<table>
<thead>
<tr>
<th>SHEET NAME</th>
<th>STD DWG NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019 TRAFFIC SIGNAL STANDARD DRAWINGS INDEX</td>
<td>16.1.0.1</td>
</tr>
<tr>
<td>2019 TRAFFIC SIGNS OF PAVEMENT MARKINGS INDEX</td>
<td>16.1.0.2</td>
</tr>
<tr>
<td>TRAFFIC SIGNAL NOTES</td>
<td>16.1.1</td>
</tr>
<tr>
<td>LEGEND</td>
<td>16.1.2.1</td>
</tr>
<tr>
<td>KEY NOTES</td>
<td>16.1.2.2</td>
</tr>
<tr>
<td>SPAN WIRE SIGNAL DESIGN</td>
<td>16.1.3</td>
</tr>
<tr>
<td>MOUNTING HARDWARE</td>
<td>16.1.4</td>
</tr>
<tr>
<td>LOOP DETECTION SHEET 1</td>
<td>16.1.5.1</td>
</tr>
<tr>
<td>LOOP DETECTION SHEET 2</td>
<td>16.1.5.2</td>
</tr>
<tr>
<td>CONDUIT DETAILS</td>
<td>16.1.6</td>
</tr>
<tr>
<td>PULL BOXES</td>
<td>16.1.7</td>
</tr>
<tr>
<td>SIGNAL POLE FOUNDATION</td>
<td>16.1.8</td>
</tr>
<tr>
<td>MAST ARM POLE LOADS SHEET 1</td>
<td>16.1.9.1</td>
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<tr>
<td>MAST ARM POLE LOADS SHEET 2</td>
<td>16.1.9.2</td>
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<td>16.1.10.2</td>
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<td>16.1.12.2</td>
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<tr>
<td>POLE FOUNDATION DETAILS</td>
<td>16.1.14</td>
</tr>
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<td>FOUNDATION FOR XCEL FACILITES</td>
<td>16.1.15</td>
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<tr>
<td>FOUNDATION FOR CAST-IN-PLACE TRAFFIC SIGNAL POLE</td>
<td>16.1.16</td>
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<td>16.1.21</td>
</tr>
<tr>
<td>DRIVER'S FEEDBACK SIGN DETAILS</td>
<td>16.1.22</td>
</tr>
<tr>
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<td>16.1.23</td>
</tr>
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<td>16.1.24</td>
</tr>
<tr>
<td>RRFB DETAIL &amp; SIGN SHEET 1</td>
<td>16.1.25.1</td>
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<td>16.1.25.2</td>
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<td>PEDESTRIAN HYBRID BEACON CROSSWALK (HAWK)</td>
<td>16.1.26</td>
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<td>CONTROL CABINET &amp; PULL BOX DETAIL</td>
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2019 TRAFFIC SIGNAL STANDARDS

**APPROVED:**

Lesley Thomas, City Engineer

Emily Gloeckner, City Traffic Engineer

3/30/19

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2019 TRAFFIC SIGNAL STANDARDS

**APPROVED:**

Lesley Thomas, City Engineer

Emily Gloeckner, City Traffic Engineer

3/30/19
# 2019 Sign and Pavement Marking Standards

## Denver Public Works
City and County of Denver
Transportation Design

<table>
<thead>
<tr>
<th>Sheet Name</th>
<th>STD DWG NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Crosswalk Layout Detail</td>
<td>16.2.1</td>
</tr>
<tr>
<td>Pavement Marking Details Sheet 1</td>
<td>16.2.2.1</td>
</tr>
<tr>
<td>Pavement Marking Details Sheet 2</td>
<td>16.2.2.2</td>
</tr>
<tr>
<td>Bike Lane Typical Marking Details</td>
<td>16.2.3</td>
</tr>
<tr>
<td>Central Business District Pavement Marking Details</td>
<td>16.2.4</td>
</tr>
<tr>
<td>Single Sign Post Mounting Details</td>
<td>16.2.5</td>
</tr>
<tr>
<td>Multiple Sign Post Mounting Details</td>
<td>16.2.6</td>
</tr>
<tr>
<td>One-Way Sign Placement Details</td>
<td>16.2.7</td>
</tr>
<tr>
<td>Traffic Sign Utility Pole Mounting Detail</td>
<td>16.2.8</td>
</tr>
<tr>
<td>Ground Mount Street Name Sign Installation Detail</td>
<td>16.2.9</td>
</tr>
<tr>
<td>Ground Mount Street Name Sign Detail</td>
<td>16.2.10</td>
</tr>
<tr>
<td>Overhead Street Name Sign &amp; Details</td>
<td>16.2.11</td>
</tr>
<tr>
<td>Neighborhood Bikeway Branding Sign</td>
<td>16.2.12</td>
</tr>
<tr>
<td>Parking Meter Post Installation</td>
<td>16.2.13</td>
</tr>
<tr>
<td>Barricade Details</td>
<td>16.2.14</td>
</tr>
<tr>
<td>Bike Rack Details</td>
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</tr>
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## 2019 Traffic Signal Standards

### Approved:

**Lesley Thomas, City Engineer**

**Emily Gloeckner, City Traffic Engineer**

**Date:**

3/29/19

## Sheet Revisions

- **Date:**
- **Comments:**
- **Initiate:**
- **Computer File Information:**
  - **Drawing File Name:**
  - **CAD Ver.:**
  - **Scale:**
  - **Version:**

## Department of Public Works
201 W Market Avenue
Denver, CO 80202
Phone: (720) 865-4500
Fax: (720) 865-4544

## Standard Drawing No.

16.1.0.2

**Traffic Signs of Pavement Markings Index**

Sheet No. 02 of 37
TRAFFIC SIGNAL NOTES

GENERAL

1. Item number refers to the appropriate section of the standard specifications for road and bridge construction – Colorado Department of Transportation 2017.

2. For work involving Xcel Energy, the contractor shall comply with the franchise agreement in place between the city & county of Denver and Xcel Energy. Xcel Energy shall provide power source within 15' of traffic signal cabinet. Therefore, all submittals for traffic signal poles shall be made to the city & county of Denver public works transportation operations (as designated) by the engineer. No traffic signal poles or street light poles shall be ordered until a submittal has been accepted from city & county of Denver public works transportation operations. All traffic signal and street lights shall be wired into the electric meter.

3. Xcel Energy to remove only Xcel owned poles and existing street lighting. The contractor shall remove all other signal equipment including all city owned signal poles with or without street lighting, mast arms, span wires, pedestal poles, signal heads, span wire, push buttons, pull boxes, controller cabinets and all foundations as shown on the plans. Contractor shall repair all sidewalks and other concrete after removals or as directed and approved by Denver public works transportation operations.

4. All salvaged signal equipment removed remains the property of the city & county of Denver and must be delivered to Denver public works transportation operations at 5440 Roslyn Street, or in accordance with public works transportation project inspector at (720) 868-4800 prior to delivery.

5. No traffic signal shall be turned on or turned off on a Friday or prior to a holiday without prior authorization from Denver public works transportation (720) 868-4800. All traffic signal shall be turned off without permanent severing and stripping.

HARDWARE

6. All signal heads (not rigidly supported top and bottom) shall be constructed of die cast aluminum and painted dark olive green in conformance with Federal specification 14056 (1/2 diameter only).

7. Polycarbonate signal heads are required for all traffic signals and pedestrian signals. All polycarbonate heads shall be dark olive green in conformance with Federal specification 14056.

8. All hardware including spacers, elbows, and pole plates shall be painted dark olive green in conformance with Federal specification 14056.

9. Light emitting diode (LED) signal lenses shall be installed in all signal indications (red, yellow, green, and walk). Don't walk, and countdown pedestrian signal head indications.

10. Contractor shall install the signal poles and pedestals at the exact location as shown in the plan unless authorized by the engineer. Contractor shall field verify the locations with the city & county of Denver public works engineer prior to start of work.

CONSTRUCTION

11. All conduit shall be schedule 80 PVC or HDPE. Two 3 INCH CONDUIT SHALL BE BRACKETED IN POLE BASE FOR ALL MAST ARM POLES. TWO 2 INCH CONDUIT SHALL BE BRACKETED IN POLE BASE FOR ALL SIGNAL POLES WITHOUT MAST ARM.

12. One pull box to be installed at locations shown as [•] on plan. Pull box for communication conduit shall be the [•] CONDUIT UNLESS SPECIFIED ON THE PLAN AS [•] SPECIAL, COMMUNICATION PULL BOX (LS) SHOWN MAY BE DESIGNATED "TRAFFIC" CONDUIT BY PHYSICALLY EMBOSSED, NOT PAINTING. SEE STD. DWG. NO. 16.17 FOR PULL BOX DIMENSIONS.

13. A single 3 INCH CONDUIT SHALL BE REQUIRED AND INSTALLED FROM THE TRAFFIC COMMUNICATION PULL BOX TO THE TRAFFIC SIGNAL CONTROLLER CABINET. CONDUIT SHALL BE SCHEDULE 80 PVC CONDUIT.

14. Interconnect conduit pull boxes shall be placed at 800 foot maximum spacing, or otherwise directed by city & county of Denver public works engineer.

15. Install water valve pull box and 3 INCH SCHEDULE 80 PVC CONDUIT FOR LOOP DETECTION INTERCEPTS SHOWN ON PLANS. SEE STD. DWG. NO. 16.1.5.

16. All holes in traffic signal poles to be drilled or sealed. Installing holes by burning with a torch is not approved.

17. For mast arm mounted signal heads, the bottom of all overhead mounted signal heads shall be on the same horizontal plane and have a minimum clearance of 18" and a maximum clearance of 15'-7" above the crown of pavement surface, unless otherwise specified by city & county of Denver public works engineer.

18. For span wire mounted signal heads, the bottom of all overhead mounted signal heads shall be on the same horizontal plane and have a minimum clearance of 15'-7" above the crown of pavement surface, unless otherwise specified by city & county of Denver public works engineer. All span wire shall include a bottom wire or who tethers.

19. Existing signal faces shall remain visible and illuminated until new signals are turned on. Blocking of existing face by new face will require new face to be temporarily wired for illumination.

20. Anchor bolts shall not be trimmed until signal pole base elevation is approved by city & county of Denver public works engineer.

HARDWARE (CONT.)

21. Pedestrian push button shall be in compliance with note section 19.4. Push buttons should be located between 1' and 6' from the edge of the curb, shoulder, or pavement.

22. All traffic signal wire connectors shall be of the Buchanan compression type with copper crimping connectors and real wrap caps or approved equal.

23. Wire splicing in the pull boxes are not allowed except for the loop wires. All loop wires shall be spliced in the water valve traffic pull boxes.

24. Three (3) spare conductors shall be provided to each hand hole and to the end of each mast arm.

25. All solderless connectors shall be used.

OUTSIDE

26. Overhead street name signs to be furnished and installed on each mast arm as noted on STD. DWG. NO. 16.12. Sign to be bolted on 1/4 inch tees. Extension which connects to mast arm by use of adapter screwed into housing.

27. Contractor shall not remove any regulatory traffic signs unless specified on plans. City & county of Denver public works engineer to be notified 48 hours prior to any sign changes at (720) 868-4300.

28. All pertinent signs and pavement markings must be in place at the time a traffic signal change is made, such as a new signal turn on and or changes made to existing signal operation.
REMOVALS
1. REMOVE SIGNAL HEAD
2. REMOVE SIGNAL POLE
3. REMOVE SIGNAL CABINET, CONTROLLER, PULL BOXES & WATER VALVE PULL BOXES
4. REMOVE MAST ARM
5. REMOVE SPAN WIRE, CABLE AND ALL ATTACHED SIGNAL HEADS AND EQUIPMENT
6. REMOVE PUSH BUTTON

ELECTRIC UTILITY COMPANY TO REMOVE EXISTING POLE

INSTALLATIONS
1. INSTALL SIGNAL HEAD OR HEAD
2. INSTALL SIGNAL CABINET, CONTROLLER AND ASSOCIATED EQUIPMENT
3. INSTALL PUSH BUTTON
4. INSTALL MAST ARM
5. INSTALL TWO 3-INCH CONDUITS
6. INSTALL SIGNAL POLE
7. INSTALL MAST ARM — LENGTH AS SHOWN
8. INSTALL SPAN WIRE
9. INSTALL COMMUNICATIONS PULL BOX MARKED "TRAFFIC COMM" ON UP
10. INSTALL COMMUNICATIONS PULL BOX MARKED "TRAFFIC" ON LEFT
11. INSTALL LOOP DETECTOR
12. INSTALL CLOSED CIRCUIT CAMERA
13. ELECTRIC UTILITY COMPANY TO INSTALL POWER FEED, CONTRACTOR TO EXTEND TO CONTROLLER
14. INSTALL LUMINARE
15. INSTALL WATER VALVE PULL BOX
16. INSTALL STREET LIGHT STANDARD
17. INSTALL EMERGENCY VEHICLE PRECEDENCE DETECTOR
18. INSTALL INTERCONNECT (SEE & TYPE AS SHOWN)
19. INSTALL VIDEO DETECTION CAMERA (PLFD OR VIDEO)
20. INSTALL ELECTRIC METER

REPLACEMENTS
1. REPLACE SIGNAL HEAD
2. REPLACE SIGNAL POLE
3. REPLACE SIGNAL CABINET, CONTROLLER AND ASSOCIATED EQUIPMENT
4. REPLACE PUSH BUTTON
5. REPLACE SPAN WIRE
6. REPLACE SPAN WIRE AND ALL ATTACHED SIGNAL EQUIPMENT
7. REPLACE DETECTOR
8. ELECTRIC UTILITY COMPANY TO REPLACE EXISTING POLE

KEY NOTES
NOTES:

ANCHOR BOLTS

1. (a) 2.5" DIAMETER ANCHOR BOLTS PER CASION AND (2) 2.5" HEX (2) 2.5" NUTS FOR EACH BOLT WITH THREADED END GALVANIZED TO AT LEAST 1/2" FROM END.

2. LENGTH, THREAD LENGTH, HOOK LENGTH, AND DIAMETER OF EACH ANCHOR BOLT SHALL BE AS NOTED ABOVE IN DETAIL.

3. ANCHOR BOLTS SHALL BE MEDIUM STRENGTH, MILD STEEL OR ALLOY STEEL WITH MINIMUM DESIGN STRENGTH DETERMINED IN ACCORDANCE WITH ASTM A490 OR ASTM A500.

4. ALL THREADS FOR BOLTS AND NUTS SHALL HAVE CLASS 2 FT TOLERANCES IN ACCORDANCE WITH ANSI B1.1.

NUTS AND WASHERS

5. NUTS FOR ALLOY STEEL ANCHOR BOLTS SHALL COMPLY WITH ASTM A194 GRADE 2H OR ASTM A563, GRADE D OR C. ALL THREADS FOR NUTS SHALL HAVE A CLASS 2 FT TOLERANCE IN ACCORDANCE WITH ANSI B1.1. WHEN NUTS ARE TO BE GALVANIZED, THE UNCOATED BOLTS SHALL BE GALVANIZED PRIOR TO CUTTING THE THREADS.

6. EXPOSED NUTS SHALL BE GALVANIZED OR COATED WITH A ZINC-RICH COATING IF THE ANCHOR BOLTS ARE NOT GALVANIZED.

7. WASHERS INSTALLED WITH ANCHOR BOLTS OF ANY TYPE SHALL COMPLY TO THE REQUIREMENTS OF ASTM F1427 AND SHALL HAVE THE SAME FINISH OR COATING AS THE BOLT AND NUT.

GENERAL NOTES

1. DESIGN OF FOUNDATIONS IS BASED ON TRAFFIC SIGNAL POLE CONFIGURATIONS PROVIDED BY VAHLKORD, INC., DRAWING NO. 2015A002-07 FOR THE CITY & COUNTY OF DENVER, AND IS EXEMPT FROM ADDITIONAL TRAFFIC POLE INFORMATION.

2. DESIGN CONSIDERATIONS, 2015 ASHTO "USER SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINARIES AND TRAFFIC SIGNALS, FIRST EDITION.

3. AN UNLIMTED WIND VELOCITY OF 200 MPH HAS BEEN USED FOR THE DESIGNS HEREIN.

4. ALL FOUNDATIONS ON THIS SHEET ARE FOR SINGLE MAST ARM POLES. EXCEPT AS NOTED.

5. THE DESIGNS HEREIN ASSUME THAT SIGNS ARE INSTALLED WITHIN THE ROADWAY PREAM WITH THE FOLLOWING SOIL PARAMETERS:
   - SOIL DENSITY = 110 lb/CF
   - SOIL CONSISTENCY = 70 lb/CF FOR MEDIUM DRY CONSISTENCY SOIL
   - SF = 1.25 FOR TORSIONAL RESISTANCE AND 3.0 FOR FLEXURAL RESISTANCE

6. CONTACT THE ENGINEER IF ANY OF THE FOLLOWING SOIL CONDITIONS ARE ENCOUNTERED DURING DRILLING:
   - SIGNALS WILL NOT BE INSTALLED WITHIN THE ROADWAY PREAM
   - THE FOUNDATION SOILS ARE NON-HOMOGENOUS
   - FLOODPLAIN ENCOMPASSES
   - CREEK SOILS
   - GROUNDWATER
   - EXPANSIVE SOILS
   - SOILS WITH STRESS
   - BOTTOM OF CASION WILL EXTEND BELOW BOTTOM OF ANY ADJACENT BUILDING OR RETAINING WALL FOUNDATION
   - SLOPES GREATER THAN 10%

7. CASIONS SHALL BE PLACED AGAINST UNDISTURBED EARTH.

8. CASIONS SHALL BE CONSTRUCTED WITH AN ENTRAINED COST CLASS B CONCRETE IN ACCORDANCE WITH SECTION 503 OF THE STANDARD SPECIFICATIONS. REINFORCING STEEL SHALL BE GRADE 60.

9. CASION CONCRETE SHALL MEET THE SEVEN DAY DRY ENHANCED STRENGTH PRIOR TO INSTALLING THE SIGNAL STRUCTURE.

10. FOUNDATION TO BE PROVIDED WITH 2 CONCRETE STUB OUTS (3 - 3") DIRECTION TO BE DETERMINED BY CITY & COUNTY OF DENVER ENGINEER AND IS TO BE CONSIDERED AS PART OF THE FOUNDATION.

11. BASE PLATE, NUTS AND NUT COVERS TO BE PURCHASED BY MANUFACTURER. ANCHOR BOLTS ARE TO BE PURCHASED BY THE CONTRACTOR AND ARE INCLUDED IN THE COST OF THE FOUNDATION.

12. FOUNDATION SHALL BE PAID BY THE FEET OF OIL FILLED. USE OF THE SUPPLEMENTARY FOUNDATION FOR CONSISTENCY SOIL SHALL BE ALLOWED ONLY BY APPROVAL OF THE CITY & COUNTY OF DENVER ENGINEER.

13. PLUMBING OF POLES SHALL BE ACCOMPLISHED BY ADJUSTING NUTS AFTER LOADING OF MAST ARM.

14. EACH END OF CASION TIES TO BE TERMINATED WITH A 135° HOOK AROUND A CONCRETE BAR.

15. DESIGN IS BASED ON A MONETAL ConDURITE CONCRETE CONSIDERED IN THE VENUE OF THE CASION. CASIONS SHOULD NOT BE INSTALLED AT SITES WITH A SLOPE EXCEEDING 10%.

16. LEVELING CONCRETE SHALL BE 4.000 PSI CLASS B OR ENHANCED CONCRETE.

17. YIELD STRESS OF REINFORCING STEEL SHALL BE MINIMUM 60,000 PSI.
**Detail 9**

**Upper Handhole**

- **Cover Mounting Clutch**
- **Handhole Trim**
- **0.50" Str. Half Coupling**

**Detail 10**

**Signal Arm Slip Joint**

- **Shank Section Data**

**Detail 11**

**Handhole**

- **Pole Tube Wall**
- **Handhole Trim**
- **0.50" Nut Holder with Fasteners for Grounding, Located at 1/8" from Handhole**

**Detail 12**

**Pole Base**

- **Bolt Circle**
- **Nut Cover**

**Detail 13**

**Anchor Bolt**

- **Anchor Bolt with 02" Hex Nut and 02 Washers**
- **Ferr Bolt with Threads**
- **End Galvanized to at least 1/2"**

**Signal Arm End Cap**

- **Removable End Cap Held in Place with 03 Stainless Steel Set Screws and 03 Stainless Steel Thru Bolts**

**Notes:**

- All dimensions on Sheet 06.10.2 for further reference.
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Maximum arm length combination for dual configuration are 40'-0" / 40'-0". Arm lengths exceeding these will require a special pole design.
ALL CONDUCTORS SHALL BE SIZED IN CONFORMITY WITH N.E.C. REQUIREMENTS. USE 19+13 CONDUCTOR #4 AND MINIMUM.

BOLT CIRCLE DIMENSIONS VARY, BOLT CIRCLE SHALL BE CENTERED ON FOUNDATION.

GROUND ONE #8 SOFT DRAWN BARE COPPER GROUND WIRE FROM GROUNDING LUG AT BASE OF POLE TO GROUND ROD.

4" PVC SLEEVE INSTALLED IN POLE BASE AS SHOWN FOR GROUNDING CONDUCTORS.

4" CHAMFER ON ALL EXPOSED EDGES.

4" MAXIMUM PROJECT 2" & 5/8"

FINAL GRACE (TYP.)

2" DIA.

GROUND ROOD

EARTH 4-36 OR 15 #5 REBAR

6" -4-6 OR 15 #5 REBAR AT 1'-6" CENTERS

6" DIA. + 6"-0" COPPER CLAD GROUND ROD, MINIMUM BEHIND SURFACE AND 6" MINIMUM AWAY FROM CONCRETE BASE.

COMPLETE CONDUCTOR TO GROUND ROOD WITH APPROVED GROUND ROOD CLAMP.

6" DIA. WITH TOP 8" OF ROD GALVANIZED.

TRAFFIC SIGNAL LIGHT POLE - STEEL (NO MASTARM)

TYPICAL FOUNDATION SECTION

ALTERNATIVE CONCRETE LIGHT STANDARD FOUNDATION WITH SPICE BOX

NOTES:

2. FOUNDATION SHALL BE 7 FT. FOR LIGHT STANDARDS 20 FT. THRU 40 FT., AND 6 FT. FOR LESS THAN 20 FT.

3. LIGHT STANDARD FOUNDATION DEPTH IS BASED ON A MAXIMUM POLE HEIGHT OF 40 FT. IN SUELL CLAY WITH N > 8 OR MEDIUM SAND WITH N > 15 AS DETERMINED BY ASTM C 1505 STANDARD PENETRATION TEST.

4. CONCRETE SHALL BE CLASS B.

5. FOUNDATIONS FOR LIGHT STANDARDS HIGHER THAN 40 FT. OR LIGHT STANDARDS WITH MULTIPLE LUMINARIES OR BANKS, OR VARIED SOILS OR WIND CONDITIONS, SHALL BE DESIGNED BY THE CONTRACTOR'S ENGINEER AND SHOWN ON THE PLANS.

WHERE FOUNDATION IS LOCATED IN THE SIDEWALK, THE TOP OF THE FOUNDATION SHALL BE FLUSH WITH THE TOP OF THE SIDEWALK CONFORMING TO ADA REQUIREMENTS.

10" DEEP GRAVEL BED

1" CLEAR

6" CLEAR (RIOTED SPIKED)

ONE OR TWO 2" PVC SLEEVE PLAN

GROUNDS SUPPORT RING

CONCRETE SPICE BOX

FOUNDATION FOR CAST-IN-PLACE TRAFFIC SIGNAL POLE

STANDARD DRAWING NO.

DEPARTMENT OF PUBLIC WORKS

501 WEST COLORADO AVENUE
DENVER, CO 80222
PHONE: (205) 931-9920
FAX: (205) 933-4044

Issued By:

Table:

Computer File Information

Sheet Revisions

Cover Sheet

Sheet No. 24 of 37

[Signature]

[Signature]
NOTES:
1. ALL MATERIALS AND CONSTRUCTION SHALL CONFORM TO THE
   REQUIREMENTS OF THE SPECIFICATIONS.
2. UNSTABLE SOIL OR STEEP SLOPE MAY REQUIRE DEEPER
   FOUNDATIONS. SEE SPECIFICATIONS. CABINETS SHALL NOT
   BE LOCATED IN DRAINAGE AREAS, UNLESS THEY ARE ELEVATED.
3. CONDUIT SIZE SHALL BE 2" SCHEDULE 80 PVC.
4. ANCHOR BOLTS SHALL BE GALVANIZED, 16" x 16" x 4" COMPLETE WITH NUTS AND WASHERS.
5. CONDUIT PROJECTS ABOVE FOUNDATION SHALL BE 2" MIN. TO 4" MAX. CONDUITS SHALL BE CAPPED.
6. 1" SLEEVE FOR GROUND ROO, EXACT LOCATION PER CABINET MANUFACTURES REQUIREMENTS.
7. IN UNPAVED AREAS A RAISED PVC PAD 36" x 4" x 36" SHALL BE PLACED IN FRONT OF THE CABINET. THE PAD SHALL BE SET 2" BELOW THE FOUNDATION ELEVATION AND SLOPED AWAY FROM CABINET.
8. CONFIRM ACTUAL ANCHOR BOLT LAYOUT DIMENSIONS AS SHOWN
    PER THE TABLE ON THIS DRAWING PRIOR TO CONSTRUCTION.
9. A METER PEDESTAL SHALL BE PROVIDED FOR ELECTRICAL SERVICES FOR TRAFFIC SIGNALS WHEN A SEPARATE SERVICE CABINET IS SPECIFIED. THIS CABINET CAN BE USED FOR OTHER PURPOSES AS WELL, SEE PLAN.
10. CABINETS SHALL BE OFFSET A MINIMUM OF 6 FT. FROM ANY ROADWAY AND 5 FT. FROM CONTROLLER CABINET, UPS CABINET, SERVICE POLE OR PAD MOUNTED TRANSFORMER.
11. PREFORMED CONCRETE BASE FOR THE METER PEDESTAL SHALL
    BE USED ONLY WITH THE ENGINEER'S APPROVAL.
GENERAL NOTES

1. INSTALLATION DESIGN CONFORMS WITH ASPHALT "STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORT FOR HIGHWAY SIGNS, LUMINATED AND TRAFFIC SIGNALS AND SHALL BE FABRICATED IN ACCORDANCE WITH:

A. STEEL PIPE, POST ANCHOR PLATES AND BREAKAWAY PLATES SHALL CONFORM TO ASPHALT M270 (ASTM A470) GRADE 36.

B. HIGH STRENGTH BOLTS, NUTS AND WASHERS SHALL CONFORM TO ASTM A325 AND SHALL BE GALVANIZED OR CEMENT PLATED.

C. HOLES SHALL BE DRILLED AND CUES SHALL BE PREPARED SIMILAR TO "HOLE" CUT; HOWEVER, FLAME CUTTING WILL BE PERMITTED PROVIDED ALL EDGES ARE ROUNDED. METAL SHALL NOT PROJECT BEYOND THE FLANGE OF THE PLATE FACE ON BREAKAWAY PLATES.

D. ALL WELDING IS TO BE CONTINUOUS AND IN ACCORDANCE WITH CURRENT AND SPECIFICATIONS. A "KEEPER" PLATE OF 1/8" (0.125"") GALVANIZED SHEET METAL, FABRICATED TO MATCH BREAKAWAY PLATE DIMENSIONS BUT WITH HOLES RATHER THAN SLOTS, SHALL BE USED TO RESTRAIN BOLT LOOSENING DUE TO VIBRATION.

E. DRIVER FEEDBACK SIGN POLE SHALL BE MOUNTED ON THE CITY AND COUNTY OF DENVER PUBLIC WORKS TRANSPORTATION OPERATIONS STANDARD PEDESTAL POLE. POLE SHALL BE STANDARD 10' FEDERAL POLE MADE OF 6" DEEP, POLE FOOTING FOR 10' PEDESTAL POLE (SEE DETAIL 5 IN SHEET 16.13).

F. BOLTS, U-CLAMPS, NUTS AND METAL WASHERS SHALL BE GALVANIZED OR CEMENT PLATED.

2. DESIGN WIND VELOCITY = 90 MPH

3. AS DETERMINED AT EACH SPECIFIC SITE LOCATION, FOR POWER, OTHER SOLAR PANEL OR HIGH-VOLTAGE ELECTRICAL CONNECTION SHALL BE MADE.
SPEED LIMIT WHEN FLASHING

TYPICAL SIGNAL HEAD
12" YELLOW HEAD
FRONT OF POLE ONLY

FLASHER/BATTERY CABINET
LOCATED ON BACK OF POLE

TYPICAL SIGNAL HEAD SECTION - 12" LENS

SCHOOL

NOTES:
1. AS DETERMINED AT EACH SPECIFIC SITE LOCATION, FOR POWER, EITHER SOLAR PANEL OR HARD-WIRE ELECTRICAL CONNECTION SHALL BE MADE.
2. AS DETERMINED AT EACH SPECIFIC SITE LOCATION, EITHER DIRECTIORAL ANTENNA OR HARD-WIRE TRAFFIC SIGNAL CONNECTION SHALL BE MADE.
3. TEMPORARY SIGN PLACARD TO BE INSTALLED OVER 55-1 " WHEN FLASHING" TEXT UNTIL BEACONS ARE OPERATIONAL.
4. THIS SIGN INSTALLATION HAS BEEN DESIGNED FOR A 30 MPH WIND VELOCITY.

DEPARTMENT OF PUBLIC WORKS
FLASING BEACON & SIGN
SHEET 1

STANDARD DRAWING NO. 16.1.23

Sheet No. 32 of 37
WHEN FLASHING
RIGHT TURNS
AND
ONLY
BUSES
WHEN FLASHING
RIGHT TURNS
AND
ONLY
BUSES
PUBLIC WORKS
DEPARTMENT OF
FLASHING BEACON & SIGN
SHEET 2
BUSES AND RIGHT TURNS ONLY WHEN FLASHING
RECTANGULAR RAPID FLASHING BEACON SYSTEM
PEDESTRIAN PEDESTAL INSTALLATION (TWO SIDED)

PUSH BUTTON TO TURN ON WARNING LIGHTS

30" x 30" w/11-2 STD. YELLOW (Y) PEDESTRIAN CROSSING SIGN

RATED FLASHING BAR CLEAR LENSES W/ AMBER LED LIGHTS

18" x 30" w/16-76 SUPPLEMENTAL STD. YELLOW (Y) ARMOR PLAQUE

INSTALL PEDESTRIAN PLACEMENT AND INSTRUCTION SIGN

STD. PEDESTRIAN SIGNAL PEDESTRIAN 4" DIA. STD. GALVANIZED STEEL PIPE (ASTM A36 SCH 40, 4 1/2" O.D.) W/ FLANGED BASE SEE STD Dwg NO 16.1.13.1 FOR ADDITIONAL DETAILS

CONSTRUCT FOUNDATION ACCORDING TO DETAIL 5 STD Dwg NO 16.1.13.2

SEE DETAIL "A" FOR ROD CIRCLE

SIDE VIEW

FRONT VIEW

FLANGEABLE BASE MOUNTED FLUSH WITH SIDEWALK OR ISLAND

SOLAR PANEL ENERGY SOURCE

FURE-MOUNT RATED NETWORK CONTROLLER [16W X 107W X 8"

5" X 1 3/8" X 30" DRAINAGE PIPE W/ 3" ROD CIRCLE (RC)

ANCHOR POLES X 30" L X 4" HOOK (ASTM A-36 OR A-307)

30 MPH 140 FT
35 MPH 165 FT
40 MPH 183 FT

POSTED SPEED [L]

STATE LAW

YIELD TO STATE LAW WITHIN CROSSWALK

2-50 FT

6-50 FT

2-50 FT

-sheet 2

DEPARTMENT OF PUBLIC WORKS

RRFB DETAIL & SIGN

STANDARD DRAWING NO. 6.1.29.2

Sheet No. 35 of 37
NOTES:
1. ALL PULL OR SPOKE BOXES SHALL BE TRAFFIC RATED 20,000 PSI MINIMUM.
2. BOX DIMENSIONS SHOWN ARE FOR 2 INCH CONDUIT MAXIMUM. FOR CONDUITS LARGER THAN 2 IN, REFER TO N.E.C. SECTION 314.26A FOR BOX SIZE REQUIREMENTS.

CABINET COMPONENT LIST
A. 20 IN. x 48 IN. x 12 IN. C. NEMA 3R HINGED ENCLOSURE WITH 6 IN. LEGS ANCHORED TO CONCRETE FOUNDATION PAD. THE BACK OF THE CABINET SHALL BE LOCATED 6 IN. MAXIMUM FROM THE EDGE OF THE CONCRETE PAD.
B. NEMA 1, 100A, 100, 120/240V-1–3W LOAD CENTER SIZE PANEL. MINIMUM SPACES AS REQUIRED PLUS A MINIMUM OF TWO AVAILABLE SPACES FOR FUTURE USE. INSTALL IN CABINET WITH FULL-SIZE GROUND COVER, AND BRANCH BREAKERS AS LISTED ON THE SCHEDULE.
C. ELECTRICALLY HELD LIGHTING CONTRACTOR FURNISHED WITH 120-240V COIL AND NUMBER OF POLES REQUIRED. INSTALL INSIDE CABINET.
D. NEMA 3R 120V PHOTOELECTRIC CONTROL WITH 3-PRONG TWIST-Lock RECEPTACLE BASE. INSTALL THE BASE INSIDE THE CABINET. THE PHOTOELECTRIC CONTROL SHALL BE MOUNTED ON TOP OF THE CABINET AND ORIENTED NORTHWARD TO MINIMIZE THE SUN’S INTERFERENCE.
E. 20-AMP GFI MOUNT RECEPTACLE IN A 1-GANG BACK BOX WITH COVER. INSTALL INSIDE THE CABINET.
F. NEMA 1, 125A, 240V, METER HOUSING CONFORMING TO THE UTILITY PROVIDER’S REQUIREMENTS.
G. NEMA 3R, 100A, 2-POLE CONDUCTOR, UL LISTED FOR SERVICE EQUIPMENT AND FINES AS SHOWN IN WIRE-DIA GRAPHS WITH NEUTRAL AND GROUND BARS MOUNTED ON BACK SIDE OF ENCLOSURE.
H. 4" X 8'-0" COPPER CLAD DRIVEN GROUND ROG WITH APPROVED GROUND ROG CLAMP.

NOT SHOWN IN THE DETAIL:
1. VOLTAGE SURGE ARRESTER, 650V A.C. TO GROUND MAX.
2. "HANG-OFF-AUTO" KEY SWITCH. KEPT FOR AGENCY RESPONSIBLE FOR THE MAINTENANCE OF THE SYSTEM.

DEPARTMENT OF PUBLIC WORKS
CONTROL CABINET & PULL BOX DETAIL
STANDARD DRAWING NO. 16.1.27

Sheet No. 37 of 37
TYPICAL CROSSWALK LAYOUT PROCEDURES

1. SETBACK SIDEWALK
   - Enter on sidewalk
   - Mark with chalk lines

2. SETBACK SIDEWALK ONE SIDE
   - Center on sidewalk
   - Mark with chalk lines
   - Align with curb

3. ATTACHED SIDEWALK 5' TO 10' CORNER RADIUS
   - Align with curb
   - Line extended
   - Mark with chalk lines

4. ATTACHED SIDEWALK 20' TO 30' CORNER RADIUS
   - 5' from curb
   - Line extended (typ.)
   - Mark with chalk lines

5. ATTACHED SIDEWALK WIDER THAN 10'
   - Mark with chalk lines
   - Align with back of sidewalk

6. WEL-BLOCK CROSSWALK
   - Center on sidewalk or pedestrian ramps
   - Mark with chalk lines

1. INSTALL STOP LINE 4' IN ADVANCE OF AND PARALLEL TO THE NEAREST CROSSWALK LINE UNLESS OTHERWISE SHOWN

NOTES:
1. CROSSWALK BAR DIMENSIONS
   - USE 18" WIDTH FOR CROSSWALK BARS
   - USE 18" WIDTH FOR CROSSWALK BARS

2. KEEP BARS PARALLEL TO LANE LINES EVEN IF THE CROSSWALK IS SHARED
   (SEE EXAMPLE FAR LEFT)

3. ALL BARS IN EACH CROSSWALK MUST BE SAME WIDTH

4. ADJUST TRANSVERSE ALIGNED IF NECESSARY TO ALIGN PROPERLY WITH PEDESTRIAN RAMPS. CROSSWALKS SHOULD CENTER ON PEDESTRIAN RAMPS WHEN POSSIBLE

5. CROSSWALKS SHOULD NOT EXTEND PAST THE CURB LINE OF ADJACENT ROADWAY

EXAMPLE: TYPICAL CROSSWALK BAR LAYOUT FOR SHARED CROSSWALK
**Typical Pavement Marking Examples**

- **Traffic Lane Pavement Markings**
  - Epoxy pavement marking material shall be used unless otherwise approved by Denver Public Works Transportation Operations.

- **Pocket Pavement Marking**
  - Painted pavement marking material shall be used for pocket pavement marking.
  - Unless otherwise approved by Denver Public Works Transportation Operations.

**Pavement Marking Legend and Notes**

- 4" Double yellow centerline with a separation.
- 4" Sharrow centerline.
- 10' length, 30' gap.
- 4" Solid yellow two way left edge line.
- 4" Solid yellow with 4" skip yellow. 10' length, 30' gap, and 4" separation.
- 4" Sharrow centerline. 10' length, 30' gap.
- 4" Double white right edge line or turn lane line.
- 5" Solid white 45° diagonal crossing at 15' spacing.
- 5" Sharrow centerline. 10' length, 30' gap.
- 8" Dash white and 1" dash with 1" gap.
- 8" Dashes thru intersection when shown on plans are 2' long lines with 6' gaps centered in each cross street traffic lane.

**Crosswalk Markings**
- Material shall be reflectorsized preformed thermoplastic 3" thickness full width without seams unless otherwise specified.

- 10" White traverse crosswalk line (see note 1).
- 22" x 22" white crosswalk badge.
- 24" white stop line, only when shown on plans.
- Pavement markers only when shown on plans.

**Notes:**
1. Recommended for CBD and at decorative crosswalk locations.
2. The spacing in Fig. 4 applies to left & right turn lanes.
3. When one (1) arrow is used, it shall be placed at the beginning of the full with turn lane. Otherwise use Fig. 4 for arrow placement.
TYPICAL CENTRAL BUSINESS DISTRICT

PAVEMENT MARKING EXAMPLES

PAVEMENT MARKING LEGEND AND NOTES

A. TRAFFIC LANE MARKINGS - MATERIAL SHALL BE EPoxy MARKING MATERIAL, UNLESS OTHERWISE SPECIFIED:
   1. 12" CHIP WHITE LANE LINE, 10" LINE, 20" GAP
   2. 4" SOLID WHITE RIGHT EDGE LINE OR TURN LANE LINE

B. CROSSWALK MARKINGS - MATERIAL SHALL BE REFLECTORIZED PREFORMED THERMO-PLASTIC FULL WIDTH W/OUT SEAMS UNLESS OTHERWISE SPECIFIED:
   3. 3" WHITE FRANZIERE CROSSWALK LINE
   4. 24" WHITE STOP LINE, ONLY WHEN SHOWN ON PLANS.

C. ANY PAINTED PAVEMENT MARKING QUANTITIES SHALL INCLUDE REMOVAL OF ANY CONFLUENT, PREVIOUS OR DEFUNCT MARKINGS AS NECESSARY.

D. ALL OTHER PROVISIONS OF "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" STATE DEPARTMENT OF HIGHWAYS, STATE OF COLORADO, CURRENT EDITION SHALL APPLY.

E. ALL REMOVALS SHALL BE BY GIRDING, SANDBLASTING OR WATER BLASTING METHODS PROVIDED THAT THE PAVEMENT SURFACE SHALL NOT BE MATERIALLY DAMAGED. THE PAVEMENT MARKINGS SHALL BE CLEARLY NOTED IF THEY SHALL NOT BE VISIBLE UNDER DAY OR NIGHT CONDITIONS.

TURN LANE LINE SHALL INTERSECT THE LANE LINE WHICH WILL PROVIDE THE TURN LANE WITH TWO LANES GOING AWAY FROM THE INTERSECTION. EXCEPT WHERE ONLY TWO THROUGH LANES ARE AVAILABLE.
SPEED LIMIT 30

**ELEVATION**

2" TELSPAR TUBING
SQUARE 12 GAUGE STEEL
(OR APPROVED EQUAL)

**ELEVATION**

2" TELSPAR TUBING
SQUARE 12 GAUGE STEEL
(OR APPROVED EQUAL)

**NOTE:**
ALL SIGNS SHALL BE FABRICATED FROM ASTM TYPE XL 4000 SERIES SKIN FACE SHEETING MATERIAL. ALL SIGNS ARE .032" GAUGE. 2021-115 OR .030-.045 ALUMINUM ALLOY, TREATED WITH ALUMINUM 1100 CORROSION COATING. 1/8" INCH DIAMETER HOLES PUNCHED CENTERED ON TOP AND BOTTOM, HORIZONTAL AXES WITH STANDARDS 1-1/2" RADIUS CORNERS. ALL SIGNS SHALL BE ACCOMPANIED WITH A METAL COMPONENT SYSTEM WITH ACRYLIC FILM THAT MATCHES THE WARRANTY OF THE REFLECTIVE SHEETING. SIGNS SHALL NOT BE PERMITTED FOR INSTALLING.

**ROADSIDE SIGN INSTALLATION**

**PLAN**

USE WITH:
REGULATORY SIGNS
WARNING SIGNS
GUIDE SIGNS
NEIGHBORHOOD WATCH SIGNS
OTHER NON-PARKING SIGNS

**NOTE:**
POSTS SHOULD BE INSTALLED TO PROVIDE 4" MINIMUM CLEAR WIDTH ALONG EXISTING SIDEWALK PATH FOR ADA COMPLIANCE.

**SINGLE SIGN POST MOUNTING DETAILS**

**DETAIL 1**
MOUNTED IN DIRT/VEGETATION

**DETAIL 2**
MOUNTED IN DIRT/VEGETATION

**DETAIL 3**
MOUNTED AT SIDEWALK/HARDSCAPE

**SLOPE FLOWFILL TO DRAIN**
25° BURSTED HOLE THROUGH SIDEWALK

**SAND**
CAP WITH 4" CONCRETE

DEPARTMENT OF PUBLIC WORKS

SINGLE SIGN POST MOUNTING DETAILS

STANDARD DRAWING NO.

18.2.3

Sheet No. 06 of 17
STOP
ONE WAY
STOP
ONE WAY
STOP
ONE WAY
STOP
ONE WAY
STOP
ONE WAY

STANDARD SIGN PLACEMENT FOR STOP CONTROLLED INTERSECTIONS ALONG (EAST-WEST) ONE WAY STREETS

STANDARD SIGN PLACEMENT FOR STOP CONTROLLED INTERSECTIONS ALONG (NORTH - SOUTH) ONE WAY STREETS

NOTES:

1. ONE WAY AND STREET NAME SIGNS SHOULD BE INSTALLED WITH BACK TO BACK SIGN PANELS.
   (STOP SIGNS ARE NOT REQUIRED TO BE BACK TO BACK – SEE SHEET 18.2.13)

DEPARTMENT OF PUBLIC WORKS
101 WEST COLfax AVENUE
DENVER, CO 80202
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ONE-WAY SIGN PLACEMENT DETAILS

STANDARD DRAWING NO.
18.2.7

Sheet No. 08 of 17
MOUNTING DETAIL FOR ADDING SIGNS TO EXISTING UTILITY POLES

PLAN VIEW

1/4" GALVANIZED STRAPPING

STEEL ALUMINUM
OR WOOD POLE

SIGN MOUNTING SADDLE BRACKET

SIGN

1/4" GALVANIZED STRAPPING
CONNECT ENDS TOGETHER WITH THRU SHEETS OR 10-32 x 0.25" PANHEAD SCREWS W/ 2 WASHERS AND NYLON LOCK NUTS (TOP 4 PLACES)

ATTACH SIGNS WITH 5/16" x 2½" BOLTS AND NUTS (TOP 4 PLACES) USE POP SHEETS WHEN AVAILABLE TO REDUCE LIKELIHOOD OF SIGNS BEING STOLEN

1.5" SQUARE TELSPAR INSERT (OR EQUAL) USE WHEN SIGNS ARE TO BE ADDED TO AN EXISTING POST

6" INSERT INTO MAIN POST SECURED WITH THRU BOLT AND NUT (1 PLACE)

2" SQUARE TELSPAR MAIN POST (POST MAY BE EXTENDED TO INSTALL STREET NAME SIGNS)

TOP = [ ] NORTH-SOUTH (STREETS) (S-W BLOCK NUMBERS)

BOTTOM = [ ] EAST-WEST (AVENUES) (N-S BLOCK NUMBERS)

NOTE:
1. STREET NAME SIGN ASSEMBLIES TO BE PLACED ABOVE STOP SIGNS PER FOLLOWING CRITERIA:
   - 1 ASSEMBLY PER LOCAL/LOCAL INTERSECTION
   - 2 ASSEMBLIES PER ALL OTHER STOP CONTROLLED INTERSECTIONS (LOCAL/COLLECTOR, LOCAL/ARTERIALS, ETC.)
NOTES (CONTINUED):

6. ALL OVERHEAD STREET NAME SIGNS SHALL BE FABRICATED USING WHITE RETRO-REFLECTIVE SHEETING MATERIAL AS BACKGROUND WITH LETTERS AND BORDER FORMED BY GREEN TRANSSPARENT ELECTRO-CUT FILM APPLIED OVER THE BACKGROUND MATERIAL THROUGH A PRESSURE SENSITIVE ADHESION PROCESS. THE CITY OF DENVER "O" LOGO IS TO BE MADE USING THE SAME SHEETING MATERIAL, THE LOGO MAY BE FABRICATED SEPARATELY AND THEN ADDED TO THE SIGN AS AN OVERLAY USING THE SAME ADHESION PROCESS APPROVED BY THE SHEETING MATERIAL MANUFACTURER. THE SHEETING MATERIAL AND TRANSPARENT ELECTRO-CUT FILM SHALL CONFORM TO THE FOLLOWING PRODUCT SPECIFICATIONS:

A. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION, STANDARD SPECIFICATIONS FOR TYPE XI SIGN FACE SHEETING, A VERY-HIGH INTENSITY MICRO-PRISMATIC SHEETING DESIGNED TO PROVIDE REFLECTIVE SIGN FACE RETRO-REFLECTIVITY FOR OVERHEAD SIGNS THAT ARE TO BE VIEWED BY DRIVERS AT DISTANCES OF 1000 FEET OR LESS. ELECTRO-CUT FILM USED IN CONJUNCTION WITH THE TYPE XI SHEETING MATERIAL SHALL BE ELECTRO-CUT FILM #1177C OR AN EQUIVALENT APPROVED BY THE ENGINEER.

B. THE ASTM TYPE XI SHEETING MATERIAL AND TRANSPARENT ELECTRO-CUT FILM USED SHALL INCLUDE A WARRANTY WHICH GUARANTEES AN EFFECTIVE FIELD PERFORMANCE LIFE OF AT LEAST 12 YEARS.

5. THE PREFIX E AND W (FOR STREETS EAST AND WEST OF BROADWAY) AND N AND S (FOR STREETS NORTH AND SOUTH OF ELKOWORTH AVENUE) SHALL BE USED ON ALL STREET NAME SIGNS. THE PLATE SHALL BE CENTERED BETWEEN THE DENVER "O" LOGO AND THE STREET NAME.

6. STREET NAME SIGNS TO BE BOLTED TO TELEPHONE EXTENSION WHICH CONNECTS TO MAST ARM BY USE OF ADAPTER SCREWED INTO CONNECTING SLEEVE SHALL BE INSTALLED LEVEL TO THE GROUND. SIGN SHALL BE FREE OF ANY HORIZONTAL OR VERTICAL DEFORMATION OR DISTORTIONS.

7. ALL STREET NAME SIGNS SHALL USE THE DENVER "O" LOGO EXCEPT AS AT LEFT AT TYPICAL CITY LIMIT INTERSECTIONS OR AS APPROVED BY DENVER PUBLIC WORKS TRANSPORTATION AND MOBILITY.

8. ALL MOUNTING BOLTS FOR STREET NAME SIGNS SHALL BE ZINC OR CADMIUM PLATED.
NOTES:
1. STREET NAME TEXT SHALL BE 2.75 POINT HIGHWAY "C" FONT.
2. ALL OTHER TEXT SHALL BE 2.75 POINT HIGHWAY "C" FONT.
NOTES:
1. PREVENTED U'S MAY BE INSTALLED IN ONE BASE RAIL ARRAY.
2. THE BASE RAIL ARRAY DESCRIBED IN THIS DETAIL IS INTENDED FOR BELOW THE CURB BIKE CORRAL APPLICATIONS.

MOUNTING:
1. BASE RAIL ARRAYS SHALL BE MOUNTED TO ASPHALT USING 4” x 6” HEX BOLTS, SPACED EVENLY ALONG THE BASE PLATE AS NECESSARY TO SECURE.

LOCATION SPECIFIC GUIDELINES:
1. STREET CLASSIFICATION
   - ALLOWED ON CENTRAL BUSINESS DISTRICT DOWNTOWN STREETS.
   - ALLOWED ON COLLECTOR STREETS THAT ARE DESIGNATED BIKEWAYS.
   - ALLOWED ON LOCAL STREETS.
2. SIDEWALK WIDTH
   - ALLOWED BELOW THE CURB WHEN ADJACENT SIDEWALK IS LESS THAN 1.0 FEET WIDE OR THE INSTALLATION OF BIKE PARKING WOULD OBSTRUCT PEDESTRIAN TRAVEL (SIDEWALK WIDTH DEFINED AS BACK OF CURB TO ADJACENT BUILDING WALL).

SITE SPECIFIC GUIDELINES:
1. RTD STOP (MEASURED FROM THE RTD SIGN FLAG)
   - 20 FEET AHEAD OF SIGN
   - 40 FEET BEHIND SIGN
2. VEHICLE ACCESS (CURB CUT, DRIVEWAY, INTERSECTION, ALLEYWAY)
   - DO NOT IMPERCE SHAD TREE LINE
3. FIRE HYDRANT
   - 10 FEET FROM FIRE HYDRANT
4. POWER INFRASTRUCTURE - 5 FEET FROM
   - POWER/FIRE CALL BOX, EMERGENCY FACILITY, TRAFFIC CONTROL GATES, UTILITY BOX COVERS, MAMMAL COVERS, VALVE BOX COVERS
5. CURB LANE USES - DO NOT CONFICT
   - INCLUDES LOADING ZONES, CAR SHARE, VALET, AOA, OTHER PERMITTED USES.