

## **SECTION 32 - TECHNICAL SPECIFICATIONS FOR INTELLIGENT TRANSPORTATION SYSTEMS**

### **32-1.1 DEFINITIONS**

Wherever in the Special Provisions and other contract documents the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

City Engineer: City of Fresno City Engineer, Traffic Engineer or their representative.

Engineer: City of Fresno Construction Manager, Construction Engineer or their representative.

Electrical Superintendent: City of Fresno Traffic Signals and/or ITS Supervisor or their representative.

Caltrans Standard Specifications: State of California Department of Transportation, Standard Specifications, latest edition.

Intelligent Transportation System (ITS) - Electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

Qualified Products List (QPL) – City of Fresno list of approved ITS equipment.

### **32-1.2 GENERAL**

All equipment and materials shall be certified to meet nationally recognized standards and Listed, Labeled or Identified by the appropriate Nationally Recognized Test Laboratories (NRTL) or Inspection Agencies. All electrical installations shall be in accordance with the NFPA National Electrical Code. Examination, identification, installation, and use of materials and equipment shall be approved by City of Fresno City Engineer or their designees.

All ITS work must be constructed in accordance with approved plans prepared by a registered Professional Engineer and these specifications.

Existing electrical and communication systems, or approved temporary replacements thereof, shall be kept in effective operation during the progress of the work, except when shutdown is permitted in writing by the Engineer.

The locations of foundations, standards, services, pull boxes and other appurtenances shown on the plans are approximate. Exact locations and grades will be established as necessary by the Engineer.

All work shall comply with Fresno City Electrical Ordinances and National Electrical Manufacturer's Association Standards and all regulations and codes as stated in Section 86-1.02 "Regulations and Codes" of the Caltrans Standard Specifications.

Nothing in the plans and specifications shall be construed to permit work not complying with these codes.

### **32-1.3 MATERIALS**

Attention is directed to Section 6, "Control of Materials," of the Caltrans Standard Specifications. All materials required to complete the work under this contract shall be furnished by the Contractor, except as noted in the following paragraph 23-1.4, "City-Furnished Materials". The materials furnished and used shall be new, except such used materials as may be specifically provided for on the plans. All work and materials shall be in full accordance with the latest rules and regulations of the National Board of Fire Underwriters, and local ordinance or State laws, the State of California Industrial Accident Commission's Safety Orders, and Regulations of the Pacific Gas and Electric Company pertaining to service equipment and installations thereof.

### **32-1.4 CITY- FURNISHED MATERIALS**

Attention is directed to Section 6-1.02, "State-Furnished Materials," of the Caltrans Standard Specifications.

Unless otherwise provided in this section, the Contractor shall submit a written request to the Engineer for the delivery of City-furnished material at least 15 days in advance of the date of its intended use. The request shall state the quantity and type of each material.

The Contractor shall pick up the City-furnished equipment, if any, from the City of Fresno, Street Maintenance Division, 2101 'G' Street, Bldg. "E", Fresno, California. Contact the Electrical Superintendent at least two working days prior to picking up the material. The contractor is responsible for providing adequate loading means.

### **32-1.5 EQUIPMENT LIST**

Equipment list and drawings shall conform to the provisions in Caltrans Standard Specification Section 86-1.04.

All equipment and materials that the Contractor proposes to install shall conform to these specifications and the contract plans. A list of substitute equipment and/or materials, along with a written descriptive summary, describing the functions of the components which the Contractor proposes to install shall be submitted along with their bid proposal. The list shall be complete as to the name of the manufacturer, size and identifying number of each item. The list shall be supplemented by such other data as may be required.

In all cases, the judgment of the Electrical Superintendent shall be final as to whether substitute equipment and/or material recommended by the Contractor conforms to the intent of these specifications and is acceptable for use.

### **32-1.6 WARRANTIES, GUARANTEES AND INSTRUCTION SHEETS**

Warranties, guarantees and instruction sheets shall conform to the provisions in Section 86-1.05, "Warranties, Guarantees and Instruction Sheets," of the Standard Specifications and these Special Provisions. All equipment furnished shall be guaranteed to the City by the manufacturers for a period of not less than one (1) year, unless otherwise indicated, following the date of acceptance of the signal installation of such equipment. If any part (or parts) is (are) found to be defective in materials or workmanship within the one-year period,

and it is determined by the Electrical Superintendent, or by an authorized manufacturer's representative that said part (or parts) cannot be repaired on the site, the manufacturer shall provide a replacement part (or parts) of equal kind and/or type during the repair period and shall be responsible for the removal, handling, repair or replacement and reinstallation of the part (or parts) until such time as the ITS equipment is functioning as specified and as intended herein; the repair period shall in no event exceed 72 hours, including acquisition of parts.

The one-year guarantee on the repaired or replaced parts shall again commence with the date of reassembly of the system.

All work performed by the Contractor shall be guaranteed in writing to the Engineer for the 12 months from the date of acceptance.

### **32-1.7 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS**

The Contractor shall notify the Electrical Superintendent at least two full working days (not less than 48 hours) prior to the shutdown of any traffic signal, lighting or communication system. The Contractor may use temporary splices and wiring as approved by the Engineer to maintain existing traffic signal and ITS systems. After completion of project, all wiring shall meet City Standards. Shutdowns of ITS systems shall be limited to the period from 9 a.m. to 4 p.m. of normal working days, excluding legal holidays, weekends, and non-working days as directed by the Engineer.

### **32-1.8 SCHEDULING OF WORK**

Scheduling of work shall conform to the provisions in Section 86-1.07, "Scheduling of Work" of the Caltrans Standard Specifications.

Contractor shall submit a written schedule to the Engineer one-week in advance of the start of ITS work. Any deviation from the approved submitted schedule must be approved by the Engineer.

The Contractor shall notify the Engineer at least two working days in advance of any electrical work and also at least two working day in advance of any work done intermittently to facilitate inspection.

### **32-1.9 TRAFFIC CONTROL**

Traffic control shall be provided in accordance with the State of California, "Manual of Traffic Controls for Construction and Maintenance Work Zones," latest edition and City Standard Specifications Section 7-10.

### **32-1.10 36" X 60" ITS VAULT(S)**

Vaults shall be concrete with a reinforced spring loaded torsion assisted steel lid, have fiber optic holding rack, cross bar to hold the lid from closing and steps to climb down into the vault for maintenance. All vaults shall have a smooth finished bottom including a sump hole for drainage. The concrete box design shall be reinforced to provide high strength without excess weight. Special knockouts shall be provided and incorporated

into the construction of each wall. Each communication conduit entrance shall be sealed with duct plugs and trimmed smooth. Wall penetrations shall be water resistance and seal from the interior to the exterior.

#### Vault Body and Lid Specifications

##### Dimensions:

Cover: 36" x 60"

Base: 36" x 60" x 5.25"

Shipping : 2-pc. with C.I. cover

Lid Markings: "ITS COMMUNICATIONS"

Tension assisted spring loaded for light weight checker plate cover with strength galvanizing finish with non-skid surface. Vault shall have sump hole in vault base with 2 ton riss pin for handling. Knockouts shall be on all corners. Knockouts shall be thinwall, 8" x 16", 4 each per side.

#### **INSTALLATION PROCEDURES FOR 36" x 60" VAULTS**

Conduit entrances to vaults shall be spaced approximately 2 inches from bell edge to bell edge. Provide a uniform separation of conduit bells with complete grouting to make a smooth wall without blockage of conduit access. Conduits shall extend a minimum of 2 inches, 3 inches maximum, beyond the inner wall of any vault or structure. Start pacing conduits in a gradual taper 10 feet prior to entrance of vault. Use of concrete vibrator shall be required to insure complete distribution of concrete sand slurry around outside wall of the vault.

Conduit Identification: Identify each conduit using the conduit number shown in drawings by means of a stamped brass tag at each end at access vaults.

All vaults shall rest on a 6 inch layer of crushed rock which extends past the wall of the vault as shown on the Standard Drawings. The void between the edge of the vault and native soil shall be backfilled with sand.

Vaults shall be installed to matched existing grade and conform to sloped areas for drainage.

All vaults shall be installed with extensions.

All vaults shall be wrapped with building paper prior to backfilling. When the vault is installed in a non-sidewalk area, install a formed concrete apron, 1-foot wide and 4 inches deep around the pull box. The apron shall be sloped to drain away from the vault.

#### **NON-ABRASIVE NON-SLIP COATING**

Non-Slip Coating shall comply with MIL-W-5044 and shall be applied to all vault covers. Coating shall be a one component, brushable, non-abrasive, non-slip deck coating formulated with fast drying resins. Aggregates shall be non-abrasive and non-sparking and shall not scratch or damage underlying metal surfaces.

Non-slip coating shall be resistant to fire, acids, alkalis, solvents, grease, oil, salt water, detergents, alcohol, gasoline, cellulube and other hydraulic fluids.

Non-slip coating shall be applied over a primer. Two component epoxy primers shall be used.

Non-Slip coating shall be applied to a clean, dry surface. All rust, mill scale, paint, dirt, grease, oil, etc. must be completely removed. Methods of cleaning steel surface are as follows:

Wash metal surface with one coat of a wash primer conforming to MIL-C-8514, applied in accordance with MIL-C-8507. Primer shall be applied before coating.

Primer shall be applied on surfaces immediately after the surface has been cleaned and before rust or oxidation.

### **32-1.11 48" X 84" ITS VAULT(S)**

Vaults shall be concrete with a reinforced spring loaded torsion assisted steel lid, have fiber optic holding rack, cross bar to hold the lid from closing and steps to climb down into the vault for maintenance. All vaults shall have a smooth finished bottom including a sump hole for drainage. The concrete box design shall be reinforced to provide high strength without excess weight. Special knockouts shall be provided and incorporated into the construction of each wall. Each communication conduit entrance shall be sealed with duct plugs and trimmed smooth. Wall penetrations shall be water resistance and seal from the interior to the exterior.

#### **Vault Body and Lid Specifications**

Dimensions:

Cover: 48" x 78"

Base: 48" x 78" x 5.25"

Shipping: 2-pc. with C.I. cover

Lid Markings: "ITS COMMUNICATIONS"

Tension assisted spring loaded for light weight checker plate cover with strength galvanizing finish with non-skid surface. Vault shall have sump hole in vault base with 2 ton riss pin for handling. Knockouts shall be on all corners. Knockouts shall be thinwall, 8" x 16", 4 each per side.

### **INSTALLATION PROCEDURES FOR 48" X 84" VAULTS**

Conduit entrances to vaults, shall be spaced approximately 2 inches from bell edge to bell edge. Provide a uniform separation of conduit bells with complete grouting to make a smooth wall without blockage of conduit access. Conduits shall extend a minimum of 2 inches, 3 inches maximum, beyond the inner wall of any vault or structure. Start pacing conduits in a gradual taper 10 feet prior to entrance of vault. Use of concrete vibrator shall be required to insure complete distribution of concrete sand slurry around outside wall of the vault.

Conduit Identification: Identify each conduit using the conduit number shown in drawings by means of a stamped brass tag at each end at access vaults.

All vaults shall rest on a 6 inch layer of crushed rock which extends past the wall of the vault as shown on Standard Drawings. The void between the edge of the vault and native soil shall be backfilled with sand.

Vaults shall be installed to matched existing grade and conform to sloped areas for drainage.

All vaults shall be installed with extensions.

All vaults shall be wrapped with building paper prior to backfilling. When the vault is installed in a non-sidewalk area, install a formed concrete apron, 1-foot wide and 4 inches deep around the pull box. The apron shall be sloped to drain away from the vault.

### **NON-ABRASIVE NON-SLIP COATING**

Non-Slip Coating shall comply with MIL-W-5044 and shall be applied to all vault covers. Coating shall be a one component, brushable, non-abrasive, non-slip deck coating formulated with fast drying resins. Aggregates shall be non-abrasive and non-sparking and shall not scratch or damage underlying metal surfaces.

Non-slip coating shall be resistant to fire, acids, alkalis, solvents, grease, oil, salt water, detergents, alcohol, gasoline, cellulube and other hydraulic fluids.

Non-slip coating shall be applied over a primer. Two component epoxy primers shall be used.

Non-Slip coating shall be applied to a clean, dry surface. All rust, mill scale, paint, dirt, grease, oil, etc. must be completely removed. Methods of cleaning steel surface are as follows:

Wash metal surface with one coat of a wash primer conforming to MIL-C-8514, applied in accordance with MIL-C-8507. Primer shall be applied before coating.

Primer shall be applied on surfaces immediately after the surface has been cleaned and before rust or oxidation.

### **32-1.12 ITS CONDUITS / FIBER DUCTS**

This specification covers the performance characteristics with minimum and maximum acceptable performance levels for 1.5" SDR 11 conduit. Vendors supplying conduit as described by this specification shall demonstrate compliance with the values described in this document. All duct shall be smooth wall, direct burial rated and specifically designed for fiber optic cable. Electrical conduit, PVC pipe, galvanized pipe or other similar products will not be allowed.

It is the intent of these specifications to define the parameters by which conduit will be evaluated. Furthermore, the specifications will serve as a guide for the purpose of vendor qualification.

The ITS / Fiber Duct conduits shall include bundles of two (2) – 1-1/2", four (4)-1-1/2", six (6) 1-1/2", twelve (12) 1-1/2" or one (1) 2" as shown on the plans.

### **Material Specifications**

The HDPE resin shall meet the standards for Certified Type III, Category 5, Class B (colors) or Class C (black), Grade P34 high-density polyethylene specified in ASTM D

3350. Conduit for burial shall contain sufficient protection against UV radiation to demonstrate 90% retention of tensile elongation for up to 2 years of outdoor exposure.

Material Specifications			
Property	Test Method (ASTM)	Value	Cell Class.
Density (g/cm)	D 792A or D 1505	0.940 - 0.955	3
Melt Index (g/10 min)	D 1238	< 0.15	4
Flexural Modulus (psi)	D 790	110,000 - 160,000	5
Tensile Strength @ Yield (psi)	D 638	3,000 - 3,500	4
ESCR, Condition B	D 1693	0/10 Failures / 1000 hrs.	7
Hydrostatic Design Basis (psi)	D 2837	Not Pressure Rated	0
Tensile Strength @ Break	D 638	4,500 Min.	
Tensile Elongation @ Break (%)	D 638	750 Min.	
Brittleness Temp. (C)	D 746	< -76	

**Conduit Physical Properties:**

Dimensional measurements shall be performed on samples removed from each complete length of finished conduit, unless otherwise specified. All dimensions will be expressed in inches and carried out three decimal places. Outer diameter and wall thickness will be provided as a stated standard for each conduit size with a plus/minus tolerance. Inner diameter will be stated as a nominal value.

Dimensional requirements for 1.5" SDR 11 conduit:

Nominal Size	Outside Diameter	Wall Thickness	Nominal Inner Diameter
1.50"	1.900 +/- 0.012	0.173 +0.026	1.528"

Ovality shall be expressed as a percent and calculated using IEEE Standards and included with the submittals. The ovality shall be no more than five percent.

The conduit shall have a minimum bend radius equal to twenty inches and shall have a safe working pull strength greater than 3,000 pounds.

**Quality Control:**

Manufacturer will be responsible for inspecting 100% of the conduit supplied for Conduit Dimensions, Ovality, and Visual Appearance.

Contractor shall provide a Certificate of Compliance that the conduits meet the provisions of this section.

### **Print Legend:**

The conduit shall be printed in intervals of two feet (+/- 1%) with a standard print height of 1/4" (+/- 1/16") and shall contain the following information:

- Current Year
- Manufacturer
- Conduit Diameter
- Wall Thickness
- Product Trade Name
- Sequential Footage Markings

The manufacturer shall be capable of supplying conduit with longitudinal stripes or tracers of the above data in increments of four, at ninety-degree intervals around the circumference of the conduit.

### **Physical Appearance:**

The inside surface is a smooth wall or longitudinal ribbed construction. The outside shall be smooth wall construction and shall be in new condition.

### **Packaging / Shipping:**

The conduit shall be supplied in standard lengths of 3,000 feet and should be placed on an 80"x40"x38" reel (Flange x Drum x Traverse). The HDPE conduit shall be delivered to the jobs site with Cargo Master Lift Gate service, or approved equal. Each reel shall be tagged with the following information:

- Manufacturer's Shipping Address
- Manufacturer's Product Code
- Length of Conduit
- Product Description
- Tracer Color
- Reel Number and Bar Code
- Certificate of Compliance that the conduits meet the provisions of this section

### **Pull-Tape:**

Pull-tape shall be installed in **ALL** HDPE conduit as described in this section. The ends of the tape shall be secured to the conduit to ensure that the tape does not draw back into the conduit. Pull tape shall have a pull strength of 1,800 lbs. Furthermore, there shall be 3% (+/- 0.5%) of excess tape fill inside the final conduit product.

## **Couplings & Bells:**

Coupling: All couplings shall be a compression type fitting.

Communication Bells: Communication bells installed on the ends of conduits shall be joined with a glue compatible with the materials in which it is supplied. Bells shall be installed on each conduit that enters or exits any type of pull box or vault. See plans and details for sweep and entrance construction requirements for the construction of vaults.

## **TONEABLE CONDUIT (WHITE)**

### **Description:**

All HDPE conduit shall have toneable capabilities. Only one conduit in each bundle of conduits is required to have toneable capabilities. This toneable conduit shall be an 18-gauge wire built into the wall of the conduit. See detail for conduit splice at the coupler.

Toneable conduit shall be combined with a polyethylene conduit with an integrated toning wire. The toning wire shall have the ability to be 'ripped' or pulled out of the conduit wall with simple hand tools, enabling easy access for toning and/or splicing to subsequent lengths.

### **Product Details:**

The toneable conduit (white) shall be made from high quality high-density polyethylene (HDPE), conforming to the performance criteria as identified in the section titled,

## **COMMUNICATION PERFORMANCE SPECIFICATIONS FOR HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) & TONEABLE CONDUIT.**

Toneable conduit shall have a wire that is 18-gauge copper clad steel coated with fluoropolymer jacket. The wire shall be embedded in the wall of the conduit. The copper clad steel (CCS) shall be necessary for amount of copper to carry a tone over long distances and shall have a steel core that is durable (copper not allowed). CCS shall easily be ripped out of the wall without breaking the wire. The wire shall meet the specifications listed in this specification.

The fluoropolymer-coated wire shall be 'ripped' out of the conduit wall using a pair of pliers. The fluoropolymer shall allow the wire to move independent of the conduit eliminating stresses on the wire and conduit, and eases the separation of the wire from the wall of the conduit. The fluoropolymer coating shall provide critical insulative and corrosion protection to the 'exposed' wire.

### **Toning Function:**

Contractor shall test all conduits using a generated signal, or 'tone', that is transmitted over a conductor so that the portion of the conductor buried below the earth's surface can be located without digging or using any special tools. Any conduits that cannot be located using this method of toning shall be removed and replaced.

The tone shall be produced at a very low frequency with a transmitter tuned to a particular frequency. The frequency range available on the transmitter may vary between equipment used and range shall be from 400Hz to about 80KHz. Transmission power shall be controlled in a range of .033 watts up to 5.0 watts. A 'radio' receiver tuned to locator shall be able to transmit frequencies is then used to precisely locate the energized wire.

The set-up requires a transmitter be attached to the conductive material that will act as an 'antenna' and a ground plane shall be established at the end of the antenna to close the circuit. Contractor shall proof each toneable conduit to accepted practices and tolerances and to ensure continuity with City representative on walkout proofing. This shall be required of all trench line construction.

### **Installation Procedure:**

Splicing the wire together with insulation shall be conducted. The wire from each Toneable conduit shall be grounded in every vault, pull-box or termination point. Each grounding system shall include a six foot grounding rod and attachment system for the wire installed in each vault, pull-box or termination point. Contractor shall remove the fluoropolymer jacket before crimping the connector. Contractor shall minimize the amount of fluoropolymer jacket to be removed in making the connection, leaving the remainder of the jacket intact to protect the wire from corrosion.

Simple wire splices for 18 AWG copper clad steel wire shall be used and environmentally protected with a self-healing waterproof tape.

All splices below grade shall be environmentally sealed against the elements by the Contractor.

Splices above grade such as inside an enclosure shall have the ends sealed with tape per manufacturer specifications.

At each end of the conduit the wire should be stripped from the conduit to a length long enough for splicing, or ground for toning.

### **Toneable Wire**

Shall have "Clean Design" or smooth wall for non-interference during installations.

Shall have high tensile strength copper clad steel 18 AWG wire to transmit tone-able signals over extended distances.

Shall have capabilities to locate with toning equipment from the ground surface.

Shall have Teflon coated toning wire to provide extended underground service.

Shall have easily coupled to provide extended lengths.

Shall have easy/convenient wire "Rip Out" for coupling. "Rip Out" design for toneable wires to be connected outside the coupling maintaining the dry seal.

## **Colors & Sizes (See Approved Engineered Plans)**

### **Duct Plugs**

Duct plugs shall be all high-impact plastic construction with durable elastic gaskets, corrosion proof, water-tight and reusable. Duct plugs shall consist of a bottom and top compression plate, gasket and tightening nut.

Duct plugs shall either be blank or consist of a bplex sealing system or approved equal.

### **Installation**

The Contractor shall pot-hole, daylight and identify the precise location of existing utilities prior to crossing them with the proposed conduit system. The Contractor shall conduct a USA investigation prior to construction. The Contractor shall also video tape and date all utility markings prior to construction. Any marked utility damaged by the Contractor shall be replaced at the expense of the Contractor. The Contractor shall take immediate action to resolve emergency situations.

All spoils from trenching shall be removed daily. Spoils piles will not be allowed to be stored in the street, on sidewalk, curb & gutter, on private property without written permission.

All trenches and utility crossings shall be backfilled with a two (2) sack colored (red) sand slurry. Mechanical vibration of the slurry will be required to insure all voids have been filled. Conduits shall be properly secured by an approved method prior to mechanical vibration. All trenches in the asphalt roadway shall be filled with slurry up to the edges of the asphalt. The trenches shall be protected until the slurry hardens and can be opened to traffic. Slurry of trenches in landscape and dirt areas only needs to cover the top of conduits by 12 inches.

All trenches shall be constructed parallel to the edge of pavement or to the face of curb. Any deviation shall take place in a 50 foot gradual transition. The trench locations vary and will be adjusted for conflicts with utilities. All trenches in the roadway or sidewalks should not deviate from line (parallel to edge of pavement or curb face) more that three inches unless a 50 foot transition is required.

All landscape irrigation facilities shall be modified as necessary to allow for new conduits. All damaged landscape material, ground cover, grass, plants, etc. shall be replaced in kind. All damaged grass shall be replaced with sod.

At locations where no relocation of existing sprinkler systems are shown on the Plans and the Contractor must disturb said systems in order to complete the work under this and other items, such as while removing concrete work and forming new concrete work, the Contractor shall temporarily cap said line and then return sprinkler systems to service within 48 hours. If Contractor cannot restore service in 48 hours, then Contractor shall make provision for temporary irrigation of affected landscape every 48 hours until permanent irrigation service is restored. The method of temporary irrigation service shall be approved by the Engineer.

Safe root pruning distances based upon the tree diameter and one (1) foot above ground level are as follows:

<u>Tree Diameter (inches)</u>	<u>Distance from Tree Trunk (ft.)</u>
4	1¼
5	1½
6	1¾
7	2
8	2¼
9	2¼
10	2½
11	2¾
12	3
13	3¼
14	3½
15	3¾
16	4
17	4¼
18	4½
19	4¾
20	5

Note: When it is absolutely necessary to cut closer than the safe distance from a tree trunk, only cut one side the smallest amount possible. All tree root pruning which is necessary but closer than the safe distance shall be approved by the Engineer.

Trenching shall be conducted in areas shown on the plans and in accordance with Section 16 of the City of Fresno Standard Specifications. It is the responsibility of the Contractor to identify the location and elevation of all utilities that intersect the proposed trench alignment. The alignment as shown on the plans is schematic and may require adjustment in the field. Hand trenching under curb, gutter, utilities and other permanent facilities will be required. A 1-foot separation is required when crossing any structure or other utility. Maintain a minimum 50 foot transition on both the approach and departure tapers when deviating from the alignment on the plans.

**Backfill of Conduit Trenches**

All conduit trenches shall be backfilled with a 2 sack colored (red) sand slurry. If conduit trench is located in landscape areas, stop slurry backfill 12 inches below finished grade. The conduit trench shall be completely filled with the 2 sack colored (red) sand slurry. Slurry shall be scraped smooth as to provide an even road surface. For permanent paving, the trench shall be ground to the width and depth shown on the plans. The 20 inch trench patch shall be centered on the conduit trench. If the edge of the new 20” trench patch is less than or equal to 2 feet (24”) from the lip of gutter or edge of paving, the entire section (from edge of trench patch to lip of gutter) of paving 3 inches deep shall be removed and replaced.

Minimum Trench Width – 6 inches

Maximum Trench Width – 10 inches

Minimum Trench Patch – 20 inches centered on conduit trench

Minimum Trench Paving Depth– 3 inches

Minimum Trench Paving Width – 18 inches

Maximum Trench Paving Width – 42 inches (\*)

(\*) If edge of Trench Patch is less than or equal to 24 inches from lip of curb or edge of paving, grind and replace entire paved area from edge of trench patch to lip of gutter.

Special Trench Protection Requirements:

All trenches within 3 feet of a 12 foot travel lane or within a pedestrian travel path shall be backfilled with 2 sack (red) sand slurry or trenched plated and opened to vehicular or pedestrian traffic at the end of each work day. Trenches outside of vehicular or pedestrian travel lanes or paths may be appropriately protected and barricaded. See City Specifications and Drawings for other requirements.

### **32-1.13 HORIZONTAL DIRECTIONAL DRILLING**

#### **SCOPE:**

##### **A. General:**

It is the intent of this specification to define the acceptable methods and materials for installing high density polyethylene (HDPE) conduit by directional drilling methods.

##### **B. Installation Plan:**

1. Seven (7) days prior to mobilizing equipment the Contractor shall submit their detailed installation plan to the Engineer. The plan shall include a detailed plan and profile of the bores and be plotted at a scale no smaller than 1 inch equals 20 feet horizontal and vertical.
2. The plan shall also include a listing of major equipment and supervisory personnel and a description of the methods to be used.

##### **C. Variations in Plan or Profile:**

The Contractor may request changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes shall be submitted in writing to the Engineer and receive approval of the Engineer prior to construction.

##### **D. Alignment:**

The proposed plan and profile installation locations are based on alignments to accommodate acquired easements, to avoid obstructions, and to properly maintain operation flow velocities.

##### **E. Qualifications:**

Directional drilling and conduit installation shall be done only by an experienced Contractor specializing in directional drilling and whose key personnel have at least five (5) years experience in this work.

## **MATERIALS:**

### **A. General:**

High density polyethylene conduit shall be used in HDD installations All piping system components shall be the products of one manufacturer and shall conform to Sec 32-1.12 and the latest edition of ASTM D1248, ASTM D3350, and ASTM F714.

### **B. Piping and Bends:**

Piping and Bends shall be extruded from a polyethylene compound and shall conform to the following requirements:

1. The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C, or better.
2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by pre-compounding in a concentration of not less than 2 percent.
3. The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.
4. The conduit manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the conduit in this project.
5. The conduit and bends shall have a minimum standard dimension ratio (SDR) wall thickness as specified by the Engineer.
6. Joining shall be performed by thermal buttfusion in accordance with the manufacturer's recommendations.

## **INSTALLATION:**

### **A. General:**

1. The Contractor shall install the conduit by means of horizontal directional drilling. The Contractor shall assemble, support, and pretest the conduit prior to installation in the directional drill tunnel.
2. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the conduit insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these Technical Specifications.
3. The Contractor shall prepare and submit a plan to the Engineer for approval for insertion of the HDPE conduit into the opened bore hole. This plan shall include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.

4. The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor shall erect temporary fencing around the entry and exit conduit staging areas.

#### **B. Tolerances:**

1. Conduit installed by the directional drilled method must be located in plan as shown on the Drawings, and must be no shallower than shown on the Drawings unless otherwise approved. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. This "as built" plan and profile shall be updated as the pilot bore is advanced. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor shall grant the Engineer access to all data and readout pertaining to the position of the bore head and the fluid pressures and flows. When requested, the Contractor shall provide explanations of this position monitoring and steering equipment. The Contractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. Information pertaining to the position or inclination of the pilot bores not shall be withheld from the Engineer.

2. Each exit point shall be located as shown with an over-length tolerance of 10 feet for directional drills of 1,000 linear feet or less and 40 feet for directional drills of greater than 1,000 linear feet and an alignment tolerance of 5 feet left/right with due consideration of the position of the other exit points and the required permanent easement.

#### **Ream and Pullback:**

**1. Reaming:** Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the Contractor.

**2. Pulling Loads:** The maximum allowable pull exerted on the HDPE conduit shall be measured continuously and limited to the maximum allowed by the manufacturer so that the conduit or joints are not over stressed.

**3. Torsion and Stresses:** A swivel shall be used to connect the conduit to the drill conduit to prevent torsional stresses from occurring in the conduit.

4. The lead end of the conduit shall be closed during the pullback operation.

**5. Conduit Support:** The conduit shall be equally supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during the pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the conduit allowing for free movement of the conduit during pullback. Surface damage shall be repaired by the Contractor before pulling operations resume.

6. The contractor shall at all times handle the HDPE conduit in a manner that does not over stress the conduit. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the HDPE conduit. If the conduit is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at their expense. The Contractor shall take appropriate steps during pullback to ensure that the HDPE conduit will be installed without damage.

## **F. Handling Drilling Fluids and Cuttings:**

1. During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. To the greatest extent practical, these fluids must not be discharged into the waterway. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The Contractor shall conduct their directional drilling operation in such a manner that drilling fluids are not forced through the subbottom into the waterway. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.
2. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to the street.
3. The Contractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures listed in the required permits and elsewhere in these Specifications.
4. To the extent practical, the Contractor shall maintain a closed loop drilling fluid system.
5. The Contractor shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be reused.
6. As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.

## **DRILLING OPERATIONS:**

### **A. General:**

The Contractor shall prepare a plan to be submitted for Engineer approval which describes the noise reduction program and solids control plant, pilot hole drilling procedure, the reaming operation, and the pullback procedure. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor. Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better shall be used. A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the construction drawings. The position of the drill string shall be monitored by the Contractor with the downhole survey instruments. Contractor shall compute the position in the X, Y and Z axis relative to ground surface from downhole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval). Deviations from the acceptable tolerances described in the Specifications shall be documented and immediately brought to the attention of the Engineer for discussion and/or approval. The profile and alignment defined on the construction drawings for the bores define the minimum depth and radius of curvature. At no point in the drilled profile shall the radius of curvature of the bore be less than 1,600 feet. The Contractor shall maintain and provide to the Engineer, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile. Between the water's edge and the entry or exit point the Contractor shall provide and use a separate steering system employing a ground survey

grid system, such as “TRU-TRACKER” or equal wherever possible. The exit point shall fall within a rectangle 10 feet wide and 40 feet long centered on the planned exit point. During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor’s drilling plan presented to the Engineer. The Owner retains the right to sample and monitor the waste drilling mud, cuttings and water.

## **B. Environmental Provisions:**

The Horizontal Directional Drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to the adjacent land areas involved during the construction process. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor with heavy duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water. The Contractor shall visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide the Engineer with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area. The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge. Waste cuttings and drilling mud shall be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cuttings and excess drilling fluids shall be dewatered and dried by the Contractor to the extent necessary for disposal in offsite landfills. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of locally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps or spills. Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50% of weight. Due to a limited storage space at the worksites, dewatering and disposal work shall be concurrent with drilling operations. Treatment of water shall satisfy regulatory agencies before it is discharged.

### **32-1.14 Qualified Products List (QPL)**

This specification covers the purpose, development and maintenance of the City’s ITS Qualified Products List (QPL)

This QPL has been developed as a means for determining what products, suppliers, manufacturers, equipment and methodologies may be used on City of Fresno ITS projects. The items referenced on the QPL have met the approval of the City of Fresno in one or more of the following ways:

- They have been approved by the City’s Public Works Department, Traffic Engineering Division.
- They have been used successfully before the establishment of a formal approval process.

- They currently satisfy the City's Standard Specifications.

It should be understood that this specification is open to refinement and will be under close scrutiny to ensure that the information contained herein is complete and accurate. Over the years many items will be added and deleted.

Many products that may be used in the City of Fresno will not be represented in this document because they conform to a generic specification, and the approval procedure is in accordance with the standard specifications.

### **Qualified Products List**

The City's Public Works Department, Traffic Engineering Division shall maintain the QPL. The City will confirm that the materials or equipment appearing on the QPL meet the specifications described in the product specific item or the field tested needs of the City and the ITS system. Any material or producer not on the list shall require project specific testing.

In order for a manufacturer to be placed on the City's QPL, a formal *Qualified Products Evaluation Form* must be submitted with samples of the materials or equipment to the City's Public Works Department, Traffic Engineering Division. The materials or equipment shall be required to be submitted for laboratory and field testing for a period of up to 12 months prior to acceptance by the City and placement on the QPL.

### **Quality Control Testing**

The City requires that all producers in the QPL perform quality control (QC) testing on their material. Producers must maintain a complete record of all test reports for the previous two years and current calendar year.

### **Random Testing and Auditing**

The City reserves the right to sample materials on the QPL for testing and to perform audits of test reports. City representatives may sample material from the manufacturing plant, the project site, and other locations. The City reserves the right to test samples to verify compliance with Standard Specifications and corresponding supplement specifications. Producers must maintain a complete record of all test reports for the previous two years and current calendar year.

### **Disqualification**

Products that do not perform or are found to be non-compliant with the City's Standard Specifications or the field tested needs of the City and the ITS system may be removed from the QPL at any time and remain unlisted until such time that adherence to the specifications can be verified and the product has undergone satisfactory performance evaluation.