CITY AND COUNTY OF DENVER
DEPARTMENT OF TRANSPORTATION & INFRASTRUCTURE
TRANSPORTATION DESIGN
RISE NEW SIGNALS SOUTH PROJECT
CITY AND COUNTY OF DENVER PROJECT NO. 2024-PROJMSTR-0000472

General Contract Conditions shall be the City and County of Denver, Department of Department of Transportation & Infrastructure, “Standard Specifications for Construction General Contract Conditions”, 2011 edition and hereinafter modified shall be used for this project.

STANDARD CONSTRUCTION SPECIFICATIONS

The Standard Specifications for Construction for this Project shall consist of the applicable sections and subsections, numbered Section 200 through Section 700, of the 2025 "Colorado Department of Transportation Standard Specifications for Road and Bridge Construction."

The Colorado Department of Transportation General Provisions consists of Sections 100 through 109 of the above-mentioned specifications. With the exception of General Provision Sections 101, 105, 106, 107 and 108, all other General Provisions are not applicable to this Project and are hereby deleted. In place of the deleted sections, the City and County of Denver “Standard Specifications for Construction, General Contract Conditions,” 2011 Edition, shall apply to this contract. Supplements or amendments to the Standard Specifications for Construction, General Contract Conditions are listed in the Special Contract Conditions.

The following Project Special Provisions take precedence over Specifications or Plans and supplement or amend the referenced” Standard Specifications for Road and Bridge Construction” adopted in 2025 by the Colorado Department of Transportation, which is to be used to control construction of this Project.

DETAILED CONSTRUCTION SPECIFICATIONS

The Detailed Specifications for this project are defined in the City of Denver Contract Requirements and Contract Documents.

STANDARD CONSTRUCTION DETAILS

It is the intent of the City to use applicable details from the Colorado Department of Transportation M&S Standards, the City of Denver's Wastewater Management Division Standard Details, and the Denver Water Department's Standard Drawings, most recent editions. Drainage related appurtenances shall follow the City and County of Denver (CCD), Department of Department of Transportation & Infrastructure document titled "Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications". This document can be found at the following web address: www.denvergov.org

The Colorado Department of Transportation (CDOT) Special Provisions, Standard Special Provisions are to be used for the project. Use CDOT Project Special Provisions that revise the above described documents, and prevail over above described documents.

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The Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, dated 2025, controls construction of this project. The following Special Provisions supplement or modify the Standard Specifications and take precedence over the Standard Specifications and Plans.

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NOTICE TO BIDDERS

It is recommended that bidders on this project review the work site and plan details with an authorized City representative. Prospective bidders shall contact one of the following listed authorized City representatives at least 24 hours in advance of the time they wish to review the project.

Project Engineer/Manager: Rachael Vigil
City & County of Denver
Department of Transportation & Infrastructure
Transportation Implementation Division
201 West Colfax Avenue, Dept. 508
Denver, CO 80202
Office Phone: 720-865-3289
Rachael.Vigil@denvergov.org

The above referenced individual(s) is (are) the only representative(s) of the City with authority to provide any information, clarification, or interpretation regarding the plans, specifications, and any other contract documents or requirements.

A mandatory pre-bid conference will be held for this project in accordance with City and County of Denver contracting process at the City and County of Denver Offices located at 201 West Colfax Avenue, Denver Colorado 80202.

COMMENCEMENT AND COMPLETION OF WORK

Section 108 of the Standard Specifications is hereby revised for this project as follows:

Subsection 108.03 shall include the following:

The Contractor's progress schedule may be a Bar Chart Schedule.

Salient features to be shown on the Contractor's Progress Schedule are:

1. Notice to Proceed
2. Mobilization(s)
3. Erosion Control
4. Removals
5. Curb and Gutter, Median Cover Material, Curb Ramps
6. Sidewalk
7. Hot Mix Asphalt
8. Traffic Signals
9. Signing & Striping
10. Construction Traffic Control
11. Landscape Restoration

REVISION OF SECTION 101
DEFINITION AND TERMS

Section 101 of the Standard Specifications is hereby revised for this project as follows: Certain terms utilized in the Specifications referred to in the paragraph above shall be interpreted to have different meaning within the scope of this Contract. A summary of redefinitions follows:

"Department" shall mean the City and County of Denver, Colorado.

"Engineer" shall mean the Director of Denver Department of Transportation & Infrastructure, or designated representative.

"Laboratory" shall mean City and County of Denver, Colorado or their designated representative.

"Project Engineer" shall mean the Director of Denver Department of Transportation & Infrastructure, or designated representative.

"State" shall mean City and County of Denver, Colorado (where applicable).

REVISION OF SECTION 105
COOPERATION OF THE CONTRACTOR

Section 105 of the Standard Specifications is hereby revised for this project as follows:

Subsection 105.10 shall include the following:

All work orders on this On-Call shall be initiated by an RFP from the City and County of Denver. Once a RFP is submitted to the Contractor from the City and County of Denver, the Contractor shall have 10 business days to reply with a scope and fee for the RFP.

Other construction agencies may be working in the vicinity of the project. The Contractor shall conduct the work so as not to interfere with or hinder the progress or completion of the work being performed by other agencies or contractors. All Traffic control conflicts that arise between the needs of the various construction contractors and other agencies shall be brought to the attention of the Engineer. The Engineer will decide the method of resolution.

REVISION OF SECTION 106
CONFORMITY TO THE CONTRACT OF HOT MIX ASPHALT

Section 106 of the Standard Specifications is hereby revised for this project as follows:

Subsection 106.05 shall include the following:

For this project, Contractor process control testing of hot mix asphalt is mandatory.

REVISION OF SECTION 107
WORKER SAFETY

Section 107 of the Standard Specifications is hereby revised for this project as follows:

Subsection 107.06 shall include the following:

Contractors shall comply with the CCD Noise Control Ordinance for all construction activities scheduled to occur between the hours of 9:00 p.m. to 7:00 a.m. Monday – Friday and 5:00 p.m. and 8:00 a.m. Saturday through Sunday if noise levels are expected to exceed 50 dBA in residential areas or 60 dBA in commercial areas. Nighttime construction activities exceeding noise levels during these restricted hours may not be initiated without first obtaining this permit variance from CCD.

Under any circumstances where nighttime construction activities will take place between the restrictive hours listed above where noise levels will exceed the noise impact thresholds, the contractor is required to apply for a construction noise variance no less than one month before the startup date for construction. Note: the CCD board only meets the 2nd Thursday of every month.

Applications shall be submitted through the Denver Department of Environmental Health (DEH) at a cost of $25.00 for application processing.

The contractor is responsible for fulfilling the requirements set forth by the CCD and is responsible for obtaining the permit variance prior to the construction startup date. All exemption requests and permitting requirements will not be paid for separately, but will be included in the work. Copies of the final application approval shall be provided to CDOT R6 Noise Specialist (Jordan Rudel) for recording and documentation purposes demonstrating compliance with the local agencies regulations.

If the Contractor is ordered to cease operations due to violations of a noise ordinance as a result of equipment back up alarms, the Contractor shall take whatever actions are necessary to comply with the ordinance and continue work on the project. This includes the option of using an observer in lieu of using the equipment's back up alarms as allowed by 29 CFR 1926.601(b) (4) (II) of the OSHA Safety and Health Standards. Should the Contractor fail to mitigate the noise ordinance violation, the Contractor shall be deemed to have waived any right to a claim as a result of work suspension or being required to perform the work at times not specified in the Contract.

If the Contractor uses an observer in lieu of back up alarms, the Contractor shall follow all of the OSHA requirements regarding the use of observers.

All costs incidental to the foregoing requirements shall be included in the original contract prices for the project.

REVISION OF SECTION 107
PROTECTION OF EXISTING VEGETATION

Section 107 of the Standard Specifications is hereby revised for this project as follows:

Subsection 107.13 shall include the following:

The Contractor shall save all existing vegetation (including trees, shrubs, ground covers, grasses, wetlands & riparian) in this area, except for that vegetation, which must be removed to accommodate construction of the project, per the plans. Specific areas of vegetation to be protected shall be as directed by the Engineer and shall be protected by using orange construction fencing, wire fencing with metal posts or silt fence. Fencing for trees shall be installed at the drip line of the tree or as approved by the Engineer. Equipment shall not be installed or stockpile material within 15 feet of existing trees to remain.

The Contractor shall perform all the work in such a manner that the least environmental damage will result. All questionable areas or items shall be brought to the attention of the Engineer for approval prior to removal or any damaging activity.

The Contractor shall promptly report any vegetation damaged or scarred during construction to the Engineer for assessment of damages. Damaged or destroyed fenced vegetation, shall be replaced at the expense of the Contractor. Vegetation of replaceable size shall be replaced at the Contractor's expense. When trees, shrubs beyond replaceable size or wetlands have been damaged or destroyed, the Contractor shall be liable for the appraised value based upon the official current publications. For trees and shrubs use the International Society of Arboriculture, Guide for Plant Appraisals. The Contractor shall pay any fines or jail time should a wetland be damaged, at no cost to the project. The value of disturbed vegetation shall be calculated according to the following formula:

(Vegetation size) x (Species) x (Location) x (Condition) x (Arborist or Wetland Specialist) = Vegetation value

A consulting Arborist retained by the Department will determine the value of the trees and shrubs. A consulting Wetland Specialist shall determine the value of the wetland or wetland species. This value will be deducted from any money due to the Contractor.

The determination as to whether a plant is of replacement size or beyond will be made by the City's Landscape Architect or Wetland Specialist. Contact Jim Myers at CCD Forestry Department.

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REVISION OF SECTION 107
PROTECTION OF EXISTING VEGETATION

If the fence is knocked down or destroyed by the Contractor, the Engineer will suspend the work, wholly or in part, until the fence is repaired to the Engineer's satisfaction at the Contractor's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

REVISION OF SECTION 108
PROSECUTION AND PROGRESS

Section 108 of the Standard Specifications is hereby revised for this project as follows:

Subsection 108.03 shall include the following:

The Contractor shall establish daily working hours for the project and submit them to the Engineer for approval along with the Progress Schedule. All work performed by the Contractor or any of the Contractor's agents during a working day shall be accomplished within these pre- established working hours. Daily working hours shall not exceed 10 consecutive hours for each 24 hour working day. Neither the Contractor nor any of the Contractor's agents shall work at times outside of the daily working hours without prior approval by the Engineer. Requests for changes in working hours shall be submitted to the Engineer in writing at least 48 hours before the proposed change in working hours would take effect.

REVISION OF SECTION 201
CLEARING AND GRUBBING

Section 201 of the Standard Specifications is hereby revised to include:

Subsection 201.02, paragraph 2 shall be deleted and replaced with the following:

Removals shall be completed to the proposed subgrade elevation for the work, or as designated by the Engineer.

Removal of trees with less than a 4 inch diameter, when measured 24 inches or less above the existing grade, will not be measured and paid for separately. These tree removals will be included in the clearing and grubbing work.

Subsection 201.02, paragraph 8 shall be deleted and replaced with the following:

All tree trimming will be performed by the City and County of Denver through the City Forester's Office. Contact the City Forester two (2) days prior.

Subsection 201.02 is hereby revised to include:

All trees designated to remain shall be protected in accordance with Denver's Standard Detail for Tree Protection Area.

Subsection 201.03 is hereby revised to include:

Clearing and grubbing will not be measured and paid for separately but shall be included in the cost of the work.

Tree protection will be measured and pay for by the number of tree protections successfully installed in accordance with the City and County of Denver's Tree Protection Detail. Tree protection will be paid for in accordance to Revision Section 212 – Tree Protection.

REVISION OF SECTION 202
REMOVAL OF STRUCTURES, ASPHALT MAT AND OBSTRUCTIONS

Section 202 of the Standard Specifications is hereby revised as follows:

Subsection 202.01 shall be revised to include the following:

This work includes removal and disposal of existing asphalt mat within the project limits as shown on the plans or at locations directed by the Engineer.

Subsection 202.02 shall be revised to include the following:

The existing asphalt mat which varies in thickness shall be removed in a manner that minimizes contamination of the removed mat with underlying material. The removed mat shall become the property of the Contractor and shall be either disposed of outside the project site, or used in one or more of the following ways:

1. Used in embankment construction in accordance with subsection 203.07(c).
2. Placed in bottom of fills as approved by the Engineer.
3. Placed in the subgrade soft spots as directed by the Engineer.

The Engineer will mark the limits of removals in the field. Removals in the vicinity of trees to remain shall conform to applicable provisions of the Denver Forestry's Tree Protection specification.

Subsection 202.03 is hereby replaced as follows:

All salvable material shown on the plans shall be removed, without unnecessary damage, in sections or pieces that may be readily transported, and delivered by the Contractor to the location noted on the plans, or as directed by the Engineer. The Contractor shall be held responsible for the safekeeping of all salvable materials during the period of the Contract until they are delivered to the City. The Contractor shall make good or replace at his own expense any such materials damaged, stolen or otherwise lost prior to receipt by the City. All salvable materials, as designated on the plans, shall remain the property of the City.

Subsection 202.07 is hereby replaced as follows:

All concrete pavement, sidewalks, structures, curbs, gutters, asphalt pavement, etc., designated for removal, shall be broken into pieces and disposed of outside the limits of the project, unless otherwise designated on the plans, or as directed by the Engineer.

Old concrete construction which abuts new construction, edges of pavement, sidewalks, curbs, etc., to be left in place shall be saw cut to true line with a vertical face.

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REVISION OF SECTION 202
REMOVAL OF STRUCTURES, ASPHALT MAT AND OBSTRUCTIONS

Where old asphalt construction abuts new construction, edges of asphalt pavement, patching, etc., asphalt to be left in place shall be wheel cut or sawcut to a neat vertical face with minimal jagged edges to the satisfaction of the Engineer. The Engineer, at his discretion, may require asphalt to be sawcut.

Removal of stone curb shall include the complete removal of the curb head and concrete foundation. No payment will be made for sprinkler relocation, utility relocation, etc., beyond the limits of construction as shown on the plans. Stone curb designated for salvage shall be carefully removed to prevent damage and delivered to the location indicated in the plans or specifications, or as directed by the Engineer.

Delete Subsection 202.09 and replace it with the following:

202.09 Removal of Asphalt Mat (Planing). Before beginning planing operations, the Contractor shall submit a planing plan and a Process Control Plan (PCP) for approval by the Engineer. The planing plan shall include at a minimum:

(1) The number, types and sizes of planers to be used.
(2) The width and location of each planing pass.
(3) The number and types of brooms to be used and their locations with respect to the planers.
(4) The proposed method for planing and wedging around existing structures such as manholes, valve boxes, and inlets.
(5) The longitudinal and transverse typical sections for tie-ins at the end of the day.
(6) If requested by the Engineer, a plan sheet showing the milling passes.

The PCP shall include as a minimum:

(1) The schedule for replacing the cutting teeth.
(2) The daily preventive maintenance schedule and checklist.
(3) Proposed use of automatic grade controls.
(4) The surface testing schedule for smoothness.
(5) The process for filling distressed areas.
(6) The schedule for testing macrotexture of the milled surface.
(7) Corrective procedures if the milled surface does not meet the minimum macrotexture specification.
(8) Corrective procedures if the milled surface does not meet the minimum transverse or longitudinal surface finish when measured with a 10 foot straightedge.

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REVISION OF SECTION 202
REMOVAL OF STRUCTURES, ASPHALT MAT AND OBSTRUCTIONS

The Contractor shall not start the planing operation until the hot mix asphalt (HMA) mix design has been approved and a CDOT Form 43 has been signed by the Engineer.

The existing pavement shall be milled to the cross-slope as shown on the plans and shall have a surface finish that does not vary longitudinally or transversely more than ⅜ inch from a 10 foot straightedge. A 10 foot straightedge shall be supplied by the Contractor.

All milled surfaces shall be broomed with a pick-up broom, unless otherwise specified, before being opened to traffic. A sufficient number of brooms shall be used immediately after planing to remove all milled material remaining in the roadway.

If the Contractor fails to adequately clean the roadway, work shall cease until the Engineer has approved the Contractor's revised written proposal to adequately clean the roadway.

The milled surface shall have a macrotexture equal to or less than 0.170 inches for single-lift overlays and 0.215 inches for multiple-lift overlays as tested per CP 77. Milled surfaces that do not meet these criteria shall require corrective action per the PCP. The Contractor shall be responsible for testing the macrotexture of the milled surface at the location directed by the Engineer per CP 77 at a stratified random frequency of one test per 10,000 square yards or a minimum of once per work day.

At the completion of each day's work, longitudinal vertical edges greater than 1 inch shall be tapered. No transverse vertical edges will be allowed. Longitudinal milled surface tie-ins to existing pavement shall be tapered to not less than a 3:1 slope, transverse milled surface tie-ins to existing pavement shall be tapered to not less than a 50:1 slope. Transverse tapered joints may be tapered with the planing machine, a temporary asphalt ramp, or other methods approved by the Engineer. No longitudinal joint between the milled and existing surfaces shall fall between 1 to 5 feet of any lane line.

If the transverse joint is tapered with a temporary asphalt ramp, the milled surface at the joint shall be constructed as a butt joint the full depth of the lift of asphalt to be placed on the milled surface. The Contractor shall be responsible for maintaining this asphalt ramp until all corresponding HMA is placed. All work associated with this joint will not be paid for separately but shall be included in the cost of planing.

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REVISION OF SECTION 202
REMOVAL OF STRUCTURES, ASPHALT MAT AND OBSTRUCTIONS

If the transverse joint is tapered with a planing machine, a butt joint shall be cut into the taper the full depth of the lift of asphalt to be placed on the milled surface before commencement of resurfacing. All work associated with this joint will not be paid for separately but shall be included in the cost of planing.

Other approved transverse joint tapers shall be maintained at the expense of the Contractor, and at a minimum shall incorporate a butt joint the full depth of the lift of asphalt to be placed on the milled surface before commencement of resurfacing.

Distressed or irregular areas identified in the planed surface by the Engineer shall be patched.

The roadway shall be left in a safe and usable condition at the end of each work day. The Contractor shall take appropriate measures to ensure that the milled surface does not trap or hold water. All required pavement markings removed by the planing shall be restored before the roadway is opened to traffic.

All milled surfaces to be overlaid with HMA shall be covered with new asphalt within 5 working days. All areas on this project that are not overlaid within the specified calendar days will be assessed a lane rental fee of $1,000 per occurrence for each day or fraction thereof and any required surface repairs shall be paid for by the Contractor.

All planing shall be completed full width and parallel to the travel lanes before resurfacing commences unless otherwise directed by the Engineer.

All material generated by the planing operation shall become the property of the Contractor unless otherwise noted in the Contract.

Each planer shall conform to the following:

The planer shall have sufficient power, traction and stability to maintain an accurate depth of cut. The propulsion and guidance system of the planer shall be maintained in such condition that the planer may be operated to straight and true lines.

The planer shall be capable of operating with automatic grade controls (contact or non-contact) on both sides of the machine using a 30 foot averaging system or other approved grade control systems. The use of such controls shall be described in the Contractor's PCP.

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REVISION OF SECTION 202
REMOVAL OF STRUCTURES, ASPHALT MAT AND OBSTRUCTIONS

The planer shall be capable of picking up the removed material in a single operation. A self-loading conveyor shall be an integral part of the planer. Windrows will not be allowed.

Subsection 202.11 shall be revised to include the following:

Removal of asphalt mat will be measured by square yard. If the existing asphalt mat is over 9" thick, the unit price will be increased in proportion to the additional thickness (18" asphalt mat will be paid at twice the unit price). If the asphalt mat is greater than 4" and is over concrete pavement, both asphalt removal and concrete pavement removal will be paid. If the asphalt mat is less than 4" and is over concrete pavement, only concrete pavement removal will be paid.

Removal of asphalt mat (planing or milling) will be measured by the square yard, regardless of thickness.

Removal of asphalt mat from concrete gutter and other concrete designated to remain shall be measured by the square yard. Removal of asphalt mat from gutter shall include sandblasting and compressed air cleaning as part of that pay item.

Subsection 202.12 is hereby deleted and replaced as follows:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment shall be full compensation for sawcutting, scraping, sandblasting, removing, hauling and disposal of such items, excavation and subsequent backfill (with moisture/density control per the Revision of Subsection 203.07) to proposed subgrade elevation. The price shall also include salvageable materials removed, their custody, preservation, storage, haul and disposal as provided herein.

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REVISION OF SECTION 202
REMOVAL OF STRUCTURES, ASPHALT MAT AND OBSTRUCTIONS

Payment will be made under:

Pay Item	**Pay Unit**
Removal of Tree	Each
Removal of Concrete Median Cover Material	Square Yard
Removal of Sidewalk	Square Yard
Removal of Curb	Linear Foot
Removal of Curb and Gutter	Linear Foot
Removal of Concrete Curb Ramp	Square Yard
Removal of Concrete Pavement	Square Yard
Removal of Asphalt Mat (Planing)	Square Yard
Removal of Ground Sign	Each

When the Contract does not include pay items for Removal of Structures and Obstructions, the removal will not be paid for separately but shall be included in the work.

REVISION OF SECTION 202
REMOVAL OF PAVEMENT MARKING

Section 202 of the Standard Specifications is hereby revised for this project as follows:

In subsection 202.11, delete the second paragraph and add the following:

Removal of pavement marking will not be measured but shall be included in the work. Sandblasting of pavement that is to be covered with pavement marking material will not be measured and paid for separately but shall be included in the cost of the work.

REVISION OF SECTION 203
POTHOLING

Section 203 of the Standard Specification is hereby revised for this project as follows:

Subsection 203.05(f) Potholing shall include the following:

The work shall include One Pothole per utility per conduit crossing or as approved by the Engineer.

All surface material disturbed by potholing shall be restored in kind in accordance with the provisions of the most recent release of the *Standards and Details for the City and County of Denver*.

- All potholes must be core drilled.
- All potholes must be backfilled using only one of the following methods:
    - Wet Sand
    - Flowfill
    - Flashfill
    - The Contractor may submit a written request to use a material not specified above (squeegee, pea gravel, and native material will not be allowed)
- Potholes in an asphalt street must be patched back using hot bituminous asphalt, minimum 9- inch in depth.
- Potholes in a concrete street must be patched back with fast curing high strength concrete no less than 8000 psi in 28 days and a 3000 psi in 60 minutes.
- Full concrete panel replacement is required when a third pothole is core drilled in the same panel. The contractor that cut the last pothole (i.e. 3rd) will be required to replace the panel.
- Any pothole in a sidewalk will require a full panel replacement.
- Any pothole in the curb and gutter or any drainage way will require at a minimum, a half panel replacement.

REVISION OF SECTION 203
EXCAVATION AND EMBANKMENT

Section 203 of the Standard Specification is hereby revised for this project as follows:

Subsection 203.07 Embankment Placement and Compaction Requirements shall include the following:

The contractor may use the existing soil to replace the upper two feet of subgrade material under the pavement without two feet of R-Value 20 soil. From the project borehole, the top four feet of existing soil meet the minimum requirements but it is recommended that the top six inches be reconditioned. The maximum liquid limit (14.0), Plasticity Index (2.0). and percent passing the #200 sieve (22.4%) shall be similar to the existing soil.

REVISION OF SECTION 208
SWEEPING

Section 208 of the Standard Specification is hereby revised for this project as follows:

Subsection 208.01 shall include the following:

This work is for sweeping paved surfaces during construction as part of the project Best Management Practices (BMP).

Subsection 208.04 shall include the following:

Paved surfaces adjacent to the construction site shall be swept by the close of business day and during the day as needed when sediment and other materials are tracked or discharged onto them. Sweeping shall be completed with a pickup broom or equipment capable of collecting sediment. Sweeping with a kick broom will not be allowed. Street sweepers using water while sweeping is preferred in order to minimize dust. Flushing off paved surfaces with water is prohibited.

Subsection 208.11 shall include the following:

Sweeping, when used as a BMP as shown in the Contract, will be measured by the number of hours that a pickup broom or equipment capable of collecting sediment, authorized by the Engineer, is used to remove sediment from the roadway or other paved surfaces. Each week the Contractor shall submit to the Engineer a statement detailing the type of sweeping equipment used and the number of hours it was used to pick up sediment. Operator will not be measured and paid for separately, but shall be included in the work.

Subsection 208.12 of the Standard Specifications shall be modified as follows:

Payment will be made under:

Pay Item	**Pay Unit**
Sweeping (Sediment Removal)	Hour

Payment for Sweeping shall be full compensation for all work necessary to complete this item.

REVISION OF SECTION 208
EROSION CONTROL

Section 208 of the Standard Construction Specifications is hereby removed in its entirety and replaced with the following:

PART I: DEFINITIONS

Definitions used for this Section shall consist of those listed in Title 1 of the City and County of Denver "Standard Specifications for *Construction*, General Contract Conditions", 2011 edition.

Definitions used for this Section hereby incorporate those identified within the City and County of Denver Construction Activities Stormwater Manual (CASM).

Additional Definitions applicable to this Section are listed heretofore:

Basis of Payment: The terms under which "Work" is paid, as a designated "Pay Item" in accordance with the quantity measured and the "Pay Unit."

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, installation of devices, maintenance procedures, and other management practices deployed to stabilize the construction site to prevent or reduce the pollution of State Waters (see definition below). Stormwater BMPs can be classified as "structural" (i.e., devices installed or constructed on a site) or "non-structural" (procedures, such as modified landscaping practices).

Colorado Department of Health and Environment (CDPHE): State of Colorado, Water Quality Control Division responsible for issuance of State Construction Stormwater Permit.

Construction Activities Stormwater Discharge Permit (CASDP): Permit issued by the City for compliance with City & County of Denver Revised Municipal Code and Department of Department of Transportation & Infrastructure Rules & Regulations concerning the discharge of pollutants in storm generated runoff from construction sites to Municipal Separate Storm Sewer System (MS4, see definition below) or State Waters, via the Municipal Separate Storm Sewer System (MS4).

Construction Activities Stormwater Manual (CASM): City and County of Denver Construction Activities Stormwater Manual (CASM), 2010 edition.

Colorado Department of Transportation (CDOT): State agency that has published standards for Erosion Control with accompanying Erosion Control Supervisor certification courses.

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Erosion Control Supervisor (ECS): The Erosion Control Supervisor is assigned by the Contractor to perform duties as described in this Section. The ECS shall be properly trained in BMPs per requirements of Part V below, and shall be under the direction of a Professional Engineer licensed in the State of Colorado when performing any modifications to the Project Stormwater Management Plan (SWMP), as required by CDPHE.

Final Stabilization: Point of construction when all ground surface disturbing activities at the site have been completed and uniform vegetative cover has reached 70% of pre-disturbance vegetative cover, or equivalent permanent features have been employed. At this point, all temporary BMPs can be removed, all construction and equipment maintenance wastes have been disposed of properly; and all elements of the Stormwater Management Plan have been completed.

Major SWMP Modification: Changes to the original SWMP that removes or adds additional area to the Project, or modifies the final hydrology or drainage of the Project.

A Major SWMP Modification requires the submission of revised Stormwater Management Plan (SWMP) elements to the Permit Authority for review and approval. Any adjustments to a SWMP must be performed either by or under the direction of a Professional Engineer licensed in the State of Colorado.

Minor SWMP Modification: Modification to the SWMP that does NOT increase the scope or change hydrology of the Project but: modifies/improves specific BMPs in use at site, indicates progression in phasing of the Project, or specifies relocation of previously approved BMPs within the Project. Any adjustments to a SWMP must be performed either by or under the direction of a Professional Engineer licensed in the State of Colorado.

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Municipal Separate Storm Sewer System (MS4): A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

a) Owned or operated by a State, city, town, county, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of stormwater or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or a designated and approved management agency under Section 208 of the Federal Clean Water Act that discharges to State Waters;
b) Designed or used for collecting or conveying stormwater;
c) Which is not a combined sewer; and
d) Which is not part of a Publicly Owned Treatment Works (POTW).

Permit Authority: The Department authorized by the City to review and process CASDP Applications for Capital and/ or governmental sponsored Projects. The responsible City department serving as the Permit Authority is the Department of Transportation & Infrastructure Project Controls Office. As a clarification, the Development Services Department of the City serves as the point of intake and permit processing center.

Permit Enforcement Authority: The Department authorized by the City to inspect and enforce CASDP Rules and Conditions for all construction Projects within the City's MS4 Boundary. The responsible City department serving as the Permit Enforcement Authority is the Wastewater Management Division of the Department of Department of Transportation & Infrastructure.

State Construction Stormwater Permit: Colorado Revised Statues require that all construction sites/development Projects, which, by definition, disturb one or more acres in area, shall be covered by a State issued general permit for construction activities. Information on the application requirements for the State permit can be obtained by phone at 303-692-3500; or by visiting their offices located at 4300 Cherry Creek Drive South, Denver, CO 80246 – 1530, or on the Web at: https://www.colorado.gov/pacific/cdphe/news/water-quality-permits

State Waters: Any and all surface waters which are contained in or flow in or through this State, not to include waters in sewage systems, waters in treatment works of disposal systems, waters in potable water distribution systems, and all water withdrawn for use until use and treatment have been completed.

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Examples of State Waters include, but are not limited to, perennial streams, intermittent or ephemeral gulches and arroyos, ponds, lakes, reservoirs, irrigation canals or ditches, wetlands, stormwater conveyances (when they discharge to a surface water), and groundwater.

Stormwater Management Plan (SWMP): The Stormwater Management Plan contains the requirements necessary to accomplish all the following:

The SWMP establishes a minimum standard to construct, install, maintain, and remove required BMPs during the life of the Contract to prevent or minimize pollution of stormwater due to erosion, sediment transport, and construction related pollutant generated during all phases of the Project. A SWMP consists of the following elements:

(i) CASDP Narrative Worksheet with Narrative Report. The Narrative Report and supporting documents should fully address the methods to be used to prevent sediment, debris, and other pollutants from entering the MS4 and/ or State Waters in and around the Project area. Proposed structural and non-structural BMPs should be described with sufficient implementation detail to insure that the logical phases of the proposed construction Project meet the performance standards listed in the CASM.

(ii) Proposed site drawings and Best Management Practice (BMP) installation details as they apply to the site conforming to the Urban Storm Drainage Criteria Manual, Vol. 3, "Best Management Practices", most current version as issued by the Urban Drainage and Flood Control District (UDFCD), or those established by the City's Department of Department of Transportation & Infrastructure. If erosion control drawings were included within the bid documents for the Project, they shall be used for bid purposes and initial planning/ deployment of BMPs on the Project. If provided drawings are signed/ sealed by a Professional Engineer, they have been pre-approved by the Permit Authority and may be used without revision for purposes of submitting for CASDP. If provided drawings do not have signature/ seal of Professional Engineer licensed by the State of Colorado, they will require revision by the Contractor with Professional Engineer signature/ seal prior to submission to the City and County of Denver for CASDP.

(iii) Supporting documentation related to proposed BMPs that are not currently identified in UDFCD Vol. 3 or as otherwise published by the City.

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Any preparation of or adjustments to a SWMP must be performed either by or under the supervision of a Professional Engineer or Landscape Architect, licensed in the State of Colorado. SWMP elements submitted to the City shall also meet currently established criteria of the CDPHE as the SWMP must meet all local, State and Federal requirements.

Substantial Completion of Erosion Control: Point of construction when permanent BMPs have been installed, initial growth is in place, and the site is waiting for vegetative cover to reach 70% of pre-disturbance vegetative cover.

PART II: DESCRIPTION

This Work shall consist of constructing, installing, maintaining, and removing when required, BMPs during the life of the Contract until Final Stabilization to prevent or minimize erosion, sedimentation, and pollution of any waters including storm, drainageways, MS4, State Waters, and/ or wetlands.

Work under this Section includes the Contractor obtaining required Permits, utilizing SWMP elements provided in the Contract, and/ or SWMP elements specifically prepared by the Contractor as defined herein. The work shall also consist of providing on-going maintenance and monitoring of the SWMP as may be necessary due to the specific and/or dynamic needs of the Project as well as meet all requirements set forth within the CASM.

The Contractor shall coordinate the construction of temporary BMPs with the construction of permanent BMPs to assure economical, effective, and continuous erosion and sediment control and water pollution prevention throughout the construction period until Final Stabilization is achieved.

When a provision of this Section or an order by the Permit Enforcement Authority requires that an action be immediate or taken immediately, it shall be understood that the Contractor shall at once begin effecting completion of the action and pursue it to completion in a manner acceptable to the Permit Enforcement Authority, and in accordance with applicable Permitting requirements.

PART III: MATERIALS

Materials to be used for BMPs shall conform to each specific detail as set forth within the Project SWMP or as noted on the Contract Drawings.

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PART IV: EROSION CONTROL PERMIT STATUS

The current SWMP status for the Project is as follows:

A SWMP is currently not required for this project as the proposed disturbed area and/ or proximity to stream does not meet the minimum criteria for requiring a CASDP. All provisions of the following Parts V-VIII of this Section are hereby deleted and shall not be made part of the Project. However, the responsibilities for minimizing sediment pollution from the Project have not been waived, and as such, the City hereby requires the Contractor to perform as specified in the following notes. Because a SWMP and CASDP are not necessary for the Project, all cost for performance of the following notes shall not be paid for separately, but shall be included in the work unless otherwise specified in the section.

"A CASDP Permit will not be required for this project, however, the Contractor and/or their authorized agents shall ensure that all potential pollutants generated during demolition, excavation, trenching, boring, grading, or other construction Work associated with this permit, be prevented from discharge to stormwater conveyance systems in the vicinity of the Project.

The Contractor and/or their authorized agents shall remove all sediment, mud, construction debris, or other potential pollutants that may have been discharged to or, accumulate in the flow lines of storm drainage appurtenances and public rights of ways of the City and County of Denver and CDOT as a result of construction activities associated with this Project. All removals shall be conducted in a timely manner.

The Contractor shall be held responsible for remediation of any adverse impacts to the CCD or CDOT MS4, State Waters, waterways, wetlands, and or other public or private properties, resulting from work done as part of this Project.

The Contractor and/or their authorized agents shall insure that all loads of cut and fill material imported to or exported from the Project shall be properly covered to prevent loss of the material during transport on public rights of way." (Sec.49-552; Revised Municipal Code)

Approved erosion and sediment control 'Best Management Practices' shall be maintained and kept in good repair for the duration of the Project. All necessary maintenance and repair shall be completed immediately upon discovery of any deficiency or defect.

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The Contractor and/or their authorized agents shall implement the following Best Management Practices (BMPs) on site during construction. Best Management Practice (BMP) installation details and maintenance shall conform to the Urban Storm Drainage Criteria Manual, Vol. 3, "Best Management Practices", most current version as issued by the Urban Drainage and Flood Control District (UDFCD), or those established by the City's Department of Department of Transportation & Infrastructure.

1. VEHICLE TRACKING CONTROL: This BMP is required at all access points for ingress/egress from off-site impervious surfaces to construction site pervious areas that are used by vehicular traffic or construction equipment.

2. INLET PROTECTION: This BMP is required on all existing or proposed storm sewer inlets in the vicinity of the construction site that may receive site runoff. The BMP must be appropriate to the type of storm inlet and appropriate for the ground surface at the inlet.

3. INTERIM SITE STABILIZATION: This BMP is required to provide a measure for preventing the discharge of sediment from construction sites where overlot grading or other site disturbance has occurred. This BMP is particularly necessary on sites where construction activities/disturbance will be limited to small areas of the Project site. Acceptable BMPs include:
   a) Preserving existing vegetation
   b) Seeding and planting
   c) Mulching
   d) Mulching and seeding
   e) Temporary/Permanent re-vegetation operations
   f) Chemical soil stabilizer application (requires WMD approval)

4. WASTE MANAGEMENT/CONTAINMENT: This BMP requires that all construction wastes, fuels, lubricants, chemical wastes, trash, sanitary wastes, contaminated soils or debris shall be contained on site, protected from contact with precipitation or surface runoff, periodically removed from the construction site, and properly disposed of.

5. SPILL PREVENTION /CONTAINMENT: This BMP defines the measures proposed for preventing, controlling, or containing spills of fuel, lubricants, or other pollutants; and protecting potential pollutants from contact with precipitation or runoff.

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6. CHUTE WASHOUT CONTAINMENT: Water used in the cleaning of cement truck delivery chutes shall be discharged into a predefined, bermed containment area on the job site. The required containment area is to be bermed so that wash water is totally contained. Wash water discharged into the containment area shall be allowed to infiltrate or evaporate. Dried concrete waste shall be removed from the containment area and properly disposed of. The direct or indirect discharge of water containing waste concrete to the storm sewer system is prohibited (Sec.56-102a, c; Revised Municipal Code, City and County of Denver).

7. SWEEPING: This BMP requires that impervious surfaces which are adjacent to or contained within construction sites be swept on a daily basis or as needed during the day when sediment and other materials are tracked or discharged on to them. Either sweeping by hand or use of Street Sweepers is acceptable. Street sweepers using water while sweeping is preferred in order to minimize dust. Flushing off paved surfaces with water is prohibited.

8. PERIMETER CONTROL: This BMP requires that a construction site install a perimeter control measure along the edge of the construction Site, to prevent, or filter the discharge of surface runoff from the construction site. The type of perimeter control used shall be determined based on site conditions and location. Maintenance and repair of the control measure shall occur as needed, in a timely manner.

9. STOCK PILES: Soils that will be stockpiled for more than thirty (30) days shall be protected from wind and water erosion within fourteen (14) days of stockpile construction. Stabilization of stockpiles located within 100 feet of receiving waters, or with slopes 3 to 1 or greater shall be completed within seven (7) days following stockpile construction. Stabilization and protection of the stockpile may be accomplished by any of the following: Mulching, Temporary/Permanent Revegetation Operations, Chemical Soil Stabilizer Application (requires Denver Department of Transportation & Infrastructure approval), or erosion control matting/Geotextiles. If stockpiles are located within 100 feet of receiving waters, a drainageway or the site perimeter, additional sediment controls shall be required.

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10. SAW CUTTING OPERATIONS: The Contractor shall protect all storm sewer facilities adjacent to any location where pavement cutting operations involving wheel cutting, saw cutting, or abrasive water jet cutting are to take place. The Contractor shall remove and properly dispose of all waste products generated by said cutting operations on a daily basis or as needed throughout the work day. The discharge of any water contaminated by waste products from cutting operations to the storm sewer system is prohibited. (Sec.56-102a, c; Revised Municipal Code, City and County of Denver)

PART V: CONSTRUCTION REQUIREMENTS

A) SCHEDULES:
At least 10 working days prior to the beginning of any construction work, the Contractor shall submit for approval a schedule for accomplishment of temporary and permanent BMPs shown in the SWMP. This schedule shall specifically indicate the sequence of clearing and grubbing, earthwork operations, and construction of temporary and permanent BMPs. The schedule shall include BMPs for all areas within the Project boundaries, including but not limited to, haul roads, borrow pits, and storage and other staging sites.

Work shall not be started until the BMP schedule has been approved in writing by the Project Manager, and on site pre-construction inspection is performed and approved by CCD's NPDES inspector. Once the work has started, and during the active construction period, the Contractor shall update the schedule for all BMPs on a regular basis, and as required to keep the SWMP in compliance.

B) CONSTRUCTION IMPLEMENTATION:
The Contractor shall incorporate into the Project all BMPs that are appropriate for the current phase of work, as outlined in the accepted schedule.

C) UNFORESEEN CONDITIONS: The Contractor shall direct the ECS (under the supervision of a Professional Engineer licensed in the State of Colorado) to design and implement BMPs for correcting conditions unforeseen during design of the Project, or as possible for emergency situations, which arise during construction. The Project's SWMP, UDFCD Vol 3 standards and details, and CDOTs "Erosion Control and Storm-Water Quality Guide," and any approved modification to these documents as proposed by the Contractor, shall be used as reference documents for the purpose of designing appropriate BMPs. Measures and methods proposed by the Contractor to deal with unforeseen conditions shall be reviewed and approved in writing by the Permit Enforcement Authority and the Project Manager prior to implementation and construction.

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In an emergency situation, the Contractor shall use best judgment for immediately responding to the emergency situation as it arises, and shall notify the Permit Enforcement Authority and ECS of the emergency situation and BMPs employed in response as soon as practical after installation.

D) PERMITS:
The Contractor shall obtain all required permits for the Project including those required by federal, state, and local agencies. The Contractor shall obtain (or transfer from the City when specified) required erosion control and water quality permits and shall be responsible for compliance with all requirements under any such permits.

E) EROSION CONTROL SUPERVISOR:
Contractor shall assign to the Project an employee or subcontractor to serve as Erosion Control Supervisor (ECS). The ECS shall be a person other than the Contractor's superintendent, foreman, or equivalent supervisory position. The ECS shall be experienced in aspects of BMP construction and have satisfactorily completed a Colorado DOT or equivalent ECS training program authorized by the City. Proof that this requirement has been met shall be submitted to the Project Manager at least ten working days prior to the beginning of any soil disturbance work. A list of authorized ECS training programs is available from the City upon request.

Additionally, per definition, the ECS shall be under the direction of a Professional Engineer licensed in the State of Colorado when performing any modifications to the Project Stormwater Management Plan (SWMP).

The ECS shall be responsible for oversight of the implementation, maintenance, and revision of the SWMP for the duration of the Project. CCD requires the ECS to fulfill responsibilities as outlined by CDPS such as having financial control and authority to implement BMPs. The ECS's responsibilities shall be as follows:

1) Ensure compliance with all water quality permits or certifications in effect during the construction work.
2) Supervise the installation, construction, and maintenance of all BMPs specified in the Contract and coordinate the construction of BMPs with all other construction operations.
3) Direct the implementation of suitable BMPs as necessary to correct unforeseen conditions or emergency situations. Direct the dismantling of those features when their purpose has been fulfilled due to completion of each Project phase unless the Permit Enforcement Authority agrees that the features be left in place.

4) Attend the preconstruction conference, erosion control preconstruction inspection, Project scheduling meetings, weekly construction/ field meetings, substantial completion and final stabilization inspections, and other meetings regarding construction that could impact water quality.
5) Evaluate all non-stormwater coming onto the site, such as springs, seeps, and landscape irrigation return flow. If such flow is identified, the ECS shall propose appropriate SWMP modifications to the Contractor to protect off-site water from becoming contaminated with sediment or other pollutants.
6) Coordinate with the Contractor to implement necessary actions to reduce anticipated or presently existing water quality or erosion problems resulting from construction activities.
7) Coordinate with the Contractor to ensure all labor, material, and equipment deployed to meet SWMP requirements is judged appropriately.
8) During construction, update and record the following items in the SWMP as changes occur:
    (i) Construction boundaries (may require Major SWMP Modification)
    (ii) Areas of disturbance (may require Major SWMP Modification)
    (iii) Areas used for storage of construction materials, equipment, soils, or wastes.
    (iv) Location of any dedicated asphalt or concrete batch plants.
    (v) Location of construction offices and staging areas.
    (vi) Location of work access routes during construction.
    (vii) Location of borrow and waste.
    (viii) Location of temporary and permanent stabilization

    The ECS shall start a new site map before the current one becomes illegible. All site maps shall remain with the SWMP paperwork.

9) Amend the SWMP whenever there are: additions, deletions, or changes in locations of BMPs. SWMP revisions shall be recorded immediately. Items shall be dated and signed at time of occurrence. Specifically, amendments shall include the following:
    (i) A change in design, construction, operation, or maintenance of the site which would require the implementation of new or revised BMPs; or
    (ii) Changes when the SWMP proves to be ineffective in achieving the general objectives of controlling pollutants in stormwater discharges associated with construction activity.
    (iii) Changes when temporary BMPs are no longer necessary from changes in Project phase and are removed. All inspection and maintenance activities or other repairs shall be documented.

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All inspection and maintenance activities or other repairs shall be documented. The SWMP and documentation shall be kept on the Project site at all times.

10) Modify the site map with arrows to indicate direction of surface and storm water flowing across the Project site.
11) When adding or revising BMPs in the SWMP, amend the narrative to explain what, when, where, why, and how the BMP is being used, and add a detail to the SWMP.
12) If using existing topography, vegetation, etc. as a BMP, label it as such in the SWMP site map; amend the Narrative to explain when, why, and how the BMP is being used in the SWMP.
13) Record on the SWMP, and implement the approved plan for concrete and asphalt saw cutting, grinding, and milling containment and removal.
14) Update the potential pollutants list in the SWMP throughout construction meeting CASDP requirements.
15) Spills, leaks, or overflows that result in the discharge of pollutants shall be documented on the inspection form. The ECS shall record the time and date, weather conditions, reasons for spill, and how it was remediated. The ECS shall immediately report to the Contractor and Project Manager the following instances of noncompliance:
    (i) Noncompliance which may endanger health or environment.
    (ii) Spills or discharge of hazardous substance or oil which may cause pollution of the City MS4 or State Waters.
    (iii) Discharge of stormwater which may cause an exceedance of a water quality standard.
16) Perform a thorough inspection of the stormwater management system at least every seven (7) days and within 24 hours after any precipitation or snowmelt event with the potential to cause surface erosion. If no land disturbing construction activities are present during a storm event, post-storm event inspections shall be conducted prior to commencing any new land disturbing construction activities, but no later than seventy-two (72) hours following the storm event. The inspection records shall be kept on-site in a written or previously approved format. Inspections shall be conducted during the progress of the work, during work suspensions, or until Final Stabilization of all disturbed areas is approved by Permit Enforcement Authority and shall include the following services at a minimum:
    (i) The construction site perimeter, disturbed areas, and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. BMPs identified in the SWMP shall be observed to ensure that they are operating correctly.

(ii) The description of potential pollutant sources, and the BMPs identified in the SWMP, shall be revised and modified as appropriate based on the results of the inspection as soon as practicable after such inspection. Modification to the SWMP shall be implemented in a timely manner and in accordance with applicable Permit requirements.

(iii) The operator shall keep a record of inspections. Uncontrolled releases of sediment or polluted storm water or measurable quantities of sediment found off the site shall be recorded with a brief explanation as to the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. Inspection records shall be made available to the City upon request. Note: documentation of uncontrolled releases at site DOES NOT alleviate any State or Federal requirements for reporting of discharges or upset conditions. Care shall be taken to ensure compliance with all regulatory requirements at site.

(iv) Seven (7) day inspections are required during construction and at all times until Final Stabilization has been achieved. Seeding and mulching of disturbed areas does NOT count as final stabilization until such time as 70% pre disturbed vegetative cover has been achieved. Sites with growth in place sufficient to deter erosion that have not yet achieved final stabilization may petition the City to grant an alternative inspection schedule while awaiting additional growth for final stabilization. These inspections must be conducted in accordance with the above paragraphs.

F) APPLYING BMPs TO STABILIZE SITE:

The duration of the exposure of incomplete construction to the effects of weather shall be as short as practicable. BMPs such as: seeding, surface roughening, mulching, applying tackifier, use of geotextiles and matting, permanent landscaping, or other selected BMPs shall be applied within fourteen (14) calendar days of completion of grading/soil disturbance activities to stabilize the construction site unless disturbed area is within 100 feet of an MS4 or State Waters or has slopes of 3 to 1 or greater in which case BMPs shall be implemented within seven (7) calendar days of completion of grading activities. Disturbed areas where work is temporarily halted shall be temporarily stabilized within seven (7) days after the activity ceased unless work is to be resumed within thirty (30) calendar days after the activity ceased.

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Clearing and grubbing operations shall be scheduled and performed to minimize both the area of the Project disturbed at a given time and the amount of time that disturbed areas remain open. BMPs such as temporary seeding are required between successive construction stages when disturbed areas will not be stable or active for thirty (30) calendar days or more. No payment will be made for additional work required because the Contractor has failed to properly coordinate the BMP schedule, thus causing previously stabilized areas to be disturbed by operations that could have been performed prior to the stabilization. Upon failure of the Contractor to coordinate the permanent BMPs with the grading operations in a manner to effectively control erosion and prevent water pollution, the Permit Enforcement Authority can suspend the Contractor's grading operations and the Project Manager can withhold monies due to the Contractor on current estimates until such time that all aspects of the work are coordinated in an acceptable manner.

G) WORK OUTSIDE LIMITS OF CONSTRUCTION: Non-contiguous areas outside the limits of construction that are used by the Contractor that include, but are not limited to, borrow pits, haul routes, storage and disposal areas, field offices, maintenance, batching areas, etc., shall have appropriate BMPs implemented by the Contractor at the Contractor's expense. Should said areas meet applicable CASDP Permit criteria, the Contractor shall obtain a separate CASDP or amend existing CASDP for each area as applicable at no additional expense to the City.

H) MAINTENANCE: The Contractor shall continuously maintain erosion and sediment control BMPs on a daily basis or as directed by the ECS so that they function properly during and after construction (including work suspensions) until Final Stabilization has been approved by the Permit Enforcement Authority. Maintenance includes, but is not limited to, the following items:

(i) From the time seeding and mulching work begins until the date the Project has reached Substantial Completion of Erosion Control, the Contractor shall keep all seeded areas stabilized at all times. Any damage to seeded areas or to mulch materials shall be promptly repaired.
(ii) All inspection sediment removal, and BMP maintenance activities to comply with all Federal, State & Local erosion control permit requirements until Final Stabilization is reached.
(iii) All removal and replacement of existing BMPs due to damage to same suffered either by the contractor, outside agencies, the public, or acts of God.
(iv) All required mechanical and/ or manual street sweeping.
(v) Discretionary changes required of any regulatory enforcement officer.

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If the Contractor fails to maintain the BMPs in accordance with the Contract, or as directed, the City may at the expiration of a period of 48 hours, after having given the Contractor written notice, proceed to maintain BMPs as deemed necessary. The cost thereof will be deducted from any compensation due, or which may become due to the Contractor under this Contract.

I) MINOR SWMP MODIFICATIONS: Shall be made in the field by the Contractor and thoroughly documented in the Contractor's SWMP narrative and drawings. Should the Permit Enforcement Authority deem minor field modifications inadequate, the Contractor may be required to a) make specific modifications as requested by the Permit Enforcement Authority or b) return to the original approved design specifications. Minor SWMP Modifications are allowed, covered under the original CASDP, and required as part of standard maintenance and operation.

J) MAJOR SWMP MODIFICATION: The City reserves the right to require changes in the Work or Project Limits that may require a Major Modification to the SWMP and/ or CASDP due to unforeseen circumstances. Should this occur, the Contractor will be responsible for the following (as applicable) and applying for CASDP amendment:

(i) Make required revisions to comply with changing Federal or State rulemaking if it occurs within timeframe of the Project
(ii) Make required revisions due to unforeseen or unplanned conditions leading to deficient Drawings/ SWMP (hazardous materials encountered, landfills, expansion of work limits, etc.)
(iii) Prepare revised SWMP elements endorsed by a Professional Engineer licensed in the State of Colorado.

K) SUBSTANTIAL COMPLETION OF EROSION CONTROL: When a CASDP is required for the Project, Substantial Completion of the Project as defined by the City and County of Denver General Contract Conditions cannot be reached until Substantial Completion of Erosion Control has been granted. Granting of Substantial Completion of Erosion Control must be requested by the Contractor and be approved by the Permit Enforcement Authority in the form of a "Certificate of Substantial Completion of Erosion Control".

L) FINAL STABILIZATION: Granting of Final Stabilization must be requested by the Contractor and be approved by the Permit Enforcement Authority. Other permanent soil stabilization techniques may be proposed, in writing, by the Contractor and used upon approval, in writing, by the Project Manager and Permit Enforcement Authority.

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The Contractor shall follow the following procedures for approval of Final Stabilization:

(i) The Contractor shall file Inactivation Request for Construction Activities Stormwater Discharge Permit (available within CASDP guidance documents) with the Permit Enforcement Authority.

(ii) The Contractor shall coordinate with the Permit Enforcement Authority to hold a Final Inactivation Inspection.

(iii) If passing, the Permit Enforcement Authority transmits a letter of approval for Final Stabilization.

(iv) If not passing, the Permit Enforcement Authority transmits a letter of denial for Final Stabilization with associated inspection report to Contractor.

(v) Stabilization, inspection and maintenance requirements shall continue until confirmation of having met final closure requirements have been granted in writing by the Permit Enforcement Authority. When Final Stabilization has been reached, the Permit Enforcement Authority shall issue a "Certificate of Final Stabilization".

(vi) Once the Inactivation request is approved by the City and County of Denver, the contractor can apply to close the State Stormwater Permit.

M) FINAL ACCEPTANCE:

CASDP obligations (including reaching Final Stabilization) may hinder the ability to reach Final Acceptance for the overall Project as defined in the City General Contract Conditions.

PART VI: CONSTRUCTION OF BMPs

BMPs shall be constructed so that they conform to all requirements as set forth within the Project SWMP. They shall meet all requirements set forth within each BMP detail and shall be installed and maintained so that they function in an effective and operable manner.

PART V: BASIS OF PAYMENT

Erosion Control items as specified in Part V shall be paid in accordance with Section 208. All other erosion control items, including to furnish, install, maintain, replace (if not due to contractor negligence), remove, and dispose of BMPs specified in the Contract shall not be paid for separately, but shall be included in the work.

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Erosion Log and Aggregate Bag will be measured by each linear foot that is installed and accepted. Payment will be full compensation for all work, materials and equipment required to complete the item, including surface preparation, maintenance throughout the project, and removal upon completion of work.

Storm Drainage Inlet Protection will be measured and pay for separately in accordance with Section 208 of the Storm Drain Inlet Protection of this specification.

All other work required as set forth in this Revised Section 208 – Erosion Control including all materials, equipment and labor, to permit, set-up, maintain, document, remove and clean-up all erosion control BMP's as per current City of Denver Stormwater Management Plans /(SWMP) requirements will not be paid separately; all costs incurred by the Contractor to meet the requirements of this Section regarding Erosion Control unless provide for in the Bid shall be included in the related appurtenance.

The cost for any corrective actions required by the State or City due to contractor's failure to obtain or comply with applicable Permits will be borne by the Contractor, including fines and penalties. In the case of failures on the part of the Contractor in controlling erosion, sedimentation, and/or water pollution, the City may provide the necessary corrective actions. All corrective action costs, including Project engineering costs, will be charged to the Contractor, and appropriate deduction will be made from the Contractor's monthly pay estimate.

The sole remedy for additional costs associated with installation of BMPs as required by regulatory agencies to ensure compliance with local and State requirements shall be included in the cost of the adjacent concrete repair work as provided in the Bid Schedule of this Contract. The Contractor however may submit a separate itemized Change Order for any required Major SWMP Modification proposed by the City during the course of the Project.

Pay Item	**Pay Unit**
Erosion Log Type 1 (12 Inch)	Lineal Foot
Aggregate Bag	Lineal Foot
Pre-Fabricated Concrete Washout Structure (Type 1)	Each
Removal and Disposal of Sediment (Labor)	Hour
Removal and Disposal of Sediment (Equipment)	Hour

REVISION OF SECTION 208
STORM DRAIN INLET PROTECTION

Section 208 of the Standard Specifications is hereby revised for this project as follows:

Subsection 208.05(j) Storm Drain Inlet Protection shall include the following:

Storm drainage inlet protection shall be placed at the nearest downstream inlet or any inlets immediately adjacent to any construction excavation or areas that require concrete work. The inlet protection shall be sewn geotextile fabric unit enclosing a porous structure in the form of a cylindrical tube placed in front of and extending beyond the inlet opening on both sides. The inlet protection shall be a Beaver Dam style as manufactured by Dandy Products Inc. (1-800-591-2284) (www.dandyproducts.com) or approved equal.

Storm Drain protection shall remain in place throughout the entire project time to ensure protection of each individual construction site.

The Contractor shall review the sites which have completed construction to ensure that the inlet protection is achieving the proper protection and remediate all issues for the entire project time.

Subsection 208.12 shall include the following:

Payment will be full compensation for all work, materials and equipment required to complete the item, including surface preparation, maintenance throughout the project, and removal upon completion of the project.

Pay Item	**Pay Unit**
Storm Drain Inlet Protection (Type I)	Lineal Foot
Storm Drain Inlet Protection (Type II)	Lineal Foot

REVISION OF SECTION 209
WATERING AND DUST PALLIATIVES

Section 209 of the Standard Specifications is hereby revised for this project as follows:

Subsection 209.07 paragraph 1 shall be deleted and replaced with the following:

Water for moisture-density control, landscaping, pre-wetting, and for dust palliatives will not be measured and paid for separately but shall be included in the cost of the work.

REVISION OF SECTION 210
RESET STRUCTURES

Section 210 of the Standard Specifications is hereby revised as follows:

Subsection 210.01 is hereby revised to include the following:

This work shall also consist of restoring existing landscaping that is disturbed during construction to its original or improved condition. This item applies to all landscaping within the limits of construction. Materials used to restore landscaping shall be replaced "in-kind" unless otherwise approved by the Engineer.

Subsection 210.02 shall include the following:

“Restore Landscaping, In Kind” shall include restoring all landscaping that is disturbed within the limits of construction. This includes landscape concrete and asphalt pavers, landscape rock, flowers, shrubs and landscape timbers. The Contractor shall be required to maintain the landscaping planting in accordance with Section 214.

Subsection 210.09 shall include the following:

Signs and traffic signals shall be reset in accordance with the City and County of Denver Transportation Engineering requirements at locations indicated on the plans. It will be the Contractor's responsibility to supply and install any new materials needed to restore the signs and traffic signals to service at the new location.

Subsection 210.10 shall include the following:

Manholes, water meters and valves shall be adjusted in accordance with the applicable standards of the Utility Owner. The Contractor will be responsible for determining the proper Utility Owner and coordinating these adjustments.

Survey range boxes shall be adjusted as directed by the Engineer.

Reset Inlet Grate will include for each existing single inlet all materials, equipment and labor, to remove and dispose of the existing castings and provide and place new castings with mounting hardware, grout and up to 1 course of standard brick riser as per Wastewater Standard Details DRWG NO. S-716 and all other labor, equipment, materials and hauling and disposals necessary to complete the work.

Restoration of landscaping beyond limits outlined on the plans and/or as marked in the field by the Engineer will not be paid for.

2
REVISION OF SECTION 210
RESET STRUCTURES

Subsection 210.13 shall be revised to include the follows:

Pay Item	Pay Unit
Reset Ground Sign	Each
Reset Sign Panel	Each
Reset Bench	Each

When the contract does not include pay items for Reset Structures, these items will not be paid for separately but shall be included in the work.

REVISION OF SECTION 212
LANDSCAPE RESTORATION

Section 212 of the Standard Specifications is hereby revised as follows:

Subsection 212.01 shall include the following:

Disturbance of existing landscaping shall be minimized wherever possible. The Contractor shall notify the Engineer or Project Manager of any potential disturbance before beginning of work.

Landscape restoration shall consist of the repair and/or replacement of all landscape materials that may be damaged through the actions of the Contractor or his agents. This work may include but is not limited to sod, fencing, plantings, sprinkler systems and decorative features.

Landscape restoration requires the contractor to submit irrigation shop drawings to the Project Engineer for Denver Parks and Recreation approval prior to commencing any irrigation restoration. Prior to the start of construction, the contractor shall coordinate with Denver Parks and Recreation personnel to activate and operate the existing irrigation system within the project limits to become familiar with the existing conditions and plan for future modifications.

The Contractor shall perform all landscape restoration activities after signal installation in accordance with the City and County of Denver Parks and Recreation Standard Specifications for the following work items: Tree Retention and Protection, Soil Preparation, Sodding, Irrigation Systems, and Concrete Walks, Curbs, and Miscellaneous Flatwork

The referenced specifications are available at the following URL: https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Parks-Recreation/Planning-Design-Construction-Community-Engagement/Construction-Design-Resources

Subsection 212.07 shall include the following:

Landscape Restoration will not be measured and paid for separately but shall be included in the project Allowance for Landscaping.

Subsection 212.08 shall include the following:

Payment will be made under:

Pay Item	**Pay Unit**
Landscaping	A/W

REVISION OF SECTION 212
TREE PROTECTION

Section 212 of the Standard Specifications is hereby revised as follows:

Subsection 212.01 shall include the following:

This work is for the installation of tree protections as shown in the plans or as directed by the Engineer. The work performed shall be in accordance with Denver Parks and Recreation Department's standards and specifications.

Subsection 212.07 shall include the following:

Tree Protection will be measured as each and paid for by the number of tree protections successfully installed that are in accordance with the City and County of Denver's Tree Protection Detail.

Subsection 212.08 is hereby revised to include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below. Payment shall be full compensation for all material and labor to successfully install the tree protection.

Payment will be made under:

Pay Item	**Pay Unit**
Tree Protection	Each

REVISION OF SECTION 403
HOT MIX ASPHALT

Section 403 of the Standard Specifications is hereby revised as follows:

Subsection 403.02 shall include the following:

The design mix for hot mix asphalt shall conform to the following:

Table 403-1

Property	Test Method	Value For Grading		
		SX(100)	S(100)	Patching
Air Voids, percent at: N (design)	CPL 5115	3.5 – 4.5	3.5 – 4.5	3.5 – 4.5
Lab Compaction (Revolutions): N (design)	CPL 5115	100	100	100
Stability, minimum	CPL 5106	30	30	30
Aggregate Retained on the 4.75 mm (No. 4) Sieve for S, SX and SG, and on the 2.36mm (No. 8) Sieve for ST and SF with at least 2 Mechanically Induced fractured faces, % minimum*	CP 45	70	70	70
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109 Method B	80	80	80
Minimum Dry Split Tensile Strength, psi	CPL 5109 Method B	30	30	30
Grade of Asphalt Cement, Top Lift		PG 76-28	-	PG 76-28
Grade of Asphalt Cement, Bottom Lifts		-	PG 64-22	PG 64 - 22
Voids in the Mineral Aggregate (VMA) % minimum	CP 48	See Table 403-2	See Table 403-2	See Table 403-2
Voids Filled with Asphalt (VFA), %	AI MS-2	65 - 75	65 - 75	65 - 75
Dust to Asphalt Ratio Fine Gradation Coarse Gradation	CP 50	 0.6 - 1.2 0.8 – 1.6	 0.6 - 1.2 0.8 – 1.6	 0.6 - 1.2 0.8 – 1.6

Note: AI MS-2 = Asphalt Institute Manual Series 2

Note: Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems.

Note: Gradations for mixes with a nominal maximum aggregate size of one-inch or larger are considered a coarse gradation if they pass below the maximum density line at the #4 screen.
Gradations for mixes with a nominal maximum aggregate size of 3/4" to 3/8" are considered a coarse gradation if they pass below the maximum density line at the #8 screen.
Gradations for mixes with a nominal maximum aggregate size of #4 or smaller are considered a coarse gradation if they pass below the maximum density line at the #16 screen.

*Fractured face requirements for SF may be waived by RME depending on project conditions.

2
REVISION OF SECTION 403
HOT MIX ASPHALT

All mix designs shall be run with a gyratory compaction angle of 1.25 degrees and properties must satisfy Table 403-1. Form 43 will establish construction targets for Asphalt Cement and all mix properties at Air Voids up to 1.0 percent below the mix design optimum. CDOT will establish the production asphalt cement and volumetric targets based on the Contractor's mix design and the relationships shown between the hot mix asphalt mixture volumetric properties and asphalt cement contents on the Form 429. CDOT may select a different AC content other than the one shown at optimum on the Contractor's mix design in order to establish the production targets as contained on the Form 43. Historically, Air Voids adjustments typically result in asphalt cement increases from 0.1 to 0.5 percent. Contractors bidding the project should anticipate this change and factor it into their unit price bid.

Table 403-2

	Minimum Voids in the Mineral Aggregate (VMA)			
Nominal Maximum Size*, mm (inches)	***Design Air Voids **			
	3.5%	4.0%	4.5%	5.0%
37.5 (1½)	11.6	11.7	11.8	N/A
25.0 (1)	12.6	12.7	12.8	
19.0 (¾)	13.6	13.7	13.8	
12.5 (½)	14.6	14.7	14.8	
9.5 (⅜)	15.6	15.7	15.8	
4.75 (No. 4)	16.6	16.7	16.8	16.9
	* The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%. ** Interpolate specified VMA values for design air voids between those listed. *** Extrapolate specified VMA values for production air voids beyond those listed.			

The Contractor shall prepare a quality control plan outlining the steps taken to minimize segregation of HMA. This plan shall be submitted to the Engineer and approved before beginning the paving operations. When the Engineer determines that segregation is unacceptable, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

3
REVISION OF SECTION 403
HOT MIX ASPHALT

CDOT approved Warm Mix Asphalt (WMA) may be allowed on this project per CP 59. Unique requirements for WMA design, production and acceptance testing as documented during CDOT WMA approval shall be submitted and approved before creation of the Form 43 and before any WMA production on the project. Delays to the project due to WMA submittal and review will be considered within the Contractor's control and will be non-excusable.

Contractors proposing to use WMA shall supply detailed design, production and acceptance testing requirements prior to completion of the Form 43. Approved WMA submittals shall contain all of this information prior to CDOT approval. Only CDOT Approved WMA incorporating additives from the Approved Products List (APL) will be allowed for use on the project.

Hot mix asphalt for the top lift of patching used on the roadway surface shall conform to the gradation requirements for Hot Mix Asphalt (Grading SX) (100) (PG 76-28). Hot mix asphalt for lower lifts of patching used on the roadway surface shall conform to the gradation requirements for Hot Mix Asphalt (Grading S) (100) (PG 64-22).

A minimum of 1 percent hydrated lime by weight of the combined aggregate shall be added to the aggregate for all hot mix asphalt.

Subsection 403.03 shall include the following:

The Contractor shall construct the work such that all roadway pavement placed prior to the time paving operations end for the year, shall be completed to the full thickness required by the plans. The Contractor's Progress Schedule shall show the methods to be used to comply with this requirement.

The Hot Mix Asphalt (HMA) provided under this contract shall meet the requirements of MPGEC Item 20.

4
REVISION OF SECTION 403
HOT MIX ASPHALT

Delete subsection 403.05 and replace with the following:

403.05 The accepted quantities of hot mix asphalt will be paid for in accordance with subsection 401.22, at the contract unit price per ton for the bituminous mixture.

Payment will be made under:

Pay Item	Pay Unit
Hot Mix Asphalt (Grading SX)(100)(PG 76-28)	Ton
Hot Mix Asphalt (Grading S)(100)(PG 64-22)	Ton

Aggregate, asphalt recycling agent, asphalt cement, additives, hydrated lime, and all other work and materials necessary to complete each hot mix asphalt item will not be paid for separately, but shall be included in the unit price bid. When the pay item includes the PG binder grade, any change to the submitted mix design optimum asphalt cement content to establish production targets on the Form 43 will not be measured and paid for separately, but shall be included in the work. No additional compensation will be considered or paid for any additional asphalt cement, plant modifications and additional personnel required to produce the HMA as a result in a change to the mix design asphalt cement content.

Historically, typical asphalt cement increases reflected on the Form 43 are from 0.1 to 0.5 percent. However, the Contractor should anticipate the AC increases typical of his mixes. Contractors bidding the project should anticipate this change and factor it into their unit price bid.

When the pay item does not include the PG binder grade, asphalt cement will be measured and paid for in accordance with Section 411. Asphalt cement used in Hot Mix Asphalt (Patching) will not be measured and paid for separately, but shall be included in the work.

Excavation, preparation, moisture density control, reconditioning, and tack coat of areas to be patched will not be measured and paid for separately, but shall be included in the work.

REVISION OF SECTION 411
ASPHALT MATERIALS

Section 411 of the Standard Specifications is hereby revised as follows:

Subsection 411.04 shall be revised to include the following:

Emulsified Asphalt will not be measured and paid for separately, but shall be included in the work.

REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

Section 412 of the Standard Specifications is hereby revised as follows:

Subsection 412.01 shall be revised to include the following:

This work shall also include driveway, cross-pan, valley pan, and alley paving. All work shall be in accordance with the latest edition of the City and County of Denver's Transportation Standards and Details for Engineering Division.

Subsection 412.03 shall be revised to include the following:

Mix designs must be submitted for approval by the Engineer and shall be designed for the opening times required by the Traffic Control Plan. Such mix designs shall be submitted in a timely manner so as not to delay the scheduled commencement of the project, taking into account time for testing of the mix by the Contractor's laboratory. It is the Contractor's responsibility to provide Quality Control concrete strength testing and provide test results in a testing frequency, method and report as per Pre-construction submittal approved by the City Project Manager. Quality Control testing, reports and submittals will not be paid for separately but shall be included in the work.

Portland Cement Concrete Pavement shall conform to the requirements of MGPEC Item 30.

Subsection 412.04 shall be deleted and replaced with Subsection 601.05, with the following revisions:

Calcium chloride (up to 1 percent by weight of cement) or Type C or E accelerators may be used under the following conditions:

a. The median daily temperature is less than 55 degrees (Average of previous three days).
b. The date of placement is between September 30th and May 30th.
c. The concrete temperature may not exceed 80 degrees F prior to placement.

Difficulties encountered as a result of use of accelerators, the costs of associated delays, and corrective action costs shall be borne by the Contractor.

2
REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

When High Early Strength is requested by the engineer for the convenience of the City, field strength of 2500 psi shall be achieved in 24 hours or less. An additional charge per cubic yard will be negotiated and paid for high early concrete when directed to be used by the Project Manager. If high early concrete is placed by the contractor without the request of the City the entire additional cost will be borne by the contractor. When directed by the Project Manager, a maturity meter (James Instrument Model No. 3006) shall be used to monitor on-site maturity of pavement concrete. The Contractor shall establish a maturity versus strength relationship for the concrete mixture being used. This correlation may be achieved by casting and curing cylinders on site, monitoring temperature and maturity of cylinders and paving concrete versus time, and testing cylinders at time intervals to establish the correlation.

Subsection 412.10 shall be revised to include the following:

The Contractor is required to submit a detailed breakdown of paving equipment, vibratory devices, finishing tools, and provisions for protection from or avoidance of damage from weather impacts. This information shall be submitted for approval by the Engineer prior to commencing any construction activities.

Subsection 412.12 shall be revised to include the following:

The Contractor shall insure that new concrete items built under this contract drain properly and, as such, there are no areas of standing water on new concrete items.

The Contractor shall protect all new concrete items built under this Contract against defacement, or other injury, from any cause. If said damage cannot be adequately repaired to the satisfaction of the Engineer, the Contractor shall remove and replace the unacceptable items at Contractor's expense.

Subsection 412.13(a) 1, shall be deleted and replaced with the following:

Longitudinal Construction Joints. Keyways in longitudinal construction joints are optional. Deformed steel tie bars of specified length, size, spacing, and material shall be placed perpendicular to the longitudinal joints by an approved method. When adjacent lanes of pavement are constructed separately, Grade 40 (not Grade 60) tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed. If epoxy-coated steel tie bars are bent and then straightened into final position, at the Engineer's discretion the bars shall be repainted with epoxy coating prior to placement of the adjacent concrete. The tie bars shall be inserted into the plastic state concrete between the auger and the vibrators. Other methods of the bar placement may be acceptable if the Contractor can demonstrate satisfactory performance of his alternate method.

3
REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

Proposals of alternate methods or additional costs associated with other methods shall be at the Contractor's expense.

Subsection 412.13(b), delete the first sentence and replace it with the following:

Weakened plane joints shall be formed by sawing to the depth specified on the drawings, in accordance with the requirements of this subsection or as otherwise approved by the Engineer, except as follows: When required to adhere to the City Noise Control Ordinance, joints shall be formed initially by deep tooling or "soft-cut" methods, followed by sawing at the first available time within the ordinance.

Subsection 412.13(b) 2, delete the first and second paragraphs and replace with the following:

Transverse weakened plane joints shall be formed by sawing a groove in hardened concrete in accordance with plan details.

The Contractor shall cut the transverse and longitudinal joints to the width and depth required. The cut shall be made with a power driven saw. Any damage to the concrete pavement such as spalling or fracturing shall be repaired by the Contractor as directed by the Engineer at no cost to the project. The joints shall be immediately flushed with water to remove any sawing residue from the joint and pavement surface.

If concrete approaches or any widening beyond the width of the initial pass is constructed subsequent to the driving lanes, transverse weakened plane joints shall immediately be formed in the approaches extending from any joints in the driving lanes.

Subsection 412.13(b) 2, shall be revised to include the following:

The time schedule for sawing weakened plane joints shall be as follows: Every second joint shall be sawed 2 to 12 hours after pavement placement, provided the concrete has sufficiently set so as to preclude the dislodging of aggregate particles by the saw. Unless otherwise directed by the Engineer, the exact time of sawing shall be determined by the Contractor and will be dependent on weather conditions, ambient temperature, mix characteristics and other factors that may affect the setting time of the concrete. Every effort shall be made to saw early enough to control or limit random cracking. The intermediate joints shall be sawed prior to opening to traffic, but in no case longer than 48 hours after placement of the concrete.

4
REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

The Contractor shall adhere to the City Noise Control Ordinance. In the event that the need for saw cutting is anticipated during restricted time periods, a "soft-cut" saw shall be used before restricted hours, or deep tooling of joints shall be performed on plastic concrete, followed by saw cutting of the concrete as soon as possible during unrestricted hours. At the discretion of the Engineer, saw cutting will be prohibited between 10:00 p.m. and 7:00 a.m.

Delete the first paragraph of Subsection 412.15 and replace with the following:

412.15 Cold Weather Concrete Paving. The Contractor is responsible for the strength and quality of the concrete placed during cold weather. Before starting paving operations, the Contractor shall be prepared to protect the concrete from freezing. Maturity meters, to monitor and record time and pavement temperature, shall be installed at the time of placement when the air temperature is expected to fall below 40 ˚F during the next three days or as requested by the Engineer when the air temperature is expected to fall below 45 ˚F during the next three days. The Contractor shall maintain the temperature of the pavement at or above 40 ˚F until the pavement has attained a compressive strength of at least 2000 psi. The compressive

strength of the concrete shall be determined by the use of maturity meters. Maturity meters shall be placed in three locations for each day's concrete paving operations. One maturity meter shall be placed in the final 15 feet of paving, and the two other maturity meters shall be placed at locations designated by the Engineer. The maturity meter probes shall be located on the outside edge of the slab, at least 1 foot and not more than 2 feet from the edge and at mid depth of the slab. Each maturity meter shall be capable of recording the time and temperature. The maturity meters shall remain in place until the concrete has attained a compressive strength of 2000 psi.

Subsection 412.18 shall be deleted and replaced with the following:

412.18 Sealing Joints.

This work shall consist of sawing, cleaning and sealing Portland cement concrete pavement joints for new pavements.

Cleaning, repairing and proper curing of any spalls, fractures, breaks or voids in the concrete surface of the joints shall be accomplished at least 4 days prior to installing the backer rod material or joint sealant. Joint sealing or resealing shall be performed only when the ambient and pavement temperatures are 50 degrees F or higher, unless otherwise approved by the Engineer.

5
REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

The pavement surface and joints shall be dry and the sealant shall not be placed unless the weather conditions are dry. The sealant shall be placed a minimum of 4 days after joints are washed clean.

The Contractor shall thoroughly clean the joint and adjacent pavement for a width of not less than one inch on each side of the joint of all scale, dirt, dust, residue, or any foreign material that will impair bonding of the joint sealant. Immediately prior to the placement of backer rod material and the sealant, the joints shall be cleansed using a minimum of 100 psi compressed air.

Work shall be stopped when and if it is found that there is oil or moisture in the compressed air. Work shall not resume until suitable adjustments are made. The Contractor is to check for such oil or moisture at the start of every work cycle and periodically during the cycle using an Engineer approved method. The backer rod shall be placed in such a manner that the grade for the proper depth of the sealant material is maintained. Under no conditions shall the Contractor place the backer rod material or the sealant if there is dust, moisture, oil or any foreign material on that portion of the concrete that is to receive the backer rod material or joint sealant.

A copy of the manufacturer's recommendations pertaining to the heating and application of the sealant shall be submitted to the Engineer prior to the beginning or work, and these recommendations shall be adhered to by the Contractor, with such exceptions as this specification may require.

The sealant material shall be hot applied into the joint using equipment and techniques recommended by the joint sealant manufacturer. The surface of the finished joint seal shall have a flat level surface that is 3/16+/-1/16 inch below the surface of the concrete pavement. Sealant not placed within these tolerances will not be measured and paid for, and the Contractor shall remove the joint sealant material and clean and reseal these joints in accordance with the criteria outlined in the special provision at no additional cost to the project. If, in the opinion of the Engineer, the Contractor shows an inconsistency in his ability to fill the joints to the required dimensions, the Contractor shall cease his operations until such time as he can comply with the required criteria in a consistent manner.

In addition, the Engineer may elect to check for bonding or adherence to the sides of the joint. Material shall conform to Subsection 705.01(a).

The joint material must withstand a 20 pound pull force applied perpendicular to the joint as indicated in "COLORADO PROCEDURE 67-90".

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REVISION OF SECTION 412
PORTLAND CEMENT CONCRETE PAVEMENT

Subsection 412.22 shall be deleted and replaced with the following:

The pavement shall be cleaned and opened to traffic in accordance with the time requirements shown on the plans or in the specifications.

Pavement shall not be opened until it has reached a compressive strength of 2500 psi in-place, regardless of the curing time required by the Traffic Control Plan. The TCP may necessitate the required compressive strength to be attained within 72 hours or less.

Subsection 412.24 shall be revised to include the following:

Payment under Concrete Pavement shall be full compensation for all materials and labor required to complete the various pavement sections, including expansion joints, areas of thickened edges, driveways, and alley paving.

New curb and gutter that is adjacent to new concrete pavement will not be measured and paid for separately but included in the square yard measurement for concrete pavement. Measurement and payment will be to back of curb except where curb ramp limits overlap.

Pay Item	**Pay Unit**
Concrete Pavement (6 Inch) (Fast Track)	Square Yard
Concrete Pavement (8 Inch)	Square Yard

When the contract does not include pay items for Portland Cement Concrete Pavement, these items will not be paid for separately but shall be included in the work. High early strength concrete shall be paid for under the Concrete Pavement (6 inch) (Fast Track) pay item.

REVISION OF SECTION 503
VACUUMED CAISSON

Section 503 of the Standard Specifications is hereby revised for this project as follows:

Section 503.01 is hereby revised to include the following:

This work consisted of constructing the Traffic Signal Pole Foundations using a vacuum method at the locations as shown on the plans and as directed by the Engineer. The placing of reinforcing steel and concrete in the excavated holes must in accordance with these specifications and in conformity with the lines and grades on the plans or established.

Traffic Signal Pole Foundations shall conform to the requirements of the City and County of Denver's Standard Details for Signal Pole Foundations (Detail 16.1.8).

Section 503.14, is herby revised to include the following:

Caisson excavations performed with a vacuum pothole machine will be to prevent drilling through existing utilities. The locations where vacuum method is employed shall be per the approved plans or at the discretion of the Engineer.

Section 503.22 is hereby revised to include the following:

Vacuumed Caissons will be measured by the linear foot from the elevation shown on the plans to the bottom of the hole excavated.

Section 503.23 is hereby revised to include the following:

Pay Item	**Pay Unit**
Vacuumed Caisson (XX Inch)	Linear Foot

The unit price of vacuumed caissons shall be full compensation for making all excavations; hauling and disposal of excavated material; performing all necessary pumping; furnishing and placing required concrete and anchor bolts and reinforcement steel, including the reinforcement projecting above the tops of the caissons necessary for splicing; all backfilling; removing casings; and for furnishing all tools, labor, equipment, and incidentals necessary to complete the work. No extra payment will be made for casing left in place.

REVISION OF SECTION 608
SIDEWALKS, CURB RAMPS AND BIKEWAYS

Section 608 of the Standard Specifications is hereby revised for this project as follows:

Subsection 608.01 shall be deleted in its entirety and replaced with the following:

Concrete Sidewalk construction shall conform to the requirements of the City and County of Denver's Standard Details for Curb/Gutter and Sidewalk (Detail 5.2 through 5.4).

Concrete Curb Ramp construction shall conform to the requirements of the City and County of Denver's Standard Details for Curb Ramps (Detail 7.0 through 7.7). Construction of concrete ADA curb ramps to include the installation of detectable warnings.

Concrete Driveway construction shall conform to the requirements of the City and County of Denver's Standard Detail for Standard Commercial Driveway (Detail 6.0 through 6.2).

Subsection 608.02, delete in its entirety and replace as follows:

Materials shall meet the requirements specified in the following subsections:

Joint Fillers 705.01

Concrete for sidewalks, curb ramps, and driveways shall be Class "P", broom finish with natural color as specified in subsections 601.02 and 601.03, except that No. 67 coarse aggregate shall be used.

Detectable warnings shall be the composite dome (Armor-Tile Tactile Systems) for 5' wide curb ramps or the cast-iron dome for the 6' and wider curb ramps. Installation of the detectable warnings on ADA curb ramps shall be in strict accordance with the manufacturer's recommendations.

Alternate materials may be used, if pre-approved by the Engineer. The Contractor shall submit a sample of the product, the name of the selected supplier, and documentation that the product meets all contrast requirements and will be fully compatible with the curb ramp surface to the Engineer for approval prior to the start of work.

Concrete shall be cured with a non-pigmented "clear" curing compound.

2
REVISION OF SECTION 608
SIDEWALKS, CURB RAMPS AND BIKEWAYS

All concrete used for sidewalks, curb ramps, and driveways shall be reinforced with polypropylene fibers. Polypropylene fibers shall be FIBERMESH or FORTA FIBRE. Length of fibers shall be as recommended by the manufacturer. Add 1.5 pounds FIRBERMESH or FORTA FIBRE per cubic yard of concrete. The fiber additive utilized in the concrete mix shall be that supplied by the Fibermesh Company, 4019 Industry Drive, Chattanooga, TN, 37416, (800) 635-2308, or approved equal. The Contractor shall submit five (5) copies of fibrous concrete reinforcement product data for use by the Engineer.

Concrete will be subject to inspection and tests as required to assure compliance with quality requirements.

The use of calcium chloride, as permitted under Revision of Section 412, subsection 412.04, is prohibited in colored concrete.

Subsection 608.03(a) shall include the following:

Delete the third sentence and add:

Where excavation to the finished grade elevation results in subgrade of unsuitable soil, the Engineer may designate the unsuitable material to be removed and replaced with approved material. Removal of unsuitable material shall be paid for as Muck Excavation in accordance with Revision of Section 203.05(c), and backfilled with Class 6 Aggregate Base Course, or other material approved by the Engineer.

Subsection 608.03(d) shall be revised to include the following:

Finishing shall occur only after the disappearance of bleed water. The addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. Sprinkling of pigment onto the fresh surface will not be permitted.

Subsection 608.03(e) shall be revised to include the following:

For Bikeways, control joints shall be zipstrip or sawcut to a minimum depth of ¼ of the total slab thickness and no greater than ¼ inch wide. Control joints shall be spaced at 10 feet on center or as noted on the plans. Any damage to the concrete such as spalling, dislodging of aggregate particles, or cracking will be repaired by the Contractor at no additional cost to the Project. If said damage cannot be adequately repaired to the satisfaction of the Engineer, the Contractor shall remove and replace the damaged concrete at no additional cost to the Project.

Subsection 608.03(f) shall be revised to include the following:

The Contractor shall insure that new concrete items built under this contract drain properly and, as such, there are no areas of standing water on new concrete items.

3
REVISION OF SECTION 608
SIDEWALKS, CURB RAMPS AND BIKEWAYS

The Contractor shall protect all new concrete items built under this Contract against defacement, or other injury, from any cause. If said damage cannot be adequately repaired to the satisfaction of the Engineer, the Contractor shall remove and replace the unacceptable items at Contractor's expense.

Subsection 608.05 shall be revised to include the following:

Detectable warning on new curb ramps, including all work and materials necessary for fabrication, transport, and installation will not be measured and paid for separately, but shall be included in the work unless otherwise specified in the plans.

Subsection 608.06 shall be revised to include the following:

Payment will be made under:

Pay Item	Pay Unit
Concrete Sidewalk (4 Inch)	Square Yard
Concrete Sidewalk (6 Inch)	Square Yard
Concrete Curb Ramp	Square Yard
Detectable Warnings	Square Foot

Excavation to proposed subgrade elevation will not be paid for separately but shall be included in the work associated with Section 201, Clearing and Grubbing or Section 202, Removal of Structures and Obstructions.

Detectable warnings on new curb ramps, including all labor and materials necessary for fabrication, transport and installation, will not be measured and paid separately, but shall be considered included in the work unless otherwise specified in the plans

It is the Contractor's responsibility to provide Quality Control concrete strength testing and provide test results in a testing frequency, method and report as per Pre-construction submittal approved by the City Project Manager. Quality Control testing, reports and submittals will not be paid for separately but shall be included in the work.

Payment shall be full compensation for labor and materials including, but not limited to prep work, reconditioning, forms, grading, bed course, backfill, curing compound, control and expansion joint and sealant as required to complete these Pay Items.

Excavation to proposed subgrade elevation will not be paid for separately but shall be included in the work associated with Section 202, Removal of Structures, Asphalt Mat and Obstructions.

REVISION OF SECTION OF 609
CURB AND GUTTER

Section 609 of the Standard Specification is hereby revised as follows:

Subsection 609.01 shall be revised to include the following:

Combination Curb, Gutter, and Sidewalk
Variable Height Curb Head
Curb and Gutter, Variable Height Curb Head
Special Median Curb

Subsection 609.02 shall be revised as follows:

In the first paragraph, reference to Section 703.07, Bed Course Material, shall be deleted.

Paragraph 2 shall be deleted and replaced with the following:

- Concrete shall conform to the requirements for Class "P" concrete as specified in subsections 601.02 and 601.03. When curb machines are used, the Contractor will be permitted to use AASHTO M 43 Size 57 or 67 aggregate in lieu of the coarse aggregate specified in Table 601-1, and a lesser slump will be permitted.

Subsection 609.03(a) shall be revised as follows:

Excavation: Excavation shall conform to the requirements of the Revision of Section 608, Subsection 608.03(a).

Subsection 609.03(c) shall be revised to include the following:

The Contractor shall protect all new concrete items built under this Contract against defacement, or other injury, from any cause. If said damage cannot be adequately repaired to the satisfaction of the Engineer, the Contractor shall remove and replace the unacceptable items at Contractor's expense.

2
REVISION OF SECTION OF 609
CURB AND GUTTER

Subsection 609.03(d) shall be revised to include the following:

For construction of curb and gutter adjacent to existing concrete pavement, the joint pattern shall match that of the concrete pavement. The joint pattern shall be approved by the Engineer prior to construction.

Subsection 609.03(i) shall be revised to include the following:

The Contractor shall insure that new concrete items built under this contract drain properly and, as such, there are no areas of standing water on new concrete items.

It is the Contractor's responsibility to provide Quality Control concrete strength testing and provide test results in a testing frequency, method and report as per Pre-construction submittal approved by the City Project Manager. Quality Control testing, reports and submittals will not be paid for separately but shall be included in the work.

Subsection 609.07 shall be revised to include the following:

Payment will be made under:

Pay Item	**Pay Unit**
Curb Type 2 (Section B)	Linear Foot
Curb and Gutter Type 2 (Section I-B)	Linear Foot
Curb and Gutter Type 2 (Section II-B)	Linear Foot

Payment shall be full compensation for labor and materials including, but not limited to, reconditioning, grading, backfill, curing compound, control and expansion joint and sealant as required completing these Pay Items.

Excavation to proposed subgrade elevation will not be paid for separately but shall be included in the work associated with Section 202, Removal of Structures and Obstructions.

REVISION OF SECTION 610
MEDIAN COVER MATERIAL

Section 610 of the Standard Specifications shall be revised for this project as follows:

Subsection 610.02 shall include the following:

Aggregate for concrete median cover material shall be #67 or #57.

Median Cover Material (Concrete):
Concrete shall be Class B and shall conform to Section 601. A coloring agent is not required. Concrete shall not be patterned and the surface texture shall be smooth.

Median Cover Material (Patterned Concrete):
Patterned concrete color shall be integral Davis color #5447 "Mesa Buff" with a powdered release agent "Brickform Black Antique Release", RA-900 or equivalent. The color hardener shall not be a dry shake-on surface treatment type but shall be integral to the concrete mixing process. Color selection must be approved by the Engineer. Contractor shall submit color samples (as many as required) for approval.

Pattern shall be Matcrete M-161 "UK Cobblestone". Surface texture is irregular rather than smooth. Contraction joints shall be cut and spaced at a maximum of 10 feet. Contraction joints shall be placed in the joints in the rubbing bond pattern.

The thickness of both median cover material pay items shall be 6 inches.

Subsection 610.05 shall include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below.

Payment will be made under:

Pay Item	**Pay Unit**
Median Cover Material (Concrete)	Square Foot
Median Cover Material (Patterned Concrete)	Square Foot

Payment shall be full compensation for labor and materials including, but not limited to, reconditioning, grading, backfill, subgrade compaction, curing compound, control and expansion joint and sealant as required completing this Pay Item.**REVISION OF**

SECTION 612
DELINEATORS

Subsection 612.05 shall include the following:

Pay Item	**Pay Unit**
36” White Flexible Delineator Post	Each

Payment includes all labor, equipment, and materials necessary to complete the work.

REVISION OF SECTION 613
ELECTRICAL CONDUCTOR IDENTIFICATION

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.09 shall include the following:

All electrical conductors shall be tagged as follows:

Electrical conductor cable tags shall be located below the termination in the base of the streetlight, in the pull box, in the pedestal, and at the point of termination to existing facilities of the Local Utility Company supplying electrical service. The tags shall be attached with a cable tie. The information written on the tag shall include the direction and approximate length of cable, feeds running from where and to, etc.

Each incoming conductor shall be individually color coded with one (1) tape mark, while outgoing conductors shall have two (2) tape marks.

Example:

FEEDS TO PULL BOX 50' NORTH & 75' WEST THEN TO HIGHWAY SIGN	FEEDS FROM XFMR 250' SOUTH & EAST 200' WEST

Uniform tags are available in a Tag Kit. *The Tag Kit consists of: 100 tags, 3-part yellow with 1 hole, 100 black nylon ties and 1 black Sharpie pen.

Manufacturers	Catalog Numbers
Uticom Systems Inc.	U5025Y1 Or approved equal

Subsection 613.15 shall include the following:

Electrical conductor tagging will not be paid for separately, but shall be included in the cost of wiring.

Pay Item	**Pay Unit**
Wiring	Lump Sum

REVISION OF SECTION 613
ELECTRICAL CONDUIT – GENERAL

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Add the following to subsection 613.07:

This work is for the installation electrical conduits. These conduits (laterals) shall be to connect the already installed traffic signal conduits to the traffic signal controller cabinets, electric meters, and traffic signal poles. The conduit installation shall be in accordance with this specification:

All conduit bends, including factory-installed bends, shall not have a bend radius less than six times the inside diameter of the conduit.

The excavations required for the installation of conduit or cable shall be performed in such a manner as to avoid unnecessary damage to streets, sidewalks, landscaping, sprinkler systems and other improvements. Trenches shall not be excavated wider than necessary for the installation of the electrical appurtenances. Excavation shall not be performed until immediately before installation of conduits. The material from the excavation shall be placed in a position not to cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.

Trenches shall be made with a rock-wheel or other machine capable of cutting a narrow trench (4") so as to allow traffic to pass over prior to back filling. The machine shall be equipped with shields to direct the spoil downward and away from passing vehicles, workmen and pedestrians.

Off-street trenches shall be back-filled with the same material that was removed and shall be compacted and shaped to match the surrounding surface. On-street trenches within ALL roadway areas shall be back-filled with CDOT approved Structure Backfill (Flow-Fill) and capped with 9" minimum of Hot Mix Asphalt Pavement (Patching) in accordance with Section 403 and City and County of Denver Street Cut Regulations if applicable. If surrounding pavement depth is greater than 9 inches, the HMA (Patching) depth shall match the existing pavement.

All surface materials including sprinkler systems, landscaping, shrubs, sod grass, and native growth vegetation which is disturbed by trenching and back-filling operation shall be restored in kind equal to or exceeding the original conditions.

All conduit runs that will not have a copper conductor installed shall have a #12 AWG stranded copper conductor placed inside for locating purposes. Locating conductor and tape will not be measured and paid separately, but shall be included in the unit price for conduit.

2
REVISION OF SECTION 613
ELECTRICAL CONDUIT – GENERAL

Conduit shall always enter a pull box, hand-hole, or any other type structure from the direction of the run only.

All conduits shall be fully compatible with fiber optic cable. Plastic conduit shall be Schedule 80 in the diameters shown on the plans and shall be compliant with Bellcore TW-NWT-000356 requirements. Each conduit shall be equipped with a pull tape and each bore shall have a copper tracer wire of at least 12 gauge.

Plastic PVC conduit shall be certified by the manufacturer as meeting ANSI/UL 6 and 651. The manufacturer shall be ISO 9000 compliant.

All conduit bends, including factory-installed bends, shall not have a bend radius less than six times the inside diameter of the conduit.

Conduit plugs for sealing conduit shall also be supplied and installed in all open conduit ends as soon as the conduit is installed. Plugs shall be durable, fabricated from no metallic parts, be of the split design to allow removal and reinstallation around in-place cables and be easily removable and reusable. Plugs shall be capable of being installed by hand without any tools and shall provide a water and air tight seal of at least 100 psi and shall cause no damage to the cable when installed.

At some locations (as illustrated on the Plans or in these specifications, or as directed by the Engineer), new conduits shall be installed in an existing pull box. At these locations, the Contractor shall carefully excavate around the pull box and install the new conduit in the pull box in a manner that meets the requirements of this Special Provision. The Contractor shall not damage the existing pull box. If the existing pull boxes or concrete collars are cracked or damaged during conduit installation, the Contractor shall be required to replace either or both conforming to the requirements of the contract at no additional cost.

Subsection 613.14 shall include the following:

Electrical Conduit will be measured by the linear feet of conduit installed in accordance with these Special Provisions, the Project Standards or as directed by the Engineer. Electrical Conduit will include groundwork, sweeps, pull cord, copper tracer wire, adapters, fittings, splice couplings, conduit plugs (for conduits both with and without fiber optic cable), equipment, labor, and all other items necessary to complete the work.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT – GENERAL

Subsection 613.15 shall include the following:

Pay Item	Pay Unit
3 Inch Electrical Conduit (Bored)	Lineal Foot
2 Inch Electrical Conduit (Plastic)	Lineal Foot
3 Inch Electrical Conduit (Plastic)	Lineal Foot

REVISION OF SECTION 613
ELECTRIC METER PEDESTAL CABINET AND BASE

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.10 shall include the following:

New traffic signal installations require an Electric Meter Pedestal Cabinet and Base for the new traffic signal. Xcel Energy will furnish only the electric meter. The Contractor shall furnish the electric meter pedestal cabinet, and shall install the pedestal cabinet and base, by a licensed electrician (journeyman), at the locations as show on the plan and in accordance with the City and County of Denver's standard – sheets 16.1.19 and 16.1.20.

Subsection 613.14 shall include the following:

Electric Meter Pedestal Cabinet and Base will be measured and installed in accordance with these Special Provisions, the Project Standards or as directed by the City. The Electric Meter Pedestal Cabinet and Base installation will include groundwork, sweeps, pull cord, copper tracer wire, adapters, fittings, splice couplings, conduit plugs, equipment, labor, and all other items necessary to complete the work.

Contractor shall submit material specifications to the Engineer for prior approval.

Subsection 613.15 shall include the following:

Pay Item	**Pay Unit**
Electric Meter Pedestal Cabinet and Base	Each

REVISION OF SECTION 613
PULL BOXES – GENERAL

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.08 shall include the following:

Electrical pull box shall be the type A pull box. The covers of the type A pull box shall have the word "ELECTRIC" physically impressed (not painted) on top. Traffic signal pull box shall be the type B pull box. The covers of the type B pull box shall have the word "TRAFFIC" physically impressed (not painted) on top. Communication pull boxes shall be the either type C (24x36x24) or type D (30x48x18) pull boxes. The covers of the type C and D pull boxes shall have the words "TRAFFIC COMM" physically impressed (not painted) on top. The covers shall be attached to the pull box body by screw-in bolts and shall have two lift slots to aid in the removal of the lid.

All concrete collars, footings, and location marker supports shall be Portland Cement Concrete Class B and shall be in accordance with Section 601.

Pull boxes that are to be in traveled ways shall be outfitted with traffic bearing lids rated for HS 20- 44 loads. The pull boxes shall have a special concrete footing extending 8 inches around the outside and 6 inches around the inside of the pull box bottom, as shown in the plans. Pull boxes installed in dirt or landscape areas shall have a 12 inch wide by 6 inch thick concrete collar placed around the top in lieu of the concrete footing, as shown in the plans.

When the plans call for a fiber optic cable location marker to be installed at the pull box location, the concrete foundation support for the location marker shall be placed monolithically with the concrete collar.

Subsection 613.15 shall include the following:

Pay Item	**Pay Unit**
Pull Box (Type C)	Each

Type C pull boxes shall installation of the new pull boxes, modification of conduit ends, restoration of disturbed surface materials, and all other work necessary to complete the installation. All work necessary for the installation of pull boxes will not be measured and paid for separately but shall be included in the cost the work.

Type C pull boxes will be paid for on the basis of the number of pull boxes installed.

All other pull boxes required to complete the work will not be measured and paid separately but shall be included in the work of the conduit installation.

REVISION OF SECTION 613
LIGHTING (LUMINAIRE)(LED 5300 LUMENS)

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.02 shall include the following:

The Contractor shall furnish and install LED Street Light Luminaire at locations as shown on the plans. The LED Street Light Luminaire shall be compatible or interchangeable with standard LED Street Light Luminaire as stocked by the City and County of Denver.

The current LED Street Light Luminaire that are compatible with that stocked by the City and County of Denver is as follows:

Manufacturer	Catalog Numbers
E-Lite Star	ESU-CA012M03042S-525CCD1-1

The luminaire shall also include a photo cell (S-T P124-1.5-PTW or equal) and the luminaire finish shall be in Federal Green.

The Contractor shall submit a lighting materials list to the City and Denver for approval prior to ordering. 720-865-4002.

Subsection 613.09 shall include the following:

At least one grounding electrode shall be installed adjacent to each light standard. Wiring shall be a 120/240 volt or 120/208 volt, 3-wire system with individual luminaire wired for 120 volts.

Subsection 613.15 shall include the following:

Pay Item	**Pay Unit**
Luminaire (LED)(5,300 Lumens)	Each

Luminaire shall be measured and paid by the number of luminaire installed. The item shall include all labor, materials, and ancillary hardware required to provide a fully-functional system to the satisfaction of the Engineer.

REVISION OF SECTION 614
CONCRETE FOOTING (TRAFFIC SIGNAL POLE)

Section 614 of the Standard Specifications is hereby revised to include the following:

Subsection 614.01 shall include the following:

This work consists of installing concrete footing (foundations) for traffic signal pedestal pole; traffic signal imbedded steel poles (span wire poles); and traffic signal street light poles (no mast arms).
Locations of the concrete footing (foundations) are shown on the plans or as directed by the Engineer.

Subsection 614.08 (h) shall include the following:

Concrete Footing (Pedestal Pole) shall conform to the requirements of the City and County of Denver's Traffic Signal Standard Detail sheet no. 16.1.13.2 and detail nos. 4 and 5.

Concrete Footing (Imbedded Steel Pole) for span wire traffic signal poles shall conform to the requirements of the City and County of Denver's Traffic Signal Standard Detail sheet no. 16.1.14 and detail no. 6.

Concrete Footing (Traffic Street Light Pole – no mast arm) shall conform to the requirements of the City and County of Denver's Traffic Signal Standard Detail sheet no. 16.1.15 detail no. 9 for foundation on XCEL facilities, and Traffic Signal Standard Detail sheet no. 16.1.16 for foundation on city owned facilities.

Subsection 614.13 shall include the following:

Concrete Footings for Pedestal Poles, Imbedded Steel Poles, and Traffic Street Light Poles will not be measured and pay for separately but shall be included in the cost of Pedestal Poles, Imbedded Steel Poles, and Traffic Signal Light Poles installation.

REVISION OF SECTION 614
STEEL SIGNPOST (2X2 INCH TUBING)

Section 614 of the CDOT Standard Specifications is hereby revised to include the following:

Subsection 614.01 shall include the following:

This work includes the procurement and installation of singular tubular steel sign posts and supporting tubular sockets and at locations shown on the plans and in accordance with these specifications and the latest revision of the "Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways".

Subsection 614.02 Sign Posts and Sign Structures shall include the following:

All signs shall be installed on Telespar post with Telespar anchors at proper heights per current MUTCD Standards. All signs shall be mounted with City approved bolts, nut and washers.

Telespar type post and anchors shall meet or exceed the following: (All Telespar post shall be attached to anchors with 3/8" corner bolt with nut. Rivets will not be allowed)

a) Post – 1 ¾" x 1 ¾" x 10' – 11' – 12' = 14 gauge, ASTM Specification No. A446, Grade A, Drilled on 1" centers.

b) Anchors – 2" x 2" x 3', 12 gauge, ASTM Specification No. A446, drilled on 1" centers.

c) Post – 2" x 2" x 10' – 11' – 12' = 14 gauge, ASTM Specification No. A446, Grade A, Drilled on 1" centers.

d) Anchors – 2 ¼" x 2 ¼" x 3', 12 gauge, ASTM Specification No. A446, drilled on 1" centers.

e) All post and anchors shall be galvanized to ASTM Specification A525 coating designation G90

Signs placed in concrete shall be either core drilled with a 4" inch hole, or a piece of 4" inch PVC pipe may be poured into the full depth of the concrete and flush with the top of concrete.

Signs or combined signs which have an area larger than 30" x 30" shall use a 2" x 2" 14 gauge post with a 2.25"x 2.25" x 3' anchor.

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REVISION OF SECTION 614
STEEL SIGNPOST (2X2 INCH TUBING)

Subsection 614.13 shall include the following:

Steel Signpost will be measured by the actual linear foot of posts that are installed and accepted. Support posts (bases) that are required to complete the assembly as shown on the plans will not be measured and paid for separately but shall be included in the work.

Subsection 614.14 shall include the following:

Payment will be made under:

Pay Item	**Pay Unit**
Steel Signpost (2x2 Inch Tubing)	Lineal Foot

REVISION OF SECTION 614
PEDESTRIAN SIGNAL FACE (16) (COUNTDOWN)

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work includes the installation of LED Pedestrian Signal Faces with countdown timers as shown in the Contract.

Subsection 614.08 (i) shall include the following:

Pedestrian signal faces with count down timers shall meet the following requirements:

i. The dimensions of the signal housing and the LED symbols, as well as moisture and dust resistance requirements shall be in accordance with the current ITE PTCSI Standards.
ii. Signal housing shall be aluminum, painted in Federal Green and "clam-shell" mounted.
iii. The signal shall have user-selectable modes for countdown for walk cycle only, pedestrian cycle only, or both walk and pedestrian clearance.
iv. The countdown module shall have an internal conflict monitor to prevent any possible conflicts between the Hand/Person signal indications and the time display. The display shall not countdown during a Solid Hand indication.
v. LED symbols shall be solid icons and shall provide uniform light dispersion such that the "pixel" effect is minimized. Lettered or outline symbol styles will not be permitted.
vi. The Man/Hand configuration shall provide clear and distinct lamination where either symbol is in use.
vii. The LED module shall be rated for use in an ambient operating temperature range of - 40° F to 165° F.
viii. The signal shall meet NEMA Standard TS2 for voltage surge protection, and shall have an automatic reset in case of a power outage.

Subsection 614.13 shall include the following:

Pedestrian Signal Face (16) (Countdown) will be measured by the actual number of units that are installed and accepted.

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REVISION OF SECTION 614
PEDESTRIAN SIGNAL FACE (16) (COUNTDOWN)

Subsection 614.14 shall include the following:

Payment will be made under:

Pay Item	**Pay Unit**
Pedestrian Signal Face (16) (Countdown)	Each

REVISION OF SECTION OF 614
TRAFFIC CONTROL DEVICES

Section 614 of the Standard Specification is hereby revised as follows:

Subsection 614.08 (i) shall include the following:

"Light Emitting Diode" (LED) signal lenses shall be installed in all Red, Yellow, Green, signal displays. The LED signal lenses for the 12" and 8" circular balls and 12" circular arrows are hereby added to the Standard Specifications and shall comply with the following specifications:

Manufacturer Requirements and Approvals:

- The manufacturer supplying product to this specification shall have a minimum of 13 years of experience in the manufacture of LED Traffic Signals with High Flux LEDs used in the North American market.
- Manufacturers supplying products to this specification must be a registered participant and have the unique long life module part numbers being provided certified and listed on the Intertek-ETL LED Traffic Signal Modules Certification Program approved products website prior to bid opening.
- Manufacturers supplying products to this specification shall manufacture and assemble product on an Intertek ETL audited line located in the USA.
- Unique part number shall be listed on manufacturers label proving difference between standard modules and long life modules.
- If requested, documentation shall be provided by manufacturer demonstrating the changes made to their standard product that allows for ITE specification compliance over 15 year warranty period.

Physical & Mechanical Requirements: General

- Tinted or Non-Tinted Lens. Unless designated otherwise in the below table the standard lens color shall be tinted with a color meeting the colors required in paragraph 4.2 of the ITE specification. The products shall be available with non-tinted lenses as an option.
- The LED module shall utilize high flux LEDs rated at 1 watt or higher and have an incandescent, non-pixilated appearance when illuminated. The use of low power LEDs, for example 5 mm LEDs, is not permissible in the design and production of long life arrow products.
- The external lens shall have a smooth outer surface to prevent the build up of dirt/dust and shall be designed to minimize the potential for sun phantom signals.
- All LEDs utilized to illuminate circular signal modules, shall be LEDs that have been manufactured utilizing materials that have industry acceptance as being suitable for uses in outdoor applications. At no time is the use of LEDs that utilize AlGaAs technology acceptable.

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REVISION OF SECTION OF 614
TRAFFIC CONTROL DEVICES

- The thermal management system used in the traffic ball must be self-contained and internal to the traffic module. At no time shall the thermal management system used for the power supply or LEDs form any part of the external surface of the LED module.
- All plastic components shall be molded and assembled in the USA. This includes: back housing, spreading lens and front lens. Certificate of manufacturing location must be available and supplied at time of bid requested.
- All lenses shall be hard coated in the USA. Certificate of manufacturing location must be available and supplied at time of bid requested. All reflectors shall be metalized in the USA. Certificate of manufacturing location must be available and supplied at time of bid requested.

Module Identification

- In addition to the required ITE labeling all modules must be labeled with the ETL Verified label shown in Figure 1. This label designates the compliance and listing with the Intertek- ETL Traffic Signal Certification Program.

Electrical: General

- The following color scheme shall be used for all modules AC power leads: White for Common, Red for the Red ball signal, Yellow for the Yellow ball signal, and Brown for the Green ball signal.
- The AC power leads shall exit the module via a rubber grommetted strain relief, and shall be terminated with insulated female quick connect terminals with spade/tab adapters. The leads shall be separate at the point at which they leave the module.
- All external wiring utilized in the LED traffic signal module shall be anti-capillary type wire to prevent the wicking of moisture to the interior of the module.
- LED Module and power supply shall be design to remain ITE compliant over a 15 year life.
- To minimize the temperature exposure of the power supply all power supplies should be located at the bottom of the module when the arrow is facing left.
- For additional protection from moisture, all power supplies shall be conformal coated for additional protection.

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REVISION OF SECTION OF 614
TRAFFIC CONTROL DEVICES

Transient Voltage Protection

- In addition to the transient test requirements defined in the Design Qualification Testing section of ITE Vehicle Traffic Control Signal Heads (VTCSH) specification all power supplies used in the circular signals supplied to this specification shall be capable of passing an additional ring-wave surge testing in accordance with the IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits, ANSI/IEEE C62.41.2-2002, 6KV, 100 kHz ring-wave with an output impedance of 30 ohms. The short circuit current shall be 200 Amps.

Power

- Typical wattages at 25 o C for the 12" circular arrow LED traffic Signal Modules shall be: Red - 8 watts, Yellow - 13 watts, and Green - 8 watts.
- Typical wattages at 25o C for the 12" circular ball LED traffic Signal Modules shall be: Red - 7 watts, Yellow - 11 watts, and Green - 7 watts. Typical wattages at 25o C for the 8" circular ball LED traffic Signal Modules shall not exceed: Red - 8 watts, Yellow - 10 watts, and Green - 8 watts.

Quality Assurance General

- Upon Request, the supplier must provide an Intertek-ETL test report for the base model being supplied to this specification.
- The base products must be listed in the Intertek Directory of LED Traffic Signal Modules Certified Products listing at the time of bid. Upon request the supplier must provide a copy of the listing in the bid package.

Warranty Requirements:
Warranty

- Manufacturers shall provide a detailed written warranty issued by the factory of module origin with the following minimum provisions:
- Modules shall, at the manufacturer's option, be repaired or replaced if the module fails to function as intended due to workmanship or material defects within the first 15 years from the date of delivery.
- Modules shall, at the manufacturer's option, be repaired or replaced if the module exhibit luminous intensities less than the minimum specified values within the first 15 years of the date of delivery.
- Upon request, the LED lamp module manufacturer shall provide written documentation of its ability to satisfy a worst-case, catastrophic warranty claim.

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REVISION OF SECTION OF 614
TRAFFIC CONTROL DEVICES

- A current corporate annual report duly-certified by an independent auditing firm, containing financial statements illustrating sufficient cash-on-hand and net worth to satisfy a worst- case, catastrophic warranty claim is an example of suitable documentation.
- The documentation shall clearly disclose:
    - The country in which the factory of module origin is located
    - The name of the company or organization that owns the factory of module origin including any and all of its parent companies and/or organizations, and their respective country of corporate citizenship
- For firms with business and/or corporate citizenship in the United States of less than fifteen years, the process by which the end-users/owners of the modules will be able to obtain worst-case, catastrophic warranty service in the event of bankruptcy or cessation-of- operations by the firm supplying the modules within North America, or in the event of bankruptcy or cessation-of-operations by the owner of the factory of origin, shall be clearly disclosed.

Subsection 614.14 shall include the following:

LED signal lenses shall be included in the cost of the item for Traffic Signal Face and will not be paid for separately.

REVISION OF SECTION 614
TRAFFIC SIGNAL BACKPLATE

Section 614 of the Standard Specification is hereby revised as follows:

Subsection 614.08 (j) shall include the following:

Traffic signals that are mounted on the mast arm shall include a non-louvered type "Traffic signal backplate." The backplate shall include a fluorescent yellow border tape that meets ASTM D4956 Type XI reflective sheeting or approved equal, and shall be of the following:

- 1.5 Inch wide
- Diamond grade DG3 Reflective sheeting
- Florescent Yellow 4081

Subsection 614.13 shall include the following:

Traffic signal backplates will not be measured and pay for separately but shall be included in the cost of the item for Traffic Signal Face.

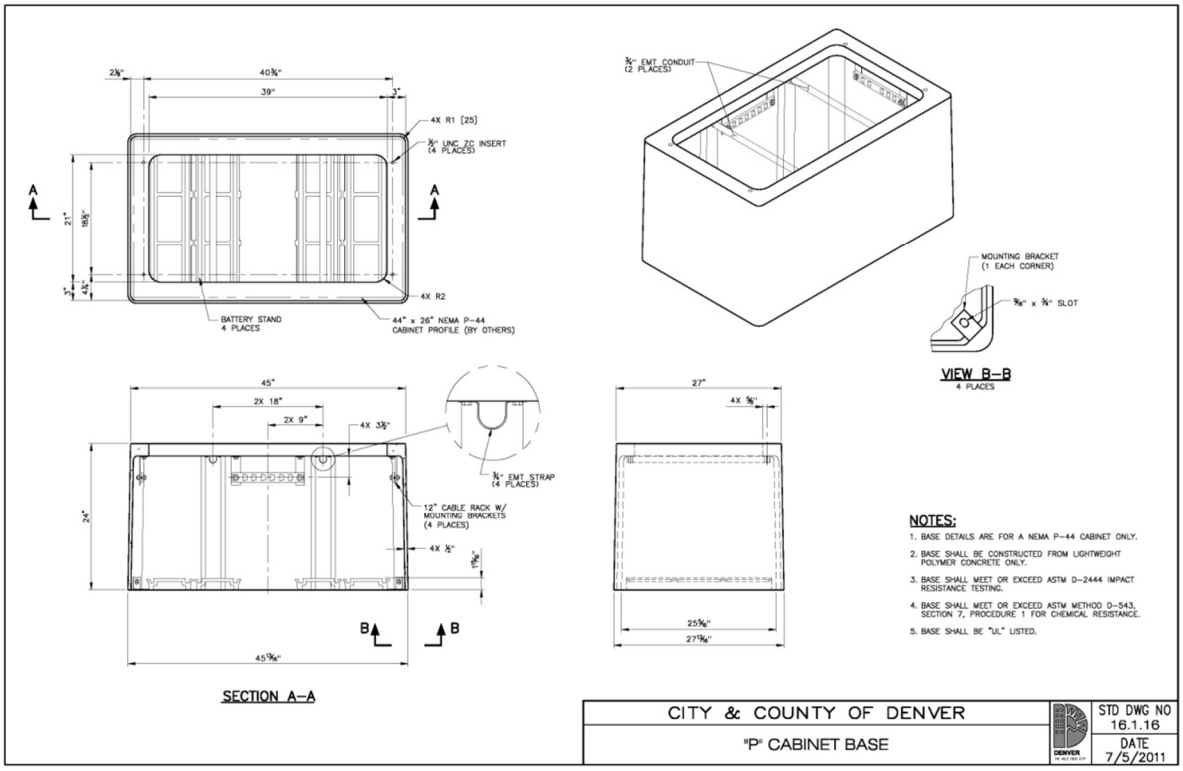
REVISION OF SECTION 614
TRAFFIC SIGNAL CABINET BASE

Section 614 of the Standard Specifications is hereby revised for this project as follows.

Subsection 614.01 shall include the following:

This work is of the installation of a composite Traffic Signal Controller Cabinet Base in accordance with City & County of Denver standards. The Contractor shall furnish and install the base that will fit the City and County of Denver's P-size traffic signal controller cabinet at the locations as shown on the plan.

Dimensions of the cabinet base (City & County of Denver Traffic Engineering Services STD DWG NO. 16.1.16) are as shown in the following drawing:



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REVISION OF SECTION 614
TRAFFIC SIGNAL CABINET BASE

Subsection 614.10 shall include the following:

Prior to starting cabinet base installation, Contractor shall obtain field verification of the location of the cabinet from the Engineer.

Cabinet base installation shall include all labor and materials to completely install a new P- size cabinet base as directed in the plans. The item shall include all excavation, conduit installation and modification work, backfill and restoration of adjacent surface area.

Subsection 614.13 shall include the following:

Installation of the traffic signal cabinet base shall not be measured and paid for separately, but shall be included in the cost for installation of the Traffic Signal Controller and Cabinet.

Subsection 614.14 shall include the following:

Installation of the traffic signal cabinet base will not be measured and paid for separately, but shall be included in the cost of the Traffic Signal Controller and Cabinet.

REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER AND CABINET

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work shall consist of furnishing, assembling, programming, and installing a completed Traffic Signal Controller and Cabinet assembly. The Cabinet assembly shall be assembled in accordance with the City and County of Standards and Specifications, and the completed Traffic Signal Controller and Cabinet shall include but not limited to the traffic signal controller, malfunction management unit (MMU), vehicle detector amplifiers, other ancillary hardware, and traffic signal cabinet base as per City and County of Denver standards. The Contractor shall install the completed Traffic Signal Controller and Cabinet assembly at the locations as shown in the plans.

Delete Subsection 614.08 (b), and replace with the following:

1.1 **Applicable Standards**

All electronic components, workmanship, and functionality of the traffic signal controller shall conform to the applicable standards for TS-2 traffic signal controllers mandated by the National Electrical Manufacturers Association's (NEMA) current edition NEMA Standards Publication TS2-2003 v02.06 for Traffic Controller Assemblies with National Transportation Communications for ITS Protocol (NTCIP) Requirements. Controller engine board and operating system shall support open architecture and be compliant with current ITE, AASHTO, and NEMA Standard Publication for Advanced Transportation Controllers (ATC) 5201.

All major components shall meet the environmental, design, and operating standards outlined in NEMA Standards Publication TS2-2003 v02.06, Section 2.

These standards specify minimum requirements for the traffic signal controller except where requirements specified in this document exceed the aforementioned documents.

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REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER AND CABINET

1.2 Hardware

1.2.1 Enclosure

The Controller enclosure shall be designed for placement on a shelf. The enclosure shall be aluminum with a protective finish and enclose all electrical components of the controller. The enclosure size shall be equal to or less than the following: TS-2 Type 1 Controller: 8.5" Tall x 8.5" Deep x 14 ¾" Wide; TS-2 Type 2 Controller: 10 3/8" Tall x 8.5" Deep x 14 ¾" Wide. All hardware and electrical components shall be modular for ease of replacement and repair. All controller input/output connectors, fuse holders, indications, displays, switches and control devices required for the operation and adjustments of the controller shall be mounted on the front panel. The front panel of the controller shall be permanently marked to identify I/O connections, fuse holders, indicators, etc.

1.2.2 Additional Hardware Requirements

- Power supply must be capable of supplying 95-250 VAC 50/60HZ Auto Sensing

- Engine Board and CPU shall be compliant with the ATC 5201 Standard as noted above and shall meet the following additional specifications:
  - Minimum Processor: Motorola PowerPC (Freescale) 8248 Processor;
    - 32-bit
    - 750 MIPs at 400 MHz
  - Minimum Required Memory
    - 1 MB SRAM
    - 64 MB SDRAM
    - 64 MB DRAM
  - On-board 5-Pin USB Motherboard Connector
- There shall be no batteries or moving parts such as fans or memory storage devices with rotating parts on the controller unit
- Display shall be a 16-line x 40-character LCD
- All keypads to be mounted on the controller front panel and are to be weather resistant and backlit
- Controller hardware shall facilitate the use of the controller in TS-2 Type 1 traffic signal control cabinets.

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REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER AND CABINET

1.2.3 Communications Ports

In addition to the NEMA TS-2 with NTCIP v02.06 Standard, the traffic signal controller shall include the following communications ports and configurations:

- Ethernet Support:
  - Side mounted, four-port 10/100 Mbit Ethernet network switch
  - Front panel mounted four-port 10/100 Mbit Ethernet network switch
  - Integrated network card supporting two independent, user programmable subnets (IP Address, Subnet Mask, and Default Gateway)
- USB Support
  - Front Mounted three-port Universal Serial Bus (USB) Hub
  - Side Mounted single USB port

1.3 Operating System

1.3.1 O/S Version

The Traffic Signal Controller shall use a Linux operating system (O/S) with kernel version 3.14 or later and shall include standard POSIX libraries for application support including real-time extensions of POSIX 1003.1b. To facilitate application level access to the ATC hardware, a Board Support Package (BSP) shall be provided by the controller manufacturer for access to hardware-specific drivers.

The operating system shall include enabled support for cgroups (control groups) for the purpose of limiting, accounting for, and isolating resource usage (CPU, Memory, etc.) of all running processes to ensure the reliability and stability of the traffic signal control application.

The Linux operating system shall include an application programming interface in compliance with the ITE, AASHTO, and NEMA Application Programming Interface (API) Standard 5401 for the ATC v2.0.

1.3.2 O/S Updates

Operating System updates shall be completed from a personal computer over an Ethernet connection and also directly from a USB flash drive plugged into the controller's front panel. The update process shall be automated and packaged as a simple executable file enabling the user to perform the update within a few steps. Minor operating system updates shall allow the user to perform the operating system update without removing the controller from operation or without placing the intersection in flash. The controller shall also allow for all traffic signal controller software updates through the Application Programming Interface without removing the controller from operation or without placing the intersection in flash.

1.4 Intersection Control Software

The intersection control software should provide at a minimum, the functionality and operations specified in the NEMA TS-2 with NTCIP v02.06 Standard. All objects and functions available in the local control software should be named and defined according to the current NTCIP standard. Additional, non-required or manufacturer specific objects and functions should have a straight-forward, logical label and/or definition.

1.4.1 Basic Functionality

In addition to the aforementioned NEMA TS-2 Standard, the controller must satisfy the following additional requirements:

- 40 programmable phases
- 16 timing rings that can be configured by the user to run concurrently or independently
- 32 overlaps
- 20 unique phase sequences that can be programmed and operated by time of day. Each sequence should allow the user to specify specific phase order and sequence beyond basic phase pair reversal/switching
- 128 unique timing patterns, each with a unique:
  - Cycle length, free, or flash command
  - Phase split table
  - Offset
  - Phase or pedestrian recall or omit (per pattern)

- User can easily configure:
  - Flashing Yellow Arrow functionality
  - Pedestrian Overlaps
  - Pedestrian advance or exclusive pedestrian intervals
  - Trailing green sequences for compound intersections
  - Preemption routines in accordance with the NEMA TS-2 specification (v02.06)
  - HAWK Signals
- Detectors
  - 10 detector tables selectable by TOD
  - 72 detectors per detector table
  - Ability to call multiple phases with one detector
  - Ability to call overlaps directly
  - Detector Diagnostics

- 16 Preempt Routines
  - Return to Coord without transition
  - Return to the longest waiting phase
  - Return to the last phase skipped in sequence
- 10 Overlap tables selectable by TOD
- Transit Priority functionality
- Peer to Peer communications
  - Allows for direct messaging between two controllers
  - Allows user to send the status of ANY input/output function in the controller as well as phase intervals, preempt intervals, etc.
- 32 Customizable Alarms

1.4.2 User Interface

In addition to the front panel screen, the traffic signal controller shall have an on-board web server which hosts a graphical user interface for monitoring and configuring the intersection control software. The web server interface shall provide access from any internet enabled device with a web browser. No additional or proprietary software shall be needed to use the graphical user interface. The user interface shall include the following features and functionality:

- User Access Control: Local software shall allow for configuration of user groups to limit read/write permissions of individual controller programming and status menus to a set of users; permissions and user accounts shall be synced to all network connected controllers via included central-based profile server.

- Real-Time Signal Performance Analytics: The local controller web-server shall support graphical signal performance analytic tools such as a split monitor, a cycle length plot, phase termination diagrams, coordination diagrams, etc., without the need of a central signal system,
- On-Board Replay: Controller shall include a graphical based, on-board utility to replay recent operation to troubleshoot a failures. At a minimum, replay shall include ring timers, phase and overlap states, detector calls, channel status, etc. for the previous 3 minutes of operation,
- Change Tracking: Front panel or web-UI entered database changes shall be logged with the time/date stamp and username.

1.4.3 Input/output Configuration

The intersection control software should allow the user to dynamically configure and modify input and output pins on an individual, pin by pin basis. In addition, the user should be able to configure the signal output channels (phase/overlap to load-switch) so that any phase, overlap, or pedestrian output can drive any available load-switch in the traffic signal cabinet. The user shall perform such configurations and modifications from the controller front panel and also through the web user interface, without the need for additional configuration software or downloading additional files to the controller.

1.4.4 Master and Peer-to-Peer Communications

The signal controller shall be capable of operating in a closed loop network with other controllers as a master or slave controller without the need for additional software or licensing. The master unit must be able to perform the duties of a master controller in the closed loop network while simultaneously conducting traffic signal operations at the local intersection. The signal controllers within the network will communicate with other controllers via serial or Ethernet communications.

The Intersection Control Software shall support Peer-to-Peer functionality. Peer-to-Peer allows the controllers to send messages to other controllers connected in the same network via Ethernet communications.

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REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER AND CABINET

1.4.5 Advanced User Programs (User Logic)

In addition to standard operations specified in the NEMA TS-2 for NTCIP v02.06 Standard, the intersection control software shall have a logic processor where the user can develop advanced logic statements and operations to be used as custom solutions or for feature development. In addition to standard Boolean logic, the user shall be able to specify conditions using all input and output functions including but not limited to phase indications and intervals, detector calls, preempt status, interval/service times, and greater than/less than relationships. For example, the processor shall provide a way for the user to program the following condition in the controller front panel: "Call preempt 5 if phase 2 is green for more than 25 seconds. Also send a message to the downstream controller to start preempt 2 in 15 seconds if the coordinator is currently in transition."

1.4.6 Database Management

The intersection control software and traffic signal controller shall be capable of storing multiple traffic signal databases (timing files) on the controller at any given time. The software should allow the user to save to or select from the list of stored databases on the controller from the front panel or web user interfaces. Databases shall be transferred between a personal computer and the traffic controller via an Ethernet connection using the web-user interface or using a standard FAT (or FAT-32) formatted USB flash drive using the controller front panel user interface. The software shall provide a user interface to select and save a database from the USB flash drive to the controller when multiple databases are located on the USB flash drive. The controller shall be able to switch between the current and stored databases at any time. The controller will set the selected database as "Active" at the end of the current sequence during an all-red condition timing less than 4 seconds.

1.4.7 Windows Based Controller Emulation Software

In addition to the above, one copy of a Windows based traffic signal controller emulation software package shall be supplied. This program would allow the user to program a traffic signal controller on a Windows based computer and shall be compatible with the latest version of the Windows operating system. The program supplied shall be the same version as the firmware version supplied with the controller. This program would allow the user to program a complete traffic signal controller and can be saved on a USB memory drive for transfer to a controller. This program shall be updated and supplied to the City at the same time as the Linux firmware for the controller and shall be supplied no charge for any updates.

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REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER AND CABINET

1.4.8 Connected Vehicle Ready

Controller shall be CV Ready: "Time to Green" and associated confidence intervals must be supported via standard or manufacturer specific NTCIP objects and over XML protocol and included in manufacturer's NTCIP MIBs.

Delete Subsection 614.08 (c) and replace with the following:

All new cabinets shall be the latest P-type cabinets as per the City & County of Denver Traffic Signal Standards. Each cabinet shall be installed on a newly installed traffic signal controller cabinet base unless otherwise specified on the plan.

Controller cabinet assemblies shall include an integrated uninterrupted power supply (UPS) units, and an Ethernet Field Switch that comply with the City and County of Denver standards (see UPS and Ethernet Field Switch specifications).

The Controller Cabinet shall also include a malfunction management unit (MMU) that meets the following requirements:

- NEMA Standard TS2-2016 for MMU2 configuration will maintaining compatibility with the NEMA TS1-1989 assemblies.
- Flashing Yellow Arrow PPLT operation and meets / exceeds the NEMA Standard MMU2 requirements of TS2-2016 FYA, providing modes for both TS-2 or TS-1 cabinet configurations.
- Real-time SDLC communications with the Controller Unit exchanges field input status, Controller Unit output status, fault status, MMU programming, and time and date.
- A time-stamped nonvolatile event log records the complete intersection status as well as AC Line events, configuration changes, monitor resets, temperature and true RMS voltages.
- A Sequence History log stored in nonvolatile memory graphically display up to 30 seconds of signal status prior to each fault event.
- View the intersection signal status remotely with manufacturer provided software via the MMU Ethernet port.

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TRAFFIC SIGNAL CONTROLLER AND CABINET

Subsection 614.09 shall include the following:

The Contractor shall assemble the traffic signal controller, cabinet, and other auxiliary hardware in accordance with the City and County of Denver Department of Transportation & Infrastructure – Transportation Operations criteria, and program the traffic signal controller per the approved traffic signal timing work order. All traffic signal timing (controller programming) shall be bench tested with a minimum of 72-hours burn time to verify successful operation prior to installation. The Contractor shall coordinate all testing and installation procedures with the City and County of Denver's Department of Transportation & Infrastructure Transportation Operations staff. The Contractor shall contact Denver Traffic at (720) 865-4002 for all testing and installation requirements.

The controller shall be installed in accordance with the details shown in the plans and in accordance with manufacturer's recommendations.

Subsection 614.10 shall include the following:

The Contractor shall demonstrate successful traffic signal operations at all new controller and cabinet locations to the satisfaction of the Engineer or Engineer's designee prior to acceptance of this item. The Contractor shall contact the Engineer or Engineer's designee 3 days before turning on signal. Work shall include all required programming of controllers and establishing or re-establishing all required wiring connections. Phasing and timing information at each location shall be furnished to the Contractor by the City & County of Denver.

All new wiring shall conform to City & County of Denver and International Municipal Signal Association (IMSA) specifications.

Subsection 614.13 shall include the following:

The unit price for the installation of traffic signal controller and cabinet shall include all labor, materials, ancillary hardware, traffic signal cabinet base, wiring and wiring re-connection (including Xcel Energy power feed) required to provide and install a complete system and successful operation of the item. Connection of the controller to the fiber optic interconnect system shall be paid for separately under item 614 "Telemetry (Field)".

Removal and disposal of existing cabinets shall be in accordance with Revision of Section 202 – Removal of Traffic Signal Equipment.

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REVISION OF SECTION 614
TRAFFIC SIGNAL CONTROLLER AND CABINET

Subsection 614.14 shall include the following:

Pay Item	Pay Unit
Traffic Signal Controller and Cabinet	Each

REVISION OF SECTION OF 614
PEDESTRIAN PUSH BUTTON (APS)

Section 614 of the Standard Specification is hereby revised for this project as follows:

Subsection 614.08 (g) shall include the following:

The Contractor shall furnish and install Accessible Pedestrian Signals (APS) pedestrian push buttons at locations as shown on the plans. The APS shall be compatible or interchangeable with standard APS stocked by the City and County of Denver.

The current APS that are compatible with that stocked by the City and County of Denver is as follows:

Manufacturer	Catalog Numbers
Campbell	Guardian
Polara	EX Communicator Navigator EN2/EN4

The Contractor shall submit APS material submittal to the City and Denver for approval prior to ordering. 720-865-4002.

The push button frame shall have a cast aluminum attachment to allow the mounting of a 9" X 12" pedestrian instruction sign and a 5" X 7¾" pedestrian instruction sign.

Pedestrian Instruction Sign: Pedestrian instruction signs shall conform to the latest version of the M.U.T.C.D., published by the U.S. Department of Transportation Federal Highway Administration.

On traffic signals, the pedestrian instruction sign shall be Type R10-3e.

On Rectangular Rapid Flashing Beacons (RRFB), the pedestrian instruction sign shall be Type R10-25, as depicted in Standard drawing No. 16.1.25.1.

Pedestrian instruction signs shall be constructed in accordance with the applicable provisions of the current CCD Standard Specifications. Pedestrian instruction sign need not be reflectorized.
The sign shall be fabricated with 0.063 aluminum. The pedestrian instruction signs shall have rounded corners ¾" radius for the 5" X 7 ¾" sign and 1 ½" radius for the 9" X 12" sign.

Subsection 614.13 shall include the following:

Pedestrian Push Button (APS) shall be measured by the number of units installed and accepted.

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REVISION OF SECTION OF 614
PEDESTRIAN PUSH BUTTON (APS)

Subsection 614.14 shall include the following:

Pay Item	**Pay Unit**
Pedestrian Push Button (APS)	Each

Pedestrian Push Button (APS) shall be measured and paid by the number of units installed and accepted. The item shall include all labor, materials, and ancillary hardware required to provide a fully-functional system to the satisfaction of the Engineer.

Pedestrian instruction sign will not be paid for separately, but shall be included in the cost of the Pedestrian Push Button (APS) pay item.

REVISION OF SECTION 614
PEDESTRIAN PUSH BUTTON POST ASSEMBLY

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.08 (f) shall include the following:

Pedestrian Push Button Post Assembly shall conform to the requirements of the City and County of Denver's Standard Detail 7, Standard drawing No. 16.1.14. Pedestrian Push Buttons and Signs shall be handled through other items.

Subsection 614.13 shall include the following:

Pedestrian Push Button Post Assembly shall be measured by the number of units installed and shall include post, foundation and all work necessary to complete the item.

Subsection 614.14 shall include the following:

Payment will be made under:

Pay Item	**Pay Unit**
Pedestrian Push Button Post Assembly	Each

REVISION OF SECTION 614
FIRE PREEMPTION UNIT AND TIMER (SYSTEM)

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.08 shall include the following:

System Description:

The emergency vehicle traffic signal priority control system shall enable designated vehicles to remotely cause the traffic signal controller to advance to and/or hold a desired traffic signal display by using existing controller functions. The control shall be activated at a minimum distance of 548.6M (1,800 feet) along an unobstructed "line of sight" path. The control shall not terminate until the vehicle is within 12.2M (40 feet) of the detector or at the intersection.

The system shall consist of the following components:

A. Vehicle Emitter which shall be mounted on the emergency vehicle and shall transmit optical energy signals only in the forward direction. If the municipality presently uses optical pre- emption, the emitters shall be of the same manufacture currently used by the City and County of Denver Fire Department.

B. Phase Selector (minimum 2 channels) which shall cause the signal controller to advance to and/or hold the desired traffic signal display for the emergency vehicle. A pre-emption system chassis shall house two phase selectors.

C. Optical Detector which shall be mounted on or near a traffic signal and shall receive the optical energy signals generated by the Vehicle Emitter.
   a. Detector (Type A), 1 Direction, 1 Channel
   b. Detector (Type B), 2 Direction, 1 Channel
   c. Detector (Type C), 2 Direction, 2 Channel

D. Detector Cable (Optical).

System Operations:

A. The operating sequence shall be initiated when the optical detector receives the required optical energy signal from the Emitter.

B. The phase selector shall cause the traffic signal controller to advance to and/or hold the desired traffic signal display for the emergency vehicle.

C. The phase selector shall cause the controller to advance to and/or hold the desired traffic signal display even if the optical energy signals cease before the desired display is obtained.

D. The phase selector shall allow the traffic signal controller to resume normal operation within ten seconds after optical energy signals cease if the optical energy signals cease after the desired traffic signal display is obtained.

E. The phase selector shall not respond to optical energy signals from an emergency vehicle if it is already processing optical energy signals from another emergency vehicle.

System Components:

A. Vehicle Emitter:

The emitter assembly consists of an emitter and power supply and an emitter control switch assembly. The emitter assembly is mounted on a vehicle and produces a flashing optical signal when in operation. The following shall apply to the vehicle emitter:

1. Shall operate on ten to fifteen volts DC input voltage, but shall not be damaged by input voltage surges up to twenty-five volts DC.

2. Shall be controlled by a single on/off switch that requires no other adjustments by the operator. The on/off condition shall be indicated by a light located adjacent to the switch.

3. Shall be automatically disabled or de-activated by one or a combination of the following: seat switch, emergency brake switch, door switch, and transmission safety switch.

4. Shall operate over an ambient temperature range of minus 34O C to plus 60O C. (minus 30O F. to plus 140O F.)

5. Shall operate in 0 to 95 % humidity.

6. Shall be a pulsed optical energy source with a controlled repetition rate.

7. Shall not generate voltage transients on the battery input line which exceed battery voltage by more than four volts.

8. Shall produce optical energy in a cone of not more than 90 degrees horizontal and not more than 30 degrees vertical. The detectors and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

B. Optical Detector:

The optical detector receives the high intensity optical pulses produced by the emitter. These optical energy pulses are transformed by the detector into appropriate electrical signals which are transmitted to the phase selector. The optical detector is mounted at or near the intersection in a location which permits an unobstructed line of sight to vehicular approaches. The units may be mounted on signal span wires, mast arms or other appropriate structures. The following shall apply to the optical detector:

1. Shall produce optical energy in a cone of not more than 90 degrees horizontal and not more than 30 degrees vertical. The detectors and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

2. Shall be of solid state construction.

3. Shall operate over an ambient temperature range of minus 34O C to plus 60O C. (minus 30O F. to plus 140O F.)

4. Shall have internal circuitry potted in a semi-flexible compound to ensure moisture resistance.

5. Shall operate in 0 to 95 % humidity.

6. Shall have a cone of detection of not more than 13 degrees. The detector and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

C. Phase Selector:

The phase selector supplies power to and receives electrical signals from the optical detector. When detector signals are recognized as a valid call, the phase selector causes the signal controller to advance to and/or hold the desired traffic signal display. This is accomplished by activating the pre-empt input to the controller.

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REVISION OF SECTION 614
FIRE PREEMPTION UNIT AND TIMER (SYSTEM)

The phase selector is capable of assigning priority traffic movement to one of two channels on a first-come, first-serve basis. Each channel is connected to select a particular traffic movement from those normally available within the controller. Once a call is recognized, "commit to green" circuitry in the phase selector functions so that the desired green indication will be obtained even if optical communication is lost. After serving a priority traffic demand, the phase selector will release the controller to follow normal sequence operation. The following shall apply to the phase selector:

1. Shall include an internal power supply to supply power to the optical detectors.

2. Shall have minimum two-channel operation with the capability of interfacing with an additional phase selector for expansion of channels of operation.

3. Shall have adjustable detector range controls for each channel of operation, from 12M (40 feet) to 548M (1800 feet).

4. Shall have solid state indicator lights for power on and channel called.

5. Shall operate over an ambient temperature range of minus 34O C to plus 60O C (minus 30O F. to plus 140O F.)

6. Shall operate in 0 to 95 % humidity.

D. Detector Cable (Optical):
The following shall apply to the detector cable:

1. 3-Conductor cable with shield and ground wire.

2. AWG #20 (7x28) stranded.

3. Individually tinned copper strands.

4. Conductor insulation: 600 volt, 75 deg. C (167O F.).

5. 1 Conductor-yellow; 1 Conductor-blue; 1 Conductor-orange.

6. Aluminized Mylar shield tape or equivalent.

7. AWG #20 (7x28) stranded uninsulated drain wire

8. DC resistance not to exceed 11.0 ohms per 305M (1000 feet).

9. Capacitance from one conductor to other two conductors and shield not to exceed 157pf/M (48pf /ft.).

10. Jacket: 600 volts, 80 deg. C (176O F.), minimum average wall thickness - 1.14mm (.045").

11. Finished O.D.: 7.62mm (0.3") max.

System Interface:

System shall be capable of operating in a computerized traffic management system when appropriate interfacing is provided by the computer supplier.

General:

The Contractor shall furnish the manufacturer the phasing diagrams indicating controller sequence and timing.

The Contractor shall secure from the manufacturer a guarantee for the equipment for a period of sixty (60) months, which time shall commence from the date of delivery. Manufacturer shall certify upon request that all materials furnished will conform to this specification. The manufacturer or his designated representative shall be responsible for determining and setting all required range and emitter intensity for the emergency vehicle operation.

Construction Methods:

All equipment except the vehicle emitter assembly shall be installed and wired in a neat and orderly manner in conformance with the manufacturers' instructions. The vehicle emitter assembly shall be delivered to a designated City representative.

Installation of the vehicle emitter assembly shall be the responsibility of the City and County of Denver Fire Department.

Traffic signals owned and maintained by the State that have optical pre-emption equipment owned and maintained by the city shall have an Auxiliary Equipment Cabinet (AEC) attached to the controller cabinet. The optical pre-emption equipment shall be housed in the AEC.

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REVISION OF SECTION 614
FIRE PREEMPTION UNIT AND TIMER (SYSTEM)

Traffic signals owned and maintained by the city do not require an AEC to house the pre-emption equipment.

Detector cables shall be continuous with no splices between the optical detector and the AEC.

Detector locations shown on the plan are for illustration purposes only. Exact location shall be determined by the contractor or the designated representative for the best possible line of sight.

- Controller "D" harness and adapter.
- Pre-emption termination panel with terminal block and relay bases.
- Pre-emption disconnect switch, mounted on the emergency switch panel (on inside of cabinet door).
- Pre-emption test buttons, mounted on the pre-emption termination panel.

All connections from the phase selector to the "D" harness and to the cabinet wiring shall be made at the termination panel. The termination panel shall have AC+ Lights, AC-, and a switched logic ground. The switched logic ground feeds all the pre-empt inputs to the phase selector. When switched off by the pre-emption disconnect switch, the traffic controller shall not be affected by pre-empt calls from the optical pre-emption system. A minimum of two test buttons shall be provided.

If there are more than two pre-empt runs, a button for each shall be installed. A chart or print out indicating the program steps and settings shall be provided along with the revised cabinet wiring diagrams.

Test the Pre-emption System According to the following Guidelines:

1. Notify the system owner/user, such as the Municipal Fire Chief or City Traffic Engineer, of the scheduled inspection

2. Request a fire department representative and an emergency vehicle, which has an emitter to conduct the test. If not available, the contractor shall provide an emitter.

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REVISION OF SECTION 614
FIRE PREEMPTION UNIT AND TIMER (SYSTEM)

3. In the presence of the Engineer and the municipal representative, test each pre- emptied approach with the emergency vehicle. Test the following items of the system:

    a. Confirm that the emitter activates the phase selector and the phase selector activates the correct pre-emption input to the controller.

    b. Confirm adequate range. The traffic signal must be pre-empted to green sufficiently in advance of the emergency vehicle arrival. The vehicle emitter shall initiate pre-emption at a minimum distance of 548.6M (1800 feet).

    c. Confirm there are no false calls. Keep the emitter active as the emergency vehicle passes through the intersection. No other optical detectors shall sense the strobe.

4. Document the test. Provide the Engineer and, upon request, the municipality copies of the test results.

If a malfunction is found or the system needs adjustment (such as range, emitter intensity, or detector location), schedule a follow-up test. Repeat the above steps for all approaches that did not pass.

All adjustments such as emitter intensity, phase selector range, sensitivity, detector placement, shall be made at the intersection by the contractor so that the optical pre-emption operates correctly with other major manufacturers' equipment currently owned by the city.

Subsection 614.13 shall include the following:

Fire Preemption Unit and Timer (System) units shall include a four-channel card and the number of detectors as shown on the plans. Fire Preemption Unit and Timer (System) shall be measured and paid by the number of intersections at which the system is installed. The item shall include all labor, materials, and ancillary hardware required to provide a fully functioning system to the satisfaction of the Engineer.

Subsection 614.14 shall include the following:

Pay Item	**Pay Unit**
Fire Preemption Unit and Timer (System)	Each

REVISION OF SECTION 614
INTERSECTION DETECTION SYSTEM (CAMERA)(FLIR)

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work is for the installation of a fully-functional FLIR vehicle detection camera system. The Contractor shall furnish and install the FLIR vehicle detection camera system at the locations as shown in the plans or as directed by the Engineer.

Subsection 614.08 shall include the following:

Detection Camera:

The detection camera shall consist of a thermal camera, thermal lens, and enclosure; and shall meet the following specifications:

- ***Thermal Camera & Lens***
  The detection camera shall be a 320 x 240 (minimum) and 10 frames per second (minimum) thermal camera that fits into the camera enclosure specified herein. The lens shall be a fixed thermal lens. Digital zooming is allowed.

- ***Camera Enclosure***
  The camera enclosure shall consist of a dustproof and waterproof outdoor camera housing designed specifically to fit the thermal camera and thermal lens specified herein. The enclosure shall have a sun shield to prevent direct and indirect sunlight entering the lens. A thermostatically controlled heater for window defogging and defrosting is allowed.

- ***Power***
  The detection camera shall be powered by a 120/240VAC, 50/60Hz power source or by a 24VDC (±10%) power source.

- ***Reliability***
  The interface card shall be designed and manufactured to have a MTBF (Mean Time Between Failure) prediction figure of greater than or equal to 10 years continuous operation.

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- ***Certifications & Environmental***
  The detection camera shall meet the following Certifications and Environmental specifications:

Certifications	Comply with Electromagnetic Compatibility - 2004/108/EG Comply with FCC Part 15, Class A
Weatherproof	IP66 ingress protection standards (minimum)
Operating Temperature	-34°C to +74°C (-29°F to +165°F) (minimum)
Relative Humidity	Up to 100% non-condensing
Shock & vibration	NEMA II

- ***Mounting Brackets***
  A versatile mounting bracket shall be supplied to mount the camera enclosure, specified herein, to a horizontal luminaire or vertical traffic signal pole. All mounts shall be secured with stainless steel mounting straps or bolts. The mounts, including the mass and size of the detection camera, shall be designed to withstand a wind load of 120km/h (or 75mph) with a 30-second gust factor.

- ***Camera to Controller Cabinet Cable***
  Cable needed to power the detection camera specified herein, transmit thermal video and data information to the controller cabinet shall be provided and meet the specifications of the thermal video imaging detection system manufacturer.

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Thermal Video Processor:

A thermal video processor shall be included in the detection camera, specified herein, or in the interface card, specified herein; and shall meet the following specifications:

- ***Functionality***
  The thermal video processor shall provide the following functionality:

Detector Display	Capable of displaying bike detection regions on the thermal video image with associated outputs with output status shown on the screen
Detector Placement	By using a portable PC with graphical user interface software or web server
Detector Function	Capable of detecting within the view of the connected detection camera the presence of bicycles in user defined bicycle detection regions
Detector Type	Configurable as presence, count, delay, extension, or pulse mode of either arrival or departure of bicycles. The detector shall be capable of detecting pedestrians and small motorcycles too.
Detector Modification	All detectors and parameters shall be able to be changed without interrupting detection. When one detector is modified, all existing detectors shall continue to operate, including the one that is being modified. When the new detector position is confirmed, the new detector shall have no learning phase and shall be operating while the one being modified ceases to operate
Detector Failure State	Provide a constant call on each active detection channel, in the event of unacceptable interference or loss of the thermal video signal
Regions per Video Output	Up to 4 (minimum)
Detector Delay & Extension	Defined between 0.1-99 seconds and pulse mode between 0-500ms in 10ms increments.
Direction Sensitivity	Able to make a detector directional sensitive

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Camera Interface/Surge Suppression Panel

When the thermal video processor is in the detection camera, a UV resistant signal cable with 3 wires (maximum) of wire diameter AWG18 (minimum) shall be provided to power the detection camera, transmits detection information to the interface card specified herein, and provides remote communication specified herein. The cable distance between detection camera and interface card is 300m or 1,000ft (maximum).

When the thermal video processor is in the interface card with coax thermal video cables being used between the detection camera and the interface card, a surge suppression panel shall be provided that powers the detection camera with high-voltage transient protection and power isolation, and suppresses electrical spikes on the thermal video coax cable.

The camera interface/surge suppression panel shall meet the following specifications:

- ***Certifications and Environmental***
  The interface card shall meet the following Certifications and Environmental specifications:

Certifications	Comply with Electromagnetic Compatibility - 2004/108/EG Comply with FCC Part 15, Class A
Weatherproof	IP66 ingress protection standards (minimum)
Operating Temperature	-34˚C to +74˚C (-29˚F to +165˚F) (minimum)
Relative Humidity	0-95% non-condensing (minimum)
Shock & vibration	NEMA II

Interface Card:

Input/output main and expansion cards shall be supplied that are designed to convert real-time detection signals from the video processor, specified herein, into contact closure signals to the traffic light controller; and to relay traffic signal phase status to the video processor, specified herein. The interface card shall meet the following specifications:

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Functionality
The interface card shall provide the following functionality:

Cabinet/Controller Compatibility	US: EDGE card for TS-1 cabinet and 2070 TS-1 and TS-2 controllers Rest of World: EURO card for various standard controllers
Status Indicators	Visual for state of each detection output, visual state of power status (ON/OFF), visual state of camera status (operational/not operational)
Identification	Individually addressable with serial number, MAC address, IP-address, subnet mask and default gateway
Program Retention	Continue to operate in accordance with previous program after recovering from communication system or power failure
Time Synchronization	Manually or NTP time source
Detector Failure State	Provide a constant call on each active detection channel, in the event of unacceptable interference or loss of the thermal video signal
Regions per Video Output	Up to 4 (minimum)
Detector Delay & Extension	Defined between 0.1-99 seconds and pulse mode between 0-500ms in 10ms increments.
Direction Sensitivity	Able to make a detector directional sensitive

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- ***Communication***
  The interface card shall meet the following specifications:

Controller Interface Output	Contact closure via interface backplane, providing up to four channels of vehicle detection with no front panel connectors being used
ETHERNET	RJ45 port for hard-wired system set-up and monitoring
USB	USB 2.0 (minimum) on front panel for connecting a USB dongle to allow wireless set-up and monitoring via portable PC, tablet and/or smart phone 4°C to +74°C (-29°F to +165°F) (minimum)

- ***Remote Communications***
  Remote communications to allow remote management specified herein shall be provided via the interface card and shall meet the following specifications:

  a) ***Functionality***
  Remote communications shall provide the following functionality:

Cabinet/Controller Compatibility	US: TS-1 cabinet and 2070 TS-1 and TS-2 controllers when Rest of World: EURO card for various standard controllers
Thermal Video Compression	MJPEG, MPEG-4 (ISO 14496-2) and/or H.264 (ISO/IEC MPEG-4 AVC)
Thermal Video Frame Rate	Constant and variable 10 frames per second (minimum)
Thermal Video Bandwidth	Between 32 kbps and 4 Mbps (minimum)
Status Indicators	Ethernet link/activity
Identification	Individually addressable with serial number, MAC address, IP-address, subnet mask and default gateway

Program Retention	Continue to operate in accordance with previous program after recovering from communication system or power failure

b) ***Communication***

The remote communications shall meet the following specifications:

Ethernet Port	One 10/100Base-T front-panel RJ45 port (minimum)
Thermal Video Input	Via front panel connector

- ***Power***

  The interface card shall meet the following power specifications:

Input Voltage	24VDC ±10% (via cabinet detector rack backplane)
Power Consumption	10W (maximum)

- ***Physical Properties***

  The interface card shall meet the following physical properties specifications:

Size	US: Fits directly into NEMA TS-1 cabinet detector rack or fits on DIN-rail Rest of world: Fits directly in EURO half/full 19" rack or fits on DIN-rail

- ***Reliability***

  The interface card shall be designed and manufactured to have a MTBF (Mean Time Between Failure) prediction figure of greater than or equal to 10 years continuous operation.

- ***Certifications and Environmental***

  The input/output main and expansion cards shall meet the following Certifications and Environmental specifications:

Certifications	Comply with FCC Part; 15 NEMA TS 2-2003 v02.06
Operating Temperature	-37°C to 74°C (-35°F to 165°F) (minimum)
Humidity	0 – 95% non-condensing

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Remote Management System

Remote management system shall be provided to monitor, control, and troubleshoot the thermal video imaging detection devices remotely via the Ethernet communication system. The vendor shall provide all software that will be loaded and configured by staff on furnished server hardware that is connected to the thermal video imaging detection devices via the Ethernet communication system. Remote management shall meet the following minimum requirements:

- ***Diagnostic & Health Monitoring***

Management Status	Provide real-time status display of services required to access, troubleshoot, and archive data from the thermal video imaging detection system network connected devices
Network Device View	Provide view of all thermal video imaging detection system network connected devices
Operation Log	Support retrieving, displaying, and saving operational messages, warnings, and errors

- ***Remote Management & Maintenance***

Video Viewing/Recording	Support viewing and recording streaming video including detector overlay
Device Management	Support creating, editing, downloading, and uploading detector configurations
Remote Firmware Updates	Support updating firmware of any device from a remote location
Remote Backup/Restore	Support backup/restore device configuration from remote location
Access Permissions	Support password implementation
Clock Synchronization	Support the Network Time Protocol (NTP) to synchronize the internal clocks of the thermal video imaging detection system network connected devices a minimum of once a day

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Subsection 614.13 shall include the following:

Intersection detection system (Camera)(FLIR) shall be measured and paid by the number of cameras installed and accepted at each intersection. The item shall include all labor, materials, and ancillary hardware required to provide a fully functional camera system to the satisfaction of the Project Manager.

Subsection 614.14 shall include the following:

Pay Item	Pay Unit
Intersection Detection System (FLIR)	Each

REVISION OF SECTION 614
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Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.08 shall include the following:

1.1 SUMMARY

A. **Scope:** This specification describes the operation and functionality of a continuous duty, single-phase Uninterruptible Power Supply unit, hereafter referred to as the UPS.

B. **Included Features of the UPS:**

1. The UPS utilizes double conversion online topology designed to protect electronic equipment by supplying reliable, clean power featuring extremely tight voltage and frequency regulation.
2. Wide operating temperature range -40C to 74C.
3. Field replaceable air filter.
4. Field replaceable fan assembly.
5. The UPS features internal bypass and input power factor correction.
6. The primary sections of the UPS are: input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power (inverter) stage, bypass and a bidirectional DC-DC converter / battery charger. The control of power module and fault detection logic is microcontroller-based.
   a. The input disconnect and filter stage contains an input back-feed relay, input filter and transient suppression.
   b. The input PFC power stage contains non-isolated power factor correcting AC/DC converters. This converter is capable of full power operation over a very wide input voltage range.
   c. The energy storage stage is a split DC bus capacitor handling seamless transitions from battery to line and vice versa, as well as the low and high frequency power stages.
   d. The output power stage operates directly from the DC bus and develops an output of 120V AC ,60Hz. The AC output of the inverter is connected to bypass relay. The bypass relay output is routed to the output terminals of the UPS.
   e. The UPS contains a battery charger, which operates from the DC bus. The UPS can be restarted immediately after a prolonged power outage without waiting for the battery to be recharged.
7. The UPS provides early-warning fault analysis on batteries and will project battery replacement dates, enabling timely preventive maintenance.
8. The UPS has flash memory to facilitate firmware upgrades.

9. The graphical LCD display with multicolor backlight provides detailed information, with the ability to configure the display locally.

10. An integrated Network Management Card 2 (reference APC part # AP9537SUM-FC) with Environmental Monitoring is embedded into the UPS.

C. **Performance, Design, and Configurations:** The UPS and associated equipment operates in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission-critical, electronic equipment and other load devices.

1. This specification describes the performance, functionality, and design of the UPS, the external Battery Systems, and connectivity solutions.
2. All programming and miscellaneous components for a fully operational system as described in this section are available as part of the UPS.
3. The UPS and battery packs are available in the following configurations:

Type	Model	SKU
UPS	APC SECUREUPS 1300VA / 1300W, 120VAC IN/OUT RM CONFORMAL COATED	XU1K3LLXXRCC
ACCESSORIES	APC SECUREUPS BATTERY HARNESS SBS75 CABINET ACCESORY 8FT	XHHXS7A8F
	APC SECUREUPS BATTERY HARNESS SBS75 CABINET ACCESORY 4FT	XHXXS7A4F
	APC SECUREUPS BATTERY HEATER MAT 256 SQ IN 115/120VAC SINGLE PHASE IN CABINET ACCESSORY	XM050DXXXA
	APC SECUREUPS BATTERY HEATER MAT 365 SQ IN 115/120VAC SINGLE PHASE IN CABINET ACCESSORY	XM102DXXXA
	APC SECUREUPS BATTERY 50AH 12VDC EXTENDED TEMPERATURE SHELF MOUNT	XB050XX1XS
	APC SECUREUPS BATTERY 100AH 12VDC EXTENDED TEMPERATURE SHELF MOUNT	XB102XX1XS

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1.2 REFERENCE

A. **General:** The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications is the latest date as of the date of the Contract Documents, unless otherwise specified.

B. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
1. ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI approved).

C. **International Organization for Standardization (ISO):**
1. ISO 9001, "Quality Management Systems - Requirements."
2. ISO 14001, “Environmental Management Systems - Requirements with Guidance for Use.”

1.3 STANDARDS

A. **Regulatory Compliance:**

Model Description	SKU	Approvals
APC SECUREUPS 1300VA / 1300W, 120VAC IN/OUT RM CONFORMAL COATED	XU1K3LLXXRCC	UL, cUL/CSA UL-1778 (CSA 107.3 for Canada), IEC62040-2 2005 Edition and FCC Part 15 Class A,

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1.4 SYSTEM DESCRIPTION

A. **Mechanical Design**

1. The UPS is contained in a Powder coated steel chassis with plastic display panel embedded into the chassis.
2. The UPS has a field replaceable filter and fan assembly.
3. The chassis weights and dimensions are:

Description	SKU	Weight kg (lb)	Height mm (in)	Width mm (in)	Depth mm (in)
APC SECUREUPS 1300VA / 1300W, 120VAC IN/OUT RM CONFORMAL COATED	XU1K3LLXXRCC	10.0 (22.0)	88 (3.46)	432 (17.0)	260 (10.2)

B. **System Characteristics**

1. **General:**
   a. **Power Rating:** 1300VA/1300W
   b. **Output power factor :**1
   c. **Charger Power:** 750 Watts
   d. **Topology:** Double Conversion On-Line
   e. **Cooling:** Fan cooled
2. **Online Efficiency:** The UPS efficiency stated here is at full load and without degradation of output regulation as specified. Efficiency is 89% at rated load.
3. **Input:**
   a. **AC Input Nominal Voltage:** 120 V.
   b. **AC Input Voltage Window:**
      1) Full Load, 85-155 V +/- 2V, 5 V hysteresis.
   c. **Input Frequency Range:** 40 – 70 Hz, auto-selecting.
   d. **Online Input Power Factor:** 0.95% for Full Charger power Load and > 75% Loads.
   e. **Input Current Distortion:** <5% for 100% load.
   f. **Input Circuit Breaker (UPS): 3**0A UL Listed
   g. **Input Surge Protection:** 432 Joules.
4. **UPS Output:**
   a. **Nominal Output Voltage:** 120 V
   b. **Output Connector:** Terminal Block - Hardwire
   c. **Output Frequency:** 50/60 +/- 3Hz (auto-sense); 50/60 +/- 0.1 Hz (user-selectable).

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d. **Output Frequency Regulation**: Free Running: Nominal +/- 0.1 Hz.
e. **AC output voltage distortion:**
   1) 5% @ 100% full linear load; 10% @ 100% full non-linear load.
f. **AC output static voltage regulation:** ± 1%.
g. **AC output dynamic voltage regulation:** ± 5% rms in 2 cycles for 10% to 90% resistive load step of the initial value.
h. **Output Voltage Harmonic Distortion:**
   1) <5% THD for a 100% linear load.
   2) <10% THD for a 100% non-linear load.
i. **Overload Rating:** % and duration
   1) **Normal Operation (Online):**
      a) 120Vac: 105% No Limit; 125% for 1 min, 150% for 30 seconds and >175% on AC for 500mSec.
   2) **Bypass Operation:** Overload is limited by the internal 30A input circuit breaker feeding the UPS:
      a) Bypass is internal
      b) Voltage range: 120Vac 86-148Vac,.
      c) Frequency range: 47-53 Hz or 57-63 Hz based on bypass frequency setting.
      d) Transfer time: To Bypass mode – 15ms max.
      e) Transfer time: Bypass to Online mode – 15ms max.
      f) Bypass can be commanded through the diagnostic menu
j. **Derating over temperature:** Supports 100% load at 65 °C, Linearly de rate to 70% load at 74 °C.
k. **Output Load Power Factor Rating:**
   1) 0.7 lagging to 0.7 leading.
l. **Crest Factor:** 3:1

5. **Charger:**
   a. **Nominal Battery Voltage:** 48 V.
   b. **Charger capacity:** 850W Max, 15A Max, whichever is applicable.
   c. **Runtime at 100% load:** >2 hours for 100Ah battery
6. **Battery: Not supplied with UPS sold as an accessory, user must select the rating of the battery AH though the UPS user interface.**
   Battery Types available: Sealed maintenance free valve regulated lead acid battery (VRLA) with suspended electrolyte, leak proof:
   1) 100 Ah qty 4 required for 48 Vdc battery system
   2) 50 Ah qty 4 required for 48 Vdc battery system

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1.5 SUBMITTALS

A. **Proposal Submittals:**
1. Product catalog sheets or brochures.
2. Product guide specifications.
3. Product technical specifications.
4. System package submittal drawings including a single-line and mechanical diagrams.

B. **Delivery Submittals:**
1. User Manual: which includes safety information, specifications, UPS features, configuration, UPS settings and troubleshooting information, accessories details, installation details, and start-up of UPS.

1.6 PROJECT CONDITIONS

A. **Environmental Requirements:** The UPS is designed to be installed inside an Intelligent Traffic System cabinet i.e. NEMA, Caltrans etc. The cabinet should be weather proof and have particulate filtering in lieu of the filtering provided by the UPS. The UPS should be kept dry as possible if being serviced in wet weather.
The UPS is capable of withstanding any combination of the following environmental conditions in which it must operate without mechanical or electrical damage, or without a need for de-rating of the output Power.
   a. **Storage Ambient Temperature:** -45 to 85°C UPS only (without batteries)
   b. **Operating Ambient Temperature:** -40°C to 74°C (LCD display -20 to 70°C)
   c. **Relative Humidity:** 0% to 95% non-condensing.
   d. **Altitude:**
      1) **Storage Altitude:** 0 to 50,000 feet (0 to 15,000 meters) above sea level
      2) **Operating Altitude:** 0 to 10,000 feet (0 to 3000 meters) above sea level. At altitude of 10,000 feet the UPS must be loaded only up to 90% of its nominal capacity.
   e. **Audible Noise:**
      1) <55 dBA at 100% load at 3 ft (1 m).
   f. **Protection Class:** IP 20.

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1.7 WARRANTY

A. **Limited Warranty:** Schneider Electric IT Corporation (SEIT) warrants the UPS to be free from defects in materials and workmanship for a period of 3 years from the date of purchase,

1. **Warranty Limitations:**
    a. The obligation of Schneider Electric IT Corporation (SEIT) under this warranty is limited to repairing or replacing, at its own sole option, any defective product.
    b. This warranty does not apply to equipment that has been damaged by accident, negligence, or misapplication or has been altered or modified in any way.
    c. This warranty applies only to the original purchaser who must have properly registered the product within 10 days of purchase.
    d. EXCEPT AS PROVIDED HEREIN, Schneider Electric IT Corporation (SEIT) MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.
    e. EXCEPT AS PROVIDED ABOVE, IN NO EVENT WILL Schneider Electric IT Corporation (SEIT) BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THIS PRODUCT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. Specifically, Schneider Electric IT Corporation (SEIT) is not liable for any costs, such as lost profits or revenue, loss of equipment, loss of use of equipment, loss of software, loss of data, costs of substitutes, claims by third parties, or otherwise.
    f. This warranty gives you specific legal rights and you may have other rights that vary from state to state.
2. **Warranty Procedures:**
    a. To obtain service under warranty the purchaser must obtain a Returned Material Authorization (RMA) number from customer support.
    b. Products must be returned with transportation charges prepaid and must be accompanied by a brief description of the problem encountered and proof of date and place of purchase.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Basis of Design:** Products specified is SECUREUPS Uninterruptible Power Supply Unit as manufactured by APC by Schneider Electric and as listed on page 2 of this specification. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 MODES OF OPERATION

A. **Normal:** The UPS output power stage (inverter) constantly recreates the UPS output AC voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) creates an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages do not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter). The input Power Factor Correction (PFC) power stage and the output power stage (inverter) operate in an on-line manner to continuously regulate power to the critical load. The input PFC stage is capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

1. **Overload Capability:** See above specification
2. **Output Relay:** The output power stage (inverter) is equipped with an output mechanical relay to provide physical isolation of the inverter from the critical bus. The UPS when installed with Bypass Panel, allows the user to replace the failed UPS from the critical bus without interruption.
3. **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system. The UPS employs a DC Breaker to protect the system from shorting of the battery supply. The battery harness which is sold as an accessory employs fuse protection.

B. **Battery:** Upon failure of the AC input source, the critical load continues being supplied by the output inverter, which derives its power from the battery system. There is no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.

1. The UPS battery system and battery harness are sold separately as accessories. Batteries can be purchased in a 50 Ah or 100 Ah configuration, a total of 4 batteries are need to create the 48VDC that the UPS battery input requires. These replacement batteries are user-replaceable.
2. The batteries of the UPS models in this specification are maintenance-free, leak-proof, valve-regulated lead-acid (VRLA) batteries with suspended electrolyte.
3. The UPS incorporates the Intelligent Battery Management system to continuously monitor the health of the battery system. This UPS notifies the user in the event that a failed or weak battery is found.
4. The UPS is not shipped with batteries; they must be purchased separately.

C. **Charging:** Upon restoration of the AC input source, the UPS simultaneously recharges the battery and provides regulated power to the critical load.
   1. The intelligent battery management system contains a temperature monitoring circuit and temperature compensation algorithm that regulates the battery charging voltage and current so as to optimize battery life.
   2. The battery charging circuit remains active when in bypass or online states.
   3. The UPS can be restarted immediately after a prolonged power outage without waiting for the battery to be recharged.

D. **Bypass:** During bypass operation the utility power is connected to the load, bypassing the internal converters. The system automatic bypass provides a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. The design of the automatic bypass switch power path consists of a bypass relay.
   1. **Automatic Transfers:** An automatic transfer of load to bypass takes place if the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system or when other causes are corrected. When the system is in bypass mode, if bypass line becomes unavailable, the UPS will automatically switch to Online mode operation. In the event that mains power is unavailable the UPS will switch to battery power.
   2. **Manual Transfers:** Manually initiated transfers to and from bypass may be initiated by the user display interface.

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2.3 INPUT PFC POWER STAGE

A. **General:** The input Power Factor Correction (PFC) power stage of the UPS constantly rectifies the power imported from the mains input of the system, converting input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power.

B. **Input Current Total Harmonic Distortion:** The input current THDI at full system load will be held to 7% at 50% load and 5% at full load while providing conditioned power to the critical load bus and charging the batteries under steady-state operating conditions. This is true while supporting loads of both a linear or nonlinear type. This will be accomplished with no additional filters, magnetic devices, or other components.

C. **Input Current Limit:**
1. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current will not exceed 178% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

D. **Charging:**
1. The battery charging circuit contains a temperature monitoring circuit, which regulates the battery charging current to optimize battery life.
2. The battery charging circuit remains active when the UPS is in automatic bypass and in normal operation
3. The UPS charging circuit can deliver charge current at 15 Amps. Charge current is automatically adjusted with battery Ah, temperature and load.

2.4 OUTPUT POWER STAGE (INVERTER)

A. **General:** The UPS output power stage (inverter) constantly recreates the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT-driven power converters. In both normal operation and battery operation, the output power stage (inverter) creates an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages, shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter).

B. **Overload Capability:** The output power stage (inverter) is capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for indefinite length of time.

C. **Output Relay:** The output power stage (inverter) is equipped with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter will be removed from the critical bus. The UPS when installed with Bypass panel, has the provision of isolating the defective UPS from the critical Bus. This is achieved through Contactors used in the Bypass panel. This feature allows the user to replace the defective UPS without disrupting the power to the critical loads.

D. **Battery Protection:** The inverter is provided with monitoring and control circuits to limit the level of discharge on the battery system. The UPS comes with a 48 Vdc breaker to protect the battery supply. The battery harness is fused adding an additional layer of protection.

2.5 DISPLAY AND CONTROLS

A. **Control Logic:** The UPS is controlled by an embedded microcontroller which performs the following functions:
1. Monitoring the quality of the output voltage.
2. Monitoring vital parameters of the UPS.
3. Executing the state machine.
4. Intelligent battery management.
5. Controlling the input and output power stage.
6. Remaining runtime calculation.
7. Self-diagnostics, self-test, and proactive fault detection.
8. Communication to the integrated Network Management Card.

B. **Display Interface**: Located on the front of the UPS is an LCD user display comprised of a graphical, high resolution (3”x3”) LCD (256 x 128 Pixels) and 5 pushbutton switches.

Control Functions: The following controls functions can be accomplished by use of the pushbutton switches:

1. POWER ON/OFF button.
2. Escape button.
3. OK button.
4. Up button.
5. Down button.

C. **LED Status:** Located 4 Led’s on the front of the UPS to read the status of the secure UPS
1. Green LED - Output ON
2. Yellow LED – Secure UPS notification
3. Red LED - Unit needs attention
4. Blue LED - Information

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D. **Data displayed on the Display Interface:** The following indicators are available on the Display Interface Unit:
   1. Load icon and disable/mute audible alarm icon.
   2. The UPS status information (Input and Output Voltage, Battery voltage and Load,).
   3. Operation mode (On-Line mode, Bypass mode, and Battery mode).
   4. Battery status icons.
   5. Output relay Icon (Open/Close).
   6. Backlight screens: Amber is an indication that requires attention and Red indicates a UPS alarm that requires immediate attention

E. **Audible Alarms:** Using audio signal, the UPS will notify the user about important events. The following is the list of distinct audio alarms:
   1. The UPS is on battery.
   2. The UPS is on battery and the remaining battery capacity is low.
   3. The UPS has shut down due to low battery capacity.
   4. The battery needs to be replaced.
   5. The UPS is overloaded.
   6. The UPS is in fault state.

F. **Output Relays:** The UPS provides 6 programmable Output relay ports on the front panel. The following function can be programmed to each output relay.
   1. On Battery
   2. On Battery Peak
   3. Low Battery
   4. Alarm
   5. Fault
   6. Output ON
   7. Output Off
   8. Online (Inverter Mode)
   9. Bypass
   10. Timer – Peak load, ON battery,

G. **Input Contacts:** The UPS provides 2 programmable Input contacts on the front panel:
   The following function can be programmed to each input contacts.
   1. Self-Test
   2. Alarm ON (External Alarms to System)
   3. Alarm OFF (External Alarms to System)
   4. Output ON
   5. Output OFF

H. **Flash Mode Setting**:
1. Signal flash Voltage (Battery Voltage): Can be configured by the user to enable the flash mode operation.
2. For details of the available settings refer to the operation manual.

I. **Communication Interface:** For purposes of remote communications with the UPS the following are available and contained within the UPS:
1) The UPS has the following ports available; serial port (RJ45 – for manufacturing purposes only, USB Host port for use with a USB flash drive.
2) Ethernet Port allows communications over a network via web browser or SNMP or with APC StruxureWare™ management software.
3) Universal I/O port can be used to connect Temperature/Humidity sensors for environment monitoring.

2.6 BATTERY

A. The UPS does not ship with batteries. Batteries can be purchased separately and are available in 50 Ah and 100 Ah formats. Other amp hour types can be used but the user must program the battery amp hour into the UPS to ensure appropriate charging of the battery system.
B. Battery Temperature Sensor connector – Used with the battery system, monitors the temperature of the battery system which is used by the UPSs temperature compensated charger circuitry.
C. The batteries are of the valve regulated lead acid (VRLA) type. The following are the
recommended Batteries for different AH.
50Ah: XB050XX1XS
100Ah: XB102XX1XS

2.7 SMART BATTERY MANAGEMENT

A. Features:
1. Monitors and informs the user of the health of each battery system.
2. Monitors and shows on the UPS Display Interface screen the date for the end of useful life for the battery system.
3. Emits an alarm and shows a message on the UPS Display Interface screen to indicate the estimated battery end of life. On the UPS Display Interface screen, the user can set the number of days before the alarm is heard and the message appears on the UPS Display Interface screen.
4. Monitors the temperature of the battery system and automatically adjusts the battery charging.

B. Maintenance:
   1. Uses sealed lead acid battery cells and does not require maintenance.
   2. Runtime Test (Calibration): This should be performed anytime the steady state load is changed significantly, for example when a new load is added to or removed from the UPS.
   3. Battery health monitoring: The battery energy output and voltage are monitored to assess the health of the installed batteries when the UPS is operating on battery.
   4. Battery health monitoring is done during a UPS Self-Test and also during a Runtime Calibration Test. These Self-tests are activated when the UPS is operating on battery power. The UPS can be configured to perform periodic, automatic Self Tests.

C. End of useful life
   1. Near end of life notification: A warning message will appear on the UPS display interface screen when the battery system is approaching the end of its useful life. For configuration details refer to Replacement Notification Time and Replacement Battery Alarm Time. The estimated replacement date for the battery system is available through the UI.
   2. Needs replacement notification: The UPS display interface screen shows when the battery system replacement is required. All the four batteries must be replaced immediately after the notification.

CAUTION: Continued operation after end of useful life notification may cause damage to the batteries.

   3. Recycling: Please recycle the battery system.

PART 3 - ACCESSORIES

3.1 BATTERIES

The Battery supplied by the vendor shall meet, at a min, the following requirements

A. Battery Type:
   1. Be deep discharge rated and the battery enclosure shall be made up flame arresting, self-sealing, valve regulated lead acid (VRLA) batteries. The batteries shall have a high rate of discharge and be superior in rate of charge absorption. The internal construction shall be of Absorbent Glass Mat (AGM). The battery container shall be made up of flame retardant material. The batteries shall be hermetically sealed, when subjected to extreme condition, the hydrogen gas emitted shall not be more than 10 ppm. The supplied batteries are designed to be installed in any position without any leakage.

B. Battery Specification:

Capacity (Ah) 20 hrs to 1.8 Vpc at 77° F	Nominal Voltage (V)	Power Per Cell (W) 20 Min to 1.67 Vpc/cell	Weight (Kg)	Length (Inches)	Width (Inches)	Height (Inches)	Copper Inserted Terminals (inches)
50	12	111.5	16.6	9.02	5.43	8.07	0.63 - 0.236 T6
96	12	223	31	12.99	6.81	8.35	0.787-0.236 T11

C. Battery Status and Health:
1. The BBS shall have a provision to select the battery Ah capacity through User Interface on the front panel of the BBS. The BBS also shall have the run time prediction software and the remaining run time shall be displayed on the User Interface provided on the BBS. The BBS shall also have the provision for the user selectable temperature compensation settings for the optimal charging of the selected batteries. The BBS shall also include the battery life prediction analytics to determine the end of life of the connected batteries.

3.2 BATTERY HARNESS

The battery harness supplied by the contractor shall be designed to facilitate an easy connection and disconnection of the cables between the batteries and BBS system. Also, the harness should have a provision to seamlessly include an additional set of batteries. The harness should allow the replacement of the battery set without the use of tools. All the battery harness interconnected wiring shall conform to UL Style 1015 CSA TEW or equivalent. Wiring shall be of proper gauge with respect to design current and with sufficient strand count for flexibility.

A. Battery harness set:
1. The battery harness set consists of
   a) 4 battery connection cables
   b) 1 battery interconnection harness with a provision for BBS connection

c) 1 extension cable harness for installations where the distance between the batteries and the BBS is greater than the length of the battery interconnection harness

2. Battery Connection Cables:
    a) The battery connection cables consist of a pair of cables that connect to the battery positive and negative terminals. The other end of these two cables are terminated on a connector of the type SBS75 from Anderson connectors or equivalent. The battery side connection of the cables shall be provided with a ring lug with a provision for an M8 screw. The battery side ring lug must be secured with an insulating cap that covers the battery terminals when installed. The cap should provide protection against accidental contact with live terminals of the battery. The caps are ergonomically designed for easy installation and removal. The quality of the caps provided should withstand repetitive usage.

3. Battery Interconnection Harness
    a) The main purpose of this harness is to facilitate the interconnection between batteries and the BBS system. The battery interconnection harness shall have mating connectors that match the connectors on the battery connection link and the BBS. The battery interconnection harness should include a 200 Amp fuse to protect against any short circuit on the BBS side. The battery interconnection harness should support the connection of an additional set of batteries.

4. Extension Cable Harness
    a) The extension cable harness is to be installed along with battery interconnection harness for extending distance between the BBS and the battery bank. The cable ends are terminated on the matching connector to accommodate the BBS connection on one end and battery interconnection harness on the other end. Extension cable harness shall be 8 ft in length.

B. Other Harness Accessories included:
    1. The other accessories to be included are battery cable hardware, cable ties, temperature sensor cables and any other accessory necessary for completing the installation.

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY

3.3 SERVICE BYPASS UNIT

A. Service Bypass Unit (SBU):

The SBU provides power to the critical load bus from the bypass source during times when maintenance or service of the BBS is required. The SBU provides a mechanical means of complete isolation of the BBS from the electrical wiring of the installation.

1. Output Specifications

	Parameter	Specification
1	Nominal Output Voltage (V)	120
2	Changeover Switch capacity (Amps)	30 (Minimum)
3	Output Current (Amps)	30
4	Output Connections	30 Amps, 3 Pole, Anderson quick disconnect type

2. Input Specifications

	Parameter	Specification
1	Nominal Input Voltage (V)	120
2	Input frequency (Hz)	50/60
3	Input Connections	30 Amps, 3 Pole, Anderson quick disconnect type
2	Load Power Factor Range	0 to 1
4	Maximum Input Current (Amps)	30

3. SBU Construction
   a) The SBU is constructed in a rack-mounted 2U enclosure unless otherwise stated in this specification. This unit may also be mounted in a vertical orientation.

4. SBU Bypass Switch Type
    a) The SBU shall have a manually operated rotary switch with **MAKE BEFORE BREAK** mechanism. The switch shall have two operating positions; Normal mode and Bypass mode. In Normal mode, power is directed from the utility outlet, through the bypass panel and BBS to connected equipment at the output of the SBU. In Bypass mode, power from the utility is directly fed to connected equipment. Also, in Bypass mode, the BBS shall be galvanically isolated from the SBU for safe maintenance or replacement

5. SBU and BBS Connection
    a) The connection between SBU and BBS should be achieved with a single harness with an easy connect-disconnect facility. The easy connect-disconnect may be achieved by an Anderson Powerpole connector of adequate capacity. The construction and insulation levels of the Powerpole connectors should provide protection against accidental contact with live parts in the connector housing. The connectors should be ergonomically designed for an easy connect and disconnect operation. The connectors should also have a locking mechanism to avoid any loose contacts

PART 4 – EXECUTION

4.1 FIELD QUALITY CONTROL

A. **Manufacturer Field Service:**
1. **Worldwide Service:** The UPS manufacturer has a worldwide service organization available, consisting of factory-trained field service personnel to perform startup, preventive maintenance, and service of the UPS system and power equipment. The service organization offers service support 24 hours a day, 7 days a week, 365 days a year.
2. **Replacement Parts:** Parts are available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization is capable of shipping parts within four working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

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REVISION OF SECTION 614
UNINTERRUPTED POWER SUPPLY

4.1.1 MAINTENANCE

A. A complete offering of preventive and full service maintenance contracts for the UPS system and the battery system are available from APC by Schneider Electric. Contract work is performed by Schneider Electric factory-trained service personnel.

Subsection 614.13 shall include the following:

Uninterrupted Power Supply System shall be for a complete system and successful operation of the UPS. The UPS installation will be tested in accordance with this specification or as directed by the Engineer. The work shall include all labor, materials, and ancillary hardware required to provide a fully functioning system to the satisfaction of the Engineer.

Installation of the Uninterrupted Power Supply shall not be measured and paid for separately, but shall be included in the cost for installation of the Traffic Signal Controller and Cabinet.

Subsection 614.14 shall include the following:

Installation of the Uninterrupted Power Supply will not be measured and paid for separately, but shall be included in the cost of the Traffic Signal Controller and Cabinet.

REVISION OF SECTION 614
ETHERNET MANAGED FIELD SWITCH

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work consists of the installation of an Ethernet Managed Field Switch in the CCD controller cabinets. The Contractor shall furnish and install the switch within the Traffic Signal Cabinet as an integral part of the Traffic Signal Controller and Cabinet Assembly.

Subsection 614.08 shall include the following:

The Ethernet Managed Field Switch installation is hereby added to the Special Provision and the Ethernet Switch shall comply with the following specifications:

General System Requirements –The Ethernet Managed Field Switch shall be one that is currently stock by the City and County of Denver or approved equal. The current Ethernet Managed Field Switch that is stocked by the City and County of Denver is the Hirschmann Managed Fast/Gigabit Industrial Ethernet Switch and comprises of the following parts:

(1) Quantity 1- "OpenRAIL Switch Power - Managed Fast/Gigabit Industrial Ethernet Switch, Fanless Design, Power over Ethernet (PoE+) Support with up to 24 Ports and 120 Watt, 24x 10/100 Mbit/s Ethernet Ports, 4x 10/100/1000 Mbit/s Ethernet Ports, 4x FE/GE Combo Ports"
The OpenRAIL Switch Power currently stock by the City and County of Denver is the HIRSCHMANN RSPE32-24044O7T99-TPPZ999HHSE2AXX.X.XX

(2) Quantity 4 - "SFP Fiberoptic Gigabit Ethernet Transceiver, Extended Temperature Range, 1 x 1000BASE-LX with LC Connector, SFP-GIG-LX/LC EEC"
The Gigabit Ethernet Transceiver currently stock by the City and County of Denver is the HIRSCHMANN 942 196-002

(3) Quantity 2 - "Empty Module Slot Cover, RSPM"
The Empty Module Slot Cover currently stock by the City and County of Denver to be used for the HIRSCHMANN RSPE32-24044O7T99-TPPZ999HHSE2AXX.X.XX OpenRAIL Switch Power is the HIRSCHMANN 942131001 RSPM-COVER

Quantity 1 - 48VDC Rail Power Supply"
The 48VDC Rail Power Supply currently stock by the City and County of Denver to be used with the HIRSCHMANN RSPE32-24044O7T99-TPPZ999HHSE2AXX.X. OpenRail Switch Power is the BELDEN 942 200-001, "RPS 260/PoE EEC.

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REVISION OF SECTION 614
ETHERNET MANAGED FIELD SWITCH

Test Requirements - Contractor shall supply one unit of Ethernet Managed Field Switch to the Engineer for specification compliance testing and approval. If the product passes the compliance test and evaluation, the Contractor will be notified to complete the order. If the product does not pass the specification compliance testing and approval evaluation by City and County of Denver's Department of Transportation & Infrastructure – Transportation Operations, the unit will be returned to the Contractor. The Contractor shall supply other units until satisfactory test results are achieved

Subsection 614.13 shall include the following:

Each individual Ethernet Managed Field Switch package shall contain one Ethernet Managed Field Switch, set of mounting bracket(s), Installation and User guides, and Product Registration Card.

The Ethernet Managed Field Switch shall be for a complete system installed and accepted. The Ethernet Switch installation will be tested in accordance with this specification or as directed by the Engineer. Installation shall include all wiring for hook-up, related labor, material, ancillary hardware, and all necessary documentation of testing.

Installation of the Ethernet Managed Field Switch shall not be measured and paid for separately, but shall be included in the cost for installation of the Traffic Signal Controller and Cabinet.

Subsection 614.14 shall include the following:

Installation of the Ethernet Managed Field Switch will not be measured and paid for separately, but shall be included in the cost of the Traffic Signal Controller and Cabinet.

REVISION OF SECTION 614
TRAFFIC SIGNAL POLES – GENERAL

Section 614 of the Standard Specifications is hereby revised as follows:

Subsection 614.01 shall include the following:

The City and County of Denver will furnish and order all traffic signal poles and mast arms. The Contractor shall store and protect the poles and mast arms in the Contractor's yard upon delivery. The Contractor will transport the poles and mast arms to the job site for installation. The traffic signal poles, mast arms, and luminaires will be installed by the Contractor.

Contractor shall be responsible for furnishing and installing the aluminum pedestal poles.

Subsection 614.08 shall include the following:

This work is for the installation of the mast arm traffic signal poles, traffic signal light poles (no mast arm), traffic signal span wire poles (imbedded steel poles), and traffic signal pedestal poles. The Contractor shall install the traffic signal poles at locations as shown on the plans.

The mast arm traffic signal poles and the traffic signal light poles (no mast arms) will be in accordance with the latest City and County of Denver's Traffic Standards and Specifications.

General specifications of the mast arm traffic signal poles, traffic signal light poles (no mast arms), traffic signal imbedded steel poles, and traffic signal pedestal poles are as follows:

TRAFFIC SIGNAL POLES: All traffic signal poles (imbedded poles, mast arm traffic signal poles, traffic signal light poles - no mast arms) shall conform to latest City and County of Denver's Traffic Standard Details 16.1.3 and 16.1.9.1 to 16.1.12.2.

Traffic Signal Pedestal Poles shall conform to the requirements of the City and County of Denver's Traffic Signal Standard Detail 16.1.13.1 to 16.1.13.2.

The Contractor shall furnish and install a 5300 Lumens LED luminaire at all traffic signal poles as shown on the plans or as directed by the Engineer. The LED luminaire shall be in accordance with the City and County of Denver's specifications and Sections 613 - LIGHTING (LUMINAIRE)(LED 5300 LUMENS). The luminaire shall be installed on the traffic signal poles with a 10-foot luminaire arm as per the City and County of Denver's Traffic Standard Details 16.1.3, and 16.1.9.1 to 16.1.12.2.

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REVISION OF SECTION 614
TRAFFIC SIGNAL POLES – GENERAL

Handling and Shipment:
Poles shall be handled in a manner that will preserve the overall appearance and prevent damage to the coating. The use of chains or cables for loading, unloading, or installing is prohibited. Only ¾ inch diameter or larger nonabrasive nylon rope or equivalent nylon belting will be used. Adequate hold-downs and appropriate blocking shall be utilized for shipping to prevent load movement and damage to the outer coating in transit. No handling should be allowed until "dry through" condition has been achieved with the coating.

Extra care will be taken not to damage the coating. Upon arrival of the poles at the delivery point, neither chains nor cables will be used to either unloading or installation of poles.
Procedure for Field Touch-Up:
The pole manufacturer will furnish extra paint, both primer and color coat, to satisfy the needs of field touch-up requirements, in the event of minor physical damage to the coating from handling or transit. Damaged area must be clean and dry before repair application. Field touch-up will be at the direction of the pole manufacturer or their authorized representative.

Subsection 614.14 shall include the following:

Pay Item	**Pay Unit**
Traffic Signal-Light Pole Steel (XX Foot Mast Arm)(Install Only)	Each

REVISION OF SECTION 614
TELEMETRY (FIELD)

Section 614 of the Standard Specifications is hereby revised for this project as follows.

Subsection 614.01 shall include the following:

This work consists of termination of fiber optic cable for the Denver Area Fiber Network Ecosystem (DAFNE) at each traffic signal controller cabinet ("traffic signal cabinet") location(s) as identified in the planned or contracted scope of work. This work also includes furnishing and installing all necessary fiber optic cable and telemetry equipment including, but not limited to, optical splice closures, Gator Patch Terminations and Patch Cords. For questions or concerns related to the Denver Area Fiber Network Ecosystem (DAFNE), please contact the DAFNE Engineer; DAFNE@dencvergov.org.

Subsection 614.08 shall include the following:

Fiber Optic Patch at the Termination inside Traffic Signal Cabinet:
Fiber optic patch cord cables, Single-Mode (SM) or Multi-Mode (MM), shall be of length suitably long to be connected between the interconnect panel and the communications equipment (i.e. fiber optic ethernet switch). Patch cord couplings, Straight Tip Connector (ST) or Lucent Connector (LC), shall be compatible with termination points. Appropriate strain relief consisting of zip ties, shall be applied to the cables in the traffic signal cabinet at a minimum of three locations. 10 ft of slack shall be left inside each traffic signal cabinet. The preferred method of termination is a detachable Gator Patch Distribution Terminal (verify with DAFNE Engineer). Handhole/comm box locations, backbone connection locations, splice diagrams and Ethernet Switch port designations will be provided by the DAFNE Engineer.

Gator Patch Distribution Terminal:

List of Materials for Gator Patch installation:

Quantity one:

Detachable Pre-terminated SM or MM Gator Patch – minimum four (4) ports (reference location splice diagram) ST or LC– Length is to be field determined, allowing for a 10-foot loose coil in the base of the cabinet and adequate length to connect to the nearest back bone hand hole location (40' to 200')

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REVISION OF SECTION 614
TELEMETRY (FIELD)

Quantity one:

Runt Enclosure with Splice tray

Quantity Two (or Three):

ST to LC or LC to LC Patch Cords (verify with DAFNE Engineer)

Procedure:

❶ If Backbone is located in cabinet, back pull to nearest hand hole location install runt and terminate per-splice diagram. Hand hole/ comm box location and splice diagram provided by DAFNE Fiber

❷ If a lateral exists to a splice enclosure; remove lateral, land and splice Gator in place of lateral in existing enclosure (Verify with DAFNE Engineer).

❸ Install Patch cords from Gator into correctly identified ports in ethernet switch (correctly identified ports provided by DAFNE Engineer).
Optical Splice Closures:

Preform Line Products (PLP) Coyote splice enclosures shall be deployed as follows:

- Coyote Runt 8006671
- Coyote Pup 6” x 17” 8006622
- Coyote 6” x 22” 8006560
- Coyote 8” x 22” 8006561

Compatible PLP Coyote splice trays shall be used as follows:

- Runt and Pup splice enclosures shall use 80806033 splice trays with no more than 12 backbone fibers inside each tray.
- Splice enclosures 8006560 and 8006561 shall use the large 80805514 splice tray with no more than 24 backbone fibers inside each tray.

All splice enclosures and splice trays shall be provided by the Contractor or Subcontractor for splicing lateral fiber optic cables to the main (backbone) fiber cable in all pull box locations that are identified in the plans.

- Runt splice enclosures shall be used where no more than three cables enter the splice enclosure and the total backbone strand count is equal to or less than 36 strands.

- Pup splice enclosures shall be used where no more than six cables enter the splice enclosure and the total backbone strand count is equal to or less than 60 strands unless otherwise directed by City and County of Denver Fiber Network Management.
- 8006560 splice enclosures shall be used where no more than six cables enter the splice enclosure and the total backbone strand count is equal to or less than 72 strands unless otherwise directed by City and County of Denver Fiber Network Management.
- 8006561 splice enclosures shall be used where no more than six cables enter the splice enclosure and the total backbone strand count is equal to or less than 144 strands unless otherwise directed by the DAFNE Engineer.

Subsection 614.13 shall include the following:

Telemetry (Field) shall be measured by the total number of traffic signal cabinets at which the interconnect cable is terminated, and cross connected to the ethernet switch. All labor and materials required to perform the patch panel termination and cross connect to the ethernet switch is considered included in the unit price for this item.

This item, therefore, includes the following:

1. All required materials, hardware and labor required to interconnect the fiber optic lateral cable from the DAFNE backbone to and inside the Traffic Signal Cabinet as shown in the planned or contracted scope of work;

- All required termination materials and ancillary hardware and labor required to accomplish the cabinet termination;
- All required fiber optic cable;
- All required optical splice enclosures;
- All required optical splice trays;
- All other labor and material necessary to complete the item.

All labor and materials necessary to complete this item shall be considered included in the unit price and will not be paid separately. Verify all materials and hardware with the DAFNE Engineer.

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REVISION OF SECTION 614
TELEMETRY (FIELD)

Subsection 614.14 shall include the following:

Payment will be made under:

Pay Item	**Pay Unit**
Telemetry (Field)	Each

REVISION OF SECTION 614
FIBER OPTIC CABLE - GENERAL

Section 614 of the Standard Specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

This work is for furnishing and installation of fiber optic communications cable to be installed in conduit or duct as specified in the plans. All labor and materials required to terminate, splice or otherwise connect fiber optic cables at individual controller cabinets, will be paid separately under Telemetry (Field) pay item. The contractor shall be required to demonstrate successful signal system communications to the Engineer as a requirement of acceptance of this item.

Subsection 614.10 shall include the following:

All fiber optic cable shall be furnished by the Subcontractor, and installed, spliced (if required and only as approved by the Engineer), terminated, tested, and connected by the Contractor or Subcontractor as shown on the plans. Manufacturer's recommended limits for cable pull lengths shall not be exceeded.

Fiber optic cable ends shall be stored in pull boxes or splice enclosures at locations indicated in the plans or as directed by the DAFNE Engineer. Fibers to be spliced and/or connected in any manner shall be limited to those identified in the plans, and only in designated traffic signal cabinets or splice enclosures.

Fiber optic cable shall be installed in a continuous run between all splice enclosures as shown in the plans. Lateral fiber optic cable shall be spliced in splice enclosures and routed to the traffic signal cabinet as shown in the plans. Under no conditions shall the fiber optic cable be cut out or spliced at intermediate points without the express written direction of the Engineer.

Fiber optic cable shall be installed in new conduit or existing conduit as specified in the plans. The Contractor or Subcontractor shall be required to leave a minimum of 10 ft of cable slack in the traffic signal cabinet. The Subcontractor shall leave a minimum of 75 ft of cable slack in the communication hand hole as either a loop or a tail (i.e. 75 ft cable sheath length measured by the variance of the stamped length sequential markings at the duct and at the tail; or, 75 ft cable sheath length measured by the variance of the stamped length sequential markings at both ducts for a slack loop).

Fiber optic cable shall be neatly coiled and clearly tagged and labeled at each communication hand hole.

Cable tags and Labels shall be as follows:

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REVISION OF SECTION 614
FIBER OPTIC CABLE - GENERAL

Materials: Heavy plastic orange fiber optic cable identification tags with a clear sticker field lamination. The labeling shall done with a professional label creation machine (i.e. P-touch, Brady, etc.) The label shall contain direction, destination and cable strand construction (for example: 12SM/12MM). Labels shall be provided at the duct and at the splice enclosure on all fiber optic cables.

Manufacturer: Tags shall be 3M, Panduit or an approved equivalent.

Traffic signal cabinets to be connected in accordance with this specification (Fiber Optic Cable – General) shall connect directly to the appropriate ethernet switch as shown in the plans. This connection will be paid under Telemetry (Field). The DAFNE Engineer referenced in the Telemetry (Field) section is directly related to the Fiber Network and components of the Fiber Network.

Whereas the Project Manager referenced in the following sections, is directly related to the previous sections, contractual requirements, initial design/build, installation and removal of the Traffic Signals.

General Requirements:

The Contractor shall provide the Project Manager with a copy of the manufacturer's fiber optic cable specification. All installation shall be in accordance with industry standard practices.

Additional fiber optic cable costs due to damage caused by the Contractor's neglect of recommended procedures shall be the Contractor's responsibility. The main fiber optic cable shall be installed in continuous runs. The manufacturer's recommended limits for fiber optic cable pull tensions shall not be exceeded. Fiber optic cable slack shall be stored in communications hand holes. Lateral Cables to Cabinets will utilize procedures, terminations and cabling specified in the previous Telemetry Field Section.

Lateral fiber optic cable shall be installed using appropriate strain relief in the traffic signal cabinet (through cable ties) at a minimum of three locations.

It is the choice of the Contractor or Subcontractor to verify acceptance of fiber optic cable reels by performing reel tests using an Optical Time Domain Reflectometer (OTDR). All fiber optic cables to be installed shall be tested with an OTDR after installation. Documentation of fiber performance shall be provided to the DAFNE Engineer or Engineer's designee within 30 days of test. All fiber strands shall be within the manufacturer's recommended tolerances. Data shall be supplied to the DAFNE Engineer or Project Manager prior to completion of the project.

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REVISION OF SECTION 614
FIBER OPTIC CABLE – GENERAL

Each fiber strand of every fiber optic cable reel underwent testing at the factory of origin during final phases of the manufacturing process. It is the option of the fiber installation subcontractor to perform on-reel testing prior to installation to ensure continuity.

All OTDR traces shall be collected with EXFO and submitted in .trc (dual wavelength) format and shall include a 1000 meter Launch Reel (pulse suppressor).

All fiber strands within all fiber optic cable spans with one or more fusion splice events (not including pigtail splices) shall be tested at dual wavelength bi-directionally with matching OTDR models and modules, calibration dates, dynamic ranges, launch levels, parameters, and header screen information in both directions of the fiber optic cable span. The single mode wavelengths used shall be 1550nm and 1310nm. All final OTDR fiber optic cable span test results must be made after the splice handhole is closed in order to check for macro-bending problems during replacement of the slack fiber and splice enclosure.

All fiber strands shall be tested using a 1000 meter Launch Reel connected on both ends. Coupling of a patch cord onto the end of the Launch Reel for the purpose of matching connector type at a

termination is not recommended and should be avoided. In the event that this is the only option feasible to complete a test it shall be noted in the comments section of every trace file and the Contractor's Construction Superintendent shall be immediately notified for approval. The Launch Reel length should accommodate the chosen pulse width meaning the Launch Reel shall not be lost inside of a dead zone.

The reflective event caused by the mated connector pair on the end of the Launch Reel and the beginning of the fiber optic cable span shall be clearly visible on the OTDR trace with several hundred feet of smooth even backscatter previous to this event. All fusion splice events shall not exceed .20db bi-directional average loss. Any event that has a loss at 1550nm that is higher than the corresponding loss at 1310nm representing a variance .08dB or greater shall be troubleshot and repaired even if the loss is .20dB or less bi-directional loss. This means that any bend on the glass (fiber strand) that is discovered on the OTDR trace comparison between two wavelengths shall be identified, located in the field, repaired and re-tested. All fiber optic cable spans that have splice events and have a bare fiber tail at one or more ends shall be continuity checked on every fiber strand (from the connector if there is a termination) using an OTDR running on real time and a technician at the bare fiber tail manually bending the tail end of the glass (fiber strand) on each fiber strand one at a time.

If collected test data identifies a splice that does not meet the loss criteria herein, the splice shall be further tested at 1310nm in order to determine if a bend in the glass (fiber strand) exists. After determining that a bend is not present at the out of specification splice event, the subcontractor shall make a minimum of three (3) attempts to rectify the out of specification splice testing after each "re-burn". If after three (3) splice attempts the subcontractor is still unable to produce the acceptable loss value, then the Contractor's Construction Superintendent shall be immediately notified in order to decide as to whether or not the splice shall be marked out of specification and accepted.
Terminated fibers shall not exceed a .60dB mated connector pair loss measured between the Launch Reel connector and the connector at the beginning of the fiber optic cable span through its assigned bulkhead at the patch panel including the pigtail splice. The reflectance at this event shall not exceed a -40dB. If patch cord implementation between patch panels is necessary to link fiber optic cable spans the loss shall not exceed .60dB per mated connector pair and the reflectance shall not exceed -40dB through the entire patch configuration.

All OTDR traces submitted with inaccurate parameter selection shall be rejected and re-testing shall be conducted solely at the Sub-Contractor's expense. The Subcontractor shall be responsible for determining and using the shortest pulse width possible while testing that allows for a clean trace to the end of the fiber optic cable span under test. The length of noise floor at the end of the trace shall be no less than 1/3 the length of the entire fiber optic cable span including the Launch Reel and no greater than ½ the length of the entire fiber optic cable span. During testing, Subcontractor shall allow enough time for the OTDR to perform sufficient averaging on each fiber strand as to "normalize" the trace and provide clear test results, especially on longer fiber optic cable spans. Traces with inadequate averaging to produce quality test data shall result in Subcontractor having to collect the data again solely at Subcontractor's cost.

Subcontractor shall test the fiber optic cable using a Contractor approved OTDR. All OTDR's used shall also incorporate the use of exactly the same Launch Reel length for both directions of the fiber optic cable span testing for purposes of analyzing the traces. Contractor approved OTDR test instruments shall, at a minimum, have the following features:

Telcordia Technologies GR-196 compliancy or Laser Precision/GN Nettest software compatibility.

- Minimum dynamic range of 34.0 dB
- Minimum overall range of 120 km
- 1550 nm and 1310nm laser source for testing single mode fibers

- Ability to save test data for delivery to owner via transfer utilizing email with digital file attachments.
- Bi-directional OTDR files shall be submitted as soon as possible via email to the Contractor's Construction Superintendent's email address.
- The Subcontractor shall store and provide to Contractor for analysis all OTDR trace data including bi-directional fiber optic cable span shots.
- Subcontractor shall fill out a location sheet for every location completely as requested by Contractor. The comments section of the location sheet shall include the materials used, the work performed, and the splice configuration implemented.

When storing OTDR traces, Subcontractor shall use the Contractor approved name format as follows:

All base file names of trace files collected with EXFO OTDRs shall be set up to indicate Launch location_Far site location_wavelength_3-digit fiber # in the OTDR set up screen.

All trace files shall be named in the following 8-character format for Anritsu OTDRs: AAAbbbCC.xxx

AAA = three-letter code* for launch location.

bbb = three-letter code* for far site.

CC = 13 for 1310nm, 15 for 1550 nm.

xxx = three-digit number of individual fiber (e.g. fiber #1 = .001, fiber #144 = .144)

OTDR header screen information shall be filled out completely and include detailed information about the fiber optic cable span tested in the comments section, such as: location of test points, building address, cabinet address, patch panel type, patch panel position in the rack or location on a wall including room number, connector type, port assignments of the cable, and access information.

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FIBER OPTIC CABLE – GENERAL

Subcontractor shall be responsible for visually examining every fiber strand of every fiber optic cable span during the initial fiber optic cable span testing. If any attenuation events are discovered between splice locations the Contractor's Construction Superintendent shall be immediately notified. All attenuation events that occur inside the splice enclosure shall be the Subcontractor's responsibility to remedy. All events outside of the splice enclosures indicating fiber optic cable damage shall be troubleshot, located, and repaired outside of this subcontract and performed under the direction of the Contractor's Construction Superintendent.

Post Placement Testing

All fiber optic cable spans that do not have a splice point shall be tested at both 1310nm and 1550nm unidirectionally using a Launch Reel and OTDR. Accurate fiber optic cable sequential marks from both ends of the fiber optic cable shall be collected by visiting both the manhole and the hand hole locations where the fiber optic cable ends have been coiled. The total sheath footage shall be calculated based upon the fiber optic cable sequential gathered from both tail ends. The sheath footage and tail sequential shall be indicated on the OTDR files in the comments section along with location of the tails, fiber optic cable span information, fiber count, cable construction and type of test being performed.

If the fiber optic cable is terminated on one end, then the fiber optic cable shall be tested from the connectors at the termination using a Launch Reel and shall not exceed a .60dB mated connector pair from the end of the Launch Reel through the connector on the fiber optic cable span. If the fiber optic cable is not terminated on either end, then bare fiber shots shall be done from one of the bare fiber ends of the fiber optic cable using a Launch Reel connected on both ends. A pigtail of 10 feet in length or less shall be used on the end of the Launch Reel in order to maintain a reflection caused by the mated connector pair. This reflection shall be used for measurement purposes to indicate the start of the fiber optic cable span. The insertion loss measured from the end of the Launch Reel through the mated connector pair into the pigtail then through the mechanical splice into the bare fiber end of the fiber optic cable span shall not exceed 1.0dB. The sheath footage shall be verified by comparison to the optical footage of the OTDR trace. All loose tube cable sheath footage shall be between 1% and 3% shorter than the corresponding optical footage measured on an OTDR. Contractor shall be immediately notified of any variance in length (other than the normal 3% variance) or events discovered along the fiber optic cable span.

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REVISION OF SECTION 614
FIBER OPTIC CABLE – GENERAL

Care shall be taken at all times to avoid scraping, denting, twisting, or otherwise damaging the fiber optic cable before, during and after installation. Damaged fiber optic cable shall be replaced by the Contractor without additional compensation. Any visual deformation of the fiber optic cable jacket shall be considered to be damaged fiber optic cable. Fiber optic cable damage does not necessarily equal optical fiber strand damage and optical fiber strand test results need not to point towards fiber optic cable damage as proof of damaged fiber optic cable.

Fiber optic cable shall be installed in conduit or duct in the field in accordance with the contract drawings. All existing or suspected dirt and debris within the conduit shall be cleaned with compressed air before installing fiber optic cable. A manufacturer recommended lubricant shall be applied to the fiber optic cable to reduce friction between the fiber optic cable and duct or conduit.

Fiber optic cable shall be measured by the linear foot for the main (backbone), lateral and branch cables, and shall include all labor and materials required to install the main, lateral, branch, and start fiber optic cables through conduits to all pull boxes, cabinets and closures specified in the plans

Subsection 614.14 shall include the following:

Fiber optic cable for the main (backbone), lateral and branch cables shall not be measured separately, but shall be included in the item Telemetry (Field) and shall include all labor and materials required to install the backbone and lateral cables through conduit to all hand holes, traffic signal cabinets, and into splice enclosures as specified in the plans.

Installation of all internal field cabinet telemetry, splicing, and terminations of fiber optic cable at individual traffic signal cabinets is described and paid for under Telemetry (Field).

REVISION OF SECTION 614
LOOSE TUBE FIBER OPTIC CABLE

Section 614 of the Standard Specifications is hereby revised for this project as follows.

Notice:
Every effort has been made to ensure that the information contained in this specification is complete and accurate at the time of publication; however, information contained herein is subject to change.

Trademarks:
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KELLEMS® is a registered trademark of Harvey Hubbell, Inc.

Scope

This specification covers the general design requirements and performance standards for fiber optic cables intended primarily for use in the outside plant environment. The purpose of this document is to provide the essential requirements for All-Dielectric Single Jacket Loose Tube Fiber Optic cable to be used in the City and County of Denver Network Management DAFNE Fiber Infrastructure.

The product requirements and features described in this specification are those considered useful for ensuring proper selection and manufacturing of fiber optic outside plant cables.

In this specification, all observed or calculated values are rounded off "to the nearest unit" in the last right-hand place of figures used in expressing the limiting value. The round-off method of ASTM E 29 is used.

These cables must comply with applicable industry standards, such as: Telcordia Technologies GR-20 (formerly Bellcore), Electronic Industries Association (EIA), Telecommunications Industry Association (TIA), International Telecommunications Union (ITU), International Electrotechnical Commission (IEC), and American Society for Testing and Materials (ASTM).

Optical Fiber Characteristics

High quality optical fibers should be made with pure silica-based glass to have very low loss for infrared wavelengths and to be used to carry large amounts of information for very long distances in optical communication systems.

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LOOSE TUBE FIBER OPTIC CABLE

Details of the optical fibers are not covered in this specification, but the proposed cable should contain AllWave® or TrueWave® fibers for Single-Mode applications, or Multimode fibers that comply with the specific fiber requirements supplied by the City and County of Denver and meets or exceeds these specifications.

Cable Core Characteristics

Color Code
The individual colors for fibers and buffer tubes in loose tube cable cores must comply with EIA/TIA-598 as given in the following table.

Table 1 – Fiber and Tube Color Code

Fiber or Tube No.	**Color**	***Tube No.***	**Color**
1	Blue (BL)	13	Blue-Dash (BL-DS)
2	Orange (OR)	14	Orange-Dash (OR-DS)
3	Green (GR)	15	Green-Dash (GR-DS)
4	Brown (BR)	16	Brown-Dash (BR-DS)
5	Slate (SL)	17	Slate-Dash (SL-DS)
6	White (WH)	18	White-Dash (WH-DS)
7	Red (RD)	19	Red-Dash (RD-DS)
8	Black (BK)	20	Black-Dash (BK-DS)
9	Yellow (YL)	21	Yellow-Dash (YL-DS)
10	Violet (VI)	22	Violet-Dash (VI-DS)
11	Rose (RS)	23	Rose-Dash (RS-DS)
12	Aqua (AQ)	24	Aqua-Dash (AQ-DS)

Central Strength Member

The central member functions as an anti-buckling element and should be a glass/epoxy composite dielectric rod. A polyethylene overcoat may be applied to the central member to provide the proper spacing between buffer tubes during stranding.

Loose Tube Cable Buffer Tubes

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LOOSE TUBE FIBER OPTIC CABLE

Optical fibers shall be enclosed within buffer tubes that have a diameter several times larger than the diameter of the fibers. The optical fibers shall be loose within the buffer tubes allowing the fibers to move freely. The loose buffer tubes should have a 2.5 mm diameter, with a nominal wall thickness of 0.4 mm. For composite or hybrid cable designs (i.e. when both single-mode and multi-mode fibers are contained within the same cable), the single-mode fibers shall be contained in the first buffer tubes. The multi-mode fibers shall be contained in the sequenced buffer tubes following the multi-mode buffer tubes.

Table 2 – Buffer Tubes

Fiber Count	Buffer Tube OD (mm)	Fibers per Tube
1-288	2.5	12

The buffer tubes (and filler rods, if necessary) must be stranded in a reverse oscillation lay (ROL) technique around the central member to allow for easy mid-span access. The core of buffer tubes must be wrapped with two counter helically applied threads to bind together the cable core.

Filler Rods

In order to create a round cable, filler rods of the same diameter as the buffer tubes may be used to fill empty positions. Filler rods shall be made out of HDPE and shall be natural in color.

Water Blocking System

Water blocking of the core outside and around the buffer tubes must be accomplished via “dry” elements. In addition, water-blocking inside the buffer tubes must be accomplished via “dry” elements as well.

These “dry” water blocking elements form a gel compound when in contact with water. The gel should effectively fill the interstices of the core and the inside of the tubes to prevent water penetration along the length of the cable.

“Dry” water blocking elements must be in the form of binders, tapes, or yarns depending on where they are being applied.

Cable Sheath Characteristics

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LOOSE TUBE FIBER OPTIC CABLE

The sheaths described in this section are:

- All-Dielectric Single Jacket: one polyethylene jacket, no metallic elements (SJ)

Strength Elements

Sheath strength elements shall be applied over the cable core to provide the cable with the required tensile strength. These elements shall be made of fiberglass (Aramid yarns may be used as well).

Outer Jacket

An outer polyethylene jacket is applied over the cable to provide overall mechanical protection. This jacket is made of MDPE (or HDPE upon request) and is usually black. If required, the jacket could have two co-extruded colored tracer stripes located 180 degrees apart to aid in cable identification. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections.

Ripcords

For ease of jacket removal, one clearly identifiable polyester ripcord is provided under the outer jacket for SJ designs. SJ/SA designs shall have two under armor ripcords placed 180 degrees apart. SJ/SA designs shall have one ripcord under both the inner jacket and steel armor.

Cable Cross-Sections: Single Jacket (JC) - Figure 1 – Single Jacket

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LOOSE TUBE FIBER OPTIC CABLE

Table 3 – Target Cable Outer Diameters

NUMBER OF FIBERS								
	2 - 60 (5 Pos.)	2 - 72 (6 Pos.)	73 - 96 (8 Pos.)	97 - 120 (10 Pos.)	121- 44 (12 Pos.)	145-216 (18 Pos.)	217-240 (20 Pos.)	241-288 (24 Pos.)
SHEATH TYPE	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)	Cable OD in. (mm)
SJ	0.42 (10.6)	0.43 (11.0)	0.50 (12.8)	0.57 (14.4)	0.64 (16.2)	0.66 (16.7)	0.69 (17.4)	0.76 (19.2)

Mechanical, Environmental and Electrical Requirements

These cables must meet the requirements of Telcordia GR-20-CORE with all testing performed based on EIA/TIA-455 standards. The manufacturing company must provide proof of their quality control standards with ISO 9001 and TL9000 certifications. The cables must comply with the following temperature ranges:

Operation:	-40°C to 70°C (-40°F to 158°F)
Installation:	-30°C to 60°C (-22°F to 140°F)
Storage/Shipping:	-40°C to 75°C (-40°F to 167°F)

Single-Mode Fibers

Per Telcordia GR-20-CORE, the magnitude of the attenuation change shall be less than or equal to 0.05 dB for 90% of the test fibers and less than or equal to 0.15 dB for the remaining 10% of test fibers. Cable aging allows for 0.10 dB/km average attenuation change with a magnitude of the maximum attenuation change for each individual fiber to be less than 0.25 dB/km. These attenuation values include a 0.05 dB allowance for measurement repeatability.

During mechanical and environmental testing evidence of cracking, splitting or other failure of the sheath components when examined under 5X magnification would result in failure of the proposed test requirements. In addition, no fiber shall lose optical continuity because of the test.

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LOOSE TUBE FIBER OPTIC CABLE

Table 4 – Testing for Signal Mode Fibers

Cable Test	Test Method	Requirement
Tensile Loading and Bending	EIA/TIA-455-33 IEC 794-1-E1	90%<0.05 dB Max Added Loss 100%<0.15 dB Max Added Loss
Cyclic Flexing	TIA/EIA-455-104 IEC 794-1-E6	90%<0.05 dB Max Added Loss 100%<0.15 dB Max Added Loss
Cyclic Impact	EIA/TIA-455-25 IEC 794-1-E4	90%<0.05 dB Max Added Loss 100%<0.15 dB Max Added Loss
Compressive Loading	TIA/EIA-455-41 IEC 794-1-E3	90%<0.05 dB Max Added Loss 100%<0.15 dB Max Added Loss

Table 4 – Testing for Signal Mode Fibers (Continue)

Cable Test	Test Method	Requirement
Twist	EIA/TIA-455-85 IEC 794-1-E7	90%<0.05 dB Max Added Loss 100%<0.15 dB Max Added Loss
Low and High Temperature Bend	EIA/TIA-455-37 IEC 794-1-E11	90%<0.05 dB Max Added Loss 100%<0.15 dB Max Added Loss
External Freezing	EIA/TIA-455-98 IEC 794-1-F6	<0.05 dB Max Added Loss <0.15 dB Max Added Loss
Temperature Cycling	EIA/TIA-455-3 IEC 794-1-F1	□ 0.05 dB/km Mean Added Loss □ 0.15 dB/km Max Loss
Cable Aging	EIA/TIA-455-3 IEC 794-1-F1	□ 0.10 dB/km Mean Loss □ 0.25 dB/km Max Loss
Water Penetration	EIA/TIA-455-85 IEC 794-1-F5	No flow after 24 hours from one-meter length of cable

Multimode Fibers

Per Telcordia GR-20-CORE, the allowable attenuation increase during the mechanical and environmental testing is 0.20 dB. Cable aging allows for the maximum attenuation change for each individual fiber to be less than 0.40 dB/km.

During mechanical and environmental testing evidence of cracking, splitting or other failure of the sheath components when examined under 5X magnification would result in failure of the proposed test requirements. In addition, no fiber shall lose optical continuity because of the test.

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LOOSE TUBE FIBER OPTIC CABLE

Table 5 – Testing for Multi-Mode Fibers

Cable Test	Test Method	Requirement
Tensile Loading and Bending	EIA/TIA-455-33 IEC 794-1-E1	0.20 dB Max. Mean Added Loss
Cyclic Flexing	TIA/EIA-455-104 IEC 794-1-E6	0.20 dB Max. Mean Added Loss
Cyclic Impact	EIA/TIA-455-25 IEC 794-1-E4	0.40 dB Max. Mean Added Loss
Compressive Loading	TIA/EIA-455-41 IEC 794-1-E3	0.20 dB Max. Mean Added Loss
Twist	TIA/EIA-455-85 IEC 794-1-E7	0.20 dB Max. Mean Added Loss
Low and High Temperature Bend	EIA/TIA-455-37 IEC 794-1-E11	0.40 dB Max. Mean Added Loss
External Freezing	EIA/TIA-455-98 IEC 794-1-F6	0.20 dB Max. Mean Added Loss
Temperature Cycling	EIA/TIA-455-3 IEC 794-1-F1	□ 0.5 dB/km Max Added Loss 80 % □ 0.25 dB/km Added Loss
Cable Aging	EIA/TIA-455-3 IEC 794-1-F1	□ 1.0 dB/km Max Added Loss 80 % □ 0.5 dB/km Added Loss
Water Penetration	EIA/TIA-455-82 IEC 794-1-F5	No flow after one hour from one-meter length of cable

Note: The tensile rating for all of the cables described should be 2.7 kN (600 lbf), with a compression rating of at least 220 N/cm under GR-20 requirements.

Cable Marking

Printed Characters

For standard outer jackets, printed characters shall be indent printed with white characters for black jackets, black characters for non-black jackets, or as otherwise specified.

For standard striped outer jackets, printed characters shall be indent printed with white characters for red, green, orange, yellow, blue striped cables, light-blue characters for white striped cables, or as otherwise specified by the customer.

The characters shall be of proper height and space to produce good legibility. Character heights of 2 mm should facilitate adequate readability. An occasional illegible marking is permitted if there is a legible marking on either side.

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LOOSE TUBE FIBER OPTIC CABLE

Markings

The cable shall be sequentially marked at one meter, or two-foot intervals depending on specific requirements issued by the City and County of Denver. The length marks shall not be reset to zero on any length of the cable. The actual length of cable shall be within +1, -0% of the marked length.

Each length of cable shall be marked with the following legend:

"(Manufacturer Name) OPTICAL CABLE, (Product Part Number), (Month and Year of Manufacture, [MM-YY]), (Fiber Count [XXX F], where XXX is the number of optical fibers in the cable), and (Manufacturers' Serial Number)"

Re-Markings

Only one remarking is permitted. If required, either of the following methods for remarking shall be used:

- Method A: Completely remove the defective marking and remark the characters with the original color.
- Method B: Leave the defective marking on the jacket and remark on a different portion of the cable jacket with yellow character print. The new number sequence shall differ from any other existing marking by at least 5000.

Any cable that contains two sets of markings shall be labeled to indicate the color and sequential numbers to be used. The labeling shall also be applied to the reel tag.

Cable Packaging:

Reels:

The manufacturer shall supply the product using their standard reel sizes, methods, apparatus, and reel wood lagging, but stenciled according to these specifications.

The specifications outlined here are guidelines on what is expected with respect to packaging.

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REVISION OF SECTION 614
LOOSE TUBE FIBER OPTIC CABLE

Reels are assumed to be in good working condition, firm, and be able to support the product through shipping and final installation. Reels shall be clean, dry and free of excessive dirt. All reels shall be checked for high nails, stave fit and proper stenciling.

Reel Labels:

Each wooden reel shall be permanently marked with the following information:

- "(Manufacturer's name)" (red paint)
- "OPTICAL CABLE" (black paint)
- An arrow and the wording "cable end" to indicate the position of the outside cable end. (red paint)
- An arrow and the wording "ROLL THIS WAY" to indicate the direction the reel should be rolled to prevent loosening of the cable. (black paint)
- Reel Number (red paint)

Cable handling stickers/cards must be attached to both flanges of every reel. Each sticker must be stapled to the flange. See Figure 4 for illustrations of the stickers to be used.

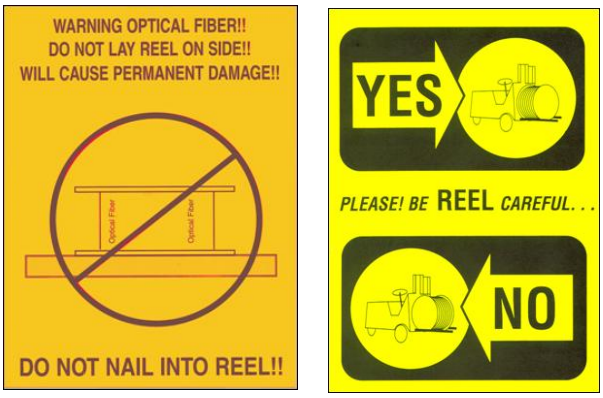

Figure 4 – Reel Stickers

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LOOSE TUBE FIBER OPTIC CABLE

Reel Lagging:

Thermal Protection

Outer layers of the reel shall be covered with a protective wrap to limit the solar heating of the cable. This helps limit the cable surface temperature so that it will not exceed 10 C (18 F) above ambient temperature under maximum solar radiation according to Telcordia GR-20-CORE requirements. All foil wrap shall be securely fastened to the cable by at least 2 pieces of strapping tape.

Composite & Wood Lagging:

Reels shipping domestically shall be lagged with a suitable protective wrap (can be the same thermal protection wrap) and banded with steel straps. This wrap shall cover the cable from flange to flange and provide some mechanical protection to the outer layers of cable as well as weather resistance. Reels shipping for export shall be lagged with wooden boards nailed to each flange and banded with steel straps in addition to the protective wrap around the outer layers of cable.

Cable Ends:

Each end of the cable shall have end seals, either end caps or KELLEMS® pulling grips, in order to prevent moisture ingress into the cable during shipping, storage, or installation.

The top end of the cable shall be securely fastened to the inside of the reel flange to prevent the cable from becoming loose in transit or during handling. The bottom end, “test tail”, shall be approximately three meters in length and easily accessible. The end shall be protected within a cable slot and be securely fastened to the outside of the reel flange with wire ties or walkout straps. Staples, nails or yarn attached to the reel during manufacturing shall be removed.

The cable slot can be partially protected to prevent the cable tail from moving outside the cable slot; however, for export orders the cable slot must be completely sealed by metallic protection rings, plywood covers, or other.

Cable Length Tolerance:

Cables ordered to standard factory lengths shall have an actual length within –0% and +5% of the length ordered unless otherwise specified by the customer.

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LOOSE TUBE FIBER OPTIC CABLE

Certified Test Data:

Each cable shall have certified test data securely fastened to the reel in a waterproof wrapping. The certified test data sheet shall include the following information:

- Cable Number
- Date
- Customer Name
- Ordered Length
- Customer Order Number
- Ship Length
- Customer Cable Code
- Customer Reel Number
- Customer's Attenuation Specification(s)
- Number of Fibers
- Cable Construction
- Fiber Transmission Data
- Bandwidth Data – only applies to Multi-Mode Fibers
- Authorized Signature

Reel Tag:

Each cable shall have a reel tag securely fastened to the reel in a waterproof wrapping. The Reel Tag (Cut Length Data Sheet) shall include the following information:

- Cable Number
- Date
- Customer Name
- Ordered Length
- Customer Order Number
- Ship Length
- Customer Cable Code

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- Customer Reel Number
- Customer’s Attenuation Specification(s)
- Number of Fibers
- Beginning and Ending Sequential Length Markings
- Gross Weight
- Net Weight
- Inspected by Signature

REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

Section 614 of the Standard Specifications is hereby revised for this project as follows.

Subsection 614.08 shall include the following:

This work consists of testing fiber optic cable. Testing shall include both new cable and existing
cable. The test procedures involve an OTDR test and an Optical Power Meter Test.

The guidelines for fiber optic cable testing include:

Test jumpers and patch cords must be of the same fiber core size and connector type as the cable system.

The light source and OTDR must operate with the range of 1310¤10 nm or 1550¤20 nm for testing
in accordance with ANSI/EIA/TIA-526-7.

The power meter and the light source must be set to the same wavelength during testing.

The power meter must be calibrated and traceable to the National Institute of Standards and
Technology (NIST).

All system connectors, adapters and jumpers must be cleaned as per manufacturer's instructions
before measurements are taken.

MATERIALS

The following items are required to perform fiber optic cable tests:

- an OTDR;
- a test reel, if necessary;
- a light source at the appropriate wavelength;
- Optical Power Measurement Equipment; and
- Test Jumpers as specified below.

(a) CPR Test Jumper-1 and Test Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested.

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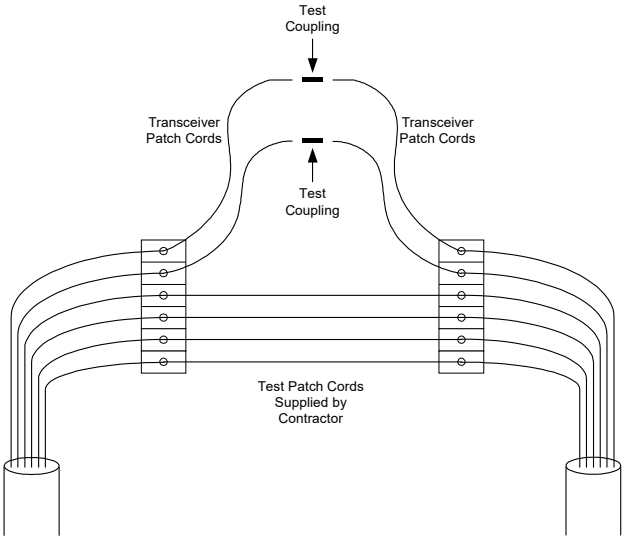
REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

OPTICAL FIBER CABLE TESTING WITH O.T.D.R

The Contractor shall perform an OTDR test of all fibers in all tubes on the reel prior to installation of the fiber. The test results shall be supplied to the Engineer prior to installation of the cable.

If the fiber is specified as “Install Only”, the Contractor shall test the fiber on the reel and provide the test results to the Engineer prior to accepting the cable. After installation, if there are unused portions of cable remaining on the reel, the Engineer may request the Contractor or other qualified technician to perform a reel test. The Contractor shall provide the Engineer the test results prior to delivering the cable to the Engineer. Any cable damaged while in the Contractor’s possession shall be replaced at the Contractor’s expense.

All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end-to-end OTDR trace performed per TIA/EIA-455-61.



The system margin loss measurements shall be provided at 1310 and 1550nm. If the Plans require installation of a fiber optic patch panel, the Contractor shall supply patch cords to patch all terminated fibers through the panel for all fiber testing. If patch cords are specified in the Plans for final equipment installation, these patch cords shall be connected using a test coupling for the end-to-end test.

OTDR readings will be used to ensure proper installation and to troubleshoot faults. OTDR signature traces will be used for documentation and maintenance. An OTDR provides an indirect estimate of the loss of the cable plant, generally, more accurate or reliable values will be obtained by using an Optical Power Meter. For fibers that are identified in the Plans to be left not terminated, an OTDR shall be used to test end-to-end attenuation.

Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

The Contractor shall use an OTDR that is capable of storing traces electronically and shall save each
final trace.

To ensure the traces identify the end points of the fiber under test and the fiber designation, the Contractor shall use a test reel, if required, to eliminate the "dead zone" at the start of the trace so that the start of the fiber under test can be identified on the trace. Indicate the length of the test reel for all test results. If the fiber designation is not indicated on the trace itself, the Contractor shall provide a cross reference table between the stored trace file name and the fiber designation.

In compliance with EIA/TIA-455-61 "Measurement of Fiber or Cable Attenuation Using an OTDR" the Contractor shall record the following information during the test procedure:

- Names of personnel conducting the test.
- Type of test equipment used (manufacturer, model, serial number, calibration date).
- Date test is being performed.
- Optical source wavelength and spectral width.
- Fiber identification.
- End point locations.
- Launch conditions.
- Method of calculation for the attenuation or attenuation coefficient.
- Acceptable link attenuation.

OPTIC FIBER CABLE TESTING WITH OPTICAL POWER METER

The Contractor shall conduct an Optical Power Meter Test for each fiber installed.

Fiber optic cable segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.

In compliance with TIA/EIA-526-7 "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant," the following information shall be recorded during the test procedure:

- Names of personnel conducting the test.
- Type of test equipment used (manufacturer, model, serial number, calibration date).
- Date test is being performed.
- Optical source wavelength and spectral width.

- Fiber identification.
- End point locations.
- Test direction.
- Reference power measurement (when not using a power meter with a Relative Power
- Measurement Mode).
- Measured attenuation of the link segment.
- Acceptable link attenuation.

The minor attenuation differences due to test direction are on par with the accuracy and repeatability
of the test method. Lateral segments within a building are limited to 90 meters. Therefore,
attenuation differences caused by wavelength are insignificant, and as a result, single wavelength
testing is sufficient.

ACCEPTABLE ATTENUATION VALUES

Acceptable attenuation values shall be calculated for each fiber tested. These values represent the maximum acceptable test values.

A connection is defined as the joint made by mating two fibers terminated with re-matchable connectors (e.g. ST, SC, LC).

MM FIBER: The general attenuation equation for any MM link segment is as follows: Acceptable Link

Attenuation = Cable Attenuation + Connection Attenuation + Splice Attenuation + Coupled Power Ratio (CPR) Adj.

62.5 nm MM Attenuation Coefficients:

- Cable Attenuation = Cable Length (km) x (3.40 dB/km@850nm or 1.00 dB/km@1300nm)
- Connection Attenuation (ST or SC connectors) = (# of Connections x 0.39 dB) + 0.42 dB
- Connection Attenuation (LC connectors) = (# of Connections x 0.14 dB) + 0.24 dB
- Splice Attenuation (Mechanical or Fusion) = Splices x 0.30 dB
- CPR Adjustment = See table below

MM Light Source CPR Adjustment					
	Cat. 1 Overfilled	*Cat. 2*	*Cat. 3*	*Cat. 4*	*Cat. 5 Underfilled*
Links with ST or SC Connections	+0.50	0.00	-0.25	-0.50	-0.75
Links with LC Connections	+0.25	0.00	-0.10	-0.20	-0.30

The Coupled Power Ratio of a light source is a measure of the modal power distribution launched into a multimode fiber. A light source that launches a higher percentage of its power into the higher order modes of a multimode fiber produces a more over-filled condition and is classified as a lower category than a light source that launches more of its power into just the lower order modes producing an under-filled condition. Under-filled conditions result in lower link attenuation, while over-filled conditions produce higher attenuation. Therefore, adjusting the acceptable link attenuation equation to compensate for a light source's launch characteristics increases the accuracy of the test procedure.

SM FIBER: The general attenuation equation for any SM link segment is as follows:

Acceptable Link Attenuation = Cable Attenuation + Connector Attenuation + Splice Attenuation
8.3 nm Single-Mode Attenuation Coefficients:

- Cable Attenuation = Cable Length (km) x (0.34 dB/km@1310nm or 0.25 dB/km@1550nm)
- Connection Attenuation (ST or SC connectors) = (# of Connections x 0.39 dB)+0.42 dB. No more than 0.75 dB per connector.
- Connection Attenuation (LC connectors) = (# of Connections x 0.14 dB)+0.24 dB.
- Splice Attenuation (Mechanical or Fusion) = Splices x 0.20 dB

TEST PROCEDURES

All fiber testing shall be performed on all fibers in the completed end-to-end system.

MM FIBER: The MM fiber cable test shall be conducted as follows:

- Clean test jumper connectors and test coupling per manufacturer's instructions.

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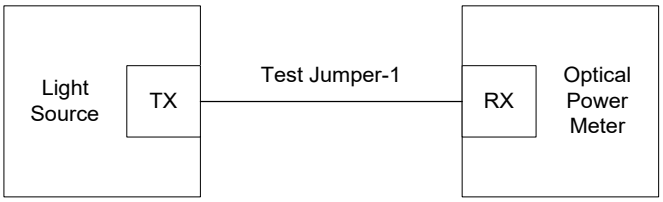
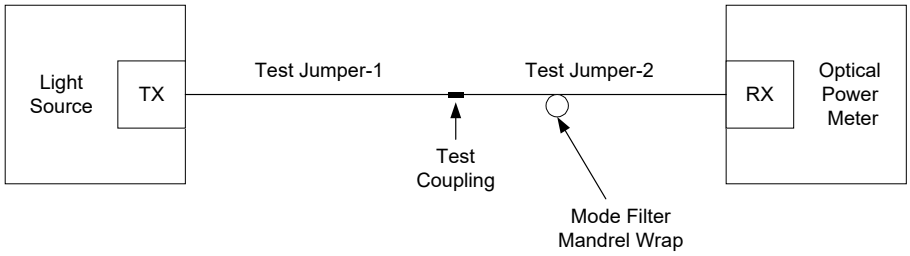
REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

- Follow the test equipment manufacturer's initial adjustment instructions.
- Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100mm (4 inches) in diameter.



- If meter has Relative Power Measurement (PM) Mode, use it. If not, reduce the Reference PM (Pref). If meter can display power levels in dBm, select this unit to simplify calculations.
- Disconnect Test Jumper-1 from power meter. Do NOT disconnect test jumper from light source.
- Connect Test Jumper-2 between power meter and Test Jumper-1 using test coupling. Test Jumper-2 should include a high order mode filter. This is done by wrapping jumper 3 times around 30mm (1.2") diameter mandrel.



- Record PM (Psum). If power meter is in Relative PM Mode, reading represents CPR value. If meter does not have Relative PM Mode, perform the following calculation:
    - If Psum and Pref are in the same logarithmic units: CPR (dB) = Psum - Pref
    - If Psum and Pref are in watts: CPR (dB) = 10 x log10 [Osum/Pref]

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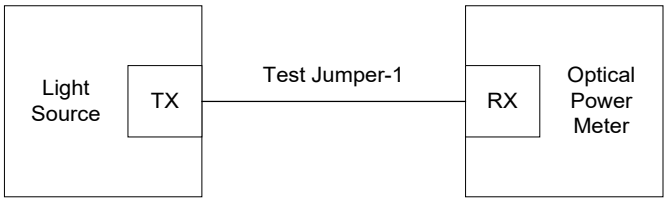
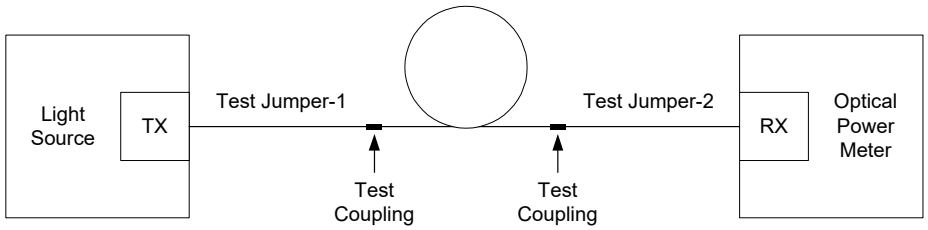
REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

SM FIBER: The SM Optical Power Meter fiber test shall be conducted as follows:

- Clean the test jumper connectors and test coupling per manufacturer's instructions.
- Follow the test equipment manufacturer's initial adjustment instructions.
- Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100mm (4 inches) in diameter.



- If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement (Pref). If the meter can display power levels in dBm, select this unit to simplify subsequent calculations.
- Disconnect Test Jumper-1 from power meter. Do NOT disconnect test jumper from light source.
- Attach Test Jumper-1 to one end of the cable plant to be measured and attach Test Jumper-2 to the other end.



- Record the PM (Psum). If the power meter is in Relative PM Mode, the meter reading represents the true value. If the meter does not have a Relative PM Mode, perform the following calculation:
    - If Psum and Pref are in the same logarithmic units: CPR (dB) = Psum - Pref
    - If Psum and Pref are in watts: CPR (dB) = 10 x log10 [Osum/Pref]

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TEST FIBER OPTIC CABLE

TEST ACCEPTANCE

The Contractor shall demonstrate that each Optical Power Test results in acceptable attenuation values.

The Contractor, solely at the Contractor's cost, shall remake any fusion splices and/or connectors that have test results exceeding acceptable attenuation values.

The Contractor, solely at the Contractor's cost, shall retest any fiber links that have been re-spliced.

The Contractor, solely at the Contractor's cost, shall bring any link not meeting the requirements of this specification into compliance.

SUBMITTALS

The Contractor shall submit test results documentation as both a hard copy and electronic copy.

After each reel test, the Contractor shall submit two (2) hard copies of the OTDR trace for every fiber on the reel. After installation, the Contractor shall submit two (2) hard copies of the OTDR trace for every spliced fiber. Hard copy traces shall be organized and bound in logical order in an 8-½" x 11" 3 ring hard cover binder in addition to other documentation listed in this Special Provision and other splicing documentation listed in the project Special Provision package.

The Contractor shall submit, after approval of the hard copy traces, electronic copies of all traces and appropriate software to allow reading the traces.

The Contractor shall submit two (2) copies of all Optical Power Test results.

The Contractor shall submit two (2) copies of the contract plans, including additional drawings issued as part of any change orders, with any deviations clearly marked in color. Deviations to be noted shall include but not be limited to the following:

- Fiber splice location;
- Fiber splice configuration; and
- Termination layout.

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REVISION OF SECTION 614
TEST FIBER OPTIC CABLE

Subsection 614.13 shall include the following:

The complete end-to-end OTDR test on one fiber, including document submission, represents one OTDR test.

The complete end-to-end optical power meter test on one fiber, including document submission, represents one optical power meter test.

Subsection 614.14 shall include the following:

No separate measurement or payment will be made for fiber optic cable testing. All cable (system) testing shall be considered incidental to the Telemetry (Field) pay item.

REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION

Section 614 of the Standard Specifications is hereby revised to include the following:

Subsection 614.01 shall include the following:

This work consists of the installation of a closed-circuit television camera at the locations shown on the plans.

Subsection 614.08 shall include the following:

Closed Circuit Television

Closed circuit television camera shall be the Panasonic WV-S65340-Z4N.

The following accessories shall be provided for each IP camera:
Panasonic PAPM4 Pole Mount Bracket
Panasonic PWM20G Gooseneck Black
Transformer Altronix T2428100 24 VAC.
Veracity VOR-OS Outsource Midspan 15/20W POE 802.3AF Injector – 1 port.

Subsection 614.10 shall include the following:

The closed-circuit television camera shall be installed in accordance with the details shown in the plans and in accordance with manufacturer's recommendations. The Contractor shall deliver the camera and accessories to the City and County of Denver's Transportation Operations at 5440 Roslyn, Building E, Tech Shop, Denver, Colorado 80216 at least 4 weeks prior to installation for the camera calibration and set up. The Contractor shall pick up the camera and shall install it at the proper location. The Contractor shall make arrangements for a City and County of Denver Transportation Operations' representative to be on-site to ensure proper installation.

Subsection 614.13 shall include the following:

Closed circuit television cameras will be measured by the actual number of closed circuit television cameras that are installed and accepted. All accessories shall not be measured separately.

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REVISION OF SECTION 614
CLOSED CIRCUIT TELEVISION

Subsection 614.14 shall include the following:

Pay Item	**Pay Unit**
Closed Circuit Television	Each

Payment will be full compensation for all labor, materials, accessories, and equipment required to complete the work.

REVISION OF SECTION 625
CONSTRUCTION SURVEYING

Section 625 of the standard specifications is hereby revised as follows:

Delete section 625 and replace with the following:

DESCRIPTION

625.01 This work consists of the construction surveying, calculating, and staking, including ROW limits, necessary for the construction of all elements of the project. The work shall be done under the supervision of a Professional Land Surveyor (PLS) who is licensed in the State of Colorado. Locating, preserving, referencing, installing and restoring land monuments such as Primary Control monuments from which the Right of Way or any land boundary will be calculated, described or monumented, Public Land Survey System (PLSS) monuments, General Land Office (GLO) monuments, Bureau of Land Management (BLM) monuments, Mineral Survey (MS) monuments, Right of Way (ROW) monuments, property boundary monuments and offsets, Range Points, benchmarks, easement monuments, and other monuments that are required by law or regulation to be established by a PLS, and the determination of any land boundary, shall be done under the supervision of a Professional Land Surveyor (PLS) who is licensed in the State of Colorado.

MATERIALS AND EQUIPMENT

625.02 The Contractor shall furnish all personnel, survey equipment, safety equipment, materials, and traffic control necessary to perform the required construction surveying and staking. All surveying equipment, including Electronic Distance Meters (EDM), total stations, theodolites, levels, rods, tapes, tripods, tribrachs, and Global Positioning System (GPS) receivers and equipment.

If any survey equipment is found to be functioning outside the manufacturer's specified tolerance, certification from an approved repair facility showing that the instruments have been repaired, properly adjusted, or both if necessary shall be included in the survey records and submitted to the City Surveyor's Office before being used.

CONSTRUCTION REQUIREMENTS

625.03 A Construction Survey Conference shall be held with the City Surveyor's Office prior to performing any surveying work under this section. The Contractor's Surveyor (PLS) and Party Chief shall attend. A Construction Survey Checklist shall be completed and signed by the City Surveyor's Office and the contractor. The Contractor shall check and verify all established Primary horizontal and vertical control points.

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REVISION OF SECTION 625
CONSTRUCTION SURVEYING

All survey records generated shall be the property of the City and shall be available to the City Surveyor's Office for inspection or reproduction at all times. All survey records shall be transmitted to the City Surveyor's Office for inclusion into the project records before final project acceptance.

Electronic formats may be acceptable, please coordinate with the City Surveyor's Office.
Copies of any new Monument Records filed by the PLS with the State Board of Registration shall be submitted to the City Surveyor prior to filing.

625.04 Contractor Surveying. The Contractor's PLS shall perform all construction surveying and staking that is necessary for construction of the project.

625.05 Staking. It is the responsibility of the Contractor's PLS to adhere to industry standards and acceptable practices in regard to staking. Any restaking will be the responsibility of the Contractor's PLS at no cost to the City.

625.06 Accuracy and Tolerances. It is the responsibility of the Contractor's PLS to adhere to industry standards and applicable standards with regard to horizontal and vertical accuracy tolerances.

625.07 Responsibility and Inspection. Supervision and coordination of construction surveying and staking is the Contractor's responsibility. The City Surveyor's Office or Engineer may inspect the Contractor's surveying; however, such inspection will not relieve the Contractor of any responsibility for accuracy or completeness of work. All Contractor surveying inaccuracies, errors, or omissions shall be corrected at the Contractor's expense.

625.08 Reset Monuments and Stakes. Survey monuments, benchmarks, and other significant stakes that are damaged, destroyed, or made inaccessible by the progress of construction shall be replaced, transferred or reestablished at the Contractor's expense.

Locating, preserving, referencing, installing and restoring land monuments as described in 625.01, shall be done in accordance with Section 629, under the supervision of a PLS who is experienced and competent in Right of Way and boundary surveying and licensed in the State of Colorado.

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REVISION OF SECTION 625
CONSTRUCTION SURVEYING

625.09 Changes. All changes in lines and grades required by field conditions and all discrepancies in grades, alignment, location or dimensions detected by the Contractor shall be immediately submitted to the Engineer in writing. No changes in given data or plans will be allowed unless approved by the Engineer in writing. All changes shall be documented by the contractor.

625.10 Pay Quantities Measurements. The Engineer will perform all interim and final measurements deemed necessary by the City to determine contract pay quantities. The Contractor shall establish and maintain Control points and stationing as required for these measurements.

625.11 Survey Records. Survey records shall be completed as the work is done. Field survey notes for construction surveying and checking by the Contractor shall be recorded in survey records in conformance with industry standards and acceptable practices.

All survey records generated shall be the property of the City and shall be available to the City Surveyor's Office or the Engineer for inspection or reproduction at all times. All survey records shall be transmitted to the City Surveyor's Office for inclusion into the project records before final project acceptance. All survey records shall be stamped with the seal of, and signed by, the responsible PLS.

Electronic submittal of survey records may be acceptable, please coordinate with the City Surveyor's Office.

METHOD OF MEASUREMENT

625.12 Construction surveying will not be measured but will be paid for on a lump sum basis.

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REVISION OF SECTION 625
CONSTRUCTION SURVEYING

BASIS OF PAYMENT

625.13 Payment for construction surveying will be the lump sum bid and will be full compensation for all surveying work necessary to complete the project to include all resetting of stakes, marks, monuments and preparing survey documentation as required.

Partial payment for construction surveying, as determined by the Engineer, will be made as the work progresses.

Payment will be made under:

Pay Item	Pay Unit
Construction Surveying	LS

REVISION OF SECTION 626
MOBILIZATION

Subsection 626 of the standard specifications is hereby revised as follows:

Subsection 626.01 is hereby revised to include:

This item also includes demobilization of equipment and supplies from this project site.

Subsection 626.02 is hereby deleted and replaced by the following:

Two payments will be made for the mobilization item. 50% of the amount bid for mobilization will be paid at the completion of mobilization. The remaining 50% of the amount bid for mobilization will be paid at the completion of the project when the equipment has been demobilized.

Pay Item	Pay Unit
Mobilization	LS

REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES

Subsection 626 of the standard specifications is hereby revised as follows:

DESCRIPTION

The City shall be the lead agency to handle communications with the media, public, City staff, and other Stakeholders identified by the City, unless otherwise required to be performed by the Contractor in this Section 626. The Contractor shall develop, implement, and maintain a Public Information Plan (PIP).

The City seeks the Design and Construction of the Project in such a manner that protects public safety, minimizes the inconveniences of Construction Work Activities, and keeps the public informed of the specifics of Work while reminding them of the benefits and purpose of the Project.

The Contractor's Public Information Officer (PIO) shall recommend processes and tools to be used to communicate Information to Stakeholders during Construction. The Contractor shall work with the City to identify additional audiences and shall recommend the appropriate communication tool for each audience, and also shall identify communication protocols for the duration of the Project. This shall include daily Information to Stakeholders reporting changes to the roadway network in advance of traffic changes and/or closures a minimum of fourteen (14) days in advance.

The Contractor shall balance meeting the Project's schedule while being responsive to community concerns about the impacts of the construction work. The City must Approve all information before it is made public.

The Contractor shall coordinate Public Information and community engagement activities for the property located on the southwest corner of Quincy with the Department of Housing Authority (DHA) community engagement contact, Quinn Miller (qmiller@denverhousing.org). The Contractor shall ensure that all Public Information materials, notifications, and outreach efforts associated with this location include Russian-language translation services to effectively communicate with the affected community.

The Contractor's PIP shall identify an approach for presenting construction-related impacts to the public.

As significant components of the PIP, there are categories of Information that shall be communicated and coordinated by the City and the Contractor, including the following:

1. **Project Vision**

   Answers to questions such as why the Project is needed, what work will be done, and how the Project will benefit the public (including extensive safety messaging).

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REVISION OF SECTION 626
PUBLIC INFORMATION SERVICES

2. **Project Construction**

   The City and the Contractor shall be responsible for meaningful public engagement to adequately convey the overall construction schedule, the Contractor shall be responsible for informing the public of construction progress and construction-related impacts.

3. **Project Progress**

   The City and the Contractor shall provide ongoing messages to keep the public and other Stakeholders informed about the Project including the schedule, traffic impacts, major milestones, etcetera.

REQUIREMENTS

1.0 PUBLIC INFORMATION OFFICER

The Contractor shall identify a qualified PIO for the Project, with at least five years of professional experience in construction/transportation-specific Public Information and Media Relations. The PIO will provide accurate and timely information on Project issues to the City and the public. The PIO shall have exceptional writing skills and experience working with print and relevant transportation communications and outreach experience. The PIO shall be responsible for overseeing all Contractor communication efforts during construction.

The PIO and/or designated representative of the PIO shall be accessible as necessary for activities associated with Public Information for the duration of the Project.

1.1 PUBLIC INFORMATION PLAN (PIP)

The Contractor/PIO shall prepare, maintain, and implement a PIP, in coordination with the City, to communicate Information to and from the public. The PIP shall include an approach to establish and enhance an effective working partnership with the City, public, key Stakeholders, and the Contractor. A PIP shall be submitted to the City for Approval within thirty (30) Days following issuance of NTP.

The PIP shall include, at a minimum, the following:

1. Demonstration of an understanding of the Project, including the purpose and benefits of the Project;
2. The Project approach to construction work that will be performed, in relation to the progress/schedule, milestones and activities, and how Public Information will unfold over the duration of the Work;
3. Approach to bi-lingual communications in both Spanish and French;

4. Messaging to the public and Stakeholders to describe the Project, its benefits, and help them understand, anticipate and cope with impacts, and detailing the approach; communication tools/contacts used for such;
5. Approach to communication when potential issues arise such as high-noise, and/or vibration events that will impact adjacent properties, extended closures, delays, etcetera;
6. Approach to digital communications (online, mobile device, text messaging, etc.) to ensure easy and accurate 24/7 access to Project Information;
7. Media support as necessary, including assistance to the City with media relations, as requested;
8. Clear delineation of responsibilities for Public Information between the City and the Contractor.

1.2 STAKEHOLDERS

The Contractor/PIO shall coordinate with the City to identify audiences requiring outreach by the City and the Contractor. The Contractor shall Work with the City to determine the best communications tactics for each audience. The PIO shall lead the outreach efforts as directed by the City.

Identified Stakeholders, other than the City, include, but are not limited to:

- Elected officials
- Area schools
- Places of worship
- Area medical facilities
- Utility Owners
- Emergency responders
- Area residents
- Area businesses
- Property owners and property management companies
- Registered Neighborhood Organizations (RNOs)

1.3 MEDIA RELATIONS/MEDIA COORDINATION

The Contractor shall provide information to the City to be used in updates on the traffic advisories.

The Contractor shall submit drafts of public notices and communication to the City at least fourteen (14) days in advance of distribution.

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PUBLIC INFORMATION SERVICES

The City will distribute the information for public notices to the media. The Contractor and City will disseminate flyers or other communications directly to local residents, businesses or other key stakeholders as needed and directed by the City.

1.4 DATA COLLECTION AND MANAGEMENT

As part of the PIP, the Contractor/PIO shall develop management plan process that outlines and provides for distribution of construction information to meet the needs of the residents and stakeholders.

Construction information shall also be provided to the City for use on the project public website (if applicable) and to the City for other uses. For example, residents, commuters, and most other stakeholders will need information about the construction schedule, what roads will be affected by the construction work, what efforts will be taken for noise and dust mitigation during construction, and the hours construction work will take place. Emergency response providers will need to know if designated routes for emergency vehicles are altered. All Stakeholders will require reliable, accurate, accessible, and timely information on when and where construction is taking place.

The Contractor shall include activities that will arise during the Project, including detours, roadway and lane closures, dust mitigation, and other work.

In all events, the Contractor shall be responsible for the accuracy and reliability of the Information it forwards to the City as soon as it becomes available.

The Contractor shall track changes (including changes to short-term Construction-related closures, unexpected Construction Work Activities, emergency closures, and scheduled Construction Work Activities), and report on all changes as quickly as possible. The Contractor shall update the Construction Work Information and make the Information available to the City for its use.

1.4.1 Information Management Maintenance and Reporting

The Contractor shall provide Construction Work Information to the City according to the following schedule:

- Thirty (30) days prior to the beginning of major Construction Work affecting the public, including detours, lane closures, access impacts, and major traffic impacts.
- Fourteen (14) days prior to the beginning of any other Construction Work affecting the public.

- Once the Contractor is made aware, the Contractor shall provide the City with Construction Work updates (e.g., cancellation of planned closures, additional lane closures, closure removals, major traffic shifts, etc.) that directly impact the public.

At a minimum, the Contractor shall provide the City clear information on construction work updates:

1. Nature of the construction work;
2. Exact limits and location of the construction work;
3. Duration/dates of construction work; and
4. Times of day/night of the construction work; and alternate access or routes as applicable.

1.4.2 Public Contact Tracking

The Contractor/PIO shall track all public contacts made from residents, businesses, and government offices, etc. At a minimum, this shall include and document (as available) the names, organizations, addresses, email addresses, and phone numbers, as well as the questions, comments, concerns, date of contact, and the response provided, date provided, and individual that provided it.

1.5 TOOLS FOR INFORMATION DISSEMINATION

The Contractor/PIO shall work with the City to identify a variety of tools and methods to disseminate information and communicate with the public and stakeholders. The Contractor shall, in its PIP, describe its recommended approach to implementing the communication tools and methods described below.

Language Assistance for LEP Persons. The City is required to provide access to Limited English Proficient (LEP) persons. LEP persons are individuals for whom English is not their primary language and who have a limited ability to read, write, speak or understand English. Examples of language assistance include, but are not limited to, translation of meeting notices and interpretation services at meetings. At a minimum, the PIO shall work with the City to provide interpretation and translation services upon request by an LEP person.

Additionally, if the community to which the project flyers shall be distributed has greater than 5 percent LEP persons, the flyers shall be translated. The PIO shall document all measures taken to communicate with LEP persons and record all requests for language assistance. Information and communications include public meeting materials, Informational phone line, email communications, flyers, Construction fencing visuals, and all other forms of Information dissemination, as described in this Section.

1.5.1 Project Identification and Signage

Public Information and warning signage shall be maintained throughout the Project. The Contractor shall describe and utilize its approach to implementing Variable Message Signs (VMS) and/or static signage to notify the public of road closures, lane closures, detours and lane shifts, along with durations of these MOT measures. All signage shall be coordinated and comply with the requirements outlined in the Maintenance of Traffic. Signage shall be maintained to an acceptable appearance and updated as required by the City throughout the duration of the Project.

1.5.2 Website Information

The City will host the project's public website (if applicable) on the City server. The Contractor shall submit for approval all website content throughout the duration of the Project. Website content shall include, at a minimum, public meeting Information and materials, Construction Information (e.g., lane closures, access restrictions, duration of impacts, etc.), calendar of Special Events, progress, safety messaging and other relevant Information. Website content updates shall be provided weekly, whenever the Construction Work Activities impact the public (lane closures, access impacts, major traffic impacts, etc.), or as requested by the City. Website content is not required to be duplicated into Spanish but needs to be ADA compliant.

1.5.3 Personal Contacts

The City expects and desires that personal contacts will be made with specific community leaders, businesses, organizations, or Stakeholders. In addition, the Contractor shall make personal contacts to businesses and properties that are immediately impacted by Construction Work. Examples of such

Construction Work include, but are not limited to, access changes, lane closures, and Utility disruptions. Other circumstances may also warrant a personal contact. Personal contacts shall be notified when Construction Work is anticipated to have direct impacts upon said personal contacts no less than ten days prior to commencement of relevant Construction Work.

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The Contractor/PIO shall work with the City to implement door-to-door flyer distribution and mailings (as necessary) during the duration of the Construction Work. The City will assist the Contractor with email communications and responding to phone communications, while the contractor will be responsible for responding to construction- specific inquiries.

All personal contacts shall be conducted as Approved by the City for directly affected properties.

The City will communicate directly with Denver City Council and other elected officials but will rely on the Contractor's PI team for construction updates and key messages.

1.5.4 Email Communication

The Contractor/PIO shall provide content for periodic (weekly and as otherwise needed) newsletter blasts and email blasts which provide current Information about Construction impacts (closures, traffic shifts, etc.), and duration of the Construction Work. The City will disseminate the content using its email or other social media platforms.

The Contractor shall coordinate with the City to develop the initial email list. The messages shall be accurate, informative, and provide at least fourteen (14) days advance notice of major traffic changes such as lane closures, lane reductions and traffic shifts. The Contractor shall maintain the email list, and shall provide a copy monthly, or upon request, to the City. Email content shall be submitted to the City for approval seven (7) days prior to the anticipated release date.

1.5.5 Social Media

Concurrent with email communication, the Contractor shall develop and provide to the City, content for dissemination through social media. The City will post the content on its social media accounts. Content should be similar to email communications but geared for Facebook, Twitter, and NextDoor platforms. The messages shall be accurate, informative, and provide at least seven (7) days advance notice of major traffic changes such as lane closures, lane reductions, and traffic shifts and provide at least two weeks advance notice prior to public meetings.

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1.5.6 Detour Maps and other graphic support

The Contractor will be required to create detour maps and other graphics throughout construction and will send to the City for review.

1.5.7 Collateral Development

The Contractor/PIO is required to create monthly collateral pieces for dissemination, such as fact sheets or newsletters describing progress or impact-specific fact sheets with detour maps included.

1.6 DELIVERABLES

At a minimum, the Contractor shall submit the following to the City for Information, Acceptance, or Approval:

Table 626-1 Deliverables

Deliverable	Information, Acceptance, or Approval	Schedule
Public Information Plan (PIP)	Approval	30 Days following issuance of NTP
Data Collection and Management Plan	Approval	Concurrent with PIP
Website updates	Approval	Weekly, as needed, and upon request
Draft public notices and communications, newsletters, email blasts, and/or media responses	Approval	As scheduled or upon request

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PUBLIC INFORMATION SERVICES

METHOD OF MEASUREMENT

The Engineer will monitor the PIO and all public information services. When the PIO provides acceptable public information services per these specifications, partial payments for the pay item Public Information Services will be made as the work progresses. Failure to provide acceptable public information services will result in a withholding of payment for this item. These partial payments will be made as follows:

Partial payments for public information services will be made once each month as work progresses. The monthly partial payments will be determined by pro-rating the lump sum bid amount by the number of months in the actual construction schedule.

BASIS OF PAYMENT

Payment will be made under:

Pay Item	**Pay Unit**
Public Information Management (Tier III)	Lump Sum

Payment for Public Information Services will be full compensation for all work, materials, and equipment to provide public information throughout the project per this specification.

Construction Signs will be measured and paid for per Section 630.

REVISION OF SECTION 627
PAVEMENT MARKING

Section 627 of the Standard Specifications is revised as follows:

Subsection 627.01 is revised to include the following:

The Contractor is responsible for installation and removal of temporary pavement marking. The Contractor shall coordinate the work of the striping, including traffic control devices and flaggers.

Subsection 627.03 is revised to include the following:

The Contractor shall replace permanent pavement markings damaged or removed as a result of the work. Pavement marking material shall be new material of the same type which existed prior to the work commencing.

Subsection 627.12 is revised as follows:

Installation and removal of temporary pavement marking will not be measured and paid for separately, but shall be included in the cost of item 412.

Replacing permanent paving marking damaged or removed as a result of the work will not be measured and paid for separately.

REVISION OF SECTION 629
SURVEY MONUMENTATION

Section 629 of the Standard Specifications is hereby deleted and replaced with the following:

DESCRIPTION

629.01 This work consists of locating, preserving, referencing, installing and restoring the following types of land monuments by a Colorado-licensed Professional Land Surveyor (PLS). The following types of monuments, if required, shall be considered included: Primary Control monuments from which Right of Way (ROW) or any land boundary will be calculated, described or monumented; Public Land Survey System (PLSS) monuments; General Land Office (GLO) monuments; Bureau of Land Management (BLM) monuments; Mineral Survey (MS) monuments; ROW monuments; property boundary monuments; and offsets, City of Denver range points, benchmarks, easement monuments, and other monuments that are required by law or regulation to be established by a PLS, along with installing or adjusting Monument Boxes.

The production of additional documentation may be required by the City Surveyor's Office. All such work included in this section shall be performed under the supervision of a Colorado- licensed PLS.

MATERIALS AND EQUIPMENT

629.02 The Contractor shall furnish all personnel, survey equipment, safety equipment, materials and traffic control necessary to perform the required Monumentation and related surveying.

CONSTRUCTION REQUIREMENTS

629.03 A construction survey conference shall be held with the City Surveyor's Office prior to performing any surveying work under this section. The Contractor's Surveyor (PLS) and party Chief shall attend. A construction survey checklist shall be completed and signed by the City Surveyor's Office and the Contractor.

The Contractor shall check and verify all established primary horizontal and vertical control points.

All survey records generated shall be the property of the City & County of Denver and shall be available to the City Surveyor's Office for inspection or reproduction at all times. All survey records shall be transmitted to the City Surveyor's Office for inclusion into the project records before final project acceptance.

Electronic formats may be acceptable; please coordinate with the City Surveyor's Office.

Copies of any new Monument Records filed by the PLS with the State Board of Registration shall be submitted to the City Surveyor prior to filing.

629.04 Locating Monuments – This work consists of field locating all survey Monumentation as discussed in 629.01 which is in place within the project limits. A diligent search of construction zones and project limits shall be performed by the PLS.

629.05 Preserving and Referencing Monuments – All monuments as described in 629.01 shall be preserved, referenced and reset by a PLS within the project limits.

629.06 Installing Monuments – All monuments described in 629.01 shall be preserved throughout construction. If any monuments as described in 629.01 are to be disturbed or removed during construction, it will be the responsibility of the Contractor's PLS to reset all monuments to current City & County of Denver standards. Appropriate documentation will be required for all reset monuments.

629.07 Monument Box – 629.07 Monument Box. This survey work shall consist of installing or adjusting monument boxes to current City or State requirements.

METHOD OF MEASUREMENT

629.08 Survey Monuments, Monument Boxes, and Adjust Monument Boxes will be measured by
the actual number of the various types installed and accepted by the Engineer. Measurement for
locating survey monuments, preserving and referencing monuments will not be measured.

BASIS OF PAYMENT

629.09 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Prior to final payment, all survey records and documentation must be submitted and accepted by the City Surveyor's Office.

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REVISION OF SECTION 629
SURVEY MONUMENTATION

The Construction Survey checklist, equipment calibrations, and survey records will not be paid for
separately but shall be included in the work. The locating of monuments, preserving and referencing
monuments will not be paid for separately but shall be included in the work.

Payment will be made under:

Pay Item	**Pay Unit**
Survey Monument (Type 1)	Each

Traffic control for monumentation and related surveying will be measured and paid for in accordance with Section 630.

REVISION OF SECTION 630
CONSTRUCTION ZONE TRAFFIC CONTROL

Section 630 of the Standard Specifications is hereby revised as follows:

Subsection 630.01 shall be revised to include the following:

The Contractor shall submit, in writing, the proposed Method of Handling Traffic (MHT) for review and approval of the Project Engineer and CCD Project Manager before the permit is submitted through e-permits. The MHT shall be developed according to this section and the construction plans.

Subsection 630.05 Traffic Cones shall include the following:

Steel drum channelizing devices shall not be used for traffic control

Subsection 630.06 Channelizing Device (fixed) shall include the following:

Non-metallic drums or tubular markers may be substituted for vertical panel channelizing devices.

Subsection 630.09 General shall include the following:

The flagger's STOP/SLOW sign paddle shall be 18 inches with letters six inches high.

Subsection 630.10(a), shall include the following:

When a different MHT is required for a subsequent construction phase, it must be submitted at least two weeks prior to starting that phase. All proposed methods of handling traffic shall be approved, in writing, by the Project Engineer following approval of the Traffic Engineering Services Department.

Approval of the proposed MHT does not relieve the Contractor of liability specifically assigned to him under the contract. The Contractor shall erect and maintain warning lights, signs, barricades, and sufficient safeguards around all excavations, embankments, and obstructions.

The contractor shall notify the Project Engineer by Thursday at 3:00 P.M. which streets they intend to work on the following week. This notification will be made for all phases of construction.

Subsection 630.10(a)(1) shall be added as follows:

The key elements of the Contractor’s method of handling traffic (MHT) are outlined in subsection 630.10(a).
The components of the Traffic Control Plan (TCP) for this project are included in the following:

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REVISION OF SECTION 630
CONSTRUCTION ZONE TRAFFIC CONTROL

- Subsection 104.04 and Section 630 of the Standard Specifications.
- DOTIPT 116.1 Traffic Control Procedures. https://www.denvergov.org/files/assets/public/v/2/doti/documents/permits/dotipt-116.1_traffic_control_procedures.pdf
- DOTIRR 22.3 Issuance of permits by the City Traffic Engineer. https://www.denvergov.org/files/assets/public/v/2/doti/documents/regulations/dotirr-022.3_issuance_of_permits_by_the_city_traffic_engineer.pdf
- Tabulation of Traffic Engineering Items included in the plans for this project.
- Latest revised Standard Plan S-630-1 Traffic Controls for Highway Construction and Standard Plan S-630-2.

Special Traffic Control Plan requirements for this project are as follows:

1. During the construction of this project, traffic shall use the present traveled roadway.

2. Work that interferes with traffic will only be permitted during the following hours:
    - The Contractor shall perform all the work on the roadway between the hours of 8:30 AM and 3:30 PM or as approved by the Project Engineer. Weekend and nighttime work will be allowed with the prior written approval of the Project Engineer. When work is performed on the roadway, the Contractor shall ensure that one lane is maintained in each direction.
    - Work will not be permitted that directly or indirectly interferes with the flow of traffic between the hours of 5:30 AM and 8:30 AM Monday through Friday; between the hours of 3:30 PM to 6:30 PM Monday through Thursday; and after 2:00 PM on Fridays unless otherwise authorized by the Project Engineer.
    - No work on Holidays or any day of a three-day or four-day weekend that includes a holiday. Holidays on which this restriction applies consist of those holidays recognized by the State of Colorado as listed in subsection 101.02.
    - Contractor shall not close lanes during special events.
    - Contractor shall coordinate lane closures with adjacent projects.
    - Contractor shall maintain business access during business hours.
    - The Contractor shall coordinate all of the work on the roadway during any special event with the City and County of Denver.

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REVISION OF SECTION 630
CONSTRUCTION ZONE TRAFFIC CONTROL

3. The Contractor shall install construction traffic control devices where they do not block or impede other existing traffic control devices or sidewalks for pedestrians, disabled persons or bicyclists. The Contractor is restricted from storing any materials, construction traffic control devices, signs, etc. in any median area or park area.

4. Vertical cuts or fills greater than 1 inch resulting from construction operations adjacent to traffic lanes, or within the clear zone shall be temporarily sloped at a 6:1 or flatter slope, and delineated at 35 foot intervals immediately after removal operations to safeguard the traveling public.

5. Construction equipment used on this project shall meet the same minimum exhaust requirements as those specified by the manufacturer of the equipment.

6. The Contractor and subcontractors shall equip their construction vehicles with flashing amber lights. Equipment to be used at night shall also be equipped with flashing amber lights. Flashing amber lights on vehicles and equipment shall be visible from all directions.

7. The Contractor shall maintain access to all roadways, side streets, walkways, alleyways, driveways, and hike/bike paths at all times unless otherwise directed by the Engineer. Only one corner of each intersection's sidewalks and bike lanes may be closed at a given time. Parking areas temporarily disturbed by construction activities shall be restored to a useable condition during non-working hours. Such temporary parking shall utilize an all weather surface. The Contractor shall develop an Access Maintenance Plan in coordination with, and based on the requirements of, the affected property owners and tenants, and submit it to the Engineer for approval prior to commencement of work. This plan shall detail all barricades, ramps, signs,

   and temporary means of access required by the property owners or tenants. Prior to commencing any work which affects access to a property, the Access Maintenance Plan for that property must be submitted and approved by the Engineer.

8. The Access Maintenance Plan shall be coordinated with all affected owners and tenants. The Access Maintenance Plan shall include documentation of this coordination, including the approval signature of each affected owner or tenant.

Should the Contractor be unable to obtain approval and signatures, documentation of the efforts made to obtain said approval and signatures must be submitted.

All access shall be maintained on surfaces equal to or better than those existing at the time the access is first disturbed. For short periods of time only as allowed by the Engineer, access may be maintained on an aggregate base course surfaces.

9. The Contractor shall maintain continuous access throughout the project for pedestrians, bicyclists, and disabled persons. When the existing access route is disturbed by construction,
a temporary all-weather access shall be provided. All temporary access shall be a minimum of 5 feet wide and meet Americans with Disabilities Act (ADA) requirements. Acceptable all weather surfacing shall be concrete or asphalt surface, or as approved by the Engineer. Delineation of pedestrian access through the work area shall be accomplished using temporary plastic fencing.

10. The costs of maintaining access will not be paid for separately, unless otherwise provided, but shall be included in the work. Utilization of materials to be incorporated into the work may be permitted. However, any degradation or other contamination or destruction shall be corrected at the Contractor's expense prior to acceptance.

11. During non-construction periods (evenings, weekends, holidays, etc.) all work shall be adequately protected to insure the safety of vehicular and pedestrian traffic, as detailed in the Contractor's MHT. Excavations or holes shall be filled in or fenced when unattended.

12. Whenever the Contractor removes, obliterates, or overlays any pavement markings, he /she shall replace them on a daily basis prior to opening the affected areas to traffic. All temporary pavement markings shall fully comply with the Standard Specifications and Special Provisions.

13. The Contractor shall not have construction equipment or materials in the lanes open to traffic any time unless directed by the Engineer.

14. All personal vehicle and construction equipment parking is prohibited where it conflicts with safety, access, or the flow of traffic. Landscaped areas, public park areas, and roadway shoulders shall be kept clear of parking and storage of all personal and construction equipment except where approved by the Engineer.

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REVISION OF SECTION 630
CONSTRUCTION ZONE TRAFFIC CONTROL

15. The Contractor shall not place tack coat on any surface to be paved where traffic will be forced to travel upon fresh bituminous materials.

16. The Contractor shall be required to make arrangements with the Regional Transportation district (RTD) prior to closing any existing bus stops within the project limits. Temporary stops will be required as directed by the Engineer and as required by RTD. For bus stop/route conflicts Regional Transportation District, RTD / 1560 Broadway, Suite 700, Denver, CO 80202 shall be contacted two business days prior to start of construction.

17. The Contractor shall be required to maintain temporary drives at any existing establishment that has singular access off of the roadways, unless otherwise approved in writing by the property owner.

18. All lane closures shall be subject to the approval of the Engineer. Request for each closure shall be made at least 24 hours in advance of the time the lane closure is to be implemented. For collectors and arterials, the Street Occupancy Permit application needs to be submitted 10 days before the requested work.

19. During no-working hours, the roadways shall be restored to a safe travel conditions for the free flow of traffic. Any maintenance required restoring the roadways to this condition, including the pavement patching and grading, shall be done prior to opening the areas to traffic or completing work for the day.

20. The Contractor shall clean the roadway of all construction debris before opening it to traffic.

21. All flagging stations used at night shall be illuminated with floodlights. Street, highway lights and “high mast lighting” may be used for flagging station illumination when approved by the Engineer. Floodlights shall be located and directed so as not to interfere with the sight of any motorists, and the cost to be included in the work.

22. Prior to removal and resetting of any sign the Contractor and Engineer shall prepare an inventory. Any signs damaged due to the Contractor’s operations shall be replaced in kind or repaired by the Contractor at no additional cost to the project.

23. Unless noted otherwise, all costs incidental to the foregoing requirements shall be included in the original contract prices for the project, including any additional traffic control items required for haul routes into the project.

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REVISION OF SECTION 630
CONSTRUCTION ZONE TRAFFIC CONTROL

Subsection 630.10 (10) shall be added as follows:

Number of hours for uniformed traffic control shall be tabulated for submittal.

Subsection 630.10 (11) shall be added as follows:

Contractor shall obtain all required access and construction permits from the City & County of Denver prior to initiating work along City right of way. Applications for collectors and arterials must be submitted ten (10) days before the requested start date. Applications for occupancy of local streets need to be submitted five (5) working days before the requested start date.

MHT's should meet the requirements in the CCD Traffic Control Procedure document.

All lane closures require an arrow board to be installed.

All streets that will be reduced in the number of travel lanes should have variable message boards installed for a minimum of 3 days after the striping change to inform drivers of the lane reduction.

Subsection 630.15 is hereby deleted and replaced with the following:

The Contractor shall furnish all other personnel – including flaggers, traffic control inspector, and traffic control supervisor - and other materials necessary to perform the Construction Zone Traffic Control as required and these quantities will not be measured but will be included in the cost of Traffic Control Management.

Temporary pavement markings for traffic control will not be measured and paid for separately, but shall be included in the work.

Subsection 630.16 is hereby deleted and replaced with the following:

All traffic control shall comply with the requirements of the FHWA MUTCD Part 6 (2011 edition) – Temporary Traffic Control.

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REVISION OF SECTION 630
CONSTRUCTION ZONE TRAFFIC CONTROL

Subsection 630.18 shall include the following:

Payment will be made under:

Pay Item	Pay Unit
Traffic Control	LS

All costs incidental to maintenance of access will not be paid for separately but shall be included in the work.

All costs incidental to the foregoing requirements shall be included in the original contract prices for the project.

ALLOWANCE ITEMS

DESCRIPTION

This Special Provision contains the City and County of Denver's estimate for Allowance Items included in the Contract. The estimated amounts will be added to the total bid to determine the amount of the performance and payment bonds. Allowance work shall be performed as directed by the Engineer.

BASIS OF PAYMENT

Payment will be made in accordance with Subsection 109.04. Payment will constitute full compensation for all work necessary to complete the item.

Allowance work valued at $5,000 or less that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

Item No.	Allowance Items	Quantity	Estimated Amount
A/W 01	Furnish & Install Electrical Service	A/W	$100,000
A/W 02	Landscaping	A/W	$50,000
A/W 03	Erosion Control	A/W	$10,000
A/W 04	Environmental Health & Safety Management	A/W	$5,000

Allowance descriptions include:

A/W 01 Furnish & Install Electrical Service – This allowance is for all cost charges from the power service provider, and all necessary materials, labor and coordination required to maintain existing or establish new power sources required for permanent operation of equipment as shown in the plans, including the installation of new transformers.

A/W 02 Landscaping– This work is described in Revision of Section 212 – Landscape Restoration.

A/W 03 Erosion Control – This work consists of stormwater BMPs authorized and approved by the Engineer. This Allowance is to pay for all necessary work and materials for erosion control items not identified in the plans and at the Engineer's direction. Payment will be made based on time and materials used to perform the work. All items shall be pre-approved by the engineer prior to installation or they will be at no cost to the project.

A/W 04 Environmental Health & Safety Management – This work is described in Section 250 - Environmental, Health, and Safety Management of the Standard Specifications.

DENVER (ONLY) NOISE ORDINANCE – PERMIT VARIANCE APPLICATION TEMPLATE

Date
Subject: **Request for Variance to Noise Ordinance**
[location where work is to be performed]

Dear Ms. VanDerLoop,

- Name of company/organization seeking the variance
- What is being proposed, where it will occur, expected duration of project
- Brief history regarding proposed project
- Description of the community in the vicinity of the proposed project area

6 (a) Type and Timing of Claim:

- Specific description of proposed project (figures are helpful)
- Why does work need to be conducted at night? (CDOT can provide details to contractor)
- Are there limiting factors preventing this work from being conducted during the day? (CDOT can provide details to contractor)
- Requested variance duration; start and end dates
- Proposed work hours
- Types/categories of equipment being used for the project (if known, a detailed list should be provided as an appendix)
- Is this variance request contingent on other regulatory approvals/permits? (construction, demo, remediation)

6 (b) Date of Payment:

- [The Company's] date of payment is the date shown of this letter/request.

6 (c) Objections to Manager's Determinations:

- Specific items applicant may be in disagreement with concerning Department's recommendations or requirements

6 (d) (1) Hardship if Variance is Not Granted:

- Public safety concerns (CDOT can provide details to contractor)
- Logistical concerns
- Time constraints with a detailed explanation as to why they are necessary
- Cost considerations (specifics desirable)
- Document and evaluate possible alternatives

6 (d) (2) No Adverse Affects to Public Health:

- List expected noise levels to be generated (1) at the site where work is being performed, and (2) at the nearest sensitive receptor (CDOT can provide details to contractor from Roadway Construction Noise Model)

- Detail existing ambient sound levels (L90, Leq, Lmax) for the same areas (at least 1 night of pre-work monitoring; 9 p.m. to 7 a.m.; two nights (one weekday, one weekend) if work will occur on weekdays and weekends)
- How do the proposed levels compare with existing EPA or other guidance? (CDOT can provide details to contractor)
- Are there adverse health effects other than noise to be concerned with as a result of the proposed work? (CDOT can provide details to contractor)

6(d) (3) Maintain Harmony with the Spirit and Purpose of the Ordinance:
(CDOT can provide details to contractor for sec 6(d) (3)

- Is the scope of work considerate of present and future community concerns?
- How does the scope of work seek to minimize impacts to the community?
- Have noise mitigation techniques been included and/or considered?
- Has a noise monitoring plan been considered or proposed?
- How will community outreach be conducted prior to the start of work?
- Has a community response plan been developed to deal with any future complaints? (contact name and number of on-site representative)

6 (e) Project Location and Haul Routes:

- Figures are preferable (CDOT can provide details to contractor)

6 (f) Petitioner Information

[Company Name and Address]

[Contact Person/Project Manager info]

6 (g) Petitioner's Signature

Sincerely,

[Name and Title]

Note: In addition to this template, CDOT can provide an example of a previously written (City and County of Denver) variance application at the contractor's request.

<u>The following field work summary of requirements will be the sole responsibility of the contractor for maintaining compliance with the Denver (only) Permit Variance agreements once granted by the Department of Environmental Health.</u>

1) **Construction Activity Allowable Noise Levels:** Unless the accommodations described in below are provided, construction noise levels shall not exceed:
   a. an hourly Leq of 75 dBA, or 5 dBA greater than an ambient hourly Leq measuring more than 75 dBa, or
   b. an Lmax of 86 dBA during the hours of 9:00 p.m. to 7:00 a.m. (Nighttime Hours)

2) **Hotel accommodations within eligibility zones:** (Contractor) shall make hotel accommodations available for persons residing within eligibility zones where Nighttime construction noise levels exceed allowable noise levels. The eligibility zone shall be determined by a sound study conducted by the (contractor) and approved by DEH prior to a seven-day notification period. During nighttime construction, (contractor) shall conduct noise monitoring to verify the sound study results and shall expand and may restrict the eligibility zone to the areas where the actual noise levels exceed an hourly Leq of 75 dB(A) or an Lmax of 86 dB(A). (Contractor) shall consider any special circumstances brought to their attention regarding individuals in the eligibility zone who cannot utilize hotel vouchers and who may be at risk during this period of time, e.g., residents of 24-hour health care facilities. (Contractor) shall make their best effort to accommodate the needs of such individuals during Construction Activity.

3) **Notifications:** Not less than seven days prior to commencement of construction during Nighttime Hours, (contractor) shall notify individual households located within a 1000 foot radius of the construction, as well as representatives of each affected Registered Neighborhood Organizations. Notice shall be in writing or by direct personal contact from (contractor) representative, and shall include the expected start time, expected duration, character of work activity planned, names and telephone numbers of available contact persons (for additional information or questions), contact numbers for complaints, and any other relevant parameters or programs. Households within the eligibility zone shall receive notice regarding their eligibility for hotel vouchers at the same time or earlier.

4) **Mitigation Requirements/Activity Restraints:**When construction is conducted during Nighttime Hours and such activity emits noise levels that exceed ambient noise levels at residential properties, (contractor) shall utilize best reasonable management practices to mitigate construction noise impacts to the adjacent property owners. Best reasonable management practices include the following:
    a. Using reasonable best efforts to complete the construction as quickly as possible.
    b. Minimizing nighttime construction duration near residential areas whenever possible.
    c. Re-routing of truck traffic away from residential streets when possible.
    d. Conducting truck loading, unloading and hauling operations so that noise levels are kept to a minimum
    e. Configuring equipment on the site to minimize back-up alarm noise, where practical and feasible (for example, by using circular movement of trucks).
    f. Shielding jackhammers, saws, and pavement breakers through use of an existing sound barrier wall or temporary barrier where practicable
    g. Maintaining all equipment to meet manufacturer's specifications.

h. Informing employees, contractors and subcontractors performing construction of the general requirements of this variance and exercising best efforts to ensure that such employees, contractors and subcontractors follow best management practices in mitigating construction noise.

5) **Monitoring:** (Contractor) shall perform monitoring sufficient to demonstrate compliance with the requirements of the noise variance and to demonstrate to the community the noise levels that are present.
   a. Noise measurements shall be collected using ANSI guidelines for community noise monitoring
      i. Manufacturer's specifications for appropriate meter use shall be followed.
      ii. All noise measurements shall be made using the A-weighted scale (dB(A)) and a slow response. Fast response measurements may be used to measure impact noise levels.
      iii. Noise measurements shall be made at the nearest residential property line, unless physically impractical.

   b. All nighttime construction activity shall be initially monitored. Monitoring shall include spot measurements, as appropriate and hourly Leq. Monitoring shall be required for the following activity groups, but not be limited to:
      i. Joint Repair
      ii. Milling Operations
      iii. Rubble load-out
      iv. Paving operations

   c. Monitoring shall meet the following requirements:
      i. Each construction activity shall be monitored a minimum of two days for Lmax and hourly Leq levels to establish an activity baseline for each activity when initially undertaken, and to establish the expected worst case situation (outside lane).
      ii. Noise monitoring shall be provided in response to all noise complaints.
      iii. All noise monitoring data and documentation shall be provided to DEH at least weekly when applicable, and such data shall be available to the public from DEH. DEH and their designated representatives may inspect collected data more frequently.

   d. The following documentation, in a manner and form mutually agreed upon by CDOT, (contractor) and DEH, shall be provided for noise monitoring that is conducted:

      i. Manufacturer names, model numbers, and serial numbers of each SLM and acoustical calibrator used.
      ii. Software manufacturer, program and version.

iii. Dates of annual certified calibration of SLM, microphone and acoustical calibrator.
iv. Pre- and post- monitoring calibration data for the Sound Level Meter.
v. Date and specific location (address if appropriate) of monitoring.
vi. Start time and end time of monitoring
vii. Ambient weather conditions including temperature, relative humidity, wind speed and cloud cover.
viii. Signature of technician collecting the data
ix. List of each hourly Leq for the monitoring period, with associated Lmax levels.
x. All measurements associated with any unusual noise events that occurred, cause of such event if known, correction of such event (if any), and adjusted and unadjusted measurements.

6) **Complaint Notification and Response:** (Contractor) shall ensure that methods are available to receive, address, and respond to concerns raised by people in the community, through:
   a. Assuring that a field representative is available to respond to complaints regarding construction noise levels and provide monitoring. The field representative shall be empowered to shut down construction activity, authorize correction or remediation of sources of excess noise, and authorize resumption of construction activity as necessary to maintain compliance with allowable noise levels.
   b. Providing telephone access to a field representative during hours of project activities to receive complaints or comments from the public for the duration of the project. All complaints immediately shall be recorded, investigated and addressed as appropriate by the field representative and reported to DEH in a manner mutually agreed by DEH, CDOT and (contractor). A response, in a reasonable form requested by the caller, summarizing the investigation and any corrective actions taken by CDOT and (contractor) shall be provided to the caller. Written copies of complaints received and responses by (contractor) shall be provided weekly to DEH and CDOT.

All application requirements and chapter 36 ordinance requirements regarding night time construction noise activities must be coordinated by the contractor with the City/County Denver. The contractor is fully responsible for the timely submittal of the variance application and fulfilling the requirements set forth by the City/County of Denver to allow construction activities during p.m. hours under the granted variance.

UTILITIES

Known utilities within the limits of this project are:

UTILITY OWNER ADDRESS	CONTACT NAME EMAIL	TELEPHONE
AT&T Transmission	Ian Wettland Wettland@att.com	303-324-6001
Comcast	Butch Buster Butch.buster@comcast.com	303-603-5682
Department of Transportation and Infrastructure – Denver (DOTI) - Traffic	Chad Tavelli Chad.tavelli@denvergov.com	720-448-6700
Department of Transportation and Infrastructure – Denver (DOTI) - Wastewater	Selena A.K. Klosowski Selena.klosowski@denvergov.com	303-446-3520
Denver Water Department (DWD)	Kela Naso Kela.naso@denverwater.com	720-517-4486
Lumen	Jerry Mulunda jerry.mulunda@lumen.com	720-957-3815
MCI - Verizon	Lane Grady Lane.grady@verizon.com	303-8227-9756
Metro Water Recovery	Rika Beck Rbeck@metrowaterrecovery.com	303-286-3308
Viaero	Shannon McKenzie Shannon.mckenzie@viaerofiber.com	970-467-404
Xcel Energy – Builders Call Line (BCL)	BCLCO@xcelenergy.com	1-800-628-2121
Zayo	James Black Zayo.relo.colorado@zayo.com	719-216-8508

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UTILITIES

The work described in these plans and specifications requires coordination between the Contractor and the Utility Owners in accordance with CDOT 2023 Standard Specifications for Road and Bridge Construction Subsection 105.11 and Title 7 of the City and County of Denver (DOTI) Standard Specifications for Construction – General Conditions in conducting their respective operations as necessary to complete the utility work with minimum delay to the project.

All new underground facilities, including laterals up to the structure or building being served, installed as part of this project must be electronically locatable when installed, in compliance with Colorado Revised Statutes, Title 9, Article 1.5.

3
UTILITIES

PART 1 - CONTRACTOR SHALL PERFORM THE WORK LISTED BELOW:

The Contractor shall protect in place all utilities. The Contractor will contact each utility company a minimum of two weeks, unless otherwise noted, prior to working in the utility company's area.

Prior to excavating, the Contractor shall positively locate (through potholing if necessary) all potential conflicts with existing underground utilities and proposed construction, as determined by the Contractor according to proposed methods and schedule of construction.

If a need for additional utility work by either the Contractor or a Utility Owner arises, the following shall apply:

The Contractor shall be responsible for coordinating the adjustment of utilities on this project. The Contractor shall keep each Utility Owner advised of any work being performed in the vicinity of their facilities, so that each Utility Owner can coordinate any needed locates, adjustments, or inspections.

Contractor shall provide the appropriate Utility Owner ample notice, but not less than two (2) weeks, prior to commencing activities in the vicinity of their facilities. Any additional work performed by the Contractor on behalf of the impacted Utility Owner shall not be paid for by CDOT but shall be paid by the Utility Owner requiring the work.

The Contractor shall notify and request approval of any additional work from the Project Owner for additional utility work prior to commencing.

The Contractor shall examine the site for evidence of failures or deficiencies in existing utility owner facilities and to immediate notify the utility owner with any such evidence of pre-existing damage. The Contractor shall repair any damages (direct or indirect) that may be subsequently discovered and proven to have been caused by the construction activities, without such evidence of pre-existing damage. The Contractor shall have the sole responsibility to repair utility company facilities within six feet of the construction activity or with a period of two years from the date of warranty commencement, when failures were caused by the construction activities. The Contractor shall protect all utility company facilities within the area of construction, this includes all steps necessary to prevent subsidence of the soil near utility company facilities.

The Contractor shall follow the utility standards of DOTI, as applicable. In cases where there are discrepancies between the standards the more stringent standard shall apply. Any discrepancies identified by the Contractor shall be brought to the attention of the Project Engineer for clarification and resolution.

AT&T

The Contractor shall protect in place all AT&T facilities within the project area as shown in the plans.

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UTILITIES

The Contractor shall contact AT&T if any AT&T facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with AT&T to schedule and complete the work by AT&T forces.

Timing: The Contractor shall notify AT&T a minimum of two weeks in advance of construction activity commencing near AT&T facilities.

Comcast

The Contractor shall protect in place all Comcast facilities within the project area as shown in the plans.

The Contractor shall contact Comcast if any Comcast facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with Comcast to schedule and complete the work by Comcast forces.

Timing: The Contractor shall notify Comcast two weeks in advance of construction activity commencing near Comcast facilities.

Denver Transportation and Infrastructure (DOTI) Traffic Operations

The Contractor shall protect in place all DOTI Traffic facilities within the project area as shown in the plans.

The Contractor shall contact DOTI Traffic if any DOTI Traffic facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall schedule and complete the work to be completed by a pre-approved DOTI contractor.

Timing: The Contractor shall notify DOTI Traffic Operations a minimum of two weeks in advance of construction activity commencing near the Denver Traffic Operations facilities.

Denver Transportation and Infrastructure (DOTI) Wastewater

The Contractor shall protect in place all DOTI Wastewater facilities within the project area as shown in the plans.

The Contractor shall contact DOTI Wastewater if any DOTI Wastewater facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall schedule and complete the work to be completed by a pre-approved DOTI contractor.

Timing: The Contractor shall notify DOTI Wastewater a minimum of two weeks in advance of construction activity commencing near the DOTI Wastewater facilities.

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UTILITIES

Denver Water Department (DWD)

The Contractor shall protect in place all DWD facilities within the project area as shown in the plans.

The Contractor shall contact DWD if any DWD facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall schedule and complete the work to be completed by a pre-approved DWD contractor.

Timing: The Contractor shall notify Denver Water Department two weeks in advance of construction activity commencing near Denver Water Department facilities.

Lumen

The Contractor shall protect in place all Lumen facilities within the project area as shown in the plans.

The Contractor shall contact Lumen if any Lumen facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with Lumen to schedule and complete the work by Lumen forces.

Timing: The Contractor shall notify Lumen two weeks in advance of construction activity commencing near Lumen facilities.

MCI

The Contractor shall protect in place all Lumen facilities within the project area as shown in the plans.

The Contractor shall contact MCI if any MCI facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with MCI to schedule and complete the work by MCI forces.

Timing: The Contractor shall notify MCI two weeks in advance of construction activity commencing near MCI facilities.

Viaero

The Contractor shall protect in place all Viaero facilities within the project area as shown in the plans.

The Contractor shall contact Viaero if any Viaero facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with Viaero to schedule and complete the work by Viaero forces.

Timing: The Contractor shall notify Viaero two weeks in advance of construction activity commencing near Viaero facilities.

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UTILITIES

Xcel Energy - Electric Distribution and Transmission

The Contractor shall call the Builder's Call Line 90 days prior to construction at 1-800-628-2121.

The Contractor shall protect in place all Xcel Electric facilities within the project area as shown in the plans.

The Contractor shall contact Xcel Energy if any Xcel Energy facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with Xcel Energy to schedule and complete the work by Xcel Energy forces.

Timing: The Contractor shall notify Xcel Energy a minimum of two weeks in advance of construction activity commencing near Xcel Energy facilities.

Xcel Energy - Lighting/Traffic

The City and County of Denver has sent a Work Request to Xcel Energy per the Franchise Agreement between the City and County of Denver and Public Service Company of Colorado, and the related Operating Agreement and Street Lighting Agreement (collectively known as the "Franchise Agreements").

In reference to new/modified service to City facilities (i.e., power supply, removal or installation of poles, etc.), Section 5.3 of the Operating Agreement states: "The company (Xcel Energy) shall complete each project requested by the City within a reasonable time. The Parties agree that for Traffic Facilities, a reasonable time shall not exceed one hundred twenty (120) days from the date upon which the Executive Director of Public Works makes a Work Request and for all other City Facilities a reasonable time shall not exceed one hundred eighty (180) days from the date upon which the Executive Director of Public Works makes a Work Request." When requesting that the City initiate a Work Request to Xcel Energy, the Contractor should consider the time limits contained in the Franchise Agreements.

The Contractor shall be responsible for the coordination of power source work to be performed by Xcel Energy. Once the Work Request has been submitted, the Contractor will be provided the Builder's Call Line (BCL) Application numbers for electrical services for the Xcel Energy work elements to be coordinated with the project.

> BCL applications have been completed for each electrical service, demolition work, and City and County of Denver traffic signal work. The requests have been processed through Xcel Energy Builder's Call Line at 1-800-628-2121 or BCLCO@Xcelenergy.com.
>
> The name of the owner for each meter or flat-rated service shall be the owner's name and billing address responsible for paying the utility bill and shall be listed on the BCL application. The Contractor shall be listed as the Builder and the contact during construction on the BCL application.

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UTILITIES

The Contractor shall perform the required coordination to establish the power sources for traffic signals and lighting, as shown on the electrical/fiber and traffic signal plans. The Contractor shall perform all work necessary to maintain existing or establish new power sources to the devices called for in the plans and per the standard for any metered or flat-rated services.

All cost charges from the power service provider, and all necessary materials and labor shall be reimbursed from the Adjustment Furnish and Install Electrical Service.

Timing: The Contractor shall notify Xcel Energy a minimum of two weeks in advance of construction activity commencing near Xcel Energy facilities. The Xcel Energy portion of this work shall be completed within the time frames set forth in the franchise agreement in a manner that does not interfere with the project construction activities of the City and County of Denver. This work is expected to be coordinated with construction and take one working day at each location to complete.

Xcel Energy – Gas Distribution and High Pressure

The Contractor shall call the Builder's Call Line 90 days prior to construction at 1-800-628-2121.

The Contractor shall protect in place all Xcel Gas facilities within the project area as shown in the plans.

The Contractor shall coordinate with Xcel Energy if any facility is found to be in conflict with the proposed project improvements. If a relocation or adjustment is necessary, the Contractor shall coordinate with Xcel Energy to schedule and facilitate the work by Xcel Energy forces.

Timing: The Contractor shall notify Xcel Energy a minimum of two weeks in advance of construction activity commencing near Xcel Energy facilities.

Zayo

The Contractor shall protect in place all Zayo facilities within the project area as shown in the plans.

The Contractor shall contact Zayo if any Zayo facility is found to be in conflict. If a relocation or adjustment is necessary, the Contractor shall coordinate with Zayo to schedule and complete the work by Zayo forces.

Timing: The Contractor shall notify Zayo two weeks in advance of construction activity commencing near Zayo facilities.

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UTILITIES

PART 2 - UTILITY OWNERS SHALL PERFORM THE WORK LISTED BELOW:

The Contractor shall protect in place all utilities. The Contractor will contact each utility company a minimum of two weeks, unless otherwise noted, prior to working in the utility company's area.

If a need for utility work by either the Contractor or a Utility Owner arises, the following shall apply:

The Contractor shall be responsible for coordinating the adjustment of utilities on this project. The Contractor shall keep each Utility Owner advised of any work being performed in the vicinity of their facilities, so that each Utility Owner can coordinate any needed locates, adjustments, or inspections.

Contractor shall provide the appropriate Utility Owner ample notice, but not less than two (2) working days, prior to commencing activities in the vicinity of their facilities. Any additional work performed by the Contractor on behalf of the impacted Utility Owner shall not be paid for by CDOT but shall be paid by the Utility Owner requiring the work.

AT&T

No impacts are anticipated to AT&T facilities.

AT&T shall coordinate with the Contractor if any AT&T facility is found to be in conflict. If a relocation or adjustment is necessary, AT&T shall schedule and complete the work by AT&T forces.

Timing: The Contractor shall notify AT&T a minimum of two weeks in advance of construction activity commencing near AT&T facilities.

Comcast

No impacts are anticipated to AT&T facilities.

Comcast shall coordinate with the Contractor if any Comcast facility is found to be in conflict. If a relocation or adjustment is necessary, Comcast shall schedule and complete the work by Comcast forces.

Timing: The Contractor shall notify Comcast two weeks in advance of construction activity commencing near Comcast facilities.

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UTILITIES

Denver Transportation and Infrastructure (DOTI) -Traffic Operations

No impacts are anticipated to DOTI facilities.

DOTI Traffic shall coordinate with the Contractor if any DOTI Traffic facility is found to be in conflict. If a relocation or adjustment is necessary, DOTI Traffic shall inspect the work.

Timing: The Contractor shall notify DOTI two weeks in advance of construction activity commencing near Comcast facilities.

Denver Transportation and Infrastructure (DOTI) - Wastewater

No impacts are anticipated to DOTI facilities.

DOTI Wastewater shall coordinate with the Contractor if any DOTI Wastewater facility is found to be in conflict. If a relocation or adjustment is necessary, DOTI Wastewater shall inspect the work.

Timing: The Contractor shall notify DOTI Wastewater two weeks in advance of construction activity commencing near DOTI Wastewater facilities.

Denver Water Department (DWD)

No impacts are anticipated to DWD facilities.

DWD shall coordinate with the Contractor if any DWD facility is found to be in conflict. If a relocation or adjustment is necessary, DWD shall inspect the work.

Timing: The Contractor shall notify DWD two weeks in advance of construction activity commencing near DWD facilities.

Lumen

No impacts are anticipated to Lumen facilities.

Lumen shall coordinate with the Contractor if any Lumen facility is found to be in conflict. If a relocation or adjustment is necessary, Lumen shall schedule and complete the work by Lumen forces.

Timing: The Contractor shall notify Lumen two weeks in advance of construction activity commencing near Lumen facilities.

MCI

No impacts are anticipated to MCI facilities.

MCI shall coordinate with the Contractor if any MCI facility is found to be in conflict. If a relocation or adjustment is necessary, MCI shall schedule and complete the work by MCI forces.

Timing: The Contractor shall notify MCI two weeks in advance of construction activity commencing near MCI facilities.

Viaero

No impacts are anticipated to Viaero facilities.

Viaero shall coordinate with the Contractor if any Viaero facility is found to be in conflict. If a relocation or adjustment is necessary, Viaero shall schedule and complete the work by Viaero forces.

Timing: The Contractor shall notify Viaero two weeks in advance of construction activity commencing near Viaero facilities.

Xcel Energy – Electric Distribution and Transmission

No impacts are anticipated to Xcel Energy electric facilities.

Xcel Energy shall coordinate with the Contractor if any Xcel Energy facility is found to be in conflict. If a relocation or adjustment is necessary, Xcel Energy shall schedule and complete the work by Xcel Energy forces.

Timing: The Contractor shall notify Xcel Energy two weeks in advance of construction activity commencing near Xcel Energy facilities.

Xcel Energy – Lighting/Traffic

After the Contractor has completed the installation for the traffic signal poles and luminaries including conduit, electric meter foundation and pedestal, and wiring to the power source at each location, Xcel forces shall connect the meter and power source and install new transformers.

Timing: This work is expected to be coordinated with construction and take one working day at each location to complete.

Xcel Energy – Gas Distribution

No impacts are anticipated to Xcel Energy gas facilities.

Xcel Energy shall coordinate with the Contractor if any Xcel Energy facility is found to be in conflict. If a relocation or adjustment is necessary, Xcel Energy shall schedule and complete the work by Xcel Energy forces.

Timing: The Contractor shall notify Xcel Energy two weeks in advance of construction activity commencing near Xcel Energy facilities.

Zayo

No impacts are anticipated to Zayo facilities.

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UTILITIES

Zayo shall coordinate with the Contractor if any Zayo facility is found to be in conflict. If a relocation or adjustment is necessary, Zayo shall schedule and complete the work by Zayo forces.

Timing: The Contractor shall notify Zayo two weeks in advance of construction activity commencing near Zayo facilities.

GENERAL

The Contractor shall comply with Article 1.5 of Title 9, CRS ("Excavation Requirements") when excavating or grading is planned in the area of underground utility facilities. Through 811, the Contractor shall notify all affected utilities at least two (2) business days, not including the actual day of notice, prior to commencing such operations. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) at phone no. **811 or 1-800-922-1987**, to have locations of UNCC registered lines marked by member companies. All other underground facilities shall be located by contacting the respective owner. Utility service laterals shall also be located prior to beginning excavation or grading.

The locations of utility facilities as shown on the plan and profile sheets were obtained from the best available information. No warranty is made for the adequacy or accuracy of subsurface information provided. The Contractor shall cooperate with the Utility Owners in their relocation operations as provided in subsection 105.11 of the Standard Specifications for Road and Bridge Construction. No guarantee is made that utility conflicts will be resolved prior to construction activities and any delays resulting from utility relocation work shall be dealt with in accordance with subsection 108.08 of the Standard Specifications for Road and Bridge Construction as amended.

Utilities are depicted on these plans in accordance with their achieved “Quality Level” as defined in the American Society of Civil Engineers, Utility Engineering & Surveying Institute, and Construction Institute’s document ASCE 38-22, “Standard Guideline for Investigating and Documenting Existing Utilities”. Reliance upon these data for risk management purposes during bidding does not relieve the excavator or Utility Owner from following all applicable utility damage prevention statutes, policies, and/or procedures during excavation.

All costs incidental to the foregoing requirements will not be paid for separately but shall be included in the work.