equipment. All gas and oil fired comfort heating equipment shall show a minimum combustion efficiency of 75 percent at maximum rated output. Combustion efficiency is defined at 100 percent minus stack losses in percent of heat input. Stack losses are:
   A. Loss due to sensible heat in dry flue gas.
   B. Loss due to incomplete combustion.
   C. Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the flue.

(c) Pipe Insulation. All piping installed to serve buildings or within buildings shall be thermally insulated in accordance with Table 62-R, except as stated in Section 6216 (b).

(d) Duct Construction. All ducts, plenums and enclosures installed in or on buildings shall be constructed and thermally insulated in accordance with Section 6217.
SECTION 6224. SERVICE WATER HEATING.
(a) General Requirements for Water Heaters, Storage Tanks, Boilers and Piping.
   1. Water heating storage tanks, boilers and piping for all water heating systems shall be installed in accordance with Section 6218.
   2. Water heaters shall be labeled as meeting the efficiency requirements of Section 6218 (b).

(b) Temperature Control.
   1. Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use.
   2. A separate shut down switch shall be provided to permit turning off the energy supplied to electric service water heating systems. A separate valve shall be provided to permit turning off the energy supplied to the main burner(s) of all other types of service water heating systems.

(c) Swimming Pools that Are Integral Components of Buildings.
   1. Heated swimming pools shall be equipped with controls to limit heating water temperatures to no more than 80 degrees F.
      EXCEPTION: Pools used for therapeutic purposes are exempt from this requirement when approved by the Department.
   2. Uncovered (unenclosed) heated pools shall be controlled so that the electric or fossil fueled pool water heating systems are inoperative whenever the outdoor air temperature is below 60 degrees F.

(d) Pump Operation. Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

(e) Insulation. For recirculation systems piping heat loss shall be limited to a maximum of 25 Btu/h ft² of external pipe surface for above ground piping and a maximum of 35 Btu/h ft² of external pipe surface for underground piping. Maximum heat loss shall be determined at a Δt equal to the maximum water temperature minus a design ambient temperature of no higher than 65 degrees F.

(f) Conservation of Hot Water.
   1. Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.
   2. Lavatories in restrooms of public facilities shall conform to the requirements of Section 6218 (g) 2.

SECTION 6225. ELECTRICAL POWER AND LIGHTING. The electrical power distribution and lighting systems shall conform to the requirements of Sections 6219 and 6220.
DIVISION VII
STANDARDS

SECTION 6226. STANDARDS. Unless provided for in other portions of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>ORGANIZATION STD. NO.</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE</td>
<td>1 Handbook of Fundamentals, 1977.</td>
</tr>
<tr>
<td></td>
<td>4 Charts and Graphs from 90-1975 (included herein):</td>
</tr>
<tr>
<td></td>
<td>8B Design Temperatures for Colorado Cities and Towns, Supplement to Climate data for Air Conditioning Design, ASHRAE Rocky Mountain Region, April 1978 (available at the Colorado Office of State Planning and Budgeting).</td>
</tr>
<tr>
<td>ASTM</td>
<td>9 Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors. Specifications E-283-73.</td>
</tr>
<tr>
<td></td>
<td>12 Household Automatic Electric Storage-Type Water Heaters, C-72.1-1972.</td>
</tr>
<tr>
<td>Title</td>
<td>Reference</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Large Automatic Storage Type Water Heaters</td>
<td></td>
</tr>
<tr>
<td>with Heaters with Inputs of 75,000 Btu per hour or less</td>
<td></td>
</tr>
<tr>
<td>ARI Standard for Positive Displacement Refrigerant Compressor and</td>
<td>Condensing Units, 520-1978.</td>
</tr>
<tr>
<td>Condensing Units</td>
<td></td>
</tr>
<tr>
<td>Standard for Packaged Terminal Air Conditioners, 310-1976.</td>
<td></td>
</tr>
<tr>
<td>and Two Family Dwellings and Multi-family Housing</td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND**

**ORGANIZATION**

**ANSI**
American National Standards Institute, Inc.
10 East 40th Street
New York, New York 10016

**ARI**
Air Conditioning and Refrigeration Institute

**ASHRAE**
American Society of Heating, Refrigeration and Air Conditioning Engineers
345 East 47th Street
New York, New York 10017

**ASTM**
American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

**SC**
Colorado State Housing
1313 Sherman Street
Denver, CO 80203

62-34
SECTION 6227. TABLES, CHARTS, FIGURES AND APPENDIX.
### Table 62-A
For Nonresidential Buildings

<table>
<thead>
<tr>
<th>Element</th>
<th>Mode</th>
<th>Value</th>
<th>Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>#1</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>UW</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#2</td>
</tr>
<tr>
<td></td>
<td>Cooling</td>
<td>OTTV</td>
<td>33.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#3</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>UW</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#4</td>
</tr>
<tr>
<td></td>
<td>Cooling</td>
<td>OTTV</td>
<td>33.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#5</td>
</tr>
<tr>
<td></td>
<td>Heating or Cooling</td>
<td>UR</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#6</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>UF</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#7</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>R Value</td>
<td>4.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#8</td>
</tr>
<tr>
<td></td>
<td>Heating</td>
<td>R Value</td>
<td>6.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>#9</td>
</tr>
<tr>
<td></td>
<td>Cooling</td>
<td>127.0 Btu/ft²</td>
<td></td>
</tr>
</tbody>
</table>

### Table 62-B
Allowable Air Infiltration Rates For Nonresidential Buildings

<table>
<thead>
<tr>
<th>Windows</th>
<th>Doors</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfm per foot of operable sash crack</td>
<td>cfm per lin. foot of crack</td>
</tr>
<tr>
<td></td>
<td>Swinging, Sliding, Revolving</td>
</tr>
<tr>
<td>0.5</td>
<td>11.0</td>
</tr>
</tbody>
</table>

1. When tested at pressure differential of 1.567 lb/ft² which is equivalent to the impact pressure of a 25 mph wind. Windows located above 3 stories shall be tested at a pressure differential of 6.269 lb/ft² which is equivalent to the impact pressure of a 50 mph wind.

2. Compliance with the criteria for air leakage of all types of doors shall be determined by Std. 9, Standard Method of Test for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
Equation 1  \[ U_o = \frac{U_w A_w + U_g A_g + U_d A_d}{A} \]

Where:

- \( U_o \) = the average or combined transmittance of the gross exterior wall, floor or roof/ceiling assembly area (except slabs on grade).
- \( A \) = the gross exterior wall, floor or roof/ceiling assembly area.
- \( U_w \) = the thermal transmittance of the components of the opaque wall, floor or roof/ceiling assembly area.
- \( A_w \) = opaque wall, floor or roof/ceiling assembly area.
- \( U_g \) = the thermal transmittance of the glazing (window or skylight) area.
- \( A_g \) = glazing area.
- \( U_d \) = the thermal transmittance of the door, or similar opening.
- \( A_d \) = door area.

Note: Where more than one type of wall, window, roof/ceiling, door and skylight is used, the \( U \) and \( A \) terms for those items shall be expanded into subelements as:
- \( U_{wall1} A_{wall1} + U_{wall2} A_{wall2} \), etc.

Equation 2  \[ OTTV = \frac{(U_w A_w T_{DEQ}) + (A_f SF \ SC) + (U_f A_f \ \Delta T)}{A} \]

Where:

- \( OTTV \) = average or combined thermal transfer value.
- \( A \) = gross exterior wall.
- \( U_w \) = \( U \) value of opaque wall (all elements).
- \( A_w \) = opaque wall area.
- \( U_f \) = \( U \) value of the fenestration area.
- \( A_f \) = fenestration area.
- \( T_{DEQ} \) = shading coefficient of the fenestration (see definitions).
- \( SC \) = shading coefficient of the fenestration (see definitions).
- \( \Delta T \) = temperature difference between exterior and interior design condition degrees F.
- \( SF \) = solar factor value = 127 Btu/h \( \cdot \) ft\(^2\)

Note: Where more than one type of wall is used, the respective terms for those elements shall be expanded into subelements, as:
- \( (U_{w1} A_{w1} T_{DEQ1}) + (U_{w2} A_{w2} T_{DEQ2}) + \text{etc.} \)

Temperature Difference for use with Equation 2

<table>
<thead>
<tr>
<th>Weight of Construction Lbs/ft(^2)</th>
<th>T(_{DEQ}) Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 25</td>
<td>44</td>
</tr>
<tr>
<td>26 - 40</td>
<td>37</td>
</tr>
<tr>
<td>41 - 70</td>
<td>30</td>
</tr>
<tr>
<td>71 and Above</td>
<td>23</td>
</tr>
</tbody>
</table>
Table 62-C
Minimum COP for Heat Pumps, Heating Mode

<table>
<thead>
<tr>
<th>Source and Outdoor Temperature (F)</th>
<th>Minimum COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Source - 47 db/43 wb</td>
<td>2.2</td>
</tr>
<tr>
<td>Air Source - 17 db/15 wb</td>
<td>1.2</td>
</tr>
<tr>
<td>Water Source - 60 Entering</td>
<td>2.2</td>
</tr>
</tbody>
</table>

1When tested at the Standard Rating Conditions specified in Table 62-H

Table 62-D
Minimum EER and COP for Electrically Driven Heating, Ventilating and Air Conditioning System Equipment—Cooling

<table>
<thead>
<tr>
<th>Standard Rating Capacity</th>
<th>EER</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 65,000 Btu/h</td>
<td>6.1</td>
<td>1.8</td>
</tr>
<tr>
<td>(19,050 watts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65,000 Btu/h (19,050 watts and over)</td>
<td>6.8</td>
<td>2.0</td>
</tr>
</tbody>
</table>

1When tested at the Standard Rating Conditions specified in Table 62-I

Table 62-E
Minimum COP and EER for Electrically Driven Heating, Ventilating and Air Conditioning System Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Condensing Means</th>
<th>Air</th>
<th></th>
<th></th>
<th>Water</th>
<th></th>
<th></th>
<th>Evaporator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EER</td>
<td>COP</td>
<td></td>
<td>EER</td>
<td>COP</td>
<td></td>
<td>EER</td>
</tr>
<tr>
<td>Centrifugal</td>
<td></td>
<td>7.5</td>
<td>2.2</td>
<td></td>
<td>12.9</td>
<td>3.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-contained Water chillers</td>
<td>Positive</td>
<td>7.2</td>
<td>2.1</td>
<td>10.9</td>
<td>3.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condenserless Water chillers</td>
<td>Positive</td>
<td>8.9</td>
<td>2.6</td>
<td>10.9</td>
<td>3.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor and Condenser units</td>
<td>Positive</td>
<td>7.8</td>
<td>2.3</td>
<td>11.3</td>
<td>3.3</td>
<td>11.3</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>65,000 Btu/h (19,050 watts and over)</td>
<td>Positive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1When tested at the Standard Rating Conditions specified in Table 62-J

2Ratings in accordance with Std 14 as applicable. COP based on condensing unit Standard Rating Capacity and energy input to the unit, all at sea level.

Table 62-F
Minimum COP for Heating, Ventilating and Air Conditioning System Heat Operated Cooling Equipment

<table>
<thead>
<tr>
<th>Heat Source</th>
<th>Minimum COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct fired (gas, oil)</td>
<td>0.40</td>
</tr>
<tr>
<td>Indirect fired (steam, hot water)</td>
<td>0.65</td>
</tr>
</tbody>
</table>
### Table 62-G
Minimum Pipe Insulation

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Fluid Temperature Range, F</th>
<th>Runouts up to 2&quot;</th>
<th>1&quot; and less</th>
<th>1 1/2 to 2&quot;</th>
<th>2 1/2 to 4&quot;</th>
<th>5&quot; to 6&quot;</th>
<th>8&quot; and larger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Systems</td>
<td></td>
<td>1 1/4</td>
<td>1 1/4</td>
<td>2</td>
<td>2 1/2</td>
<td>3 1/2</td>
<td>3 1/2</td>
</tr>
<tr>
<td>Steam and Hot Water</td>
<td>High Pressure/Temp 306-450</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Med. Pressure/Temp 251-305</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low Pressure/Temp 201-250</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low Temperature 120-200</td>
<td>1/2</td>
<td>3/4</td>
<td>1</td>
<td>1</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td></td>
<td>Steam Condensate (for Feed Water)</td>
<td>Any</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td>Cooling Systems</td>
<td>Chilled Water 40-55</td>
<td>1/4</td>
<td>1/4</td>
<td>1/4</td>
<td>1</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td>Refrigerant, or Brine</td>
<td>Below 40</td>
<td>1</td>
<td>1</td>
<td>1 1/2</td>
<td>1 1/2</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
</tbody>
</table>

1 Runouts not exceeding 12' in length to Individual Terminal Units.

### Table 62-H
HVAC System Heating Equipment (Heat Pumps)
Standard Rating Conditions

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Type</th>
<th>Air Source</th>
<th>Water Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Entering Equipment</td>
<td>F</td>
<td>70 db</td>
<td>70 db</td>
</tr>
<tr>
<td>Outdoor Unit Ambient</td>
<td>F</td>
<td>47 db/43 wb</td>
<td>--</td>
</tr>
<tr>
<td>Entering Water Temp</td>
<td>F</td>
<td></td>
<td>17 db/15 wb</td>
</tr>
<tr>
<td>Water Flow Rate</td>
<td>F</td>
<td></td>
<td>60</td>
</tr>
</tbody>
</table>

### Table 62-I
HVAC System Equipment—Cooling

|                      | Temperatures       |                      |              |              |
|----------------------|-------------------|----------------------|--------------|
|                      | db    | wb    | Inlet | Outlet |
| Air Entering Equipment | F    | 80    | 67    | --     | --     |
| Condenser Ambient (Air Cooled) | F | 95    | 75    | --     | --     |
| Condenser Water (Water Cooled) | F | --    | --    | 85     | 95     |

Standard Ratings are at sea level.
Table 62-J
Applied HVAC System Components
Standard Rating Conditions—Cooling

<table>
<thead>
<tr>
<th>Item</th>
<th>Centrifugal or Self-Contained Reciprocating Water Chiller</th>
<th>Condenserless Reciprocating Water Chiller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaving Chilled Water Temp</td>
<td>F 44</td>
<td>44</td>
</tr>
<tr>
<td>Entering Chilled Water Temp</td>
<td>F 54</td>
<td>54</td>
</tr>
<tr>
<td>Leaving Condenser Water Temp</td>
<td>F 95</td>
<td>--</td>
</tr>
<tr>
<td>Entering Condenser Water Temp</td>
<td>F 85</td>
<td>--</td>
</tr>
<tr>
<td>Non-Ferrous Tubes</td>
<td>* 0.0005</td>
<td>0.0005</td>
</tr>
<tr>
<td>Fouling Factor, Water</td>
<td>* 0.0010</td>
<td>0.0010</td>
</tr>
<tr>
<td>Steel Tubes</td>
<td>* 0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Fouling Factor, Refrigerant</td>
<td>* 0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Condenser Ambient (Air or Evap. Cooled)</td>
<td>F 95{degrees}F/75{degrees} wb</td>
<td>--</td>
</tr>
<tr>
<td>Compressor</td>
<td>Water Cooled or (Evap. Cooled) F --</td>
<td>105</td>
</tr>
<tr>
<td>Saturated</td>
<td>Air Cooled</td>
<td>120</td>
</tr>
</tbody>
</table>

Standard Ratings are at sea level.
*h ft² F/Btu

Table 62-K
Lamp Efficacies

The following are initial lumen output per watt input, including ballast losses:

<table>
<thead>
<tr>
<th>Application</th>
<th>Lumens per Watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where moderate color rendition is appropriate</td>
<td>55</td>
</tr>
<tr>
<td>Where good color rendition is appropriate</td>
<td>40</td>
</tr>
<tr>
<td>Where high color rendition is appropriate, spaces are less than 50 ft² or where use of low wattage High Intensity Discharge (HID) lamps under 250 W or fluorescent lamps under 40 W is appropriate</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 62-L
Luminaire Coefficients of Utilization (CU)

Coefficients of utilization (CUs) are to be for luminaires for use in the types of spaces listed below, and those luminaires shall have a CU of no less than that listed below (for each type space) for a Room Cavity Ratio (RCR) of 1 and reflectances as in (c) below.

<table>
<thead>
<tr>
<th>Space Use</th>
<th>Minimum CU (at RCR = 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For spaces with tasks subjected to veiling reflections (where design levels of illumination are listed in terms of equivalent sphere illumination (ESI) and where visual comfort is important.</td>
<td>0.55</td>
</tr>
<tr>
<td>For spaces without tasks, or with tasks not subjected to veiling reflections, but where visual comfort is important.</td>
<td>0.63</td>
</tr>
<tr>
<td>For spaces without tasks and where visual comfort is not a criterion.</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Table 62-M
Reflectances and Light Loss Factors

<table>
<thead>
<tr>
<th>Interior Spaces</th>
<th>Reflectance</th>
<th>Light Loss Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling Cavity</td>
<td>80 percent</td>
<td></td>
</tr>
<tr>
<td>Wall</td>
<td>50 percent</td>
<td></td>
</tr>
<tr>
<td>Floor Cavity</td>
<td>20 percent</td>
<td></td>
</tr>
</tbody>
</table>

1 For interior spaces, initial cavity and surface reflectances shall be shown.

CHART 62-1

U Values for Opaque Walls

Glass, percent of wall surface

Combinations of Wall and Single Glazed Openings—for Use with Section 6622 (b) 1.

1 One-half the opaque door area shall be included in the total glazed openings area.

62-41
Glass, percent of wall surface
Combinations of Wall and Double Glazed Openings—for Use with Section 6222 (b) 1.

¹The total area of opaque doors shall be included in the glazed openings area.
**FIGURE 1**

Wall Assemblies

*U_w* selected shall not exceed the *U_o* determined by Section 6222 (b) for any wall section.

Note: Details shown are for insulation and are not complete construction details.

<table>
<thead>
<tr>
<th>WALL DETAILS</th>
<th>R Value of Insulation</th>
<th><em>U_w</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Typ. Interior finish</td>
<td>Typ. exterior finish</td>
<td></td>
</tr>
<tr>
<td>2. Lath and plaster</td>
<td>2. Wood or plywood siding</td>
<td>11</td>
</tr>
<tr>
<td>3. 3/8&quot; min. wood</td>
<td>3. Brick veneer</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wood Stud Construction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>Exterior Finish See Schedule</td>
</tr>
<tr>
<td>Section</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Air Space</th>
<th>Exterior Finish See Schedule</th>
<th>4</th>
<th>.15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid Insulation</td>
<td>6.25</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>Plan View</td>
<td>8</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>.08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Interior Finish | Exterior Finish See Schedule | 7 | .12 |
| See Schedule | 11 | .08 |
| 14 | .06 |
| 19 | .05 |

<table>
<thead>
<tr>
<th>Steel Stud Construction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>Exterior Finish See Schedule</td>
</tr>
<tr>
<td>Section</td>
<td>6.25</td>
</tr>
<tr>
<td>Air Space or Insulation</td>
<td>Insulation</td>
</tr>
<tr>
<td>Plan View</td>
<td>10</td>
</tr>
<tr>
<td>12.5</td>
<td>.06</td>
</tr>
</tbody>
</table>
**FIGURE 1 (cont'd.)**

**Wall Assemblies**

$U_w$ selected shall not exceed the $U_o$ determined by Section 6222 (b) 2 for any wall section.

Note: Details shown are for insulation and are not complete construction details.

<table>
<thead>
<tr>
<th>Wall Details</th>
<th>R Value of Insulation</th>
<th>$U_w$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior finish 1/2&quot; gypsum board on furring strips</td>
<td>Solid Group in space</td>
<td>.38</td>
</tr>
<tr>
<td>Brick</td>
<td>2&quot; space with loose fill R:4</td>
<td>.16</td>
</tr>
<tr>
<td>Brick</td>
<td>4&quot; space with loose fill R:3</td>
<td>.10</td>
</tr>
<tr>
<td>Brick Masonry Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td>Interior Finish</td>
<td>4</td>
</tr>
<tr>
<td>Brick</td>
<td>Insulation</td>
<td>6.25</td>
</tr>
<tr>
<td>Brick</td>
<td>7</td>
<td>.09</td>
</tr>
<tr>
<td>Brick</td>
<td>11</td>
<td>.07</td>
</tr>
<tr>
<td>Concrete Construction</td>
<td>4</td>
<td>.18</td>
</tr>
<tr>
<td>4&quot; Min</td>
<td>Interior Finish</td>
<td>6.25</td>
</tr>
<tr>
<td>Normal Wt. Concrete</td>
<td>7</td>
<td>.12</td>
</tr>
<tr>
<td>Concrete</td>
<td>11</td>
<td>.08</td>
</tr>
<tr>
<td>Concrete</td>
<td>Interior</td>
<td>4</td>
</tr>
<tr>
<td>Light Wt. Concrete</td>
<td>6.25</td>
<td>.12</td>
</tr>
<tr>
<td>Concrete</td>
<td>7</td>
<td>.11</td>
</tr>
<tr>
<td>Concrete</td>
<td>11</td>
<td>.08</td>
</tr>
</tbody>
</table>
**Wall Assemblies**

\( U_W \) selected shall not exceed the \( U_W \) determined by Section 6222 (b) 1 for any wall section.

**Note:** Details shown are for insulation and are not complete construction details.

<table>
<thead>
<tr>
<th>Masonry Construction</th>
<th>Wall Details</th>
<th>R Value of Insulation</th>
<th>( U_W )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interior finish 1/2&quot; gypsum board on furring strips</td>
<td>No insul.</td>
<td>.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loose fill in cores</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No insul.</td>
<td>.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loose fill in cores</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>Ext. Finish</td>
<td>No. insul. (no int. fin.)</td>
<td>.25</td>
</tr>
<tr>
<td></td>
<td>Block</td>
<td>Loose fill in cavity</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>Air Space</td>
<td>No insul. with int. fin.</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Int. Finish</td>
<td>Loose fill in cavity with int. finish</td>
<td>.11</td>
</tr>
<tr>
<td></td>
<td>Block</td>
<td>No insul. int. finish</td>
<td>.23</td>
</tr>
<tr>
<td></td>
<td>Int. Finish</td>
<td>Loose fill in cores with int. finish</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>Int. Fin.</td>
<td>1&quot; rigid glass fiber insul. int. finish</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>Block</td>
<td>R 7 insul. with int. fin.</td>
<td>.10</td>
</tr>
</tbody>
</table>
**FIGURE 2**

*Roof/Ceiling Assemblies*

*U*<sub>f</sub> selected shall not exceed the value specified in 6222 (b) 2

Note: Details shown are for insulation and are not complete construction details.

<table>
<thead>
<tr>
<th>Roof Details</th>
<th>R Value of Insulation</th>
<th><em>U</em>&lt;sub&gt;f&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical interior finish schedule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Gypsum wallboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Lath and plaster</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>.07</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>.03</td>
</tr>
<tr>
<td>Air Space &amp; Ventilation Desirable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>.03</td>
</tr>
<tr>
<td>CATHEDRAL TYPE CEILING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Built-up Roof Sheathing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigid Insulation</td>
<td>Wood deck'g 9.5</td>
<td>.08</td>
</tr>
<tr>
<td>Beam</td>
<td>Plywood 10.5</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>Wood or Plywood Sheeting</td>
<td></td>
</tr>
</tbody>
</table>

1. Skylites not exceeding one percent of the roof area are permitted.
Floor Assemblies

$U_f$ selected shall not exceed the $U_o$ specified in Section 6222 (b) 3.

<table>
<thead>
<tr>
<th>Floor Details</th>
<th>R Value of Insulation</th>
<th>$U_f$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>No insulation</td>
<td>.32</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>.15</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>.11</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>6.25</td>
<td>.12</td>
</tr>
</tbody>
</table>
### APPENDIX A

**Resistance Values of Structural and Finish Materials, Insulations, Air Spaces, and Surface Films**

<table>
<thead>
<tr>
<th>Material Description</th>
<th>R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Bevel siding, 1/2 x 8, taped</td>
<td>0.81</td>
</tr>
<tr>
<td>Wood siding shingles, 16&quot;, 7 1/2&quot; exposure</td>
<td>0.37</td>
</tr>
<tr>
<td>Asbestos-cement shingles</td>
<td>0.20</td>
</tr>
<tr>
<td>Stucco, per inch</td>
<td>0.06</td>
</tr>
<tr>
<td>Building paper</td>
<td>0.14</td>
</tr>
<tr>
<td>1/2&quot; nailing base insul, board sheathing</td>
<td>0.32</td>
</tr>
<tr>
<td>1/2&quot; insul, board sheathing, regular density</td>
<td>0.24</td>
</tr>
<tr>
<td>25/32&quot; insul, board sheathing, regular density</td>
<td>0.31</td>
</tr>
<tr>
<td>1/4&quot; plywood</td>
<td>0.37</td>
</tr>
<tr>
<td>3/8&quot; plywood</td>
<td>0.47</td>
</tr>
<tr>
<td>1/2&quot; plywood</td>
<td>0.62</td>
</tr>
<tr>
<td>5/8&quot; plywood</td>
<td>0.78</td>
</tr>
<tr>
<td>1/4&quot; hardboard</td>
<td>0.18</td>
</tr>
<tr>
<td>Softwood, per inch</td>
<td>1.25</td>
</tr>
<tr>
<td>Softwood board, 3/4&quot; thick</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Concrete blocks, three oval cores
- Cinder aggregate, 4" thick: R-1.11
- Cinder aggregate, 12" thick: R-1.89
- Cinder aggregate, 8" thick: R-1.72
- Sand and gravel aggregate, 8" thick: R-1.11
- Lightweight aggregate (expanded clay, shale, slag, pumice, etc.), 8" thick: R-2.00

Concrete blocks, two rectangular cores
- Sand and gravel aggregate, 8" thick: R-1.04
- Lightweight aggregate, 8" thick: R-2.18

Common brick, per inch: R-0.20
- Face brick, per inch: R-0.11
- Sand-and-gravel concrete, per inch: R-0.08
- Sand-and-gravel concrete, 5 inches thick: R-0.64
- 1/2" gypsumboard: R-0.45
- 5/8" gypsumboard: R-0.56
- 1/2" lightweight-aggregate gypsum plaster: R-0.32
- 25/32" hardwood finish flooring: R-0.68
- Asphalt, linoleum, vinyl, or rubber floor tile: R-0.05
- Carpet and fibrous pad: R-2.08
- Carpet and foam rubber pad: R-1.23
- Asphalt roof shingles: R-0.44
- Wood roof shingles: R-0.94
- 3/8" built-up roof: R-0.33

### Air Spaces (3/4"")
- Heat flow UP: R-0.61
- Non-reflective: R-0.67
- Reflective, one surface: R-0.37
- Heat flow DOWN: R-1.02
- Reflective, one surface: R-3.55
- Heat flow HORIZONTAL: Non-reflective: R-1.01
- Reflective, one surface: R-3.48

Note: The addition of a second reflective surface facing the first reflective surface increases thermal resistance values of an air space only 4 to 7 per cent.

### Surface Air Films
INSIDE (still air)
- Heat flow UP (through horizontal surface): R-0.61
  - Non-reflective: R-0.61
- Heat flow UP (through horizontal surface): R-0.52
  - Non-reflective: R-0.45
- Heat flow HORIZONTAL (through vertical surface): R-0.68
  - Non-reflective: R-0.68

OUTSIDE
- Heat flow any direction, surface any position
  - 15 mph wind (winter): R-0.25
  - 7.5 mph wind (summer): R-0.25

### Example Calculations
(to determine the U value of an exterior wall)

<table>
<thead>
<tr>
<th>Wall Construction</th>
<th>Uninsulated Wall Resistance</th>
<th>Insulated Wall Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside surface (film), 15 mph wind</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>Wood bevel siding, lapped</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>1/2&quot; insul. bd. sheathing, reg. density</td>
<td>1.32</td>
<td>1.32</td>
</tr>
<tr>
<td>3 1/2&quot; air space</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>R-11 insulat</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>1/2&quot; gyspumboard</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Inside surface (film)</td>
<td>0.68</td>
<td>0.68</td>
</tr>
</tbody>
</table>

**Totals**

|        | 444   | 14.43 |

For uninsulated wall, \( U = \frac{1}{R} = \frac{1}{4.44} = 0.22 \)

Therefore, heat loss for the above uninsulated wall section at a +10°F outside design temperature is equal to 0.22 x 60 (or 70-10) equals 13.2 Btu per sq. ft. of wall section.

For insulated wall, \( U = \frac{1}{R} = \frac{1}{14.43} = 0.07 \)

Therefore, heat loss for the above insulated wall section at a +10°F outside design temperature is equal to 0.07 x 60 (or 70-10) equals 4.2 Btu per sq. ft. of wall section.

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*Additional resistance values can be obtained from ASHRAE Handbook of Fundamentals published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers.*
CHAPTER 63
CONSTRUCTION IN DESIGNATED SPECIAL CONSTRUCTION ZONES
(Ordinance No. 114 Series 1980)

SECTION 6301. SCOPE. All construction, alteration, repairs, demolition or moving in areas designated under Article 647 of the Revised Municipal Code as Special Construction Zones shall conform to the provisions of this Chapter.

SECTION 6302. GENERAL PROVISIONS.
(a) No permits for construction, alteration, repairs, demolition or moving in a designated Special Construction Zone shall be issued without being in compliance with all recommendations contained in the engineer's report if required by Section 303.
(b) If the applicant is required to prepare an engineer's report pursuant to Section 303, the Department may require such additional information and recommendations as it deems necessary and may require such additional measures as are necessary to minimize potential hazards during construction and control hazards from the completed structure.
(c) All construction and excavation sites shall be subject to inspection by the Fire Department, Building Department, and the Department of Health and Hospitals, and results of tests or monitoring required by this Chapter shall be available at the site for inspection.
(d) In the event of a material violation with the requirements of this Chapter, the Building Inspection Division may stop all construction activity until it is satisfied that the violation has been corrected.

SECTION 6303. HAZARDOUS GASES GENERATED BY LANDFILLS.
(a) New Construction. Except as provided in Sections 303(f) and 6303(c) of this Building Code, all new buildings, structures and utilities to be constructed in a Special Construction Zone which is so designated because of the presence of hazardous gasses generated by landfills shall be designed by an engineer registered in the State of Colorado to control and protect against accumulation of over 1.0% by volume of flammable gas in the building, structure or utility, and the following precautions shall be taken during and after construction activity.
1. A flammable gas indicator shall be utilized at all times during trenching, excavating, drilling, or when working within ten (10) feet of an open excavation.
2. When trenching, excavating, or drilling deeper than two (2) feet into the soil or fill, or in the presence of detectable concentrations of 1.0% by volume of flammable gas, the operating equipment shall be provided with spark proof exhausts.
3. A dry chemical fire extinguisher, approved by the Fire Department, shall be provided on all equipment used in the landfill.
4. Personnel within or near an open trench or drill hole deeper than two (2) feet into the soil or fill shall be fully clothed, wear shoes with non-metallic soles, wear a hard hat and wear safety goggles or glasses.

5. Exhaust blowers shall be used in instances where trenches may show a build up of flammable gas of 1.0% by volume or less than 19.5% by volume of oxygen.

6. Smoking and/or an open flame shall not be permitted in any area within 100 feet of the excavation.

7. Personnel shall be kept upwind of any open trench unless the trench and the downwind atmosphere are continuously monitored.

8. Before personnel are permitted to enter an open trench, the trench shall be monitored for flammable gas and at least an 19.5% by volume oxygen sufficiency. When in the excavation, each work party shall be working no more than five (5) feet from a continuously operating flammable gas and oxygen monitor.

9. The applicant shall employ an inspector whose duty it shall be to effect continuous compliance with the foregoing precautions. The inspector shall be a qualified person approved by the Department or shall be an engineer registered with the State of Colorado or a person in the employ of, or subject to the direct supervision and control of such an engineer. Said inspector shall submit a written report of his inspection to the applicant and to the Department at ten (10) day intervals during active construction stating that all new construction is in compliance with these regulations, and that all testing and monitoring has been and is being done as required by these regulations.

10. After construction is completed, hazardous gas monitoring devices approved by the Fire Department shall be installed in the completed building or structure in such number and in such places within the building or structure as may be required by the Fire Department.

(b) Alteration or Repair of Existing Building, Structures or Utilities. Except as provided in Sections 303(f) and 6303(c) no alterations or repairs to any existing building, structure or utility, shall be made unless the following precautions are taken:

1. Within five (5) days prior to applying for a permit under Chapter 3 of the Building Code to alter or repair an existing building, structure, or utility, the site of the work shall be tested for the presence of flammable gas by an engineer registered in the State of Colorado.

2. If said test results show that there is less than 2.0% of the Lower Explosive Limit (L.E.L.) of hazardous gas, then the permit for the work shall be issued. Upon completion of the work the applicant shall install hazardous gas monitoring devices approved by the
Fire Department in such number and in such places within the building or structure as may be required by the Fire Department, but the applicant shall be exempt from all other requirements of this Section 6303.

3. If the test results show that there is 2% or more of the Lower Explosive Limit (L.E.L.) of hazardous gas, then the applicant shall take all of the precautions pursuant to Section 6303(a) as if the construction were new construction.

(c) **Exemption.** Whether or not he is an applicant for a permit, the owner of real property ("owner") within a Special Construction Zone may apply to the Building Department for a certificate of exemption from the provisions of Article 647 of the Revised Municipal Code and Section 6303 of the Building Code. To obtain such exemption, said owner shall have his property tested by an engineer registered in the State of Colorado and tests shall meet the following requirements:

1. A test for the presence of flammable gas shall be performed at a time when there is frost on his property to a depth of at least six inches in the soil, and again at a time when there is no frost in the soil, and again within five (5) days of the date when an exemption certificate is applied for.

2. The test holes shall be placed along each major boundary line of the real property for which the exemption is sought in such number and at such locations as the engineer deems proper.

3. If the test results show that there is less than 2.0% of the lower explosive limit (L.E.L) of flammable gas, and if such test results are satisfactory to the Department, then the Department shall issue a certificate stating that the real property described in the certificate is exempt from the provisions of Article 647 of the Revised Municipal Code and Section 6303 of the Building Code.

4. As a condition of receiving said exemption certificate from the Department, the owner shall acquire and install in all existing and future buildings and structures, devices approved by the Fire Department to monitor for the presence of hazardous gas in such number and in such places within the building or structure as may be required by the Fire Department.

5. **Revocation.** Upon a finding that flammable gas is present in amounts greater than 2% of the lower explosive limit on any property where an exemption certificate has been issued, the Department shall revoke said exemption certificate. Further, upon a finding that the monitoring devices on any property for which an exemption certificate has been issued are inoperative, the Department may suspend or revoke the exemption certificate.
CHAPTER 64  
REQUIREMENTS FOR HANDICAPPED PERSONS

SECTION 6401: GENERAL REQUIREMENTS.  
(a) Scope. In addition to other requirements of this Building Code, all occupancies A through H and J, except J occupancies accessory to I occupancies shall be accessible to the handicapped in the manner provided in this Chapter.  
EXCEPTION 1: H-3 occupancies (attached housing) where all sleeping facilities are on the second floor.  
EXCEPTION 2: Multi-story buildings not exceeding 3 stories will not require elevators to provide accessibility if the provision of an elevator would represent two and one-half percent or more of the total construction cost without an elevator.  
(b) Design, Installation and Materials. Design, installation and materials used in all structures shall comply with this Building Code and the requirements of ANSI A117.1-1980, except insofar as they are modified by this Chapter. Where a conflict exists between this Chapter and the standards indicated herein the requirements of this Chapter shall govern.  
(c) Site Development. For parking, passenger loading zone, curb, ramp and other site development requirements refer to the Zoning Ordinance of the Revised Municipal Code and the Planned Unit Development/Planned Building Group Rules and Regulations.  
(d) Exceptions. The Building Department may grant exceptions to or modify any particular standard or specification when it is determined that it is impractical and would create an unusual hardship or would unreasonably complicate the construction, alteration or repair in question. Any such exemption or modification of the provisions of this Chapter shall be made in writing as a matter of public record.  
(e) Reference and Numbering. The numbering system used in this Chapter references ANSI A117.1-1980, see Standards Section 6404. For purposes of this Building Code, numbers referencing the ANSI standard are preceded by an 'A' and enclosed in parentheses.  
Example: (A3.1). All other numbers are consistent with the Building Code. Any Section or portions of a Section deviating from ANSI A117.1-1980 are in italics. Sections or portions of Sections indicated as 'Reserved' are omitted from this Code. Parts 1 and 2 of ANSI A117.1-1980 are not a part of this Code.  

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64-1
SECTION 6402: MISCELLANEOUS INSTRUCTIONS AND
DEFINITIONS.

(a) (A3.1) Graphic Conventions. Graphic conventions used in the illus-
tration are shown in Table 64-B. Dimensions that are not marked
"minimum" or "maximum" are absolute, unless otherwise indicated in
the text or captions.

(b) (A3.2) Dimensional Tolerance. All dimensions are subject to con-
ventional building industry tolerances for field conditions.

(c) (A3.3) Notes. The text of this standard does not contain notes or foot-
notes. Additional information, explanations, and advisory materials are
located in the Appendix of ANSI A117.1-1980. Paragraphs marked
with an asterisk have such related, non-mandatory material in the
ANSI Appendix. In the Appendix, the corresponding paragraph num-
bers are preceded by an A. Numbering used in this text conforms to
ANSI A117.1-1980, (3.1 etc.)

(d) (A3.4) General Terminology.
comply with. Meet one or more specifications of this standard.
if, if....then. Denotes a specification that applies only when the condi-
tions described are present.
may. Denotes an option or alternative.
shall. Denotes a mandatory specification or requirement.
should. Reserved.

(e) (A3.5) Definitions. The following terms shall, for the purpose of this
standard, have the meaning indicated in this section.
access aisle. An accessible pedestrian space between elements such
as parking spaces, seating and desks, that provides clearances ap-
propriate for use of the elements.
accessible. Describes a site, building, facility or portion thereof that
complies with this standard and that can be approached, entered and
used by physically disabled people.
accessible element. Part of an accessible route or accessible func-
tional space; an item specified by this standard (for example, controls
and the like).
accessible route. A continuous unobstructed path connecting all ac-
cessible elements and spaces in a building or facility that can be negoti-
ated by a severely disabled person using a wheelchair and that is also
safe for and usable by people with other disabilities. Interior accessible
routes may include corridors, floors, ramps, elevators, lifts and clear
floor space at fixtures. Exterior accessible routes may include parking
access aisles, curb ramps, walks, ramps and lifts.
adaptability. The ability of certain building elements, such as
kitchen counters, sinks and grab bars, to be added to, raised, lowered or
otherwise altered so as to accommodate the needs of either the disabled
or nondisabled, or to accommodate the needs of persons with different
types or degrees of disability.
administrative authority. *The Department.*

assembly area. A room or space accommodating fifty or more individuals for religious, recreational, educational, political, social or amusement purposes or for the consumption of food and drink, including all connected rooms or spaces with a common means of egress and ingress. Such areas as conference rooms would have to be accessible in accordance with other parts of this standard but would not have to meet all of the criteria associated with assembly areas.

automatic door. A door equipped with a power-operated mechanism and controls that open and close the door automatically upon receipt of a monetary actuating signal. The switch that begins the automatic cycle may be a photoelectric device, floor mat, or manual switch mounted on or near the door itself (see power-assisted door).

children. People below the age of twelve (that is, elementary school age and younger).

circulation path. An exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks, hallways, courtyards, stairways and stair landings.

clear. Unobstructed.

common use. Refers to those interior and exterior rooms, spaces or elements that are made available for the use of a restricted group of people (for example, residents of an apartment building, the occupants of an office building or the guests of such residents or occupants).

coverage. The extent or range of accessibility that a particular administrative authority adopts and requires.

cross slope. The slope of a pedestrian way that is perpendicular to the direction of travel (see running slope).

curb ramp. A short ramp cutting through a curb or built up to it.

detectable. Perceptible by one or more of the senses.

disability. A limitation or loss of use of a physical, mental or sensory body part or function.

dwelling unit. A single unit of residence which provides a kitchen or food preparation area, in addition to rooms or spaces for living, bathing, sleeping and the like. A single family home is a dwelling unit and dwelling units are to be found in such housing types as townhouses and apartment buildings.

egress, means of. A path of exit that meets all applicable code specifications of the regulatory building agency having jurisdiction over the building or facility.

emergency. Refers to facilities resulting from or anticipating unforeseen combinations of circumstances, for example, storm shelters, bomb shelters and comparable refuges.

functional spaces. The rooms and spaces in a building or facility that house the major activities for which the building or facility is intended.
handicapped. Those with significant limitations in using specific parts of the environment.

housing. A building, facility, or portion thereof, excluding inpatient health care facilities, that contains one or more dwelling units or sleeping accommodations. Housing may include, but is not limited to, one and two-family dwellings, apartments, group homes, hotels, motels, dormitories and mobile homes.

marked crossings. A crosswalk or other identified path intended for pedestrian use in crossing a vehicular way.

multifamily dwelling. Any building containing more than two dwellings units.

operable part. A part of a piece of equipment or appliance used to insert or withdraw objects, or to activate, deactivate or adjust the equipment or appliance (for example, coin slot, pushbutton, handle).

power-assisted door. A door with a mechanism that helps to open the door, or relieve the opening resistance of a door, upon the activation of a switch or a continuous force applied to the door itself. If the switch or door is released, such doors immediately begin to close or close completely within 3 to 30 seconds (see automatic doors).

principal entrance. An entrance intended to be used by the residents or users to enter or leave a building or facility. This may include, but is not limited to, the main entrance.

public use. Describes interior and exterior rooms or spaces that are made available to the general public. Public use may be provided at a building or facility that is privately or publicly owned.

ramp. A walking surface in an accessible space that has a running slope greater than 1:20.

reasonable number. Reasonable number shall mean ten percent (10%) of the number provided.

running slope. The slope of a pedestrian way that is parallel to the direction of travel (see cross slope).

service entrance. An entrance intended primarily for delivery or service.

signage. Verbal, symbolic and pictorial information.

site. A parcel or land bounded by a property line or a designated portion of a public right-of-way.

site improvements. Landscaping, paving for pedestrian and vehicular ways, outdoor lighting, recreational facilities and the like, added to a site.

sleeping accommodations. Rooms in which people sleep, for example, dormitory and hotel or motel guest rooms.

tactile. Describes an object that can be perceived using the sense of touch.
tactile warning. A standardized surface texture applied to or built into walking surface or other elements to warn visually impaired people of hazards in the path of travel.

temporary. Applies to facilities that are not of permanent construction but are extensively used or essential for public use for a given (short) period of time, for example, temporary classrooms or classroom buildings at schools and colleges, or facilities around a major construction site to make passage accessible, usable and safe for everybody. Structures directly associated with the actual processes of major construction, such as porto potties, scaffolding, bridging, trailers and the like, are not included.

vehicular way. A route intended for vehicular traffic, such as a street, driveway or parking lot.

walk. An exterior pathway with a prepared surface intended for pedestrian use, including general pedestrian areas such as plazas and courts.

walking aid. A device used by a person who has difficulty walking (for example, a cane, crutch, walker or brace).

SECTION 6403: ACCESSIBLE ELEMENTS AND SPACES
(a) (A4.1) Minimum Requirements
1. (A4.1.1) Accessible Sites and Exterior Facilities. An accessible site shall meet the following minimum requirements.
   (1) through (5) Reserved.
   (6) Stairs connecting levels that are not connected by an elevator shall comply with (i).
   (7) All passenger elevators shall comply with (j).
   (8) All doors or gates to accessible spaces and elements and along accessible routes shall comply with (m).
   (9) If drinking fountains are provided, they shall comply with (o).
   (10) If toilet rooms are provided, they shall comply with (v). If bathing facilities are provided, a reasonable number, but always at least one, of bathrooms shall comply with (w). If toilet and bathing facilities are provided for both sexes, a reasonable number, but always at least one, of toilet rooms and bathrooms, bathing facilities, or shower rooms complying with (v) and (w) shall be provided for each sex.
   (11) Tactile warnings shall be provided at hazardous conditions as specified in (cc).
   (12) All signs shall comply with (dd).
(13) and (14) Reserved.
(15) If places of assembly are provided, they shall comply with (gg).

2. **Accessible Buildings.** Accessible buildings and facilities shall meet the following minimum requirements:

1. At least one accessible route complying with (c) shall connect accessible building or facility entrances with all accessible spaces and elements within the building or facility.
2. All objects that overhang circulation paths shall comply with (d).
3. Ground and floor surfaces along accessible route and in accessible rooms and spaces shall comply with (e).
4. Stairs connecting levels that are not connected by an elevator shall comply with (i). This requirement is not mandatory within dwelling units.
5. All passenger elevators shall comply with (j).
6. If windows intended to be operated by occupants are provided, then a reasonable number, but always at least one, of windows in each accessible space shall comply with (l).
7. All doors to accessible spaces along accessible routes shall comply with (m).
8. An accessible building or facility shall have at least one accessible principal entrance that complies with (n).
9. **If drinking fountains are provided, they shall comply with** (o).
10. **If toilet rooms are provided, they shall comply with** (v). If bathing facilities are provided, a reasonable number, but always at least one, of bathrooms shall comply with (w). If toilet and bathing facilities are provided for both sexes, a reasonable number, but always at least one, of toilet rooms and bathrooms, bathing facilities, or shower rooms complying with (v) and (w) shall be provided for each sex.
11. **If storage facilities such as cabinets, shelves, closets and drawers are provided in accessible spaces, a reasonable number but at least one, shall comply with** (y).
12. Controls and operating mechanisms in accessible spaces, along accessible routes, or as parts of accessible elements (for example, light switches and dispenser controls) shall comply with (aa).
13. If emergency warning systems are provided, they shall comply with (bb).
14. Tactile warnings shall be provided at hazardous conditions as specified in (cc).
15. If signs are provided, they shall comply with (dd).
16. Reserved.
If seating, tables or work surfaces are provided in accessible spaces, a reasonable number, but always at least one, of seating spaces, tables, or work surfaces shall comply with (ff).

If places of assembly are provided, they shall comply with (gg).

3. (A4.1.3) Accessible Housing. Accessible housing shall comply with the minimum requirements in (a)1 and (a)2. It shall also meet the requirements of Section (hh) of this Chapter.

(b) (A4.2) Space Allowances and Reach Ranges

1. (A4.2.1*) Wheelchair Passage Width. The minimum clear width for single wheelchair passage shall be 32 in (815mm) at a point and 36 in (915mm) continuously (see Fig. 1).

2. (A4.2.2) Width for Wheelchair Passing. The minimum width for two wheelchairs to pass is 60 in (1525mm) (see Fig. 2).

3. (A4.2.3*) Wheelchair Turning Space. The space required for a wheelchair to make a 180-degree turn is a clear space of 60 in (1525mm) diameter (see Fig. 3(a)) or a T-space (see Fig. 3(b)).

4. (A4.2.4*) Clear Floor or Ground Space for Wheelchairs.

5. (A4.2.4.1) Size and Approach. The minimum clear floor or ground space required to accommodate a single stationary wheelchair and occupant is 30 in by 48 in (760mm by 1220mm) (see Fig. 4(a)). The minimum clear floor or ground space for wheelchairs may be positioned for forward or parallel approach to an object (see Fig. 4(b) and (c)). Clear floor or ground space for wheelchairs may be part of the knee space required under some objects.

6. (A4.2.4.2) Relationship of Maneuvering Clearances to Wheelchair Spaces. One full unobstructed side of the clear floor or ground space for a wheelchair shall adjoin or overlap an accessible route or adjoin another wheelchair clear floor space. If a clear floor space is located in an alcove or otherwise confined on all or part of three sides, additional maneuvering clearances shall be provided as shown in Fig. 4 (d) and (e).

7. (A4.2.4.3) Surfaces of Wheelchair Spaces. Clear floor or ground spaces for wheelchairs shall comply with (e).

8. (A4.2.5) High Forward Reach. If the clear floor space only allows forward approach to an object, the maximum high forward reach allowed shall be 48 in (1220mm) (see Fig. 5(a)). If the high forward reach is over an obstruction, reach and clearances shall be as shown in Fig. 5(b).

9. (A4.2.6) Side Reach. If the clear floor space allows parallel approach by a person in a wheelchair, the maximum high side reach allowed shall be 54 in (1370mm) and the low side reach
shall be no less than 9 in (230mm) above the floor (Fig. 6(a) and (b)). If the side reach is over an obstruction, the reach and clearances shall be as shown in Fig. 6(c).

(c) (A4.3) Accessible Route.

1. (A4.3.1*) General. All walks, halls, corridors, aisles and other spaces that are part of an accessible route shall comply with (c).

2. (A4.3.2) Location
   (1) Reserved.
   (2) Reserved.
   (3) Accessible routes shall connect accessible building or facility entrances with all accessible spaces and elements and with all accessible dwelling units within the building or facility.
   (4) An accessible route shall connect at least one accessible entrance of each accessible dwelling unit with those exterior and interior spaces and facilities that serve the accessible dwelling unit.

3. (A4.3.3) Width. The minimum clear width of an accessible route shall be 36 in (915mm) except at doors (see (m)5 and 6). If a person in a wheelchair must make a turn around an obstruction, the minimum clear width of the accessible route shall be as shown in Fig. 7.

4. (A4.3.4) Passing Space. If an accessible route has less than 60 in (1525mm) clear width, then passing spaces at least 60 in by 60 in (1525mm by 1525mm) shall be located at reasonable intervals not to exceed 200 ft. (61m). A T-intersection of two corridors or walks is an acceptable passing place.

5. (A4.3.5) Head Room. Accessible routes shall comply with (d)2.

6. (A4.3.6) Surface Texture. The surface of an accessible route shall comply with (e).

7. (A4.3.7) Slope. An accessible route with a running slope greater than 1:20 is a ramp and shall comply with (h). Nowhere shall the cross slope of an accessible route exceed 1:50.

8. (A4.3.8) Changes in Level. Changes in level along an accessible route shall comply with (e)2. If an accessible route has changes in level greater than 1/2 in (13mm), then a curb ramp, ramp elevator or elevator or platform lift approved by the Department shall be provided that complies with (g), (h), (j), or (k), respectively. Stairs shall not be part of an accessible route.

9. (A4.3.9) Doors. Doors along an accessible route shall comply with (m).

10. (A4.3.10) Egress. Where more than one exit is required by Section 3302, at least two accessible routes shall serve as a means of egress for emergencies or connect to an accessible place of refuge, with the
exception of H-3 occupancies. Such accessible routes and places of refuge shall comply with the requirements of this code. In buildings providing refuge areas in elevator lobbies, or stairwells, in compliance with Chapters 18 and 33, those areas may be considered as the means of egress for handicapped persons.

(d) (A4.4) Protruding Objects
1. (A4.4.1*) General. Objects projecting from walls with their leading edges between 27 in and 80 in (685mm and 2030mm) above the finished floor shall protrude no more than 4 in (100mm) into walks, halls, corridors, passageways or aisles (see Fig. 8(a)). Objects mounted with their leading edges at or below 27 in (685mm) above the finished floor may protrude any amount (see Fig. 8(a) and (b)). Free-standing objects mounted on posts or pylons may overhang 12 in (305mm) maximum from 27 in to 80 in (685mm to 2030mm) above the ground or finished floor (see Fig. 8(c) and (d)). Protruding objects shall not reduce the clear width of an accessible route or maneuvering space (see Fig. 8(e)).

2. (A4.4.2) Head Room. Walks, halls, corridors, passageways, aisles or other circulation spaces shall have 80 in (2030mm) minimum clear head room (see Fig. 8(a)).

(e) (A4.5) Ground and Floor Surfaces
1. (A4.5.1*) General. Ground and floor surfaces along accessible routes and in accessible rooms and spaces, including floors, walks, ramps, stairs and curb ramps, shall be stable, firm and relatively nonslip under all weather conditions and shall comply with (e).

2. (A4.5.2) Changes in level. Changes in level up to 1/4 in (6mm) may be vertical and without edge treatment. Changes in level between 1/4 and 1/2 in (6mm and 13mm) shall be leveled with a slope no greater than 1:2. Changes in level greater than 1/2 in (13mm) shall be accomplished by means of a ramp that complies with (h).

3. (A4.5.3*) Carpet. If carpet or carpet tile is used on a ground or floor surface, then it shall be securely attached, have a firm cushion, pad or backing or no cushion or pad; and have a level loop, textured loop, level cut pile or level cut/uncut pile texture. The maximum pile height shall be 1/2 in (13mm). Exposed edges of carpet should be fastened to floor surfaces and have trim along the entire length of the exposed edge. Carpet edge trim shall comply with (e)2.

4. (A4.5.4) Gratings. If gratings are located in walking surfaces, then they shall have spaces no greater than 1/2 in (13mm) wide in one direction. If gratings have elongated openings, then they shall be placed so that the long dimension is perpendicular to the dominant direction of travel.
(f) (A4.6) Reserved.

(g) (A4.7) Reserved.

(h) (A4.8) Ramps.

1. (A4.8.1*) General. Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp and shall comply with (h).

2. (A4.8.2*) Slope and Rise. The least possible slope shall be used for any ramp. The maximum slope of a ramp in new construction shall be 1:12. The maximum rise for any ramp run shall be 30 in (760mm). Curb ramps and ramps to be constructed on existing sites or in existing buildings or facilities may have slopes and rises as shown in Table 64-c(2) if space limitations prohibit the use of a 1:12 slope or less.

3. (A4.8.3) Clear Width. The minimum clear width of a ramp shall be 36 in (915mm).

4. (A4.8.4) Landings. Ramps shall have level landings at the bottom and top of each run. Landings shall have the following features:
   (1) The landing shall be at least as wide as the widest ramp run leading to it.
   (2) The landing shall be a minimum of 60 in (1525mm) clear.
   (3) If ramps change in direction at landing, a minimum level run from each ramp of 60 in (1525mm) shall be provided not less than the width of the ramp.
   (4) If a doorway is located at a landing, then the area in front of the doorway shall comply with (m)6.

5. (A4.8.5*) Handrails. If a ramp has a rise greater than 6 in (250mm) or a horizontal projection greater than 72 in (1830mm), then in it shall have handrails on both sides, if less than 6 inch rise one handrail is required per Section 3306(e). Handrails are not required on curb ramps. Handrails shall comply with (z)2 and shall have the following features:
   (1) Handrails shall be provided along both sides of ramp segments. The inside handrail on switchback or dogleg ramps shall always be continuous.
   (2) If handrails are not continuous, they shall extend at least 12 in (305mm) beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface.
(3) The clear space between the handrail and the wall shall be 1-1/2 in (38mm).

(4) Gripping surfaces shall be uninterrupted by other construction elements or obstructions.

6. (A4.8.6) Cross Slope and Surfaces. The cross slope of ramp surfaces shall be no greater than 1:50. Ramp surfaces shall comply with (e).

7. (A4.8.7) Edge Protection. Ramps and landings with drop-offs shall have curbs, walls, railings or projecting surfaces that prevent people from slipping off the ramp. Curbs shall be a minimum of 2 in (50mm) high (see Fig. 9).

8. (A4.8.8) Outdoor Conditions. Outdoor ramps and their approaches shall be designed so that water will not accumulate on walking surfaces.

(i) (A4.9) Stairs.

1. (A4.9.1) Minimum Number. Stairs connecting levels not connected by an elevator shall comply with (i). These specifications are not mandatory for stairs within dwelling units.

(2) (A4.9.2) Reserved.

(3) (A4.9.3) Nosings. The undersides of nosings shall not be abrupt. The radius of curvature at the leading edge of the tread shall be no greater than 1/2 in (13mm). Risers shall be sloped or the underside of the nosing shall have an angle not less than 60 degrees from the horizontal. Nosings shall project no more than 1-1/2 in (38mm) (see Fig. 10).

4. (A4.9.4) Handrails. Stairways shall have handrails at both sides of all stairs. Handrails shall comply with (z) and shall have the following features:

(1) Handrails shall be continuous along both sides of stairs. The inside handrail on switchback of dogleg stairs shall always be continuous (see Fig. 11(a) and (b)).

(2) If handrails are not continuous, they shall extend at least 12 in (305mm) beyond the top riser and at least 12 in (305mm) plus the width of one tread beyond the bottom riser. At the top, the extension shall be parallel with the floor or ground surface. At the bottom, the handrail shall continue to slope for a distance of the width of one tread from the bottom riser; the remainder of the extension shall be horizontal (see Fig. 11(c) and (d)). Handrail extensions shall comply with (d).
(3) The clear space between the handrail and the wall shall be 1-1/2 in (38mm).

(4) **Gripping surfaces shall be uninterrupted by other construction elements or obstructions.**

5. (A4.9.5) **Reserved.**

6. (A4.9.6) **Outdoor Conditions.** Outdoor stairs and their approaches shall be designed so that water will not accumulate on walking surfaces.

(j) (A4.10) **Elevators.**

1. (A4.10.1) **General.** If elevators are provided, all passenger elevators on an accessible route and/or those used for evacuation purpose shall comply with (j) and with the American National Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks, ANSI A17.1. *See Chapter 55.*

2. (A4.10.2) **Automatic Operations.** Elevator operation shall be automatic. Each car shall be equipped with a self-leveling feature that will automatically bring the car to floor landings within a tolerance of 1/2 in (13mm) under rated loading to zero loading conditions. This self-leveling feature shall be automatic and independent of the operating device and shall correct for overtravel and undertravel.

3. (A4.10.3) **Hall Call Buttons.** Call buttons in elevator lobbies and halls shall be centered at 42 in (1065mm) above the floor. Such call buttons shall have visual signals to indicate when each call is registered and when each call is answered. Call buttons shall be a minimum of 3/4 in (19mm) in the smallest dimensions. The button designating the up direction shall be on top (see Fig. 12).

4. (A4.10.4) **Hall Lanterns.** A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call. Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that say “up” or “down”. Visible signals shall have the following features:

   (1) Hall lantern fixtures shall be mounted so that their centerline is at least 72 in (1830mm) above the lobby floor.

   (2) Visual elements shall be at least 2-1/2 in (64mm) in the smallest dimension.

   (3) Signals shall be visible from the vicinity of the hall call button. In car- lanterns located in cars, visible from the vicinity of hall call buttons and conforming to the above requirements, shall be acceptable (see Fig. 12).
5. (A4.10.5) Raised or Indented Characters on Hoistway Entrances. All elevator's hoistway entrances shall have raised or indented floor designations provided on both jambs. The centerline of the characters shall be 60 in (1525mm) from the floor. Such characters shall be 2 in (50mm) high and shall comply with (dd). Permanently applied plates are acceptable if they are permanently fixed to the jambs. (see Fig. 12).

6. (A4.10.6) Door Protective and Reopening Device. Elevator doors shall open and close automatically. They shall be provided with a reopening device that will stop and reopen a car door and hoistway door automatically if the door becomes obstructed by an object or person. The device shall be capable of completing these operations without requiring contact for an obstruction passing through the opening at heights of 5 in and 29 in (125mm and 735mm) from the floor (see Fig. 12). Door reopening devices shall remain effective for at least 20 seconds. After such an interval, doors may close in accordance with the requirements of ANSI A17.1. See chapter 55.

7. (A4.10.7*) Door and Signal Timing for Hall Calls. The minimum acceptable time from notifications that a car is answering a call until the doors of that car start to close shall be calculated from the following equation:

\[
T = \frac{D}{1.5 \text{ ft/s}} \quad \text{OR} \quad T = \frac{D}{455 \text{ mm/s}}
\]

where \( T \) = total time in seconds and \( D \) = distance (in feet or millimeters) from a point in the lobby or corridor 60 in (1525mm) directly in front of the farthest call button controlling that car to the centerline of its hoistway door (see Fig. 13). For cars with in-car lanterns, \( T \) begins when the lantern is visible from the vicinity of hall call buttons and an audible signal is sounded.

8. (A4.10.8) Door Delay for Car Calls. The minimum time for elevator doors to remain fully open in response to a car call shall be 3 seconds.

9. (A4.10.9) Floor Plan of Elevator Cars. The floor area of elevator cars shall provide space for wheelchair users to enter the car, maneuver within reach of controls, and exit from the car. Acceptable door opening and inside dimensions shall be as shown in Fig. 14. The clearance between the car platform sill and the edge of any hoistway landing shall be no greater than 1-1/4 in (32mm).

10. (A4.10.10) Floor Surfaces. Floor coverings shall comply with (e).
11. (A4.10.11) **Illumination Levels.** The level of illumination at the car controls, platform and car threshold and landing sill shall be at least 5 footcandles (53.8 lux).

12. (A4.10.12*) **Car Controls.** Elevator control panels shall have the following features:
   
   (1) **Buttons.** All control buttons shall be at least 3/4 in (19mm) in their smallest dimension. They may be raised, flush or reeded.

   (2) **Tactile and Visual Control Indicators.** All control buttons shall be designated by raised or indented standard alphabet characters for letters, arabic characters for numerals or standard symbols as shown in Fig. 15(a) and as required in ANSI A17.1. See Chapter 55. Raised and indented characters and symbols shall comply with (dd). The call button for the main entry floor shall be designated by a raised or indented star at the left of the floor designation (see Fig. 15(a)). All raised or indented designations for control buttons shall be placed immediately to the left of the button to which they apply. Applied plates, permanently attached, are an acceptable means to provide raised or indented control designations. Floor buttons shall be provided with visual indicators to show when each call is registered. The visual indicators shall be extinguished when each call is answered.

   (3) **Height.** All floor buttons shall be no higher than 54 in (1370mm) above the floor. Emergency controls, including the emergency alarm and emergency stop, shall be grouped at the bottom of the panel and shall have their centerlines no less than 35 in (890mm) above the floor (see Fig. 15(a) and (b)).

   (4) **Location.** Controls shall be located on a front wall if cars have center opening doors and at the side wall or at the front wall next to the door if cars have side opening doors (see Fig. 15(c) and (d)).

13. (A4.10.13*) **Car Position Indicators.** In elevator cars, a visual car position indicator shall be provided above the car control panel or over the door to show the position of the elevator in the hoistway. As the car passes or stops at a floor served by the elevators, the corresponding numeral shall illuminate and an audible signal shall sound. Numerals shall be a minimum of 1/2 in (13mm) high. The audible signal shall be no less than 20 decibels with a frequency no higher than 1500 Hz. An automatic verbal announcement of the floor number at which a car stops or which a car passes may be substituted for an audible signal.

14. (A4.10.14*) **Emergency communications.** If provided, emergency two-way communication systems between the elevator
and a point outside the hoistway shall comply with ANSI A17.1 See Chapter 55. The highest operable part of a two way communication system shall be a maximum of 54 in (1370mm) from the floor of the car. It shall be identified by raised or recessed symbol and lettering complying with (dd) and located adjacent to the device. If the system uses a handset, then the length of the cord from the panel to the handset shall be at least 20 in (735mm).

(k) (A4.11) Reserved.
(l) (A4.12) Reserved.
(m) (A4.13) Doors.

1. (A4.13.1) General. All doors to accessible spaces and elements and along accessible routes shall comply with the requirements of (m).

2. (A4.13.2) Revolving Doors and Turnstiles. Revolving doors or turnstiles shall not be the only means of passage at an accessible entrance or along an accessible route.

3. (A4.13.3) Gates. Gates, including ticket gates, shall meet all applicable specifications of (m).

4. (A4.13.4) Double-Leaf Doorways. If doorways have two door leaves, then at least one leaf shall meet the specifications in (m)5 and (m)6. That leaf shall be an active leaf.

5. (A4.13.5) Clear Width. Doorways shall have a minimum clear opening of 32 in (315mm) with the door open 90 degrees measured between the face of the door and the stop (see Fig. 16(a), (b), (c) and (d), except that 32 in (815mm) nominal doors with offset hinges may be installed in dwelling units. Openings more than 24 in (610mm) in depth shall comply with (b)1 and (c)3 (see Fig. 16(e)).

6. (A4.13.6) Maneuvering Clearances at Doors. Except in dwelling units minimum maneuvering clearances for doors that are not automatic shall be as shown in Fig. 17. The floor or ground area within the required clearances shall be level and clear. Entry doors to acute care hospital bedrooms for in-patients shall be exempt from the requirement for space at the latch side of the door (see dimension “x” in Fig. 17) if the door is at least 44 in (1120mm) wide.

7. (A4.13.7) Two Doors in Series. The minimum space between two hinged or pivoted doors in series shall be 48 in (1220mm) plus the width of any door swinging into the space. Doors in series shall swing either in the same direction or away from the space between the doors (see Fig. 18). This requirement may be reduced to 60 in (1525mm) between the doors when there is a 24 in (610mm) offset on the latch side of the door.
8. (A4.13.8*) Thresholds at Doorways. Thresholds at doorways shall not exceed 3/4 in (19mm) in height for exterior sliding doors or 1/2 in (13mm) for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be leveled with a slope no greater than 1:2 (see (e)2).

9 (A4.13.9*) Door Hardware. Handles, pulls, latches, locks and other operating devices on accessible doors in corridors and public areas shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching or twisting of the wrist to operate. Lever-type mechanisms, push-type mechanisms and u-shaped handles are acceptable designs. When sliding doors are fully open, operating hardware shall be exposed and usable from both sides. In dwelling units, only doors at accessible entrances to the unit itself will be made adaptable for the handicapped. Doors to hazardous areas shall have hardware complying with (cc)3.

10 (A4.13.10*) Door Closers. If a door has a closer, then the sweep period of the closer shall be adjusted so that from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 in (75mm) from the latch, measured to the leading edge of the door.

11. (A4.13.11*) Door Opening Force. The maximum force for pushing or pulling open a door shall be as follows:
   A. Fire doors shall not exceed the maximum opening force allowable by Chapter 18 of this code.
   B. Other doors:
      (i) exterior hinged doors: 8.5 lbf (37.8N)
      (ii) interior hinged doors: 5 lbf (22.2N)
      (iii) sliding or folding doors: 5 lbf (22.2N)
   These forces do not apply to the force required to retract latch bolts or disengage other devices that may hold the door in a closed position or to doors leading to pressurized stair enclosures and/or refuge areas.

12. (A4.13.12*) Automatic Doors and Power-Assisted Doors. If an automatic door is used, then it shall comply with American National Standard for Power Operated Doors, ANSI A156.10-1979. Slowly opening, low-powered, automatic doors shall be considered a type of custom design installation as described in paragraph 1.1.1 of ANSI A156.10-1979. Such doors shall not open to back check faster than 3 seconds and shall require no more than 15 lbf (66.6N) to stop door movement. If a power-assisted door is used, its door-opening force shall comply with (m)11 and its closing shall conform to the requirements in Section 10 of ANSI A156.10-1979.
(n) (A4.14) Entrances

1. (A4.14.1) Minimum Number. The principal entrance to a building or facility shall be part of an accessible route and shall comply with (c). Such entrances shall be connected by an accessible route to public transportation stops, to accessible parking and passenger loading zones, and to public streets or sidewalks if available (see ANSI A117.1-1980 and Zoning Code.). They shall also be connected by an accessible route to all accessible spaces or elements within the building or facility.

2. (A4.14.2) Service Entrances. A service entrance shall not be the sole accessible entrance unless it is the only entrance to a building or facility (for example, in a factory or garage).

(o) (A4.15) Drinking fountains and Water Coolers.

1. (A4.15.1) Minimum Number. Minimum accessible plumbing facilities to be provided may vary with occupant load and use, but in no case shall be less than the number specified in Table 64-A.

2. (A4.15.2) Spout Height. In new construction spouts shall be no higher than 35 in (915mm), measured from the floor or ground surfaces to the spout outlet (see Fig. 19(a)). In renovation construction, drinking cups may be provided when spout height adjustment is not practicable.

3. (A4.15.3) Spout Location. The spouts of drinking fountains and water coolers shall direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The spout shall provide a flow of water at least 4 in (100mm) high so as to allow the insertion of a cup or glass under the flow of water.

4. (A4.15.4) Controls. Controls shall comply with (aa)4.

5. (A4.15.5) Clearances.

   (1) Wall and post mounted cantilevered units shall have a clear knee space between the bottom of the apron and the floor ground at least 27 in (685mm) high, 30 in (760mm) wide and 17 in to 19 in (430mm to 485mm) deep (see Fig. 19(a) and (b)). Such units shall also have a minimum clear floor space 30 in by 48 in (760mm by 1220mm) to allow a person in a wheelchair to approach the unit facing forward.

   (2) Free-standing or built-in units not having a clear space under them shall have a clear floor space at least 30 in by 48 in (760mm by 1220mm) that allows a person in a wheelchair to make a parallel approach to the unit (see Fig. 19(c) and (d)). This clear floor space shall comply with (b)4.
(p) (A4.16) Water Closets.

1. (A4.16.1) General. Accessible water closets shall comply with (p). For water closets in adaptable dwelling units, see (hh)7.

2. (A4.16.2) Clear Floor Space. Clear floor space for water closets not in stalls shall comply with Fig. 20. Clear floor space may be arranged to allow either a left-handed or right-handed approach.

3. (A4.16.3) Height. The height of water closets shall be 17 in to 19 in (430mm to 485mm) measured to the top of the toilet seat (see Fig. 21).

4. (A4.16.4) Grab Bars. Grab bars for water closets not located in stalls shall comply with Fig. 21 and with (z).

5. (A4.16.5) Flush Controls. Flush controls shall be hand operated and shall comply with (aa)4. Controls for flush valves shall be mounted on the wide side of toilet areas no more than 44 in (1120mm) above the floor.

6. (A4.16.6) Dispensers. Toilet paper dispensers shall be installed within reach, as shown in Fig. 21(b).

(q) (A4.17) Toilet Stalls.

1. (A4.17.1) Location. Accessible toilet stalls shall be on an accessible route and shall meet the requirements of (q). Clearance for entry into the stall shall conform to Fig. 17.

2. (A4.17.2) Water Closets. Water closets in stalls shall comply with (p).

3. (A4.17.3) Size and Arrangement. The size and arrangement of toilet stalls shall comply with Fig. 22(a) in new construction. The size and arrangement of toilet stalls shall comply with either Fig. 22(a) or (b) in renovation or remodel construction. The width dimension of the toilet stall shown in Fig. 22(b) shall be the absolute dimension of 36 in (915mm). Toilet stalls with a minimum depth of 56 in (1420mm) (See Fig. 22(a)) or 66 in (1675mm) (see Fig. 22(b)) shall have wall-mounted water closets. If the depth of toilet stalls is increased at least 3 in (75mm) then a floor-mounted water closet may be used. Arrangements shown for stalls may be reversed to allow either a left- or a right-hand approach.

4. (A4.17.4) Toe Clearances. In standard stalls, the front partition and at least one side partition shall provide a toe clearance of at least 9 in (230mm) above the floor. If the depth of the stall is greater than 60 in (1525mm), then the toe clearance is not required.
5. (A4.17.5*) Doors. Toilet stall doors shall comply with (m).
6. (A4.17.6) Grab Bars. Grab bars complying with the length and positioning shown in Fig. 22(a), (b), (c) and (d) shall be provided. Grab bars may be mounted by any desired method as long as they have a gripping surface at the locations shown and do not obstruct the required floor area. Grab bars shall comply with (z).

(r) (A4.18) Urinals.
1. (A4.18.1) General. Accessible urinals shall comply with (r).
2. (A4.18.2) Height. Urinals shall be stall-type or wall-hung with an elongated rim at a maximum of 17 in (430mm) above the floor.
3. (A4.18.3) Clear Floor Space. A clear floor space 30 in by 48 in (760mm by 1220mm) shall be provided in front of urinals to allow forward approach. This clear space shall adjoin or overlap an accessible route and shall comply with (b)4.
4. (A4.18.4) Flush Controls. Flush controls shall be hand operated, shall comply with (aa)4 and shall be mounted no more than 44 in (1120mm) above the floor.

(s) (A4.19) Lavatories and Mirrors.
1. (A4.19.1) General. The requirements of (s) shall apply to lavatory fixtures, vanities and built-in lavatories.
2. (A4.19.2) Height and Clearances. Lavatories shall be mounted with a clearance of at least 29 in (735mm) from the floor to the bottom of the apron. Knee and toe clearance shall comply with Fig. 23.
3. (A4.19.3) Clear Floor Space. A clear floor space 30 in by 48 in (760mm by 1220mm) complying with (b)4 shall be provided in front of a lavatory to allow a forward approach. Such clear floor space shall adjoin or overlap an accessible route and shall extend a maximum of 19 in (485mm) underneath the lavatory (see Fig. 24).
4. (A4.19.4) Exposed Pipes and Surfaces. Hot water and drain pipes under lavatories shall be insulated or otherwise covered. There shall be no sharp or abrasive surfaces under lavatories.
5. (A4.19.5) Faucets. Faucets shall comply with (aa)4. Lever-operated, push-type and electronically controlled mechanisms are examples of acceptable designs. Self-closing valves are allowed if the faucet remains open for at least 10 seconds.
6. (A4.19.6*) Mirrors. Mirrors shall be mounted with the bottom edge no higher than 40 in (1015mm) from the floor (see Fig. 23).
(t) (A4.20) Bathtubs.
1. (A4.20.1) General. Accessible bathtubs shall comply with (t). For bathtubs in adaptable dwelling units, see (hh)9.
2. (A4.20.2) Floor Space. Clear floor space in front of bathtubs shall be as shown in Fig. 25.
3. (A4.20.3) Seat. An in-tub seat or a seat at the head end of the tub shall be provided as shown in Fig. 25 and 26. The structural strength of seats and their attachments shall comply with (z)3. Seats shall be mounted securely and shall not slip during use.
4. (A4.20.4) Grab bars. Grab bars complying with (z) shall be provided as shown in Fig. 25 and 26.
5. (A4.20.5) Controls. Faucets and other controls complying with (aa)4 shall be located as shown in Fig. 26.
6. (A4.20.6) Shower Unit. A shower spray unit with a hose at least 60 in (1525mm) long that can be used as a fixed shower head or as a hand-held shower shall be provided.
7. (A4.20.7) Bathtub Enclosures. If provided, enclosures for bathtubs shall not be obstruct controls or transfer from wheelchairs onto bathtub seats or into tubs. Enclosures on bathtubs shall not have tracks mounted on their runs.

(u) (A4.21) Shower Stalls.
1. (A4.21.1*) General. Accessible shower stalls shall comply with (u). For shower stalls in adaptable dwelling units, see (hh)10.
2. (A4.21.2) Size and Clearances. Shower stall size and clear floor space shall comply with Fig. 27(a) or (b). The shower stall in Fig. 27(a) shall be 36 in by 36 in (915mm by 915mm). The shower stall in Fig. 27(b) shall fit into the space required for a bathtub.
3. (A4.21.3) Seat. A seat shall be provided in a shower stall 36 in by 36 in (915mm by 915mm) and shall be as shown in Fig. 28. The seat shall be mounted 17 in to 19 in (430mm to 485mm) from the bathroom floor and shall extend the full depth of the stall. The seat shall be on the wall opposite the controls. The structural strength of seats and their attachments shall comply with (z)3.
4. (A4.21.4) Grab Bars. Grab bars complying with (z) shall be provided as shown in Fig. 29.
5. (A4.21.5) Controls. Faucets and other controls complying with (aa)4 shall be located as shown in Fig. 29. In shower stalls 36 in by 36 in (915mm by 915mm), all controls, faucets and the shower unit shall be mounted on the side wall opposite the seat.
6. **(A4.21.6) Shower Unit.** A shower spray unit with a hose at least 60 in (1525mm) long that can be used as a fixed shower head or as a hand-held shower shall be provided.

7. **(A4.21.7) Curbs.** If provided, curbs in shower stalls 36 in by 36 in (915mm by 915mm) shall be no higher than 4 in (100mm). Shower stalls that are 30 in by 60 in (760mm by 1525mm) shall not have curbs.

8. **(A4.21.8) Shower Enclosures.** If provided, enclosures for shower stalls shall not obstruct controls or obstruct transfer from wheelchairs onto shower seats.

(v) **(A4.22) Toilet Rooms.**

1. **(A4.22.1) Minimum Number.** *Minimum accessible plumbing facilities to be provided may vary with occupant load and use, but in no case shall be less than the number specified in Table 64-A.*

2. **(A4.22.2) Doors.** All doors to accessible toilet rooms shall comply with (m). Doors shall not swing into the clear floor space required for any fixture.

3. **(A4.22.3) Clear Floor Space.** The accessible fixtures and controls required in (v)4, (v)5, (v)6, and (v)7 shall be on an accessible route. An unobstructed turning space complying with (b)3 shall be provided within an accessible toilet room. The clear floor spaces at fixtures and controls, the accessible route, and the turning space may overlap.

4. **(A4.22.4) Water Closets.** If toilet stalls are provided, then a reasonable number, but always at least one, shall comply with (q), its water closet shall comply with (p). If water closets are not in stalls, then a reasonable number, but always at least one, of water closets shall comply with (p).

5. **(A4.22.5) Urinals.** If urinals are provided, a reasonable number, but always at least one, shall comply with (r).

6. **(A4.22.6) Lavatories and Mirrors.** If lavatories and mirrors are provided, a reasonable number, but always at least one of each, shall comply with (s).

7. **(A4.22.7) Controls and Dispensers.** If controls, dispensers, receptacles or other equipment is provided, at least one of each shall be on an accessible route and shall comply with (aa).

(w) **(A4.23) Bathrooms, Bathing Facilities and Shower Rooms.**

1. **(A4.23.1) Minimum Number.** *Minimum accessible plumbing facilities to be provided may vary with occupant load and use, but in no case shall be less than the number specified in Table 64-A.*
2. (A4.23.2) Doors. Doors to accessible bathrooms shall comply with (m). Doors shall not swing into the floor space required for any fixture.

3. (A4.23.3) Clear Floor Space. The accessible fixtures and controls required in (w)4, (w)5, (w)6, (w)7, (w)8, and (w)9 shall be on an accessible route. An unobstructed turning space complying with (b)3 shall be provided within an accessible bathroom. The clear floor spaces at fixtures and controls, the accessible route and the turning space may overlap.

4. (A4.23.4) Water Closets. If toilet stalls are provided, then a reasonable number, but always at least one, shall comply with (q), its water closet shall comply with (p). If water closets are not in stalls, then a reasonable number, but always at least one, shall comply with (p).

5. (A4.23.5) Urinals. If urinals are provided, then a reasonable number, but always at least one, shall comply with (r).

6. (A4.23.6) Lavatories and Mirrors. If lavatories and mirrors are provided, then a reasonable number, but always at least one of each, shall comply with (s).

7. (A4.23.7) Controls and Dispensers. If controls, dispensers, receptacles or other equipment is provided, at least one of each shall be on an accessible route and shall comply with (aa).

8. (A4.23.8) Bathing and Shower Facilities. If tubs or showers are provided, then at least one accessible tub that complies with (t) or at least one accessible shower that complies with (u) shall be provided.

9. (A4.23.9*) Medicine Cabinets. If medicine cabinets are provided, at least one shall be located with a usable shelf no higher than 44 in (1120mm) above the floor space. The floor space shall comply with (b)4.

(x) (A4.24) Sinks.

1. (A4.24.1) General. If accessible sinks are provided, they shall comply with (x). Sinks in kitchens of accessible dwelling units shall comply with (hh)18.

2. (A4.24.2) Height. Sinks shall be mounted with the center or rim no higher than 34 in (865mm) from the floor.

3. (A4.24.3) Knee Clearance. Knee clearance that is 27 in (685mm) high, 30 in (760mm) wide and 19 in (485mm) deep shall be provided underneath sinks.
4. **(A4.24.4) Depth.** Each sink shall be a maximum of 6-1/2 in (165mm) deep.

5. **(A4.24.5) Clear Floor Space.** A clear floor space at least 30 in by 48 in (760mm by 1220mm) complying with (b)4 shall be provided in front of a sink to allow forward approach. The clear floor space shall be on an accessible route and shall extend a maximum of 19 in (485mm) underneath the sink *(see Fig. 24)*.

6. **(A4.24.6) Exposed Pipes and Surfaces.** Hot water and drain pipes under sinks shall be insulated or otherwise covered. There shall be no sharp or abrasive surfaces under sinks.

7. **(A4.24.7) Faucets.** Faucets shall comply with (aa)4. Lever-operated, push-type, touch-type, or electronically controlled mechanisms are acceptable designs.

(y) **(A4.25) Storage.**
1. **(A4.25.1) General.** If provided, accessible storage facilities such as cabinets, shelves, closets and drawers shall comply with (y).

2. **(A4.25.2) Clear Floor Space.** A clear floor space at least 30 in by 48 in (760mm by 1220mm) complying with (b)4 that allows either a forward or parallel approach by a person using a wheelchair shall be provided at accessible storage facilities.

3. **(A4.25.3) Height.** Accessible storage spaces shall be within at least one of the reach ranges specified in (b)5 and (b)6. Clothes rods shall be a maximum of 54 in (1370mm) from the floor *(see Fig. 30)*.

4. **(A4.25.4) Hardware.** Hardware for accessible storage facilities shall comply with (aa)4. Touch latches and U-shaped pulls are acceptable.

(z) **(A4.26) Handrails, Grab Bars and Tub and Shower Seats.**
1. **(A4.26.1*) General.** All handrails, grab bars and tub and shower seats shall comply with (z).

2. **(A4.26.2*) Size and Spacing of Grab Bars and Handrails.** The diameter or width of the gripping surface of a handrail or grab bar shall be 1-1/4 in to 1-1/2 in (32mm to 38mm) or the shape shall provide an equivalent gripping surface. If handrails or grab bars are mounted adjacent to a wall, the space between the wall and the handrail or grab bar shall be 1-1/2 in (38mm) *(see Fig. 31(a), (b) and (c))*. Handrails may be located in a recess if the recess is a maximum of 3 in (75mm) deep and extends at least 18 in (455mm) above the top of the rail *(See Fig. 31(d))*.
3. (A4.26.3) Structural Strength. The structural strength of grab bars, tub and shower seats, fasteners and mounting devices shall meet the following specifications:

(1) Bending stress in a grab bar or seat induced by the maximum bending moment from the application of 250 lbf (1112N) shall be less than the allowable stress for the material of the grab bar or seat.

(2) Shear stress induced in a grab bar or seat by the application of 250 lbf (1112N) shall be less than the allowable shear stress for the material of the grab bars or seat. If the connection between the grab bar or seat and its mounting bracket or other support is considered to be fully restrained, then direct and torsional shear stresses shall be totaled for the combined shear stress, which shall not exceed the allowable shear stress.

(3) Shear force induced in a fastener or mounting device from the application of 250 lbf (1112N) shall be less than the allowable lateral load of either the fastener or mounting device or the supporting structure, whichever is the smaller allowable load.

(4) Tensile force induced in a fastener by a direct tension force of 250 lbf (1112N) plus the maximum moment from the application of 250 lbf (1112N) shall be less than the allowable withdrawal load between the fastener and the supporting structure.

(5) Grab bars shall not rotate within their fittings.

4. (A4.26.4) Eliminating Hazards. A handrail or grab bar and any wall or other surface adjacent to it shall be free of any sharp or abrasive elements. Edges shall have a minimum radius of 1/8 in (3.2mm).

(aa)

(A4.27) Controls and Operating Mechanisms.

1. (A4.27.1) General. Controls and operating mechanisms in accessible spaces, along accessible routes, or as part of accessible elements (for example, light switches, dispenser controls) shall comply with (aa).

2. (A4.27.2) Clear Floor Space. Clear floor space complying with (b)4 that allows a forward or a parallel approach by a person using a wheelchair shall be provided at controls, dispensers, receptacles and other operable equipment.
3. **(A4.27.3) Height.** The highest operable part of all controls, dispensers, receptacles and other operable equipment shall be placed within at least one of the reach ranges specified in (b)5 and (b)6. Except where the use of special equipment dictates otherwise, electrical and communications system receptacles on walls shall be mounted no less than 15 in (380mm) above the floor.

4. **(A4.27.4) Operation.** Controls and operating mechanisms *except in H-3 occupancies* shall be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist. The force required to activate controls shall be no greater than 5 lbf (22.2N).

(bb) **(A4.28) Alarms.**

1. **(A4.28.1) General.** If emergency warning systems are provided, they shall include both audible alarms complying with (bb)2 and visual alarms complying with (bb)3. In facilities with sleeping accommodations, the sleeping accommodations shall have an auxiliary visual alarm system complying with (bb)4.

2. **(A4.28.2) Audible Alarms.** Audible alarms shall comply with the requirements of Chapter 38.

3. **(A4.28.3) Visual Alarms.** Visual alarms shall be provided in all areas required to be accessible. Visual alarms shall conform to the requirements of Chapter 38.

4. **(A4.28.4) Auxiliary Alarms.** Accessible sleeping accommodations shall have a visual alarm connected to the building fire alarm system conforming to the requirements of Chapter 38.

(cc) **(A4.29) Tactile Warnings.**

1. **(A4.29.1) Reserved.**

2. **(A4.29.2) Reserved.**

3. **(A4.29.3)* Tactile Warnings on Doors to Hazardous Areas.** Doors that lead to areas that might prove dangerous to a blind person (for example, doors to loading platforms, boiler rooms, stages and the like) shall be made identifiable to the touch by a textured surface on the door handle, knob, pull or other operating hardware. This textured surface may be made by knurling or roughening or by a material applied to the contact surface. Such textured surfaces shall not be provided for emergency exit doors or any doors other than those to hazardous areas.

4. **(A4.29.4) Reserved.**

5. **(A4.29.5) Reserved.**
6. (A4.29.6) Reserved.
7. (A4.29.7) Reserved.

(dd) (A4.30) Signage.
1. (A4.30.1*) General. All signage that provides emergency information or general circulation directions shall comply with (dd)2, (dd)3 and (dd)5. Tactile signage shall also comply with (dd)4.
2. (A4.30.2) Character Proportion. Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10.
3. (A4.30.3*) Color Contrast. Characters and symbols shall contrast with their background—either light characters on a dark background or dark characters on a light background.
4. (A4.30.4*) Raised or indented characters or symbols. Letters and numbers on signs shall be raised or incised 1/32 in (0.8mm) minimum and shall be sans serif characters. Raised characters or symbols shall be at least 5/8 in (16mm) high, but no higher than 2 in (50mm). Indented characters or symbols shall have a stroke width of at least 1/4 in (6mm). Symbols or pictographs on signs shall be raised or indented 1/32 in (0.8mm) minimum.
5. (A4.30.5) Symbols or Accessibility. When accessible facilities are identified, then the international symbol of accessibility shall be used. The symbol shall be displayed as shown in Fig. 32.

(ee) (A4.31) Reserved.

(ff) (A4.32) Seating, Tables and Work Surfaces.
1. (A4.32.1) Minimum Number. If fixed or built-in seating, tables or work surfaces are provided in accessible spaces, a reasonable number, but always at least one, of seating spaces, tables or work surfaces shall comply with (ff).
2. (A4.32.2) Seating. If seating spaces for people in wheelchairs are provided at tables, counters or work surfaces, clear floor spaces complying with (b)4 shall be provided. Such clear floor space shall not overlap knee space by more than 19 in (485mm) (see Fig. 33).
3. (A4.32.3) Knee Clearances. If seating for people in wheelchairs is provided at tables, counters and work surfaces, knee spaces at least 27 in (685mm) high, 30 in (760mm) wide and 19 in (485mm) deep shall be provided (see Fig. 33).
4. (A4.32.4*) Height of Work Surfaces. The tops of tables and work surfaces shall be from 28 in to 34 in (710mm to 865mm) from the floor or ground.
(gg) (A4.33) Assembly Areas.

1. (A4.33.1) Minimum Number. If assembly areas are provided, accessible viewing positions shall comply with (gg) and the following table:

<table>
<thead>
<tr>
<th>Capacity of Assembly</th>
<th>Number of Viewing Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 25</td>
<td>1</td>
</tr>
<tr>
<td>26 to 50</td>
<td>2</td>
</tr>
<tr>
<td>51 to 75</td>
<td>3</td>
</tr>
<tr>
<td>76 to 100</td>
<td>4</td>
</tr>
<tr>
<td>101 to 150</td>
<td>5</td>
</tr>
<tr>
<td>151 to 200</td>
<td>6</td>
</tr>
<tr>
<td>201 to 300</td>
<td>7</td>
</tr>
<tr>
<td>301 to 400</td>
<td>8</td>
</tr>
<tr>
<td>401 to 500</td>
<td>9</td>
</tr>
<tr>
<td>501 to 1000</td>
<td>(1)</td>
</tr>
<tr>
<td>Over 1000</td>
<td>(2)</td>
</tr>
</tbody>
</table>

(1) 2 percent of total
(2) 20 plus 1 for each 100 over 1000

Assembly areas with audio-amplification systems shall have a listening system complying with (gg)6 and (gg)7 to assist a reasonable number of people, but no fewer than two, with severe hearing loss in the appreciation of audio presentations.

2. (A.33.2*) Size of Wheelchair Locations. Each wheelchair location shall provide minimum clear ground or floor spaces as shown in Fig. 34 and shall accommodate two people in wheelchairs.

3. (A4.33.3*) Placement of Wheelchair Locations. Wheelchair areas shall be an integral part of any fixed seating plan and shall be dispersed throughout the seating area. They shall adjoin an accessible route that also serves as a means of egress in case of emergency and shall be located to provide lines of sight comparable to those for all viewing areas.

4. (A4.33.4) Surfaces. The ground or floor at wheelchair locations shall be level and comply with (e).

5. (A4.33.5) Access to Performing Areas. An accessible route shall connect wheelchair seating locations with performing areas, including stages, arena floors, dressing rooms, locker rooms and other spaces used by performers.

6. (A4.33.6*) Placement of Listening Systems. If the listening system provided serves individual fixed seats, then such seats shall be located within a 50 ft (15 m) viewing distance of the stage or playing area and shall have a complete view of the stage or playing area.

7. (A4.33.7*) Types of Listening Systems. Audio loops and radio frequency systems are two acceptable types of listening systems.
(hh) (A4.34) Dwelling Units.

1. (A4.34.1) General. In H-1, H-2, and H-3 occupancies consisting of 8 or more units, one unit of the first 8 units and one unit for each 7 units thereafter shall comply with the requirements of Section 6402 (hh) for accessible housing.

   Exception: H-3 occupancies where all sleeping facilities are on the second floor.

2. (A4.32.2") Minimum Requirements. An accessible dwelling unit shall be on an accessible route. An accessible dwelling unit shall have the following accessible elements and spaces as a minimum:

   (1) Common spaces and facilities serving individual accessible dwelling units (for example, entry walks, trash disposal facilities and mail boxes) shall comply with (b) through (gg).

   (2) Accessible spaces shall have maneuvering space complying with (b)2 and (b)3 and surfaces complying with (e).

   (3) At least one accessible route complying with (c) shall connect the accessible entrances with all accessible spaces and elements within dwelling units.

   (4) Reserved.

   (5) Reserved.

   (6) Doors to and in accessible spaces that are intended for passage shall comply with (m).

   (7) A reasonable number, but always at least one of accessible entrances to the dwelling unit shall comply with (n).

   (8) Storage in accessible spaces in dwelling units, including cabinets, shelves, closets and drawers shall comply with (y).

   (9) All controls in accessible spaces except in H-3 occupancies shall comply with (aa). Those portions of heating, ventilating, and air-conditioning equipment requiring regular, periodic maintenance and adjustment by the resident of a dwelling shall be accessible to people in wheelchairs. If air distribution registers must be placed in or close to ceilings for proper air circulation, this specification shall not apply to the registers. at least one, of alarm connections complying with (bb)4 shall be provided in the dwelling unit.

   (11) Reserved.

   (12) A reasonable number, but always at least one, of full bathrooms shall comply with (hh)5. A full bathroom shall include a water closet, a lavatory and a bathtub or a shower.

   (13) The kitchen shall comply with (hh)13.
(14) If laundry facilities are provided, they shall comply with (hh)24.

(15) The following spaces shall be accessible and shall be on an accessible route:

(i) The living area, including kitchen.

(ii) The dining area.

(iii) The sleeping area, or the bedroom in one-bedroom dwelling units or one-bedroom in dwelling units with two or more bedrooms.

(iv) Balconies, carports and garages, if provided with the dwelling unit. *Grade level entry while not required is preferred and can be achieved with wood earth separation in conformance with Chapter 25 of this Code through construction of a foundation wall with a reverse ledge designed to provide bearing for wood framing with concrete at least 3 in (78mm) in thickness separating the wood from the earth.*

3. (A4.34.3) Adaptability. Consumer information required by Section (hh)4 shall be provided with each filing for a building permit for H-2 and H-3 occupancy buildings. The specifications of (hh)5 and (hh)13 as modified by this Chapter are based on the concept of adaptability.

4. (A4.34.4) Consumer Information. To ensure that the existence of adaptable features will be known to the owner or occupant of a dwelling, the following consumer information shall be provided in each accessible dwelling unit for rent or sale:

(1) Notification of the alternate heights available for the kitchen counter and sink, and the existence of removable cabinets and bases, if provided, under counters, sinks and lavatories.

(2) Notification of the provisions for the installation of grab bars at toilets, bathtubs and showers.

(3) Notification that the dwelling unit is equipped to have a visual emergency alarm installed.

(4) Identification of the location where information and instructions are available for changing the height of counters, removing cabinets and bases, installing a visual emergency alarm system, and installing grab bars.

(5) Notification that the dwelling unit has been designed in accordance with American National Standard Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People, ANSI A117.1-1980.
In addition, the renters and buyers of accessible dwelling units shall be provided with the following information:

(1) Reserved.
(2) Reserved.
(3) Reserved.
(4) Reserved.
(5) Reserved.

5. \((A4.34.5^*)\) Adaptable Bathrooms. Adaptable bathrooms shall be on an accessible route and shall comply with the requirements of (hh) 5 - 12.

6. \((A4.34.5.1)\) Doors. *Doors may swing into the clear floor space required for any fixture, but shall not encroach into the required clear space when opened 90° or more.*

7. \((A4.34.5)\) Water Closets.

(1) Clear floor space at the water closet shall be as shown in Fig. 35(a). The water closet may be located with the clear area at either the right or left side of the toilet.

(2) The height of the water closet shall be at least 15 in (380mm) measured to the top of the toilet seat.

(3) Structural reinforcement or other provisions that will allow installation of grab bars shall be provided in the locations shown in Fig. 35(b). If provided, grab bars shall be installed as shown in Fig. 21. and shall comply with (a).

(4) The toilet paper dispenser shall be installed within reach as shown in Fig. 35(b).

8. \((A4.34.5.3)\) Lavatory, Mirrors and Medicine Cabinets.

(1) The lavatory and mirrors shall comply with (s).

(2) If a cabinet is provided under the lavatory, then it shall be removable to provide the clearances specified in (s)2.

(3) If a medicine cabinet is provided above the lavatory, then the bottom of the medicine cabinet shall be located with a usable shelf no higher than 44 in (1120mm) above the floor.

9. \((A4.34.5.4)\) Bathtubs. If a bathtub is provided, then it shall have the following features:

(1) Floor Space. Clear floor space at bathtubs shall be as shown in Fig. 25.

(2) Reserved.

(3) Grab Bars. Structural reinforcement or other provisions that will allow installation of grab bars shall be provided in the locations shown in Fig. 36. If provided, grab bars shall be installed as shown in Fig. 26. and shall comply with (a).

(4) Controls. Faucets and other controls shall be located as shown in Fig. 26 and shall comply with (aa)4.
(5) Shower Unit. A shower spray unit with a hose at least 60 in (1525mm) long that can be used as a fixed shower head or as a hand-held shower shall be provided. In H-1, H-2, and H-3 occupancies if only a tub is provided, it must comply with this requirement; if both a tub and a shower are provided, one must comply with this requirement.

10. (A4.34.5.5) Showers. If a shower is provided, it shall have the following features:

(1) Size and Clearances. Shower stall size and clear floor space shall comply with either Fig. 27(a) or (b). The shower stall in Fig. 27(a) shall be 36 in by 36 in (915mm by 915mm). The shower stall in Fig. 27(b) will fit into the same space as a standard 60 in (1525mm) long bathtub.

(2) Seat. A seat shall be provided in the shower stall in Fig. 27(a) as shown in Fig. 28. The seat shall be 17 in to 19 in (430mm to 485mm) high measured from the bathroom floor and shall extend the full depth of the stall. The seat shall be on the wall opposite the controls. The structural strength of seats and their attachments shall comply with (z)3. Seats shall be mounted securely and shall not slip during use.

(3) Grab Bars. Structural reinforcement or other provisions that will allow installation of grab bars shall be provided in the locations shown in Fig. 37. If provided, grab bars shall be installed as shown in Fig. 29 and shall comply with (z).

(4) Controls. Faucets and other controls shall be located as shown in Fig. 29 and shall comply with (aa)4. In the shower stall in Fig. 27(a), all controls, faucets and the shower unit shall be mounted on the side wall opposite the seat.

(5) Shower Unit. A shower spray unit with a hose at least 60 in (1525mm) long that can be used as a fixed shower head or as a hand-held shower shall be provided. In H-1, H-2 and H-3 occupancies if only a shower is provided it must comply with this requirement; if both a tub and a shower are provided, one must comply with this requirement.

11. (A4.34.5.6) Bathtub and Shower Enclosures. Enclosures for bathtubs or shower stalls shall not obstruct controls or transfer from wheelchairs onto shower or bathtub seats. Enclosures on bathtubs shall not have tracks mounted on their rims.

12. (A4.34.5.7) Clear Floor Space. Clear floor space at fixtures may overlap.

13. (A4.34.6) Adaptable Kitchens. Kitchens and their components shall be on an accessible route and shall comply with the requirements of (hh)13 - 22.
14. **(A4.34.6.1*) Clearance.** Clearances between all opposing base cabinets, counter tops, appliances or walls shall be 40 in (1015mm) minimum, except in U-shaped kitchens, where such clearance shall be 60 in (1525mm) minimum.

15. **(A4.34.6.2) Clear Floor Space.** A clear floor space at least 30 in by 48 in (760mm by 1220mm) complying with (b)5 that allows either a forward or a parallel approach by a person in a wheelchair shall be provided at all appliances in the kitchen, including the range or cooktop, oven refrigerator/freezer, dishwasher and trash compactor. Laundry equipment located in the kitchen shall comply with (hh)24.

16. **(A4.34.6.3) Controls.** All controls in kitchen shall comply with (aa).

17. **(A4.34.6.4) Work Surfaces.** At least one 30 in (760mm) section of counter shall provide a work surface that complies with the following: *(See Fig. 38)*

   1. The counter shall be adjustable or replaceable as a unit.
   2. Base cabinets. If provided, shall be removable under the full 30 in (760mm) minimum frontage of the counter. The finished floor shall extend under the counter to the wall.
   3. Counter thickness and supporting structure shall be 2 in (50mm) maximum over the required clear area.
   4. A clear floor space 30 in by 48 in (760mm by 1220mm) shall allow a forward approach to the counter. Nineteen inches (485mm) maximum of the clear floor space may extend underneath the counter. The knee space shall have a minimum clear width of 30 in (760mm) and a minimum clear depth of 19 in (485mm). This may be accomplished by the use of a removable front panel.
   5. There shall be no sharp or abrasive surfaces under such counters.

18. **(A4.34.6.5*) Sink.** The sink and surrounding counter shall comply with the following requirements *(see Fig. 39):*

   1. The total width of the sink and counter area shall be 30 in (760mm) minimum. Initial installation may include standard base-cabinetry and a 36 in (915mm) high countertop.
   2. Rough-in plumbing shall be located to accept connections of supply and drain pipes for sinks mounted at the height of 28 in (710mm).
   3. The depth of a sink bowl shall be no greater than 6-1/2 in (165mm). Only one bowl of double or triple-bowl sinks needs to meet this requirement.
   4. Faucets shall comply with (aa)4. Lever-operated or push-type mechanisms are two acceptable designs.
(5) Base Cabinets, if provided, shall be removable under the full 30 in (760mm) minimum frontage of the sink and surrounding counter. The finished flooring shall extend under the counter to the wall.

(6) *Upon adaptation*, counter thickness and supporting structure shall be 2 in (50mm) maximum over the required clear space.

(7) A clear floor space 30 in by 48 in (760mm by 1220mm) shall allow forward approach to the sink. Nineteen inches (485mm) maximum of the clear floor space may extend underneath the sink. The knee space shall have a minimum clear width of 30 in (760mm) and a clear depth of 19 in (485mm).

(8) There shall be no sharp or abrasive surfaces under sinks. Hot water and drain pipes under sinks shall be insulated or otherwise covered.

19. **Ranges and Cooktops.** Ranges and cooktops shall comply with (hh)15 and (hh)16. If ovens or cooktops have knee spaces underneath, then they shall be insulated or otherwise protected on the exposed contact surfaces to prevent burns, abrasions or electrical shock. The clear floor space may overlap the knee space, if provided, by 19 in (485mm) maximum. The location of controls for ranges and cooktops shall not require reaching across burners.

20. **Ovens.** Ovens shall be of the self-cleaning type and be located adjacent to an adjustable height counter with knee space below *(see Fig. 40)*. For side-opening ovens, the door latch side shall be next to the open counter space, and there shall be a pull-out shelf under the oven extending the full width of the oven and pulling out not less than 10 in (255mm) when fully extended. Ovens shall have controls on front panels. They may be located on either side of the door.

21. **Refrigerators/Freezers.** Refrigerator/freezers shall comply with (hh)21. Refrigerators shall be:

(1) Of the vertical side-by-side refrigerator/freezer type; or

(2) Of the over-and-under type and meet the following requirements:

(i) Have at least 50 percent of the freezer space below 54 in (1370mm) above the floor.

(ii) Have 100 percent of the refrigerator space and controls below 54 in (1370mm).

Freezers with less than 100 percent of the storage volume within the limits specified in (b)5 or (b)6 shall be the self-defrosting type.
22 (A4.34.6.9) Dishwashers shall comply with (hh)15 and (hh)16. Dishwashers shall have all rack space accessible from the front of the machine for loading and unloading dishes.

23. (A4.34.6.10*) Kitchen Storage. Cabinets, drawers and shelf storage areas shall be adaptable to comply with (y) and shall have the following features:
   (1) Maximum height shall be 48 in (1220mm) for at least one shelf of one cabinet or storage shelf (see Fig. 38).
   (2) Door pulls or handles for wall cabinets shall be mounted as close to the bottom of cabinet doors as possible. Door pulls or handles for base cabinets shall be mounted as close to the top of cabinet doors as possible.

24. (A4.34.7) Laundry Facilities. If laundry equipment is provided within individual accessible dwelling units, or if separate laundry facilities serve one or more accessible dwelling units, then they shall meet the requirements of (hh)25 through (hh)27.

25. (A4.34.7.1) Location. Laundry facilities and laundry equipment shall be on an accessible route.

26. (A4.34.7.2) Washing Machines and Clothes Dryers. Washing machines and clothes dryers in common use laundry rooms shall be front loading.

27. (A4.34.7.3) Controls. Laundry equipment shall comply with (aa).

This ordinance shall be effective for plans for buildings and structures submitted to the Department on or after the first day of August, 1983 and for all buildings and structures on which permits are issued on or after the first day of October, 1983.

SECTION 6404. STANDARDS. Unless provided for in other Sections of this Building Code, the following Standards shall apply.

ORGANIZATION               TITLE OF PUBLICATION

ANSI                     Specifications for Making Buildings and Facilities
                          Accessible to and Usable by Physically
                          Pedestrian Doors, Power Operated. ANSI A
                          156.10-1979.

LEGEND                   ORGANIZATION

ANSI                     American National Standards Institute, Inc.
                          1430 Broadway
                          New York, N.Y. 10018

SECTION 6405. TABLES AND ILLUSTRATIONS.
<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>USE</th>
<th>WATER CLOSETS</th>
<th>URINALS</th>
<th>LAVATORIES</th>
<th>DRINKING FOUNTAINS</th>
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<td></td>
<td></td>
<td>MALE</td>
<td>FEMALE</td>
<td>MALE</td>
<td>FEMALE</td>
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<td></td>
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<tr>
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<td>addl. 900</td>
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<td>1 per 250</td>
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<td>1 per 225</td>
<td>1 per 150</td>
<td>1 per ea. 2 water clos.</td>
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<td>1 for each</td>
<td>1 for each</td>
<td>1 for each</td>
<td>water clos. and/or urin.</td>
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<td>addl. 150</td>
<td>1 per ea. 2</td>
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<td>1 per ea. 2 water clos.</td>
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<td>1 for each</td>
<td>1 for each</td>
<td>water clos. and/or urin.</td>
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<td>addl. 100</td>
<td>addl. 60</td>
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<td>1 per 40</td>
<td>1 per 60</td>
<td>1 per 60</td>
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</tbody>
</table>

(a) The plumbing facilities shown are for the number of persons shown or any fraction thereof. In regard to bathing facilities and shower rooms ANSI A117.1 (1980) Section (4.23) shall apply and separate handicap accessible facilities shall be provided for each sex for whom such facilities are provided. See Table 5-E
TABLE 64-B
GRAPHIC CONVENTIONS

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
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<tr>
<td>[Diagram]</td>
<td>Typical dimension line showing U.S. customary units (in inches) above the line and SI units (in millimeters) below</td>
</tr>
<tr>
<td>[Diagram]</td>
<td>Dimensions for short distances indicated on extended line</td>
</tr>
<tr>
<td>[Diagram]</td>
<td>Dimension line showing alternate dimensions required</td>
</tr>
<tr>
<td>[Diagram]</td>
<td>Direction of approach</td>
</tr>
<tr>
<td>max</td>
<td>Maximum</td>
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<tr>
<td>min</td>
<td>Minimum</td>
</tr>
<tr>
<td>...............</td>
<td>Boundary of clear floor area</td>
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<tr>
<td>-----------------</td>
<td>Centerline</td>
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TABLE 64-C
ALLOWABLE RAMP DIMENSIONS

Allowable Ramp Dimensions for Construction in Existing Sites, Buildings, and Facilities

<table>
<thead>
<tr>
<th>Slope*</th>
<th>Maximum Rise</th>
<th>Maximum Run</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>in</td>
<td>mm</td>
</tr>
<tr>
<td>Steeper than 1:10 but no steeper than 1:8</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Steeper than 1:12 but no steeper than 1:10</td>
<td>6</td>
<td>150</td>
</tr>
</tbody>
</table>

*A slope steeper than 1:8 not allowed.
TABLE 64-D
FIGURES
(Note: All numbers in parentheses refer to the ANSI A117.1-1980 Standard.)

Fig. 1
Minimum Clear Width for Single Wheelchair

Fig. 2
Minimum Clear Width for Two Wheelchairs

(a) 60-in (1525-mm) Diameter Space

Fig. (3)
Wheelchair Turning Space

(b) T-Shaped Space for 180° Turns
TABLE 64-D (Continued)

Fig. (4)
Minimum Clear Floor Space for Wheelchairs

(a) Clear Floor Space

(b) Forward Approach

(c) Parallel Approach

(d) Clear Floor Space in Alcoves

NOTE: If \( x \leq 24 \) in (610 mm), then an additional maneuvering clearance of 6 in (150 mm) shall be provided as shown.

NOTE: If \( x \leq 15 \) in (380 mm), then an additional maneuvering clearance of 12 in (305 mm) shall be provided as shown.

(e) Additional Maneuvering Clearances for Alcoves

64-38
TABLE 64-D (Continued)

High Forward Reach Limit

NOTE: x shall be < 25 in (635 mm); z shall be >= x. When x < 20 in (510 mm), then y shall be 48 in (1220 mm) maximum. When x is 20 to 25 in (510 to 635 mm), then y shall be 44 in (1120 mm) maximum.

(b) Maximum Forward Reach over an Obstruction

Fig. (5)
Forward Reach

64-39
TABLE 64-D (Continued)

(a) Clear Floor Space
Parallel Approach

(b) High and Low
Side Reach Limits

(c) Maximum Side Reach
over Obstruction

Fig. (6)
Side Reach
TABLE 64-D (Continued)

(a)  
90° Turn

(b)  
Turns around an Obstruction

NOTE: Dimensions shown apply when x < 48 in (1220 mm).

Fig. (7)  
Width of Accessible Route
TABLE 64-D (Continued)

(a) Walking Parallel to a Wall

(b) Walking Perpendicular to a Wall

Fig. (8) Protruding Objects
(c) Free-Standing Overhanging Objects

this overhang can be greater than 12 [305] because no one can approach the object from this direction

(d) Objects Mounted on Posts or Pylons

corridor or other circulation space

additional protection not required between wing walls

protruding objects hanging on wall with leading edges above 27 [685]

Example of Protection around Wall-Mounted Objects and Measurements of Clear Widths

Fig. (8)
Protruding Objects (Continued)
TABLE 64-D (Continued)

<table>
<thead>
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<th>Elevation</th>
<th>Section</th>
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<td><strong>curb</strong></td>
<td>12 min 305</td>
</tr>
<tr>
<td><strong>wall</strong></td>
<td>36 min 915</td>
</tr>
<tr>
<td><strong>vertical guard rail</strong></td>
<td>36 min 915</td>
</tr>
<tr>
<td><strong>railing with extended platform</strong></td>
<td>12 min 305</td>
</tr>
<tr>
<td></td>
<td>36 min 915</td>
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</tbody>
</table>

Fig. 9 (17)
Examples of Edge Protection and Handrail Extensions
TABLE 64-D (Continued)

Fig. 10 (18)
Usable Tread Width and Examples of Acceptable Nosings

Fig. 11 (19)
Stair Handrails
Table 64-D (Continued)

(c) Extension at Bottom of Run

(d) Extension at Top of Run

Fig. 11 (19)
Stair Handrails (continued)

NOTE: The automatic door reopening device is activated if an object passes through either line A or line B. Line A and line B represent the vertical locations of the door reopening device not requiring contact.

Fig. 12 (20)
Hoistway and Elevator Entrances
NOTE: Elevator cars with a minimum width less than that above but no less than 54 in (1370 mm) are allowed for elevators with capacities of less than 2000 lb. A center opening door application may necessitate increasing the 68-in (1730-mm) dimension.
TABLE 64-D (Continued)

(a) Panel Detail

(b) Control Height

(c) Alternate Locations of Panel with Center Opening Door

(d) Alternate Locations of Panel with Side Opening Door

Fig. 15 (23)
Car Controls
<table>
<thead>
<tr>
<th>FIG. 16 (24)</th>
</tr>
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<tbody>
<tr>
<td><strong>Clear Doorway Width and Depth</strong></td>
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<tr>
<td><strong>Maximum Doorway Depth</strong></td>
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</tbody>
</table>

<table>
<thead>
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<th>TABLE 64-D (Continued)</th>
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<td><strong>32 min</strong></td>
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<tr>
<td><strong>8 15</strong></td>
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<tr>
<td><strong>Detail</strong></td>
</tr>
<tr>
<td><strong>Hinged Door</strong></td>
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<tr>
<td><strong>Sliding Door</strong></td>
</tr>
<tr>
<td><strong>Folding Door</strong></td>
</tr>
<tr>
<td><strong>24 max</strong></td>
</tr>
<tr>
<td><strong>8 15</strong></td>
</tr>
</tbody>
</table>

Fig. 16 (24)
Clear Doorway Width and Depth

Maximum Doorway Depth
TABLE 64-D (Continued)

(a) Front Approaches — Swinging Doors

Note: \( x = 12 \text{ in} (305 \text{ mm}) \) if door has both a closer and latch.

(b) Hinge Side Approaches — Swinging Doors

Note: \( x = 36 \text{ in} (915 \text{ mm}) \) minimum if \( y = 60 \text{ in} (1525 \text{ mm}) \); \( x = 42 \text{ in} (1065 \text{ mm}) \) minimum if \( y = 54 \text{ in} (1370 \text{ mm}) \).

(c) Latch Side Approaches — Swinging Doors

Note: \( y = 48 \text{ in} (1220 \text{ mm}) \) minimum if door has closer.

Note: All doors in alcoves shall comply with the clearances for front approaches.

Fig. 17 (25)

Maneuvering Clearances at Doors

64-50
TABLE 64-D (Continued)

(d) Front Approach – Sliding Doors

(e) Slide Side Approach – Sliding Doors

(f) Latch Side Approach – Sliding Doors

NOTE: All doors in alcoves shall comply with the clearances for front approaches.

Fig. 17 (25)
Maneuvering Clearances at Doors (Continued)

Fig. 18 (26)
Two Hinged Doors in Series
(a) Spout Height and Knee Clearance

(b) Clear Floor Space

(c) Free-Standing Fountain or Cooler

(d) Built-In Fountain or Cooler

Fig. 19 (27)
Drinking Fountains and Water Coolers
TABLE 64-D (Continued)

Fig. 20 (28)
Clear Floor Space at Water Closets

Fig. 21 (29)
Grab Bars at Water Closets
TABLE 64-D (Continued)

(a) Standard Stall

(b) Alternative Stall
TABLE 64-D (Continued)

(c) Rear Wall of Standard Stall

(d) Side Walls

Fig. 22 (30)
Toilet Stalls (Continued)

Fig. 23 (31)
Lavatory Clearances

Fig. 24 (32)
Clear Floor Space at Lavatories

64-55
TABLE 64-D (Continued)

(a)

With Seat in Tub

(b)

With Seat at Head of Tub

SYMBOL KEY:
● Shower controls
△ Shower head
▽ Drain

Fig. 25 (33)
Clear Floor Space at Bathtubs
TABLE 64-D (Continued)

(a)
With Seat in Tub

(b)
With Seat at Head of Tub

Fig. 26 (34)
Grab Bars at Bathtubs
TABLE 64-D (Continued)

(a) 36-in by 36-in (915-mm by 915-mm) Stall

(b) 30-in by 60-in (760-mm by 1525-mm) Stall

Fig. 27 (35)
Shower Size and Clearances

Fig. 28 (36)
Shower Seat Design
TABLE 64-D (Continued)

(a)
36-in by 36-in (915-mm by 915-mm) Stall

(b)
30-in by 60-in (760-mm by 1525-mm) Stall

Fig. 29 (37)
Grab Bars at Shower Stalls
Fig. 30 (38)
Storage Shelves and Closets

Fig. 31 (39)
Size and Spacing of Handrails and Grab Bars
Fig. 31 (39)

Size and Spacing of Handrails and Grab Bars (Continued)
TABLE 64-D (Continued)

(a)
Proportions

(b)
Display Conditions

Fig. 32 (43)
International Symbol of Accessibility
TABLE 64-D (Continued)

(a)  
Forward or Rear Access

(b)  
Side Access

Fig. 34 (46)  
Space Requirements for Wheelchair  
Seating Spaces in Series
TABLE 64-D (Continued)

(a)
Clear Floor Space for Adaptable Bathrooms

(b)
Reinforced Areas for Installation of Grab Bars

NOTE: The hatched areas are reinforced to receive grab bars.

Fig. 35 (47)
Water Closets in Adaptable Bathrooms

64-65
(a) With Seat in Tub

(b) With Seat at Head of Tub

NOTE: The hatched areas are reinforced to receive grab bars.

Fig. 36 (48)
Location of Grab Bars and Controls of Adaptable Bathtubs
TABLE 64-D (Continued)

(a) 36-in by 36-in (915-mm by 915-mm) Stall

(b) 30-in by 60-in (750-mm by 1525-mm) Stall

NOTE: The hatched areas are reinforced to receive grab bars.

Fig. 37 (49)
Location of Grab Bars and Controls of Adaptable Showers
TABLE 64-D (Continued)

(a)
Before Removal of Cabinets and Base

(b)
Cabinets and Base Removed and Height Alternatives

Fig. 38 (50)
Counter Work Surface
TABLE 64-D (Continued)

(a) Before Removal of Cabinets and Base

![Diagram of cabinets and base](image)

(b) Cabinets and Base Removed and Height Alternatives

![Diagram showing different heights](image)

Fig. 39 (51)
Kitchen Sink

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(a) Side-Hinged Door

![Diagram of side-hinged door](image)

(b) Bottom-Hinged Door

![Diagram of bottom-hinged door](image)

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**SYMBOL KEY:**
1. Countertop or wall-mounted oven.
2. Pull-out board preferred with side-opening door.
3. Clear open space.
4. Bottom-hinged door.

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Fig. 40 (52)
Ovens without Self-Cleaning Feature

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Section 6501

(a) **General.** The purpose of this Solar Energy Code is to provide minimum standards for the utilization of solar energy for domestic, commercial or industrial space heating or cooling, domestic hot water heating, swimming pool or spa heating and refrigeration systems and to maintain and promote the public health, safety and welfare by regulating and controlling the design, use, construction, quality of materials, location and maintenance of all solar energy equipment and appurtenances located within the City and County of Denver. In addition to other portions of this Building Code, this Chapter shall cover passive and active solar heating systems.

(b) **Permits and Inspections.** See Chapter 3

(c) **Additions, Alterations and Repairs.** Prior to making additions or alterations on existing systems, approval of the Department and required building permits shall be obtained. Repairs shall be made by contractors licensed to perform the necessary repair, alteration or addition.

(d) **Alternate Materials and Methods of Construction and Equipment.** See Chapter 1.

(e) **Modifications.** Modifications shall not be made to any equipment unless prior approval has been obtained from the manufacturer, listing agency and Department.

(f) **Tests.** All equipment and materials utilized in solar systems shall be tested, certified and labeled by the manufacturer and a recognized testing laboratory and be approved by the Department. All equipment and materials shall be certified to withstand the maximum stagnation temperature and pressure it may be subjected to.

(g) **Unsafe Equipment.** Unsafe equipment is equipment or materials that may constitute a health, safety or fire hazard. Equipment or materials having defects or that may be a safety or fire hazard shall be condemned by the
Department per Section 107, 108, and 109 and the use of the system incorporating such defective materials or equipment shall be shut off and not be used until repairs approved by the Department have been made. Without limitation of the foregoing, any solar system where one or more of the following conditions exists shall be determined to be hazardous by the Department.

1. Broken or cracked components including piping, tanks, collectors, heat exchangers, valves and controls.
2. Defective or leaking piping, controls or equipment.
3. Defective or improperly installed or located equipment of appurtenances.
4. Defective or maladjusted controls.
5. Systems not provided with proper safety controls.
7. Systems utilizing fluids which are not compatible with system components.
8. Where a possibility of cross connection to potable water exists.
9. Where a possibility of back siphonage exists.
10. Components with combustible temperatures less than or equal to the maximum temperatures the components must sustain.
11. Where solar system components are located closer to combustible material than specified by the manufacturer's data or recognized standards.

(h) Existing New Method and Material Approvals. Equipment and materials previously approved by the Department under New Methods and Materials (Section III) that are not in compliance with equipment and materials specified in this Chapter shall be made to comply within 180 days of enactment of this ordinance, or the approval will be null and void.

EXCEPTION: At the discretion of the Department, this time may be extended provided the manufacturer has applied for an extension within the 180 days and is diligently attempting to comply.
(i) Identification and Operation of System. Each component part used in a solar system shall have stamped, cast or indelibly marked on it the makers mark or name, the weight, pressure limitation and when required, the approved standard that applies. Operating instructions shall be provided on the premises describing the complete operation and maintenance of the system including what type fluids should be used and location and operation of all operating and safety controls.

(j) Maintenance. It shall be the responsibility of the property owner or his designated agent to properly maintain and operate the system.

(k) Access. All components of the solar system shall be accessible for inspection, repair or replacement.

(l) Protection of Hot Surfaces.

1. Solar heating systems and components which are subject to human contact and which operate at temperatures in excess of 140 degrees F. shall be insulated with approved materials. (Excluding pumps, valves, controls and Solar Collectors.)

(m) Most Restrictive. Wherever in any specific case the requirements of different sections of this Building Code vary, the most restrictive shall govern.

(n) Systems

This section is inclusive of all types of solar systems and includes, but is not limited to, the following types:

1. Passive space conditioning systems.
   A. Direct gain collection (natural convection, radiation and distribution).
      (1) Direct gain through windows
      (2) Vertical glazing and skylights
      (3) Thermal or trombe walls
      (4) Greenhouses

2. Passive domestic water heating systems
   A. Utilizes potable water only.
      (1) Integral system.
      (2) Batch system.
3. Active space conditioning air systems.
   A. Flat plate or concentrating collectors
      (1) Rock or liquid storage.
      (2) Forced air convective loop distribution.
      (3) Air to domestic hot water coils or exchangers.
      (4) Air to space heating coils or exchangers.

   A. Flat plate or concentrating collector.
      (1) Open systems.
      (2) Closed systems.

5. Active domestic hot water heating systems.
   A. Flat plate or concentrating collectors.
      (1) Open loop.
      (2) Closed loop.

6. Thermosiphon domestic Water Heating System. Potable water only is used and storage tanks located above collectors.

   A. Flat plate unglazed collectors (plastic and rubber components permitted).
   B. Glazed collectors (copper or steel pipe required to mixing valve).

   A. Glazed flatplate or concentrating collectors.
      (1) Absorption refrigeration.
      (2) Rankine cycle refrigeration.

Section 6502
Definitions. The following definitions are those that are not previously defined in other applicable chapters of this Building Code.

Accessible - Permitting close approach which may require removal or opening of an access panel, door, or similar obstructions.

Adversely Affected - Having been interfered with in a manner or to an extent which may result in a hazard.

Approved - Accepted or acceptable under an applicable
specification or standard stated or cited in this code and accepted as suitable for the proposed use by the Department.

Automatic - Self-acting, operating by its own mechanism when activated by some impersonal influence.

Auxiliary Energy Systems - Equipment utilizing energy other than incident solar either to supplement the output provided by the solar energy system as required by the design conditions; or to provide backup energy as required by the operating conditions when the solar energy system is unable to maintain design conditions. (Also called a backup system.)

Closed Loop System - A system in which heat-transfer fluid from collectors is circulated through a heat exchanger, passing its heat to the heat-storage medium (water, rocks, eutectic salts, etc.) while remaining isolated from it.

Collector, Solar - A component used for absorbing solar radiation, converting it into usable thermal energy, and for transferring the thermal energy to a heat transfer medium.

Combustible Liquid - A liquid having a flash point at or above 100 degrees F. Combustible liquid Sub-Divisions:

II. Flash point at or above 100 F and below 140 F.
III. A. Flash point at or above 140 F and below 200 F.
III. B. Flash point at or above 200 F.

Component - A distinct device or assembly that forms a functional part of a solar system including but not limited to collectors, storage, controls, pumps, etc.

Control Subsystem - The assembly of devices, whether electrical, pneumatic, or hydraulic, used to regulate the collecting, transporting, storing and utilizing energy in response to the thermal, safety and health requirements of the building and its occupants.

Corrosive Fluids - Fluids which, when in contact with living tissue, will cause damage to such tissue, or which will ignite when in contact with organic matter or
other chemicals.

Distribution System - That portion of a solar energy system which contains a heat transfer medium and moves energy throughout the system through ducts, pipes, or other means.

Drainback System - The solar heat transfer fluid automatically drains from the collector loop into a non-pressurized or pressurized tank by gravity. A heat exchanger is used to transfer heat to the pressurized water system.

Draindown System - Water is circulated from a storage tank through the collector loop. Freeze protection is provided by an automatic valve opening and dumping water at a preset low temperature.

Elasticity - The property of materials by virtue of which they tend to recover their original size and shape after deformation.

Expansion, Linear, Coefficient of - The rate of the change in length of a body with respect to the original length, for a unit change in temperature.

Flammable Liquid - Shall mean a liquid having a flash point below 100 degrees F and having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 100 degrees F and shall be known as a Class I liquid and shall be subdivided as follows:

1. Class IA Shall include those having flash points below 73 degrees F and having a boiling point below 100 degrees F.

2. Class IB shall include those having flash points below 73 degrees F and having a boiling point at or above 100 degrees F.

3. Class IC shall include those having flash points at or above 73 degrees F and below 100 degrees F.

Flash Point - The minimum temperature at which a fluid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the fluid within the vessel as specified by appropriate test
procedure and apparatus as follows:
The flash point of a fluid having a viscosity less than 45 SUS at 100 degrees F and a flash point below 200 degrees F shall be determined in accordance with the "Standard Method of Test for Flash Point by the Tag Closed Tester." ASTM D-56-77.
The flashpoint of a fluid having a viscosity of 45 SUS or more at 100 degrees F or a flash point of 200 degrees F or higher shall be determined in accordance with the "Standard Method of Test for flash Point by Pensky-Martens Closed Tester." ASTM D-93-77.
Fluid - Any material which has a fluidity greater than that of 300 penetration asphalt when tested in accordance with "Test for Penetration for Bituminous Material," ASTM D-5-73 (1978). When not otherwise identified, the term fluid shall mean both flammable and combustible fluid (Air and gas are also fluids.)
Heat Exchanger - A device designed to transfer heat between two physically separated fluids.
Heat Exchanger - Vented Double Wall - A heat exchanger provided with two physically separated heat transfer surfaces with positive leak detection to atmosphere between the surfaces.
Heat Transfer Fluid - A fluid used to transfer heat from one medium to another.
Limit Control - A device responsive to changes in pressure, temperature or liquid level that will activate or deactivate pumps, valves or other components to keep the system within design parameters.
Manual - Operated by personal intervention; also called non-automatic.
Maximum Allowable Pressure - The maximum gauge pressure permitted in a system.
Maximum Operating Pressure - The maximum working pressure is the maximum pressure the system is designed to operate at, and must be lower than the maximum allowable pressure and shall be the basis for the pressure setting.
of the pressure relieving devices.

Maximum Operating Temperature - The maximum operating temperature permitted in a system is the maximum temperature that the system is designed to operate at, and the basis for the temperature setting of the temperature relieving devices or heat rejection devices.

Maximum Attainable Temperature - The temperature of the heat transfer fluid at the outlet manifold of the solar energy collector during sustained operation in conditions of maximum ambient temperature, maximum solar insolation, and minimum fluid flow.

Commentary: May also, in some cases, be the stagnation temperature.

Non-Potable - A fluid that is not potable water.

Open Loop - A non-pressurized loop open to atmosphere.

Potable Water - Water which is safe for drinking, culinary, and domestic purposes.

Process Piping - Piping that is not utilized as a part of or for potable water, drainage, vent, hot water heating, space heating, cooling, refrigeration, gas, oil or steam.

Solar Energy System - A complete assembly of components, equipment, controls, interconnecting means and terminal elements needed to convert solar energy into thermal energy for space heating or cooling, water heating or processing purposes.

Solar Storage Subsystem - The assembly used for storing thermal energy.

Stagnation Temperature - The temperature attained in a solar collector under conditions of no flow and with conditions of maximum sunlight and ambient temperature.

Subsystem - A major, separable, functional assembly of a system such as complete collector or storage assembly.

Sustained Operation - That period of solar energy system operation after startup transients have subsided.

Toxic - Any substance (other than a radioactive substance) which has the capacity to produce personal injury or
illness to man through ingestion, inhalation, or absorption through any body surface.

Section 6503 - Licensing Requirements.

(a) Scope. In addition to specific requirements set forth in Chapter 2, the following criteria is applicable to the installation of solar equipment and systems. The installation of some systems may require multiple permits.

(b) Potable Water. All piping and appurtenances conveying potable water shall be installed by a Plumbing Contractor Class A, except that a Plumbing Contractor Class B may make installations in I and J occupancies. This includes collectors and systems where potable water is circulated through the collector and domestic hot water system or swimming pool or spa systems simultaneously.

(c) Process and Steam or Hot Water Space Heating. Steam or hot water heating systems, systems or equipment circulating process or non-potable collector fluids shall be installed by a Steam and Hot Water Heating Contractor Class A, except that a Hot Water Heating Contractor may make installations in I and J occupancies. This includes all systems where a closed loop is utilized and where heating coils, convectors, base board, radiators are utilized for comfort or process heating.

(d) Air Systems. Systems utilizing air for heating or as a heat transfer medium, or portions of hot water heating or process systems where ductwork is installed shall be installed by a Heating and Ventilating Contractor. This includes modification of sheet metal or ductwork to accommodate heating, cooling or refrigeration coils in the return or supply duct system. All ductwork installation shall be performed by a Heating and Ventilating Contractor Class A, except that a Heating and Ventilating Contractor Class B may install in I and J occupancies.

(e) Refrigeration. All portions of solar systems utilizing refrigerants or chilled water shall be installed by a Refrigeration Contractor Class A, except that a

65-9
Refrigeration  Class B contractor may make installations in I and J occupancies.

(f) Electrical. All electrical wiring over 48 volts or low voltage wiring located in a conduit or raceway shall be installed by an Electrical Contractor licensed by the State of Colorado and registered by the City and County of Denver.

(g) Structural Alterations or Additions. The support of solar components located on roofs or ground shall be performed by a Class A or B Building Contractor, except that a Class C Building Contractor may make installations in I and J occupancies.

(h) Spa and Swimming Pool Systems. All portions of solar systems utilized for heating water for swimming pools or spas shall be installed by a Plumbing Class A Contractor except that a Plumbing Class B Contractor or a licensed Swimming Pool Contractor, Building Contractor Class D-7, may make installations in I and J occupancies provided:
1. That no portion of the solar loop which is pressurized shall be installed by the Plumbing or Swimming Pool Contractor (low pressure pump permitted.)
2. That no portion of the solar loop to be installed by the Plumbing or Swimming Pool Contractor contains a closed loop.
3. If a boiler is utilized, the boiler shall be installed by a licensed steam and Hot Water Heating Contractor Class A, except that a Hot Water Heating Contractor may make installations in I and J occupancies.

Section 6504 - Prohibitions.

Scope - It shall be unlawful to:

(a) Have a solid connection from potable water to pressurized loops or to any tank or solar appurtenance containing heat transfer fluids without approved double check backflow preventer vented to the atmosphere.

(b) Recirculate potable water through radiators, radiation, coils or any device or appurtenance utilized for space
or process heating or cooling.
(c) Use flammable fluids in solar or closed loops.
(d) Utilize combustible materials in solar collectors or appurtenances except where specifically permitted by this Chapter and approved by the Department.
(e) Install fire dampers in ductwork to or from solar collectors.
(f) Allow the discharge temperature of domestic hot water to exceed 140 degrees F.
(g) Locate liquid storage tanks in crawl spaces.
Exception: Installations specifically approved by the Building Department

Section 6505 - Plans and Specifications

(a) General. Plans of each proposed installation of a solar space heating, cooling or domestic hot water heating system or combination thereof shall be submitted to and approved by the Department prior to installation. See Chapter 3.

(b) Two complete sets of plans shall be submitted for review. The plans shall include:
1. The exact address and location of the work to be performed.
2. Name and address of owner.
3. Name, address, and telephone number of the person responsible for the preparation of the drawings.
4. Floor plan(s) showing the exact location of solar equipment within the building. The location of all piping or ductwork to be installed.
5. Detailed cross section of mounting of collectors, to clearly illustrate all existing and proposed structural elements and features, location of where ceiling, floor, roof or wall penetration will occur, and clearances from roof or other structural features.
6. One line flow diagram of the system.
7. Structural calculations indicating dead, live and wind loading applied to the existing and/or proposed structural elements.

8. The Department's New Methods and Materials (Section III) approval number for the solar collector(s) solar storage system and double wall heat exchanger(s) if utilized.

9. Location and type of safety and operating controls and valves.

10. Location and type of double check vented to atmosphere backflow preventer if a solid connection is made from a solar loop utilizing other than circulating domestic hot water.

11. Floor drain or other drainage system for overflow and relief valves.

12. Zoning Administration approval for location and height on the property. Plot plan and exterior elevation of building will be required.

13. Type of fluid utilized in system.

Section 6506 - Materials and Equipment

(a) Scope. All equipment and materials utilized in solar systems, regardless of application, shall be capable of maintaining strength and integrity when exposed to the maximum temperatures or pressures which the equipment or material may be subjected to in stagnation or no-flow conditions.

(b) Tests, Specifications and Standards.

1. All equipment and materials shall be tested for its intended application by recognized testing laboratories for compliance with National Standards.

2. Materials and equipment utilized in a specific application shall be as specified in applicable National Standards.

3. Standards utilized shall be as specified in Section 6510 or as may be approved by the Department.

(c) Thermal Insulation. Insulation utilized in collectors for
duct, pipe or storage tank insulation shall be capable of maintaining its integrity when subjected to maximum thermal and weather conditions and prolonged use, and shall be specifically approved by the Department.

(d) Identification of Materials. All components and materials used in solar systems shall be permanently marked or labeled by the manufacturer as to the weight, tests, and limitations of the product. All listed products shall have the seal of the listing agency permanently affixed to the product.

(e) Collectors.

1. All collectors shall be submitted for approval by the Department.

2. All active site-built solar collectors and appurtenances, including, but not limited to, the glazing or transparent cover plates, absorber plate, piping and piping connections, back and side insulations, back and side cover panels, sealants, gaskets and other miscellaneous materials required to join, connect, or attach components comprising the collector system shall be constructed of materials capable of withstanding the maximum stagnation temperatures and pressures they may be subjected to.

   A. Site built collectors shall be installed in a manner that will not allow the temperature of adjacent combustible materials to be more than 90 degrees F above ambient.

   B. Site built collectors shall be constructed and installed to be watertight.

   C. The maximum stagnation temperature shall be included on the drawings.

   D. All site built collector installation drawings shall be stamped by an engineer.

3. All manufactured solar collectors shall be tested by a recognized laboratory and be certified by an agency approved by the Department.

   Exception: Until such time, (maximum 18 months after
enactment of this ordinance) the collector manufacturers requirements will be accepted by the Department regarding clearances to combustible construction and maximum stagnation temperatures.

A permanent label shall be attached to each unit stating the required clearance to combustible construction and the maximum stagnation temperature the unit is capable of achieving. All collectors shall be categorized at the time of Department approval into one of the following classifications:

A. Type "A" Collectors - Collectors that have a maximum stagnation temperature over 500 degrees F.

B. Type "B" Collector - Collectors that have a maximum stagnation temperature between 250 degrees F and 500 degrees F.

C. Type "C" Collector - Collectors that have a maximum stagnation temperature between 200 degrees F and 250 degrees F.

D. Type "D" Collector - Unglazed, non-concentrating collector utilizing rubber or plastic plates and piping. Maximum stagnation temperature of 200 degrees F. The installation of this class of collector is limited to non-pressure systems for swimming pool and spa heating applications in I occupancies only.

4. Glazing for collectors shall be tempered glass, or plastic material approved by the Department.

5. The following information shall be submitted to the Department with the application for approval of solar collectors.

A. Maximum stagnation temperature.

B. Mounting instructions.

C. Type of heat transfer fluid to be used.

D. Clearance requirements to combustible material.

E. Maximum operating temperature.

F. Maximum pressure - operating and stagnation.

G. Methods of temperature and pressure relief.
H. Air eliminator.
I. Type of system collector is designed for:
   (1) Closed loop.
   (2) Open loop.
   (3) Swimming pool or spa.
   (4) Draindown or drain back.
J. Labeling and operating instructions.
K. Certification by a recognized agency approved by the Department.

(f) **Heat Transfer Fluids.**
1. The use of flammable fluids is not permitted.
2. The heat transfer fluid shall be compatible with all components in the solar loop.
3. All fluids except water shall be approved by the Department.
4. The type of fluid used shall be shown on the system in a conspicuous location.
5. Systems utilizing liquid of other than circulating potable water shall not have a solid connection to the potable water, unless a double check backflow preventer vented to atmosphere is provided. Refer To 6504(a)
6. The heat transfer fluid must be capable of withstanding maximum stagnation temperatures.
7. Systems utilizing combustible fluids shall be specifically approved by the Department for each installation.
8. The storage, piping and handling of combustible liquids shall be in accordance with NFPA No. 30. See Standards.

(g) **Sealants and Gaskets.**
1. All seals, sealants and gaskets shall be capable of maintaining effective seals when exposed to maximum stagnation temperatures and pressures.
2. All seals, sealants and gaskets shall be compatible with fluids utilized in the system.

(h) **Air Handling Components.**
1. Ductwork located in A through H-2 occupancies shall comply with Table 52-A.
2. Ductwork located in H-3 and I occupancies shall comply with Table 52-B.

3. The use of flexible air ducts to and from solar collectors is prohibited.

4. The use of fiberglass duct board to and from solar collectors is prohibited.

5. The use of fire dampers in ducts to and from solar collectors is prohibited.

6. Ductwork to and from solar collectors shall be provided with sufficient clearances from combustible construction so that a temperature of the combustible material of no more than 90 degrees F above ambient is maintained, but shall not be less than the following.

<table>
<thead>
<tr>
<th>Sustained Design Surface</th>
<th>Required Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>(inches)</td>
</tr>
<tr>
<td>A. Up to 250 F</td>
<td>2</td>
</tr>
<tr>
<td>B. 250 F to 500 F</td>
<td>6</td>
</tr>
<tr>
<td>C. Over 500 F</td>
<td>As Approved by the Department</td>
</tr>
</tbody>
</table>

7. Duct insulation, sealer and adhesives shall be capable of withstanding maximum stagnation temperatures and pressures.

8. On active systems the use of building components or panned joist or stud spaces for ductwork to and from solar collector is not permitted in any occupancy.

(i) Relief Valves.

1. All relief valves shall be ASME labeled.

2. Relief valves shall be provided on all closed loops and pressurized storage tanks.

3. Piping from relief valves shall be copper or iron pipe, full size, not trapped and shall terminate in close proximity to an approved drain.

(j) Backflow Preventers.

1. Whenever solar systems are solid connected to the potable water supply, an approved double check vented to atmosphere backflow preventer meeting requirements of Chapter 50 shall be installed. Refer to 6504(a).

   EXCEPTION: Systems circulating only potable domestic
hot water.

(k) **Air Systems Thermal Storage.**

1. The construction of boxes or bins containing rocks for heat storage shall be approved by the Department on an individual basis.

(l) **Liquid Systems and Thermal Storage Tanks.**

1. All pressurized tanks shall be ASME labeled and provided with listed temperature and pressure relief valves.

   **EXCEPTION:** Tanks 120 gallons or less shall be listed by a nationally recognized testing laboratory or agency and shall be approved by the Department.

2. Non-metallic non-pressure storage tanks that are not ASME labeled shall be constructed to meet the ASME code requirements for unfired pressure vessels. However, it is not necessary that the tanks be stamped and certified. In addition, the tanks shall be capable of withstanding over 210 degrees F temperatures; shall be tested and listed by a recognized laboratory and shall be specifically approved by the Department. All tanks approved by the Department under Section 111 shall meet the above requirements.

3. Field constructed metal non-pressure tanks shall be constructed to ASME specifications and shall be specifically approved by the Department.

4. All components used in liquid systems shall be capable of withstanding temperatures, pressures and other physical stresses they may be subjected to, and be compatible with other components and fluid used in the system.

(m) **Heat Exchangers.**

1. Wherever potable water is interfaced with fluids or gasses, except air, a double wall heat exchanger with positive leak detection vented to atmosphere, shall be provided (vent shall be located at lowest part of exchanger, or as approved by the Department.)

2. Heat exchangers shall be tested by a nationally recognized laboratory and be specifically approved by
the Department.

3. The minimum strength of piping utilized in exchangers shall be specified for its application in 6505(o).

(n) Controls.

1. All controls shall be listed by a nationally recognized testing laboratory for its intended application.

2. All controls shall fail in a safe position.

3. Controls shall be operated in a normal manner and shall not be by-passed or tampered with.

4. A tempering valve or other means approved by the Department shall be installed in the domestic hot water system limiting water discharge temperature to 140 degrees F.

(o) Piping.

1. General. Piping on solar loop shall be capable of withstanding temperatures, pressures, expansion, contraction and other adverse conditions it may be exposed to, such as sunlight, weathering and ultraviolet radiation, when utilized in the particular system in an operational or stagnation mode. Piping systems used with type "A" collectors shall be designed by an engineer.

2. When utilized with the following type system piping shall be constructed of at least the type specified:

A. Systems utilizing Type "B" or Type "C" collectors for space heating, cooling or refrigeration.
   (1) Schedule 40 black steel pipe.
   (2) Type K or L copper tubing with brazed joints over (800 degrees F).

   EXCEPTION: Soft solder may be used for Type "C" collectors.

   (3) Other metallic pipe approved by the Department.
   (4) The use of non-metallic or galvanized iron pipe is not permitted.

B. Systems utilizing Type "B" or Type "C" collectors for domestic hot water.
   (1) Type K or L copper (hard temper) with brazed joints (over 800 degrees F).
EXCEPTION: Soft solder may be used on Type "C" collectors.

(2) Other metallic pipe approved by the Department.

C. Systems utilizing Type "D" collectors:

(1) Any piping material permitted in Chapters 50 or 58.

(2) Materials that have been specifically approved by the Department for the specific application.

D. Piping utilized for chilled water or refrigeration shall meet requirements of Chapter 49.

E. Underground piping shall be mill wrap pipe or pipe designed for underground installation for the intended application and approved by the Department.

F. Piping utilized for steam and hot water space heating shall meet requirements of this Chapter and Chapter 58.

G. Piping utilized for potable water distribution systems shall meet requirements of Chapter 50.

H. In-slab radiant heating systems where piping is embedded in concrete, pipe materials shall meet requirements of Chapter 58.

I. Piping conveying combustible fluids shall comply with the requirements of NFPA 30. See Standards.

Section 6507

(a) Scope. The provisions of this section shall apply to the construction and installation of components used in solar systems.

(b) Access. All components used in solar systems shall be accessible for maintenance, repair or replacement. The location of solar system components shall not interfere with the access or replacement of gas fired or electrical equipment.

(c) Building Components Functioning as Solar Components. The use of building components utilized as a part of solar systems is limited to passive systems only. Passive systems shall be approved by the Department on an
individual basis and prior to construction.

(d) **Location.** The location of collectors is subject to the requirements and approval of the Zoning Department. Solar system components shall not be located so as to interfere with the operation of doors, windows or other building components. Solar collectors shall not be located where they could adversely affect the operation of chimneys or vents utilized for fuel fired equipment. (Refer to Chapter 37.)

(e) **Protection Against Vermin and Rodents.** All penetrations of the building structure by piping or ductwork shall be properly back grouted or sealed with non-combustible material to prevent the entrance of vermin and rodents.

(f) **Protection of Solar Systems.** Solar system components subject to physical damage shall be adequately protected.

(g) **Protection Against Water Penetration.** All penetrations of the structure shall be properly sealed with approved materials to prevent water from entering the structure.

(h) **Clearances from Combustible Construction.** Under stagnant conditions heat radiated from all components including collectors, piping and ductwork shall not raise the temperature of adjacent combustible material more than 90 degrees F above ambient. Clearances specified in NFPA 90A, 90B and 89M shall be complied with. Equipment specifically listed and approved by the Department for less clearance may be installed per listing.

(i) **Mounting of Collectors - Roof or Slab.** In addition to requirements covered in Chapter 32, the following shall be complied with.

1. Prior to the installation of solar collectors on roofs, a determination shall be made that the roof structure shall support the additional load of the collector and heat transfer fluid.

2. Collectors shall be mounted per manufacturer's instructions.

3. Clearances shall be maintained between collectors and combustible construction on Types "A", "B", and "C" col-
lectors as specifically tested and listed by a recognized testing laboratory, or as designed by a registered professional engineer for site built collectors only.

4. Mounting brackets shall not trap water or ice.

5. Mounting brackets shall be non-combustible and shall be fastened with bolts that pass through roofing, sheathing into sleepers installed between rafters or other methods approved by the Department.

6. Bolts or other means of fastening shall be sealed from water penetration.

7. Collectors, supports, brackets and other materials shall have strength to support the collectors at the maximum wind load which it may be subjected to.

8. When collectors are located on concrete slabs, the slab shall be a minimum of 4" thick. Collectors shall be located a minimum of 6" above the ground surface and protected from physical damage.

9. Collectors installed on ground shall be adequately supported and anchored to a curb and footing, caisson, (minimum 12" diameter x 3' deep) or concrete pads as approved by the Department.

(j) **Piping.**

1. All piping shall be capable of withstanding the pressures, temperatures, expansion and contraction which it may be subjected to without failure.

2. Piping on systems utilizing Types "B" or "C" collectors shall be located with a minimum of 1" clearance to combustible materials, unless fluid temperature exceed 250 degrees F., in which case a minimum clearance of 6" shall be maintained to combustible materials or as approved by the Building Department.

3. Solders having a melting temperature in excess of 800 degrees F shall be used in the piping system of the collector loop of unglazed, glazed or concentrating collectors that have a potential stagnation temperature over 250 degrees F.

4. Pipe penetrations of roof shall be provided with roof
jacks meeting requirements per Chapter 32.

5. Pipes transversing roofs shall be a minimum of 12" above the roof surface.

6. All piping shall be properly hung and supported from the structure to carry weight of pipe and contents and to permit expansion and contraction.

7. All supports and straps shall be constructed of noncombustible materials.

8. Underground piping shall be buried a minimum of 15 inches below grade in an independent trench.

(k) Ductwork

1. Ductwork located in A through H2 occupancies shall comply with Table 52-A.

2. Ductwork located in H3 and I occupancies shall comply with Table 52-B.

3. The use of flexible air ducts or fiberglass duct board on collector loop is prohibited.

4. Clearances as specified in Section 6506(h) shall be maintained, except within 6 feet of collector where clearances specified by the listing agency shall be provided.

5. Roof jacks meeting requirements of Chapter 32 shall be provided where ducts penetrate roofs.

6. Duct sealants shall be capable of withstanding maximum stagnation temperatures and be approved by the Department.

7. Ducts shall be supported with sheet metal straps at a minimum of every 8 feet and at every change of direction.

8. Ducts located on roofs shall be at a height as specified in Chapter 32.

(1) Storage Tanks.

1. All storage tanks shall be designed for maximum temperatures and pressures they may be subjected to.

2. All pressurized tanks shall be ASME labeled and provided with ASME temperature and pressure relief valves.

   EXCEPTION: Tanks 120 gallons or less shall be listed by
a nationally recognized testing laboratory or agency and shall be approved by the Department.

3. Concrete tanks shall not be pressurized.

4. Outdoor buried tanks shall be located three feet away from the building for every foot they must be excavated below the footing, or shall be designed by an engineer and approved by the Department.

5. Only pressurized tanks shall be used for potable water.

6. The walls and floor of each poured in place concrete tank shall be monolithic. The exterior walls shall be double formed. The minimum compressive strength of tank walls, floor and top shall be 25 hundred (2500) pounds per square inch.

7. All non-pressure tanks shall be provided with a vent to atmosphere.

8. All non-pressure tanks shall be provided with an overflow piped to an approved drain.

(m) Structural Requirements for Collectors and Storage System.

1. The structural support for collectors, storage tanks and the other solar system components shall be provided to safely support all loads expected during the design life of the system without failure. The design load shall include the following loads:

A. Dead Loads - Include the weight of the heat transfer fluid contained in the component. See Chapter 25.

B. Live Loads - Include all dynamic and static loads caused by the operation of the solar system and all appropriate maintenance loads. Surfaces that must support maintenance personnel shall resist a single concentrated load of 250 lbs. distributed over a 4 inch square area at the most critical locations.

C. Soil and water pressures on buried elements.

D. Wind Loads - Account for all unusual shades or exposure factors in accordance with accepted engineering practice with a minimum wind load per Chapter 23.

E. Snow and Ice Loads - Include any unusual loads due to
drifting or slide off.

F. Constraint Loads - Those loads caused by temperature changes, shrinkage, moisture changes, normal functioning and thermal cycling of system and foundation settlement.

(n) Holes and Notches in Structural Members.
1. Notches or holes in structural members shall comply with applicable code section.

(o) Draining and Filling of System.
1. Liquid systems shall be capable of being filled, drained and vented without air entrapment.
2. Only systems using circulating potable water in all components may be connected to the potable water supply without approved double check vented to atmosphere backflow preventers.
3. Systems providing an air gap of two pipe diameters above the tank need not be provided with a backflow preventer.
4. Systems containing combustible or toxic fluids shall not be drained into the sewer system.

(p) Pressure Relief.
1. All components of the system, having valves capable of isolating heat generating or transfer equipment shall be provided with an approved, listed, adequately sized pressure relief valve.
2. Each pressure relief valve shall be an approved automatic type with drain and each relief valve shall be set at a pressure not to exceed the working pressure of the pipe or 150 psi, whichever is lessor.
3. Piping from relief valves shall be full sized, not trapped, and discharge 6 inches above the floor in close proximity to an approved drain.
4. Piping from relief valves on systems containing combustible or toxic fluids shall not discharge into a sewer system.

(q) Vacuum Relief. On gravity drain down or drain back systems, a vacuum relief or breaker shall be used to permit the system to drain efficiently by gravity, by admitting
atmospheric pressure into the piping. Other methods may be acceptable if approved by the Department.

(r) **Temperature Relief.** Temperature relief devices shall be provided in each portion of the system where excessive temperatures can develop and shall be set to open at not more than the maximum temperature for which the system is designed. Combination pressure and temperature relief devices may be used where applicable by system design and approved by the Department.

(s) **Provisions for Liquid Expansion.** Any portion of the system utilizing a closed loop shall be provided with a means for liquid expansion. The expansion tank, or other approved method shall have the capacity to withstand the fluid expansion from minimum fluid temperatures to maximum stagnation temperatures, and be compatible with system heat transfer fluids.

(t) **Freeze Protection.** All systems, except draindown and drainback systems utilized during periods when outdoor temperatures are below 32 degrees F, shall be provided with freeze protection.

(u) **Testing.** All piping systems shall be tested, air or hydrostatic, to one and one half times working pressure or 100 psi, whichever is greater.

(v) **Heat Transfer Fluids.**

1. All components in contact with the heat transfer fluid utilized in the system shall be compatible with the heat transfer fluid.

2. Flammable fluids shall not be used.

Section 6508 - Electrical

(a) All wiring over 48 volts and all low voltage wiring located in conduits or raceways shall be installed by an electrical contractor licensed by the State of Colorado and registered by the City and County of Denver.

(b) Installation shall comply with applicable sections of the National Electrical Code and Chapter 53 of the Denver Building Code.
Section 6509 -Fire Safety Requirements

(a) **Scope.** The design and installation of the solar system and components shall provide a level of fire safety consistent with the Building Code, Fire Code and with applicable codes and standards.

(b) **Fire Safety Requirements for Collectors.**
1. The installation of collector on roofs of buildings shall not increase the fire hazard to roofs or lower the required fire rating of the roof assembly.
2. Collectors shall be located so that debris, leaves or other combustible materials may not accumulate under the collector.

(c) **Fire Safety of Distribution and Control Systems.**
1. The installation of piping and other system components shall not increase the hazard of fire on or within structures. Adequate clearances shall be maintained to combustible materials. Control systems shall be properly wired.

(d) **Fire Safety Requirements of Storage Systems.**
1. Solar energy storage and storage container materials shall not increase the fire hazard to the building or structure.

Section 6510 -Standards. Unless provided for in other portions of this Building Code, the following standards and references shall apply.

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>TITLE OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>Power Piping, B31.1 1980</td>
</tr>
<tr>
<td>API</td>
<td>Recommended Rules for Design and Construction of Large, Low Pressure Storage Tanks. STD 620</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>1981 Handbook of Fundamentals</td>
</tr>
<tr>
<td></td>
<td>1984 Systems Handbook</td>
</tr>
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<td></td>
<td>1979 Equipment Handbook</td>
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<td>1982 Applications Handbook</td>
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<tr>
<td>DOE</td>
<td>Hazardous Properties and Environmental Effects of Materials Used in Solar Heating and Cooling Technologies. EV-0028</td>
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<td></td>
<td>Solar Heating Materials Handbook TIC 11374</td>
</tr>
<tr>
<td></td>
<td>Introduction to Solar Heating &amp; Cooling Design and Sizing CS-0011</td>
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<tr>
<td></td>
<td>Fundamentals of Solar Heating M 4082-01 (Rev.)</td>
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<tr>
<td>NBS</td>
<td>Standards for Cover Plates for Flat Plate Solar Collectors Tech. Note 1132, Solar Energy Systems</td>
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<tr>
<td>NBSIR</td>
<td>Performance Criteria For Solar Heating and Cooling Systems in Residential Buildings. 80-2095</td>
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<tr>
<td></td>
<td>Solar Collector Fire Incident Investigation - 81-2326</td>
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<td></td>
<td>Provisional Flat Plate Solar Collector Testing Procedures 78-1305A</td>
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<td></td>
<td>Solar Energy Systems. (Copper Development Association) 81-2344</td>
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<td>NFPA</td>
<td>Flammable and Combustible Liquids Code NFPA 30-1981</td>
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<tr>
<td></td>
<td>Standard For the Installation of Oil Burning Equipment NFPA 31-1978</td>
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<td>National Fuel Gas Code NFPA 54-1980</td>
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<td></td>
<td>Clearances for Heat Producing Appliances NFPA 89M-1976</td>
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<td>Air Conditioning and Ventilating Systems NFPA 90 A-1981</td>
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<td>Warm Air Heating &amp; Air Conditioning Systems NFPA 90B-1981</td>
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<td></td>
<td>Fire Tests of Roof Coverings NFPA 256-1982</td>
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<tr>
<td>NSF</td>
<td>Solar Energy Utilization For Heating and Cooling (Arizona State University) 74-41</td>
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<td>SHACNA</td>
<td>Installation Standards For Heating, Air Conditioning and Solar Systems 1981</td>
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<td>New York, NY 10018</td>
</tr>
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<td>API</td>
<td>American Petroleum Institute</td>
</tr>
<tr>
<td></td>
<td>2101 L Street, N.W.</td>
</tr>
<tr>
<td></td>
<td>Washington, DC 20037</td>
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<td>ORGANIZATION</td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| ASHRAE | American Society of Heating, Refrigeration & Air Conditioning Engineers  
        1791 Tullie Circle NE  
        Atlanta, GA 30329 |
| DOE    | National Technical Information Service  
        U.S. Department of Commerce  
        5285 Port Royal Road  
        Springfield, VA 22161 |
| NBS    | Center for Building Technology  
        National Engineering Laboratory  
        National Bureau of Standards  
        Washington, DC 20234 |
| NBSIR  | Same as Above |
| NFPA   | National Fire Protection Assoc.  
        Batterymarch Park  
        Quincy, MA 02269 |
| NSF    | National Science Foundation  
        Superintendent of Documents  
        U.S. Government Printing Office  
        Washington, DC 20402 |
| SMACNA | Sheet Metal and Air Conditioning Contractor's National Association Inc.  
        PO Box 70  
        Merrifield, Va 22116 |
CHAPTER 66

SOUND INSULATION STANDARDS FOR BUILDINGS EXPOSED TO AIRCRAFT NOISE

SECTION 6600. SCOPE
(a) Chapter 66 sets forth requirements for construction of specified occupancy classes in designated noise impact zones adjacent to Stapleton International Airport. A map depicting the current noise zones around the Airport is on file in the City Clerk's Office. This map was adopted by reference on December 10, 1984, in City Council Resolution No. 59, City Clerk Filing No. 84-541. This map shall be amended as often as required to reflect the most current annual noise exposure of the Airport which exceeds 65 LDN (Day-Night Sound Level).

(b) Provisions. The provision of Chapter 66 shall apply specifically to Group A, B, C, D, F, H, and I Occupancies. The provisions of this Chapter shall not apply to Group E, G, and J Occupancies or Occupancies included in the Stapleton Noise Insulation Program.

SECTION 6601. DEFINITIONS
(a) For the purposes of this Chapter, the following definitions shall apply:

A-Weighted Decibels, dBA - ten times the logarithm (to the base 10) of a power or intensity ratio with a weighting which correlates with the human response to the loudness of sounds.

Day-Night Sound Level, LDN - the yearly average of the A-weighted sound level integrated over a 24-hour period with a 10 dB step function weighting on aircraft events between 10:00 PM and 6:59 AM.

Exterior Wall Noise Reduction, EWN R - the calculated noise level reduction provided by the exterior construction of a building.

Heating/Ventilation/Air Conditioning, HVAC - the mechanical system which provides heating, ventilation, and air conditioning to buildings constructed or modified under this Chapter.

Level Reduction, LR - in a specified frequency band - the decrease in sound pressure level, measured at the location of the receiver, when a barrier or other sound reducing element is placed between the source and the receiver.
Noise Level Reduction, NLR - a reduction in A-weighted sound levels. Outside to Inside Transmission Loss, OITL - of a building facade, in a specified frequency band-ten times the common logarithm of the ratio of the airborne sound power incident on the exterior of the facade to the sound power transmitted by the facade and radiated to the interior. The quantity so obtained is expressed in decibels.

SECTION 6602. INTENT AND COMPLIANCE

(a) Design Requirements. The requirements of this Chapter shall ensure that building envelopes in the designated noise impact zones provide adequate sound insulation. In addition the mechanical systems will supply the requisite amount of heating, cooling, and ventilation for the building without compromising the sound insulation properties of the building envelope.

(b) Design Paths. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective sound insulation. These provisions are structured to permit compliance with the intent of this Chapter by either of the following two design paths:

Design Path I. Achieving a calculated EWNR utilizing the EWNR Calculation Form provided by the Department in conjunction with the standards set forth in Section 6603.

Design Path II. Achieving an actual NLR (to be verified by acoustical testing of the building shell) by utilizing materials and/or methods differing from those described in Design/Path I.

(c) Additions to Existing Buildings. An addition may be made to an existing building without requiring the existing building to comply with all of the requirements of this Chapter, provided the addition conforms to the requirements of this Chapter and the Code. For alterations or repairs, see Section 106.

Existing buildings within a designated noise impact zone shall not be permitted, unless the building is made to conform to all of the requirements of this Chapter and this Code. See Chapter 5.

(d) Change in Occupancy. Any change in occupancy or use of any existing building within a designated noise impact zone shall not be permitted, unless the building is made to conform to all of the requirements of this Chapter and this Code. See Chapter 5.
(e) **HVAC Requirements.** Regardless of which Design Path is chosen, the HVAC requirements in Section 6606 shall be met.

**SECTION 6603. DESIGN PATH I - Systems Analysis Approach**

**Sound Insulation Calculation Standards**

(a) **General.** This approach requires that the construction documents comply with the design specifications and construction techniques described in this Chapter. An acceptable calculated EWNR will be required prior to the approval of the plans by the Department. The construction materials available for use are listed in Section 6608. Any deviation from Design Path I, will require that the NLR standards in Section 6604, DESIGN PATH II, be met.

(b) **Noise Level Reduction (NLR) Requirements.** All non-exempt occupancies referenced in Section 6606 of this Chapter shall be designed and constructed so that the exterior shell (windows closed) provides a calculated Exterior Wall Noise Level Reduction (EWNR) equal to or greater than the values listed below.

If the outdoor Day-Night Sound Level (LDN) is:

- Then Calculated EWNR Provided By The Exterior Shell Must Be
- Equal To Or Greater Than
- Greater Than 65 dbA
- But Less Than 70 dbA
- Equal To Or Greater Than 30 dbA
- 70 dbA
- 75 dbA
- 35 dbA
- 75 dbA
- Construction is Prohibited

There are no exterior shell noise level reduction less than 65 dBA.

(c) **EWNR Calculations.** EWNR calculations must be submitted on a form furnished by the Department. When required by Chapter 3, EWNR calculations must be submitted by an engineer or architect. The EWNR Calculations for Group H and I occupancies shall be prepared for the two rooms that have the requirements for projects where the outdoor LDN levels are greatest exterior surface exposure. That is, the two rooms with the greatest area (in square feet) of exterior walls, roof (ceilings), and exposed floor. For all other occupancy groups, EWNR calculations shall be based on the most intensively occupied area. That is, the room or rooms in which the primary service of the occupancy type is provided.
(d) **Construction Techniques.** All exterior walls, roofs, and exposed floors shall be constructed airtight. All non-lap joints shall be grouted or caulked airtight with a non-hardening, non-shrinking sealant installed in strict accordance with the sealant manufacturer's specifications. Any penetrations of exterior walls by pipes, ducts or conduits shall be sealed airtight as required for joints above. Door and window openings in exterior walls shall be flashed all-around with an approved vapor barrier and sealed to prevent air infiltration. Sill sealant shall be used to prevent air infiltration at all base plates of exterior walls. Attic and crawl space vents shall not be detailed in Figure 66-5. See Section 6606 for Building Mechanical System requirements.

**SECTION 6604. DESIGN PATH II - Performance Testing Approach**

(a) **General.** This approach allows the building to be constructed using design and construction methods which vary from Design Path I. The NLR requirements must be verified through actual sound level measurements.

(b) **Restrictions.** The construction is restricted to meeting the NLR requirements below, the requirements of Sections 6605 and 6606, and all other applicable portions of the Code.

(c) **Noise Level Reduction (NLR) Requirements.** All non-exempt occupancies referenced in Section 6600 shall be designed and constructed so that the exterior shell (windows closed) provides a measured NLR equal to or greater than the values listed below.

If the Outdoor Day-Night Sound Level (LDN) is:

<table>
<thead>
<tr>
<th>Equal To Or Greater Than</th>
<th>But Less Than</th>
<th>Equal To Or Greater Than</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 dBa</td>
<td>70 dBa</td>
<td>25 dBa</td>
</tr>
<tr>
<td>70 dBa</td>
<td>75 dBa</td>
<td>30 dBa</td>
</tr>
<tr>
<td>75 dBa</td>
<td>Construction is Prohibited</td>
<td></td>
</tr>
</tbody>
</table>

Then The Measured NLR Provided By The Exterior Shell Must Be

There are no exterior shell noise levels reduction requirements for projects where the outdoor LDN levels are less than 65 dBa.

(d) **Building Testing.** Acoustical measurements shall be conducted in accordance with ASTM Standard E966-84, *Field Measurement of Airborne Sound Insulation of Building Facades and Facade Elements,* and
shall be certified by an engineer and submitted to the Department. The Noise Level Reduction (NLR) between A-weighted levels shall be calculated using the following equation:

\[
NLR = LA1 - 10 \log \left( \frac{L1(f) - OITL(f) + a(f)}{\sum_{f} 10} \right) - 10 \log [S/A] - 6, \text{ dB}
\]

Where: \( LA1 = \) A-weighted exterior noise level  
\( L1(f) = \) 1/3 octave band exterior noise level at frequency \( f \)  
a\( (f) = \) A-weighted at frequency \( f \)  
OITL\( (f) = \) 1/3-octave band transmission loss of complete assembly at frequency \( f \)

SECTION 6605. PLANS AND SPECIFICATIONS
(a) General. With each application for a building permit, plans, specifications, and EWRN calculations in compliance with this Chapter shall be submitted. A form for the calculation of EWRN values shall be supplied by the Department. If Design Path II is chosen, a Statement of Intent to comply with this Chapter shall be submitted.

(b) Details. The plans, specifications and calculations shall show in sufficient detail all pertinent data and features of the building and the sound insulation techniques as herein governed but not limited to, design criteria, exterior envelope component materials, EWR values of the envelope elements, construction techniques and other pertinent data to indicate conformance with the requirements of this chapter.

SECTION 6606. BUILDING MECHANICAL SYSTEMS
(a) Forced Air System. All buildings constructed under this code shall be provided with a forced air HVAC system with the following features:  
1.) Gas-fired appliances, including gas-fired water heaters, shall be enclosed in a room or rooms separated from habitable space. Such rooms shall be equipped with a tight fitting, self-closing door. Combustion air shall be supplied to the room directly from the outside as prescribed in Section 5112.
Exception a) Sealed combustion units or any similar type of appliance that has a closed combustion chamber and draws combustion air directly from the outside.

Exception b) Gas-fired appliances in commercial kitchens and commercial laundry rooms.

2.) A ducted connection shall be installed between the return air system and the outside, to provide a continuous supply of outside air into the building equal to at least ten (10) percent of the CFM rating of the HVAC system.

3.) Equipment for refrigerated cooling of the ventilation air shall be included as a part of the system.

4.) Controls shall be arranged to permit "fan-only" operation without activation of the heating or cooling system.

Exception: A new forced air system complying with this paragraph will not be required for additions to existing buildings if the heating system in the existing building, regardless of type, has sufficient capacity to provide heat to the addition.

(b) Exhaust to the Outside. Provision shall be made to mechanically exhaust kitchen areas, bathroom areas, and janitor/service areas so that opening of windows will not be necessary. All exhaust ducts handling clean air shall contain at least a 10 ft. length of internal sound absorbing lining (1" minimum fiberglass). Each duct shall be provided with at least one bend such that there is no direct line of sight from inside the building to the outside. Kitchen exhaust ducts, not being compatible with sound absorbing linings, shall have at least one bend to eliminate line of sight sound transmission and shall contain a solid baffle plate across the exterior termination which will still allow adequate area for proper ventilation.

(c) Fireplaces. If a fireplace is included as part of the building, compliance with this Code shall follow Design Path II as described in Section 6604. The acoustical measurements shall be performed with the fireplace damper open.

(d) Prohibitions. Due to the extremely tight construction mandated by this Chapter, the installation of solid fuel stoves, gas-fired kitchen ranges, and gas-fired clothes dryers in H2, H3, and I occupancies is prohibited.
SECTION 6807. STANDARDS


ASTM FIELD MEASUREMENT OF AIRBORNE INSULATION OF BUILDING FACADES AND FACADE ELEMENTS, E966-84

SECTION 6808. TABLES, CHARTS, FIGURES AND APPENDIX.

SECTION 6809. SUPPLEMENTS. Calculation forms and sample calculations may be adopted by Rule and Regulations per Section 105 and will be available at the Division of Building Inspections.
### Table 66-1

**ESTIMATED EWR ADJUSTMENTS FOR GLAZING TO BE APPLIED TO LABORATORY TEST DATA TO OBTAIN SOUND ISOLATION PERFORMANCE OF UNTESTED GLASS CONFIGURATIONS**

#### Single Laminated

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<thead>
<tr>
<th>Description</th>
<th>EWR Adjustment</th>
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<tbody>
<tr>
<td>Double (halve) glass thickness</td>
<td>+(-)3 dB</td>
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<tr>
<td>Double interlayer thickness</td>
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</tr>
<tr>
<td>0.030&quot; to 0.060&quot; Saflex*</td>
<td></td>
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<tr>
<td>total glass thickness less than 3/8&quot;</td>
<td>0 dB</td>
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<tr>
<td>total glass thickness 3/8&quot; or greater</td>
<td>+1 dB</td>
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#### Air Spaced

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<th>EWR Adjustment</th>
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<tbody>
<tr>
<td>Double (halve) air space</td>
<td>+(-)3 dB</td>
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<tr>
<td>Double (halve) total glass weight</td>
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<td>Change from unsealed to sealed insulating glass</td>
<td>+1 dB</td>
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<tr>
<td>Sound absorptive periphery*</td>
<td>+6 dB</td>
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#### Laminated Insulating

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<tr>
<th>Description</th>
<th>EWR Adjustment</th>
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<tbody>
<tr>
<td>Double (halve) air space</td>
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<tr>
<td>Double (halve) glass weight</td>
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</tr>
<tr>
<td>air space thickness less than 1&quot;</td>
<td>+(-)3 dB</td>
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<tr>
<td>air space thickness greater than 1&quot;</td>
<td>+(-)1 dB</td>
</tr>
<tr>
<td>Change from air spaced to laminated insulating</td>
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<tr>
<td>(equal weight, equal air space)</td>
<td>+4 dB</td>
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<tr>
<td>Sound absorptive periphery*</td>
<td>+6 dB</td>
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#### Double Laminated Insulating

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<tr>
<td>Double (halve) air space</td>
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<tr>
<td>Double (halve) glass weight</td>
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<tr>
<td>Laminated insulating to double laminated insulating</td>
<td>+3 dB</td>
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<tr>
<td>Sound absorptive periphery*</td>
<td>+6 dB</td>
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* For airspaces 3" thick or greater
Table 66-1 (cont.)

INCREASE OF EWR VALUES DUE TO EXTERIOR WALL MODIFICATIONS

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<tr>
<th>Modification</th>
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<tr>
<td>Resilient Mounting of Interior Surface Skin</td>
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<tr>
<td>Resilient Damping Board Layer Under Interior Surface Skin</td>
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<td>Sand-fill Concrete Blocks</td>
<td>3</td>
</tr>
<tr>
<td>1/2-inch Plaster on Brick or Block</td>
<td>2</td>
</tr>
<tr>
<td>1/2-inch Gyp Board on Furring Added to Concrete Block</td>
<td>5</td>
</tr>
<tr>
<td>Resiliently Mounted Skin on Concrete Block</td>
<td>8</td>
</tr>
<tr>
<td>Insulation in Concrete Block Cavities</td>
<td>3</td>
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$^1$ If two modifications are employed, use larger benefits plus one-half of smaller benefit.

### Table 66-2
Effects of Venting Attics on EWR Values With and Without Absorption

<table>
<thead>
<tr>
<th>Hard Ceiling Skins</th>
<th>Unvented Attic EWR, dB</th>
<th>Vented Attic(^2) EWR, dB</th>
<th>Vented Attic EWR, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>with ball or blow-in insulation 3-inch minimum</td>
<td>no ball or blow-in insulation</td>
</tr>
<tr>
<td>44</td>
<td>-5</td>
<td>-1.2</td>
<td></td>
</tr>
<tr>
<td>45</td>
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<td>-1.3</td>
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</tr>
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<td>-1.4</td>
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<td>-8</td>
<td>-1.5</td>
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</tr>
<tr>
<td>48</td>
<td>-8</td>
<td>-1.5</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>-9</td>
<td>-1.6</td>
<td></td>
</tr>
<tr>
<td>50</td>
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<td>-1.7</td>
<td></td>
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<tr>
<td>51</td>
<td>-10</td>
<td>-1.7</td>
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</tr>
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<td>52</td>
<td>-11</td>
<td>-1.8</td>
<td></td>
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<tr>
<td>53</td>
<td>-12</td>
<td>-1.9</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>-12</td>
<td>-1.9</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>-13</td>
<td>-2.0</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>-14</td>
<td>-2.1</td>
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<table>
<thead>
<tr>
<th>Mineral Board Ceiling Skins</th>
<th>Unvented Attic EWR, dB</th>
<th>Vented Attic(^2) EWR, dB</th>
<th>Vented Attic EWR, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>with ball or blow-in insulation 3-inch minimum</td>
<td>no ball or blow-in insulation</td>
</tr>
<tr>
<td>44</td>
<td>+2</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>+1</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>46</td>
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<td>-11</td>
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<tr>
<td>55</td>
<td>-9</td>
<td>-12</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>-10</td>
<td>-13</td>
<td></td>
</tr>
</tbody>
</table>


2 When all the attic vents are ballfied, calculate using EWR values for vented attic.
Chart 66-1. Chart for Calculation of Composite EWR for Two Wall Elements

Chart 66-2

\[ \bar{A} = 2.2 S F_f^{0.9} \]

SF_f = Floor Area (in Square Feet)

Chart 66-3

SF_t = Total Square Foot Area of the Exposed Exterior Surfaces
# Figure 66-1

**Exterior Wall Rating (EWR) in dB for Standard Exterior Construction**

<table>
<thead>
<tr>
<th>Exterior Finish</th>
<th>Wall Section</th>
<th>No.</th>
<th>Interior Finish</th>
<th>EWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Siding over 1/2&quot; Wood Sheathing</td>
<td>W1-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-7</td>
<td>1/2&quot; Plaster</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-8</td>
<td>3/8&quot; Plaster</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-9</td>
<td>1/2&quot; Gypdb / 1/4&quot; Plywood Paneling</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W1-11</td>
<td>1/2&quot; Gypdb / 1/4&quot; Hardboard Paneling</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>7/8&quot; Stucco over Paper</td>
<td>W2-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W2-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>48</td>
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</tr>
<tr>
<td></td>
<td>W2-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W2-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W2-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W2-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>W2-7</td>
<td>1/2&quot; Plaster</td>
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</tr>
<tr>
<td></td>
<td>W2-8</td>
<td>7/8&quot; Plaster</td>
<td>41</td>
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</tr>
<tr>
<td></td>
<td>W2-9</td>
<td>1/2&quot; Gypdb / 1/4&quot; Plywood Paneling</td>
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</tr>
<tr>
<td></td>
<td>W2-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>45</td>
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</tr>
<tr>
<td></td>
<td>W2-11</td>
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<td>50</td>
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</tr>
<tr>
<td>7/8&quot; Stucco over 1/2&quot; Sheathing</td>
<td>W3-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>49</td>
<td></td>
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<tr>
<td></td>
<td>W3-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>49</td>
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</tr>
<tr>
<td></td>
<td>W3-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>49</td>
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<tr>
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<td>W3-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>49</td>
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<tr>
<td></td>
<td>W3-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
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<tr>
<td></td>
<td>W3-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
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<tr>
<td></td>
<td>W3-7</td>
<td>1/2&quot; Plaster</td>
<td>46</td>
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</tr>
<tr>
<td></td>
<td>W3-8</td>
<td>7/8&quot; Plaster</td>
<td>43</td>
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<tr>
<td></td>
<td>W3-9</td>
<td>1/2&quot; Gypdb / 1/4&quot; Plywood Paneling</td>
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<tr>
<td></td>
<td>W2-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W3-11</td>
<td>1/2&quot; Gypdb / 1/4&quot; Hardboard Paneling</td>
<td>51</td>
<td></td>
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<tr>
<td>1/2&quot; - 3/4&quot; Wood Sheathing</td>
<td>W4-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W4-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>38</td>
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</tr>
<tr>
<td></td>
<td>W4-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>42</td>
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<tr>
<td></td>
<td>W4-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>44</td>
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<tr>
<td></td>
<td>W4-5</td>
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<tr>
<td></td>
<td>W4-6</td>
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<td>41</td>
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<tr>
<td></td>
<td>W4-7</td>
<td>1/2&quot; Plaster</td>
<td>43</td>
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</tr>
<tr>
<td></td>
<td>W4-8</td>
<td>7/8&quot; Plaster</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W4-9</td>
<td>1/2&quot; Gypdb / 1/4&quot; Plywood Paneling</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W4-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W4-11</td>
<td>1/2&quot; Gypdb / 1/4&quot; Hardboard Paneling</td>
<td>43</td>
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</tr>
</tbody>
</table>
### Figure 66-1 (cont.)

**Exterior Wall Rating (EWR) in dB for Standard Exterior Construction**

<table>
<thead>
<tr>
<th>Exterior Finish</th>
<th>Wall Section</th>
<th>Interior Finish</th>
<th>EWR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3/4&quot; Wood Siding</strong></td>
<td>W5-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>W5-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>W5-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>W5-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>42</td>
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<tr>
<td></td>
<td>W5-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>W5-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>W5-7</td>
<td>1/2&quot; Plaster</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>W5-8</td>
<td>7/8&quot; Plaster</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>W5-9</td>
<td>1/2&quot; Gypbd / 1/4&quot; Plywood Paneling</td>
<td>39</td>
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<tr>
<td></td>
<td>W5-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>W5-11</td>
<td>1/2&quot; Gypbd / 1/4&quot; Hardboard Paneling</td>
<td>41</td>
</tr>
</tbody>
</table>

**Construction:** Stud Wall with R11 Fiberglass in Stud Wall

| **4-1/2" Brick Veneer** | W6-1 | 1/2" or 5/8" Gypsumboard | 57 |
| | W6-2 | 3/8" Gypsumboard | 56 |
| | W6-3 | 2 Layers 1/2" Gypsumboard | 56 |
| | W6-4 | 2 Layers 5/8" Gypsumboard | 56 |
| | W6-5 | 1/2" Soundboard / 1/2" Gypsumboard | 57 |
| | W6-6 | 1/2" Soundboard / 3/8" Gypsumboard | 56 |
| | W6-7 | 1/2" Plaster | 52 |
| | W6-8 | 7/8" Plaster | 50 |
| | W6-9 | 1/2" Gypbd / 1/4" Plywood Paneling | 57 |
| | W6-10 | 1/2" Plywood Paneling | 54 |
| | W6-11 | 1/2" Gypbd / 1/4" Hardboard Paneling | 58 |
| | W6-12 | None | 44 |
| | W6-13 | 4" Brick with 2" Air Cavity, Metal Ties | 49 |
| | W6-14 | 4" Brick with 2-1/4" Cavity Filled with GROUT | 39 |
| | W6-15 | 4" Brick Mortared to Exterior Brick with 1/2" Gypsumboard Fire retarded | 51 |
| | W6-16 | 2 Wythes 4" Brick Mortared Together | 38 |
| | W6-17 | 4" CMU Mortared to Exterior | 30 |
| | W6-18 | 4" CMU Mortared to Exterior with 1/2" Plaster | 32 |
| | W6-19 | 2" Air Space, 4" CMU | 53 |

**Construction:** 4" Brick

| **9" Brick Veneer** | W7-1 | 1/2" or 5/8" Gypsumboard | 60 |
| | W7-2 | 3/8" Gypsumboard | 63 |
| | W7-3 | 2 Layers 1/2" Gypsumboard | 65 |
| | W7-4 | 2 Layers 5/8" Gypsumboard | 64 |
| | W7-5 | 1/2" Soundboard / 1/2" Gypsumboard | 64 |
| | W7-6 | 1/2" Soundboard / 3/8" Gypsumboard | 65 |
| | W7-7 | 1/2" Plaster | 53 |
| | W7-8 | 7/8" Plaster | 53 |
| | W7-9 | 1/2" Gypbd / 1/4" Plywood Paneling | 53 |
| | W7-10 | 1/2" Plywood Paneling | 53 |
| | W7-11 | 1/2" Gypbd / 1/4" Hardboard Paneling | 53 |

**Construction:** Interior Finish

**Mounted on Furring Strips (16" o.c.)**

**Construction:** Interior Finish

**Mounted Directly to the Solid Wall**

---

66-14 08/88
Figure 66-1 (cont.)

Exterior Wall Rating (EWR) in dB for Standard Exterior Construction

<table>
<thead>
<tr>
<th>Exterior Finish</th>
<th>Wall Section</th>
<th>No.</th>
<th>Interior Finish</th>
<th>EWR</th>
</tr>
</thead>
<tbody>
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<td></td>
</tr>
<tr>
<td>Construction:</td>
<td>W8-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Interior Finish</td>
<td>W8-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Mounted on Furring</td>
<td>W8-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Strips (16&quot; o.c.)</td>
<td>W8-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W8-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>61</td>
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</tr>
<tr>
<td></td>
<td>W8-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>61</td>
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<tr>
<td></td>
<td>W8-7</td>
<td>1/2&quot; Plaster</td>
<td>49</td>
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</tr>
<tr>
<td></td>
<td>W8-8</td>
<td>7/8&quot; Plaster</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W8-9</td>
<td>1/2&quot; Gypsum / 1/4&quot; Plywood Paneling</td>
<td>48</td>
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<tr>
<td></td>
<td>W8-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>48</td>
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</tr>
<tr>
<td></td>
<td>W8-11</td>
<td>1/2&quot; Gypsum / 1/4&quot; Hardboard Paneling</td>
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<td></td>
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<tr>
<td>6&quot; Concrete</td>
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<td></td>
</tr>
<tr>
<td>Construction:</td>
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<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
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<tr>
<td>Interior Finish</td>
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<td>3/8&quot; Gypsumboard</td>
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</tr>
<tr>
<td>Mounted on Furring</td>
<td>W9-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Strips (16&quot; o.c.)</td>
<td>W9-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
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<tr>
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<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
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</tr>
<tr>
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<td>W9-6</td>
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<td>W9-7</td>
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<td>7/8&quot; Plaster</td>
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<td>1/2&quot; Gypsum / 1/4&quot; Plywood Paneling</td>
<td>50</td>
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</tr>
<tr>
<td></td>
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<td>50</td>
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</tr>
<tr>
<td></td>
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<td>1/2&quot; Gypsum / 1/4&quot; Hardboard Paneling</td>
<td>50</td>
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</tr>
<tr>
<td>8&quot; Concrete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
<td>W10-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Interior Finish</td>
<td>W10-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>64</td>
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</tr>
<tr>
<td>Mounted on Furring</td>
<td>W10-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>Strips (16&quot; o.c.)</td>
<td>W10-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W10-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W10-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W10-7</td>
<td>1/2&quot; Plaster</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W10-8</td>
<td>7/8&quot; Plaster</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W10-9</td>
<td>1/2&quot; Gypsum / 1/4&quot; Plywood Paneling</td>
<td>54</td>
<td></td>
</tr>
<tr>
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<td>W10-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W10-11</td>
<td>1/2&quot; Gypsum / 1/4&quot; Hardboard Paneling</td>
<td>54</td>
<td></td>
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<tr>
<td>6&quot; Hollow Concrete</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td>W11-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>52</td>
<td></td>
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<tr>
<td>Construction:</td>
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<td>3/8&quot; Gypsumboard</td>
<td>53</td>
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<tr>
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<td>55</td>
<td></td>
</tr>
<tr>
<td>Strips (16&quot; o.c.)</td>
<td>W11-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W11-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W11-7</td>
<td>1/2&quot; Plaster</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W11-8</td>
<td>7/8&quot; Plaster</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W11-9</td>
<td>1/2&quot; Gypsum / 1/4&quot; Plywood Paneling</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W11-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W11-11</td>
<td>1/2&quot; Gypsum / 1/4&quot; Hardboard Paneling</td>
<td>41</td>
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66-15
### Exterior Wall Rating (EWR) in dB for Standard Exterior Construction

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<th>Exterior Finish</th>
<th>Wall Section</th>
<th>No.</th>
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<th>EWR</th>
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<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
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<tr>
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<td>3/8&quot; Gypsumboard</td>
<td>W12-2</td>
<td>53</td>
</tr>
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<td>Interior Finish:</td>
<td>W12-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>W12-3</td>
<td>57</td>
</tr>
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<td>Mounted on Furring Strips (16&quot; o.c.)</td>
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<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>W12-4</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>W12-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>W12-5</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>W12-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>W12-6</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>W12-7</td>
<td>1/2&quot; Plaster</td>
<td>W12-7</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>W12-8</td>
<td>7/8&quot; Plaster</td>
<td>W12-8</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>W12-9</td>
<td>1/2&quot; Gyde / 1/4&quot; Plywood Paneling</td>
<td>W12-9</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>W12-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>W12-10</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>W12-11</td>
<td>1/2&quot; Gyde / 1/4&quot; Hardboard Paneling</td>
<td>W12-11</td>
<td>43</td>
</tr>
<tr>
<td>5&quot; Block with 1/2&quot; Stucco</td>
<td>W13-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>W13-1</td>
<td>53</td>
</tr>
<tr>
<td>Construction:</td>
<td>W13-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>W13-2</td>
<td>54</td>
</tr>
<tr>
<td>Interior Finish:</td>
<td>W13-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>W13-3</td>
<td>56</td>
</tr>
<tr>
<td>Mounted on Furring Strips (16&quot; o.c.)</td>
<td>W13-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>W13-4</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>W13-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>W13-5</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>W13-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>W13-6</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>W13-7</td>
<td>1/2&quot; Plaster</td>
<td>W13-7</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>W13-8</td>
<td>7/8&quot; Plaster</td>
<td>W13-8</td>
<td>44</td>
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<tr>
<td></td>
<td>W13-9</td>
<td>1/2&quot; Gyde / 1/4&quot; Plywood Paneling</td>
<td>W13-9</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>W13-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>W13-10</td>
<td>42</td>
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<tr>
<td></td>
<td>W13-11</td>
<td>1/2&quot; Gyde / 1/4&quot; Hardboard Paneling</td>
<td>W13-11</td>
<td>42</td>
</tr>
<tr>
<td>8&quot; Block with 1/2&quot; Stucco</td>
<td>W14-1</td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>W14-1</td>
<td>54</td>
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<tr>
<td>Construction:</td>
<td>W14-2</td>
<td>3/8&quot; Gypsumboard</td>
<td>W14-2</td>
<td>56</td>
</tr>
<tr>
<td>Interior Finish:</td>
<td>W14-3</td>
<td>2 Layers 1/2&quot; Gypsumboard</td>
<td>W14-3</td>
<td>56</td>
</tr>
<tr>
<td>Mounted on Furring Strips (16&quot; o.c.)</td>
<td>W14-4</td>
<td>2 Layers 5/8&quot; Gypsumboard</td>
<td>W14-4</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>W14-5</td>
<td>1/2&quot; Soundboard / 1/2&quot; Gypsumboard</td>
<td>W14-5</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>W14-6</td>
<td>1/2&quot; Soundboard / 3/8&quot; Gypsumboard</td>
<td>W14-6</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>W14-7</td>
<td>1/2&quot; Plaster</td>
<td>W14-7</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>W14-8</td>
<td>7/8&quot; Plaster</td>
<td>W14-8</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>W14-9</td>
<td>1/2&quot; Gyde / 1/4&quot; Plywood Paneling</td>
<td>W14-9</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>W14-10</td>
<td>1/2&quot; Plywood Paneling</td>
<td>W14-10</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>W14-11</td>
<td>1/2&quot; Gyde / 1/4&quot; Hardboard Paneling</td>
<td>W14-11</td>
<td>44</td>
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</table>
**Figure 66-2**

Exterior Wall Rating (EWR) in dB for Basic Roof-Ceiling Constructions

<table>
<thead>
<tr>
<th>Roof Construction</th>
<th>Section</th>
<th>No.</th>
<th>Ceiling Construction</th>
<th>EWR</th>
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</thead>
<tbody>
<tr>
<td>Wood Shingles</td>
<td>C1-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
<td></td>
<td></td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>41</td>
</tr>
<tr>
<td>Single Joist with</td>
<td>C1-2</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Fiberglass Insulation</td>
<td>C1-3</td>
<td>Exposed Framing</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Composition Shingles</td>
<td>C2-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
<td></td>
<td></td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>39</td>
</tr>
<tr>
<td>Single Joist with</td>
<td>C2-2</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Fiberglass Insulation</td>
<td>C2-3</td>
<td>Exposed Framing</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Clay or Concrete Tiles</td>
<td>C3-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
<td></td>
<td></td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>52</td>
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<tr>
<td>Single Joist with</td>
<td>C3-2</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Fiberglass Insulation</td>
<td>C3-3</td>
<td>Exposed Framing</td>
<td>40</td>
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</tr>
<tr>
<td>Built-up Roofing</td>
<td>C4-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
<td></td>
<td></td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>44</td>
</tr>
<tr>
<td>Single Joist with</td>
<td>C4-2</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>44</td>
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</tr>
<tr>
<td>Fiberglass Insulation</td>
<td>C4-3</td>
<td>Exposed Framing</td>
<td>32</td>
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</tr>
<tr>
<td>1/2&quot; Wood and Sheet Metal</td>
<td>C5-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Construction:</td>
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<td></td>
<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
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</tr>
<tr>
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<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
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<td></td>
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<tr>
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<td>C5-3</td>
<td>Exposed Framing</td>
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<td>Roof Construction</td>
<td>Section</td>
<td>No.</td>
<td>Ceiling Construction</td>
<td>EWR</td>
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<td>--------------------------------------</td>
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</tr>
<tr>
<td>Wood Shingles</td>
<td>C6-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>53</td>
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</tr>
<tr>
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<tr>
<td>Attic Space with Fiberglass Insulation</td>
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</tr>
<tr>
<td>Composition Shingles</td>
<td>C7-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>57</td>
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<tr>
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<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay or Concrete Tiles</td>
<td>C8-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>62</td>
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<tr>
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<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
<td>59</td>
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<tr>
<td>Attic Space with Fiberglass Insulation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Built-up Roofing</td>
<td>C9-1</td>
<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
<td>55</td>
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<tr>
<td>Construction:</td>
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<td>1/2&quot; or 5/8&quot; Gypsumboard</td>
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<tr>
<td>Attic Space with Fiberglass Insulation</td>
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</tr>
<tr>
<td>1/2&quot; Wood and Sheet Metal</td>
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<td>3/8&quot; Gypsum Lathe / 1/8&quot; Plaster</td>
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**Figure 66-3**

**SINGLE GLAZED UNITS**

### Fixed Units

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<th>Description</th>
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<td>W1-2</td>
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<td>3/32&quot; Glass with Divided Lights</td>
<td>29</td>
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<tr>
<td>W1-3</td>
<td>Wood</td>
<td>1/8&quot; Glass</td>
<td>31</td>
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<td>W1-4</td>
<td>Unspecified</td>
<td>1/8&quot; Lexan Solar Sheet</td>
<td>26</td>
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<tr>
<td>W1-5</td>
<td></td>
<td>1/8&quot; Acrylite Storm Sheet</td>
<td>23</td>
</tr>
<tr>
<td>W1-6</td>
<td></td>
<td>3/16&quot; Lexan Solar Sheet</td>
<td>29</td>
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<td>W1-7</td>
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<td>1/4&quot; Glass, Weathersstripped</td>
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<tr>
<td>W1-8</td>
<td></td>
<td>1/4&quot; Laminated Glass</td>
<td>37</td>
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<td>W1-9</td>
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<td>Steel and Wood</td>
<td>5/16&quot; Glass</td>
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<td>W1-17</td>
<td></td>
<td>9/16&quot; Laminated Glass</td>
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<td>Wood</td>
<td>5/8&quot; Glass</td>
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<td>W1-19</td>
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<td>5/8&quot; Laminated Glass</td>
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<td>W1-20</td>
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<td>3/4&quot; Laminated Glass</td>
<td>41</td>
</tr>
<tr>
<td>W1-21</td>
<td></td>
<td>3/16&quot; Laminated Glass</td>
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</tr>
<tr>
<td>W1-22</td>
<td>Wood</td>
<td>1&quot; Glass</td>
<td>36</td>
</tr>
<tr>
<td>W1-23</td>
<td>Unspecified</td>
<td>1&quot; Laminated Glass</td>
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### Double Hung Units

<table>
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<tr>
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<tbody>
<tr>
<td>W1-24</td>
<td>Wood</td>
<td>3/32&quot; Old Glass Unit</td>
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<td>W1-25</td>
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<td>3/32&quot; Glass (sealed)</td>
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<td>W1-26</td>
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<td>3/32&quot; Glass, Divided Lights (sealed)</td>
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<tr>
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<td>3/32&quot; Glass (locked)</td>
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<td>W1-28</td>
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<td>1/8&quot; Glass</td>
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<td>W1-29</td>
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<td>1/8&quot; Glass, Divided Lights (sealed)</td>
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### SINGLE GLAZED UNITS

#### Casement Units

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<td>W1-31</td>
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<td>W1-32</td>
<td>Wood</td>
<td>1/8&quot; Glass (locked)</td>
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#### Sliding Units

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<td>Aluminum</td>
<td>3/32&quot; Glass (locked)</td>
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</tr>
<tr>
<td>W1-34</td>
<td></td>
<td>1/8&quot; Glass</td>
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<tr>
<td>W1-35</td>
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<td>1/4&quot; Glass</td>
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#### Awning Units

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<tbody>
<tr>
<td>W1-36</td>
<td>Wood</td>
<td>1/8&quot; Glass (sealed)</td>
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#### Jalousie Units

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<td>1/4&quot; Glass, 4-1/2&quot; Louvres, 1/2&quot; Overlap</td>
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### Fixed Units

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<tr>
<td>W2-3</td>
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<td>1/8&quot; Glass, 1/4&quot; Air Space, 1/8&quot; Glass (sealed)</td>
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<tr>
<td>W2-5</td>
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<tr>
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<tr>
<td>W2-10</td>
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<tr>
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<td>W2-12</td>
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<tr>
<td>W2-13</td>
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<td>1/4&quot; Lam. Glass, 3/8&quot; Air Space, 3/16&quot; Glass</td>
<td>38</td>
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<tr>
<td>W2-14</td>
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<td>1/4&quot; Lam. Glass, 1/2&quot; Air Space, 1/4&quot; Glass</td>
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<td>W2-15</td>
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<td>1/4&quot; Lam. Glass, 1/2&quot; Air Space, 1/4&quot; Lam. Glass</td>
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<tr>
<td>W2-16</td>
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<td>1/4&quot; Lam. Glass, 1&quot; Air Space, 3/16&quot; Glass (unsealed)</td>
<td>42</td>
</tr>
<tr>
<td>W2-17</td>
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<td>1/4&quot; Lam. Glass, 2&quot; Air Space, 3/16&quot; Glass (unsealed)</td>
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<tr>
<td>W2-18</td>
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<td>1/4&quot; Lam. Glass, 4&quot; Air Space, 3/16&quot; Glass (unsealed)</td>
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<tr>
<td>W2-19</td>
<td></td>
<td>3/8&quot; Lam. Glass, 1/2&quot; Air Space, 1/4&quot; Glass (sealed)</td>
<td>37</td>
</tr>
<tr>
<td>W2-20</td>
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<td>1/2&quot; Lam. Glass, 1&quot; Air Space, 1/4&quot; Lam. Glass (unsealed)</td>
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<tr>
<td>W2-21</td>
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<td>1/2&quot; Lam. Glass, 2&quot; Air Space, 3/16&quot; Glass (unsealed)</td>
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<tr>
<td>W2-22</td>
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<td>1/2&quot; Lam. Glass, 2&quot; Air Space, 3/8&quot; Glass (unsealed)</td>
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<tr>
<td>W2-23</td>
<td></td>
<td>1/2&quot; Lam. Glass, 4&quot; Air Space, 3/16&quot; Glass (unsealed)</td>
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<td>W2-24</td>
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<td>1/2&quot; Lam. Glass, 4&quot; Air Space, 3/8&quot; Glass (unsealed)</td>
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<td>W2-25</td>
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<td>1/2&quot; Lam. Glass, 4&quot; Air Space, 1/2&quot; Lam. Glass (unsealed)</td>
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<td>W2-26</td>
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<td>1/2&quot; Lam. Glass, 4&quot; Air Space, 1/4&quot; Lam. Glass (unsealed)</td>
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<tr>
<td>W2-27</td>
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<td>1/2&quot; Lam. Glass, 5&quot; Air Space, 1/4&quot; Glass</td>
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</tr>
<tr>
<td>W2-28</td>
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<td>1/2&quot; Lam. Glass, 8-1/2&quot; Air Space, 3/8&quot; Glass</td>
<td>56</td>
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<tr>
<td>W2-29</td>
<td></td>
<td>3/4&quot; Lam. Glass, 4&quot; Air Space, 1/8&quot; Glass (unsealed)</td>
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<td>W2-30</td>
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<td>3/4&quot; Lam. Glass, 4&quot; Air Space, 1/2&quot; Lam. Glass (unsealed)</td>
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### Fixed Units

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<tbody>
<tr>
<td>W2-31</td>
<td>Aluminum</td>
<td>3/16&quot; Glass, 2-1/2&quot; Air Space, 1/4&quot; Glass</td>
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<tr>
<td>W2-32</td>
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<td>3/16&quot; Glass, 4-3/4&quot; Air Space, 1/4&quot; Glass</td>
<td>47</td>
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<tr>
<td>W2-33</td>
<td></td>
<td>1/4&quot; Glass, 1/2&quot; Air Space, 1/4&quot; Glass</td>
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</tr>
<tr>
<td>W2-34</td>
<td></td>
<td>1/4&quot; Glass, 4&quot; Air Space, 3/16&quot; Glass</td>
<td>47</td>
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<tr>
<td>W2-35</td>
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<td>1/4&quot; Lam. Glass, 3/4&quot; Air Space, 1/4&quot; Glass</td>
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<tr>
<td>W2-36</td>
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<td>3/8&quot; Glass, 2&quot; Air Space, 1/4&quot; Glass</td>
<td>47</td>
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<tr>
<td>W2-37</td>
<td></td>
<td>3/8&quot; Lam. Glass, 1/2&quot; Air Space, 3/16&quot; Lam. Glass</td>
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<tr>
<td>W2-38</td>
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<td>3/8&quot; Lam. Glass, 5/8&quot; Air Space, 1/4&quot; Glass</td>
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### Double Hung Units

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<tbody>
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<tr>
<td>W2-42</td>
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<tr>
<td>W2-43</td>
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<td>1/4&quot; Glass, 4-1/4&quot; Air Space, 3/16&quot; Glass</td>
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</tr>
<tr>
<td>W2-44</td>
<td>Wood</td>
<td>3/32&quot; Glass, 3/16&quot; Air Space, 3/32&quot; Glass (locked)</td>
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<tr>
<td>W2-46</td>
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<td>3/32&quot; Glass, 2-1/8&quot; Air Space, 1/8&quot; Glass</td>
<td>37</td>
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<tr>
<td>W2-47</td>
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<td>1/8&quot; Glass, 3/16&quot; Air Space, 1/8&quot; Glass (unlocked)</td>
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<td>W2-49</td>
<td>Vinyl</td>
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### Casement Units

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<tbody>
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<td>Vinyl</td>
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## DOUBLE GLAZED UNITS

### Sliding Units

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<tbody>
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<tr>
<td>W2-54</td>
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<tr>
<td>W2-55</td>
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<tr>
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<tr>
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<tr>
<td>W2-62</td>
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<td>Aluminum</td>
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<td>1/4&quot; Lam. Glass, 4-1/4&quot; Air Space, 1/4&quot; Glass</td>
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<tr>
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<td>1/4&quot; Plexiglass, 4-1/4&quot; Air Space, 1/4&quot; Glass</td>
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### Awning Units

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### Tilt/Turn Units

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# TRIPLE GLAZED UNITS

## Fixed Units

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<tr>
<td>W3-3</td>
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<td>5/16&quot; Glass, 1/4&quot; Gas*, 5/32&quot; Glass, 1/4&quot; Gas*, 5/32&quot; Glass</td>
<td>33</td>
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<tr>
<td>W3-5</td>
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<td>5/16&quot; Glass, 1/2&quot; Gas*, 5/32&quot; Glass, 1/4&quot; Gas*, 5/32&quot; Glass</td>
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</tr>
<tr>
<td>W3-6</td>
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<td>5/16&quot; Glass, 1/2&quot; Gas*, 5/32&quot; Glass, 1/2&quot; Gas*, 5/32&quot; Glass</td>
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<tr>
<td>W3-7</td>
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<td>5/16&quot; Glass, 25/32&quot; Gas*, 5/32&quot; Glass, 1/4&quot; Gas*, 5/32&quot; Glass</td>
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## Operable Units

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<tbody>
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* gas filling (SF₃)
### TRIPLE GLAZED UNITS

#### Single Hung Units

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<th>Description</th>
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<tr>
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#### Double Hung Units

<table>
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<td>W3-18</td>
<td>Vinyl</td>
<td>1/8&quot; Glass, 1/4&quot; Air, 1/8&quot; Glass, 1/4&quot; Air, 1/8&quot; Glass</td>
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**Exterior Wall Rating (EWR) in dB for Doors**

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<tr>
<td>D1</td>
<td>1-3/4&quot; Hollow-Core Flush Wood</td>
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<td>No</td>
<td>1/16&quot; Undercut</td>
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<td>D2</td>
<td>1-3/4&quot; Hollow-Core Flush Wood</td>
<td>Weatherstripped</td>
<td>No</td>
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<td>D3</td>
<td>1-3/4&quot; Solid-Core Flush Wood</td>
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<td>No</td>
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<tr>
<td>D4</td>
<td>1-3/4&quot; Solid-Core Flush Wood</td>
<td>Weatherstripped</td>
<td>No</td>
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<tr>
<td>D5</td>
<td>1-3/4&quot; Steel</td>
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<tr>
<td>D6</td>
<td>2-1/2&quot; Steel</td>
<td>Mechanical Drop</td>
<td>Close, 6.1 psf</td>
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<td>D7</td>
<td>Hollow-Core Wood in Frame</td>
<td>Brass Weatherstrip, 3.91 psf</td>
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<td>D8</td>
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<td>Brass Weatherstrip, 1.23 psf</td>
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<td>D9</td>
<td>Solid-Core Wood</td>
<td>Spring Brass, 3 Sides with Plastic Hallow and Threshold Strip</td>
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<tr>
<td>D10</td>
<td>Solid-Core Wood</td>
<td>Extruded Plastic Weatherstrip</td>
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<td>D11</td>
<td>Solid-Core Wood</td>
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<td>Yes</td>
<td>Storm: Al. Glazed Single Strength</td>
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<td>D12</td>
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<td>D13</td>
<td>Sliding Glass, Glazed 3/16&quot; Safety Glass</td>
<td>No</td>
<td>Locked</td>
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Baffle to be constructed of sheet metal (minimum 20 ga.) or 1/2 inch thick plywood

Line baffle with 1-inch thick, 3 pound per cubic foot semi-rigid fiberglass panel

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