A d d e n d u m

Iowa Department of Transportation
Office of Contracts

Date of Letting: November 15, 2016
Date of Addendum: November 8, 2016

B.O.	Proposal ID	Proposal Work Type	County	Project Number	Addendum
103	77-1945-796	PCC PAVEMENT - GRADE & REPLACE	POLK	STP-U-1945(796)--70-77	15NOV103A01

Make the following changes to the PROPOSAL SPECIAL PROVISIONS LIST & TEXT:

Replace SP-151002 TRAFFIC SIGNALIZATION

POLK COUNTY STP-U-1945(796)--70-77

With the attached

SP-151002a TRAFFIC SIGNALIZATION

POLK COUNTY STP-U-1945(796)--70-77

ADD SP-151008 WATER MAIN

POLK COUNTY STP-U-1945(796)--70-77

SP-151002a
(Replaces SP-151002)

SPECIAL PROVISIONS

FOR

TRAFFIC SIGNALIZATION

Polk County
STP-U-1945(796)--70-77

Effective Date
November 15, 2016

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

TRAFFIC SIGNAL SPECIFICATIONS

PARK AVENUE WIDENING, 56TH ST. TO SW 63RD ST.
06-2011-005

TABLE OF CONTENTS

GENERAL REQUIREMENTS

This part consists of the general provisions necessary when furnishing a traffic signal installation complete, in place and operational as described in the project plans and these special provisions.

1.1 RELATED SPECIFICATIONS AND STANDARDS

Unless otherwise specified in the project plans and special provisions the traffic signal installed under this specification shall comply with:

A. Iowa Department of Transportation Standard Specifications
B. Specifications of the Underwriters Laboratories Inc.
C. National Electrical Code.
D. Manual on Uniform Traffic Control Devices latest edition.

1.2 LOCAL REQUIREMENTS

The Contractor shall notify and receive approval from the City prior to any operational shutdown of any existing traffic signal installation. Adherence to the City Electrical Code shall be required for service to the Controller.

The Contractor is responsible for locating all equipment installed as part of the project within the City right-of-way until project acceptance. Any damage as a result of failure to locate this equipment shall be the responsibility of the Contractor to replace with no additional cost to the City.

Contractor shall provide to the City “as-built” drawings that identify all changes made to the contract plans.

1.3 REMOVALS

All existing traffic signal pole foundations that become unused for the new traffic signal shall be removed. Foundations 3 feet or less in depth shall be removed completely. Foundations greater than 3 feet in depth shall be removed to 1 foot below grade

All existing traffic signal handholes that become unused for the new traffic signal shall be removed and discarded by the contractor.

Unless otherwise indicated on the plans, all existing wiring that becomes unused in this project shall be removed and discarded of by the contractor.

All holes shall be filled and surface restored.

Removals and restoration are incidental to the other pay items unless otherwise specified in the contract documents.

PART II
INSTALLATION REQUIREMENTS

This part consists of the installation details necessary during the construction of a traffic signal complete, in place, and operational as described in the project plans and these special provisions.

An anti-seize compound shall be used in the installation of all mechanical connections and fasteners, including all nuts and bolts.

2.1 FOUNDATIONS

The Contractor shall be responsible for the proper elevation, offset, and level of each foundation.

The foundations must be given 7 days to cure before poles are erected.

The Contractor shall provide designs for all concrete bases where mast arms are longer than 70 feet or when it is called for on the plans. The cost for the design shall be considered as part of the cost of the mast arm pole. This design would then be used as a substitute for footing design as shown on the signal detail sheet of the plans. The use of the ground rod and the number of conduits as indicated on the signal detail sheet of the plans shall remain the same.

When installing a conduit bend in an existing base the conduit size shall be equivalent to the conduit in the ground. The steel in the base shall not be cut or damaged and the concrete shall be broken away in the shape of a “U” with an approximate depth of at least 12inches below the depth of the surrounding ground surface. Enough concrete shall be removed so the conduit will be inside the anchor bolts of the foundation. The conduit shall be placed in the “U” with concrete added in the “U” and finished to match the base.

2.2 CONDUIT

Conduit buried in open trenches shall be placed a minimum of 36 inch deep and a minimum of 2 feet from the back of curb unless otherwise directed by the Engineer. Open trench methods of placing conduit will be permitted except where the conduit is to be placed under existing pavement. Conduit in pavement areas shall be placed to a minimum depth of 48 inches below the finished pavement surface or as directed by the Engineer.

When underground conduits parallel an existing facility, maintain at least 1 foot of separation.

All conduit shall include one, 1/2 inch wide, polyester cable pulling tape with a minimum 1200 pound tensile strength when installation is complete. All conduits shall include a tracer wire as specified in the Wiring and Cable section.

All conduit will be proofed by the Contractor upon completion to verify continuity and integrity of the duct.

2.3 WIRING AND CABLE

Each vehicle and pedestrian signal head shall have a separate cable from the signal head to the pole base. A signal head cables shall be spliced in the pole base. Within the cabinet, all signal cables shall be labeled as to their direction of origin.

All splices in the handhole compartment of a signal pole shall be made using silicone filled, screw-on wire connectors. Wires shall be twisted before the connector is added. Cable connections in signal heads and controller cabinets shall be made at the terminal blocks provided for that purpose, without using crimp-on connectors.

The Contractor shall also provide and install wiring from the end of the luminaire arm to the pole base. The Contractor shall connect the cables in the pole to the intersection lighting cable using fused connectors. Fused connectors shall be used for all connections. Unless otherwise indicated on the plans, luminaires will be supplied and installed by the Contractor.

A continuous orange tracer wire (1c No. 10 AWG) shall be included from each pole base to the controller cabinet. A separate orange tracer wire (1c No. 10 AWG) shall be included in all conduits with all fiber optic communication cable. A yellow tracer wire shall be used in conduits with only streetlight circuits. Tracer wire for the signal system shall terminate in the controller cabinet and shall be labeled with the direction of origin. Tracer wire for the communication/fiber system shall terminate in the locate box. The Contractor shall install, splice, and test the tracer wire for continuity. Every tracer wire run shall be grounded at one end.

2.4 FIBER OPTIC CABLE

The cable end shall be secured inside the controller cabinet so that no load is applied to the exposed fiber strands. The minimum bend radius for static storage shall not be less than ten times the diameter of the cable measuring the cable on the outside, or as recommended by the manufacturer.

The minimum bend radius during installation shall not be less fifteen times the diameter of the cable measuring the cable on the outside, or as recommended by the manufacturer. The Contractor should not use tie wrap devices on fiber optic cable.

A. Cable Slack: Slack shall be left in each handhole, at the top of any conduit riser, in each junction box, in each controller cabinet, and at each equipment rack or other point of termination. Slack in handholes shall be 100 feet in Type II, Type III or Type IV handholes, 30 feet in Type I handholes, and 10 feet in 18 inch handholes. This slack cable requirement may be deleted where existing handholes or through points lack sufficient area to maintain the minimum bend requirements. Where slack has been deleted, extra slack equal to the amount that would have been distributed in the through points shall be equally divided between the two controller cabinets and shall be in addition to the slack mandated at the cabinets. Slack in each handhole type shall be provided as designated on the plans. Slack cable shall be coiled and the coils bound at three points around the coil perimeter and supported in their static storage position.

B. Cable Installation in Conduits: A suitable cable feeder guide shall be used between the cable reel and the face of the conduit. The cable feeder shall be designed to protect the cable and guide the cable directly into the conduit off the reel. During the installation, the cable jacket shall be carefully inspected for jacket defects. If defects are found, the Engineer shall be notified prior to any additional cable being installed. The Contractor shall take care in the pulling of the cable to insure that the cable does not become kinked,

crushed, twisted, snapped, etc. A pulling eye shall be attached to the cable and be used to pull the cable through the conduit. A pulling swivel shall be used to preclude twisting of the cable. The cable shall be lubricated prior to entering the conduit with a lubricant recommended by the manufacturer. Dynamometers or break away pulling swing shall be used to insure that the pulling tension does not exceed the specified force of 600 pounds or the cable manufacturer's recommendations, which ever is less. The mechanical stress on the cable shall not allow the cable to twist, stretch, become crushed, or forced around sharp turns which exceed the bend radius or scar or damage the jacket. The pulling of the cable shall be hand assisted at each pull point.

Cable shall not be pulled through any intermediate junction box, manhole, pull box, pole base or any other opening in the conduit unless specifically required by the Engineer in specific facilities. The necessary length of cable to be installed shall be pulled from one junction box, manhole, pull box, pole base, or cabinet to the immediate next downstream manhole, box, pole base, or cabinet. The remaining length of cable to be installed in the next conduit shall be carefully stored in a manner that is not hazardous to pedestrian or vehicular traffic yet ensures that no damage to the cable shall occur. The cable shall be stored in a manner that shall allow that length of cable to be safely pulled into the next conduit. The Engineer shall approve the storing methods to be used.

At each hand hole or through point and at the cabinet, the cable shall be visibly and durably marked or tagged with the type of cable (single mode or multi-mode), the fiber count, and "FIBER OPTIC CABLE, CITY OF DES MOINES". Additionally, each cable shall be marked with the adjacent intersection of origin and destination. In cases where cables are spliced in a splice enclosure only the intersection of origin is needed.

Example:

FIBER OPTIC CABLE, CITY OF DES MOINES 48 FIBER – SM EAST – 63rd & HICKMAN WEST – WESTOVER & HICKMAN

C. Communications Cable Testing: All fibers from each tube in the fiber optic cable shall be tested, both on-the-reel prior to installation and after installation using a high-resolution optical time domain reflectometer (OTDR). All cable readings/measurements shall be compared to the maximum allowable deviations in the cable specification and the levels of acceptance recommended by the manufacturer in their printed documentation. Any cable having measurements outside the allowable range shall be replaced and shall not be acceptable for installation on this project.

1. On-Reel Testing: Prior to the installation, the Contractor shall perform on-site, on-reel testing. This testing shall be for both attenuation and continuity. The tests shall be conducted at 850 nm for multi-mode fibers and at 1310 nm and 1550 nm single mode fibers. The testing shall be performed by means of a pigtail splice. All test results shall be within ± 3% of factory-supplied attenuation measurements. Testing shall be done in one direction only. Except for the access to and the test preparation of any one end of the newly furnished cable to be tested, the Contractor shall

preserve the cable in its originally-shipped condition. If any fiber of the cable fails the on-reel attenuation test, the cable shall be rejected and shall not be used on this project. The rejected cable shall be replaced at the Contractor's expense.

2. System Testing: As each cable segment is terminated, the Contractor shall perform an end-to-end attenuation (power loss) test of each terminated fiber of each FO cable. This testing shall be performed using hand-held optical test sets. Overall loss for each link shall not exceed the cumulative specified maximum losses of the components. For example, at 850 nm, a 1 mile link with two splices and a connector on each end shall not exceed 7.0 dB:

1.0 mile x 5.6 dB/mile:	5.6 dB
0.2 dB per splice x 2:	0.4 dB
0.5 dB per connector x 2:	1.0 dB
Maximum allowable loss:	7.0 dB

A cable segment shall be rejected for use on this project if any terminated fiber of the cable segment fails the attenuation test. Rejected cables shall be replaced by the Contractor at the Contractor's expense. The Contractor shall retest all fibers of any replaced cable segment.

After the complete fiber optic system is installed and terminated, an OTDR reading shall be performed on all fibers to insure that each section is in compliance with the issued specification. All fibers shall be tested.

E. Fiber Optic Termination Unit:
All fibers, unless stated otherwise in the plans, shall be terminated in the fiber optic termination unit.

The enclosure shall be mounted on an EIA 19 inch rack in an area that does not interfere with the normal maintenance of the cabinet electronics

The field cable shall be secured to the enclosure in a manner that does not degrade the fiber optic cable but insures a firm and secure mount. Sufficient lengths of every loose fiber shall be coiled within the enclosure to provide spare distance and reach the fiber interface panel. Sprial wrap each individual fiber in the fan out kit.

Each fiber shall be labeled on the bulkhead by direction and intersection of origin.

Example:

A – North –
B – South – 63rd & Univ.
C – East – MH & Hick.
D - West

F. Documentation:

The Contractor shall submit a table showing all entrance and exiting footages at each handholes, pole base, splice case and controller cabinet. This table shall include “tip-to-tip” footages at each location. This table shall be submitted in electronic, spreadsheet format.

The Contractor shall record the identification, location, length, and attenuation measurements of each tested fiber and shall furnish all test reports to the Engineer. Test reports include all cable segment attenuation tests; OTDR signature traces for all fibers; and an attenuation test for the installed fibers using the insertion loss test procedure and the transmitter/receiver power level test and the Continuity Test. Fibers which have been terminated shall be indicated in the reports. Such documentation shall be submitted in either hardcopy (written) form or in Engineer-approved electronic format.

2.5 BONDING AND GROUNDING

Metal conduit, service equipment, anchor bolts, metal poles, pedestals, controller cabinets, interconnect cable shields, and all other electrical equipment shall be made mechanically and electrically secure to form a continuous system, and shall be effectively grounded. The grounding conductor shall be a No. 6 AWG copper, non-insulated wire.

Grounding shall be accomplished by bonding the grounding circuits to copper clad metal, driven electrodes. All electrodes shall be as a minimum, 5/8 inch in diameter by 10 feet long. The electrodes shall be driven vertically until the top of the rod is minimum of 4 inches below grade. Bonding to the ground rod shall be made by means of suitable screw type positive ground rod clamps. The controller cabinet ground shall measure 10 ohms or less.

Grounding to existing water lines will not be permitted.

Bonding of standards and pedestals shall be by means of a bonding strap attached to an anchor bolt or to 1 inch, or longer, brass or bronze bolt installed in the lower portion of the shaft.

The service meter and socket shall be bonded to a ground electrode by use of a ground clamp and a No. 6 AWG copper wire.

Bonding of metallic conduit in concrete pull boxes and manholes shall be by means of galvanized grounding bushings and bonding jumpers. Where there is a change, at a pull box or manhole, from non-metallic conduit to metallic conduit, the grounding wire in the non-metallic conduit shall be bonded to the metallic conduit. Saddle clamps are not acceptable.

Existing ungrounded metal poles on which cabinets are mounted shall be grounded by means of a driven ground rod.

The interconnect cable shield shall be bonded to the controller ground buss at one controller termination point for each interconnect run.

2.6 TRAFFIC SIGNAL DISPLAYS

All Overhead traffic signal heads shall have backplates. Universally adjustable brackets and cable banding shall be used to mount all pole-mounted and mast arm-mounted overhead signals. All overhead displays located on each mast arm shall have each red indication set at approximately the same elevation, unless otherwise directed by the Engineer. All optically

limited signal heads shall be properly masked to limit their field of view as directed by the Engineer.

During the course of construction and until the signals are placed in operation, signal faces shall be covered or turned away from approaching traffic. When ready for operation, they shall be securely fastened in position facing toward approaching traffic.

2.7 CONTROLLER CABINET

The aluminum rack edge shall be labeled for each detector amplifier, load switch, and isolator.

2.8 PAINTING

If the painted surface of any equipment is damaged in shipping or installation, such equipment shall be retouched or repainted in a manner satisfactory to the Engineer.

2.9 LOOP DETECTORS

The Contractor is responsible for replacing any loops found unacceptable after testing. An acceptable loop is defined as follows:

a. Inductance: equal to or greater than the calculated value
b. Leakage to ground: greater than 100 megohms
c. Loop Frequency: equal to or greater than 0.0350. Loop frequency is defined as the frequency of the loop with a vehicle present (Fp) minus the frequency of the loop with no vehicle present (Fc) divided by the frequency of the loop with no vehicle present (Fp-Fc)/Fc.

All loop detectors in new pavement shall be preformed. No saw-cut loops will be accepted in new pavement.

2.10 LOCATE BOXES

An outdoor-rated, single gang box to house communications/interconnect tracer wire shall be installed on the exterior of the controller cabinet. The location on the cabinet shall be determined by the project engineer. The locate box shall be constructed of die-cast aluminum with a die-cast zinc weatherproof cover and self-closing lid. The box shall be 2 3/4 inches by 4 1/2 inches by 2 5/8 inches D. A 12 inch long ground wire shall be attached to a lug within the box.

PART III
MATERIAL REQUIREMENTS

This part consists of material requirements necessary for the construction of a traffic signal installation complete, in place, and operational as described in the project plans and these special provisions.

3.1 TRAFFIC SIGNAL CABLE

Detector lead-in cable shall be No. 14 AWG.

3.2 SIGNS

A. Traffic Sign Blanks: All sign blanks shall be aluminum allow 6061-T6 conversion coated with Alodine 1200. 5052-H38 alloy is an acceptable alternative.

1. All blanks shall be 0.08 inches thick will the following exceptions:
    a. If either the length or width dimension of a sign is 36 inches or greater, the blank shall be 0.125 inches thick.
    b. Overhead mounted street name signs shall be 0.125 inches thick.
2. Blanks shall be finished free of any surface or edge burrs, cut marks, or other irregularities.
3. Standard signs shall be pre-drilled with standard hardware holes (0.375 inch diameter) and have no burrs or excess material retained in or around the hole. Holes placement and radii shall conform to the Standard Highway Signs Manual, current edition.
4. A diagram showing the location of holes for specialty signs will be provided at the time of order.
5. Street name signs shall not be pre-drilled.

B. Traffic Sign Faces: Shall meet all requirements of the latest edition of the MUTCD.

The background sheeting used on all signs, with the exception of pedestrian pushbutton signs, shall be 3M DG3 or Iowa DOT approved equal material. Any other applied material, including legends, letters, numbers, or borders, again with the exception of pedestrian push-button signs, shall also be 3M DG3 or Iowa DOT approved equal material. Pedestrian pushbutton signs shall be 3M Engineer Grade Prismatic or Iowa DOT approved equal reflective sheeting.

This material shall have a standard warranty to be free from any defects for a period of not less than 7 years from the date of manufacture. A copy of the standard warranty shall be provided as a part of the bid package.

C. Street Name Signs:

1. All street name signs shall be single-sided
2. The length of the street name sign shall be in 6 inch increments and will vary based on the legend.
3. Lettering shall be white and the background shall be blue or green “EC” film. The background color will be specified at the time of order.

4. Lettering shall be Series B as outlined in the Standard Highway Signs Manual.
5. All 12 inch or larger signs shall have a white border as shown in the attached detail.
6. Letter size and spacing shall conform to the MUTCD and the attached details. In cases where descending lower-case letters (g, j, p, q, and y) cannot be accommodated on the specified blank, the next larger blank size shall be used..
7. 12 inch or larger street name signs shall be made of 3M Diamond Grade DG3 reflective sheeting or Iowa DOT approved equal. 8 inch street name signs shall be made of 3M High Intensity Prismatic or Iowa DOT approved equal reflective sheeting.

D. Completed Signs: Sign faces shall be firmly attached to the aluminum sign blanks, with no air bubbles, wrinkles, creases, tears or other surface blemishes. The faces shall be neatly trimmed to match the edge of the sign blank. The sign faces shall be properly positioned to provide a uniform border around all sides of the sign.

The signs shall be handled carefully and packaged to prevent any damage to the sign faces. Any sign faces which are damaged at the time of delivery will be rejected and returned to the manufacturer. Undamaged replacement signs shall then be promptly sent, at no extra cost to the City of Des Moines.

E. Sign Mounting Brackets: All signs shall be supplied with a sign bracket. The traffic sign bracket shall be an articulated serrated bracket assembly that includes top, middle, and bottom sign mounting brackets and provides a rigid-mount for the traffic sign. All necessary hardware for a complete installation on a mast arm shall be included. The mounting assembly shall be of a cable type. Approval of other bracket supports shall be based on specifications and/or test data about their physical properties and performance properties.

All pedestrian pushbutton signs shall be mounted to the signal pole using stainless steel bolts. Bolts shall be 5/16 inch flanged with plastic washer. Holes shalled be drilled and tapped.

3.3 FIBER OPTIC CABLE AND ACCESSORIES

A. Fiber Optic Cable: Furnish and install the loose tube fiber optic cable(s) of the type, size, and number of fibers specified on the plans and all associated accessories.

The cable shall meet the latest applicable standard specifications by American National Standards Institute (ANSI), Electronics Industries Association (EIA), and Telecommunications Industries Association (TIA) for the and size specified and the specifications herein.

1. Multimode Fiber - Grade Index

Core Diameter:	62.5 um $\pm$ 1.0 um
Cladding Diameter:	125.0 um $\pm$ 1.0 um
Core Concentricity:	$\pm$ 1%
Max. Attenuation:	6.03 dB/mile

2. Single-Mode Fiber

Typical Core Diameter:	8.3 um ± 1.0 um
Cladding Diameter:	125.0 ±1.0um
Core Concentricity:	± 1%
Attenuation Uniformity:	No point discontinuity greater than 0.1 um at either 1310nm or 1550nm
Max. Attenuation:	0.40 dB/mile

The coating shall be a dual layer UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically strippable without damage to the fiber.

The central member of the cable shall be a glass reinforced plastic rod designed to prevent the buckling of the cable. The cable core interstices shall be filled with water blocking tape to prevent water infiltration.

Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross-section.

Buffer tubes shall be of dual layer construction with the inner layer made of polycarbonate and the outer layer made of polyester. Each buffer tube shall be waterblocked with a water-swellable yarn or tape. Buffer tubes shall be stranded around the central member using reverse oscillation, or "SZ", stranding process.

The buffer tubes shall meet TIA/EIA-598A, "Color coding of fiber optic cables". The fiber cable shall include loose tubes with 12 fibers in each tube.

The cable tensile strength shall be provided by a high tensile strength aramid yarn and/or fiber glass.

All dielectric cables, without armoring, shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 0.055 inches. Jacketing material shall be applied directly over the tensile strength members and flooding compound. The jacket or sheath shall be marked with the manufacturer's name and the words "Optical Cable", the year of manufacture, and sequential feet marks. The markings shall be repeated every 2 feet. The actual length of the cable shall be within the range plus one percent of the length marked. The marking shall be in a contrasting color to the cable jacket. Additionally, the jacket marking shall have a durable weather proof label which shows the actual attenuation of each fiber expressed in dB/mile.

The cable shall be fabricated to withstand a maximize pulling tension of 600 pounds during installation (Short term) and 135 pounds upon installation (Long term).

The shipping, storing, installing and operating temperature range of the cable shall be -40°F to + 158°F.

The manufacturer shall test at the 100% level all fiber optic cable for the following tests:

a. Each fiber proof tested at a minimum load of 350 Mpa.
b. Each fiber tested for attenuation and the reading shall be part of cable labeling.

The cable shall meet the appropriate standard Fiber Optic Test Procedure for the following measurements:

a. Fluid Penetration
b. Compound Drip
c. Compressive Loading Resistance
d. Cyclic Flexing
e. Cyclic Impact
f. Tensile Loading and Bending

The cable ends shall be available for testing. The cable ends must be sealed to prevent moisture impregnation.

B. Fiber Optic Jumpers/Patch Cords: All fibers entering the traffic signal controller cabinet shall be terminated in the fiber optic termination unit within the traffic controller cabinet.

Length of patch cord will vary according to distribution unit to traffic signal controller, fiber optic modem, or video modem location within controller cabinet and shall provide for 2 feet of total slack. A sufficient number of patch cords shall be installed to provide a fully-operational communications system.

Controller cabinet patch cords shall consist of factory-assembled patch cords, each containing two fibers. Each such fiber shall have a connector with ceramic ferrule on each end. Each patch cord shall have a dielectric strength member and a durable outer jacket designed to withstand handling.

C. Fiber Optic Termination Unit: The unit shall be a rack mount, drawer type enclosure that is dust and moisture repellent. The unit shall provide easy front access with removable rear tray for easy rear access and shall have a maximum dimension of 3.5 inchesH by 18.5 inchesW by 11.25 inchesD. The size of the unit shall be adequate for the number of fibers, proper winding area, and splices. The unit shall provide for cable entry from the side and be capable of accomodating up to 48 connections

D. Connectors: Only ST or LC type connectors of ceramic ferrule and Physical Contact end finish shall be used to terminate fibers to equipment. ST, LC or mechanical connectors shall not be used to splice cables. All multimode fibers shall be terminated with ST connectors. All single mode fibers shall be terminated with LC connectors.

Maximum attenuation per connector shall be 0.75 dB.

E. Splices: Fusion splices shall be used for all splices.

The fiber cable shall be installed in continuous runs as designated on the plans. Splices shall be allowed only in the splice enclosures and controller cabinets as located on the plans.
Maximum attenuation per splice shall be 0.3 dB.

F. Fan Out Kits: Fan out kits shall be provided for separation and protection of individual fibers with buffer tubing and jacketing materials suitable for termination of the fiber and fiber optic connector as specified.

G. Splice Enclosure: Ends of continuous fiber cable runs and/or traffic signal controller branch circuit points will be spliced in an outside plant splice enclosure located in handholes as shown on plans.

Enclosure shall accept a minimum of six cables and provide enough trays to splice all fibers. All fiber cables shall enter the enclosure at one end.

Enclosure shall be watertight and re-enterable using gel-compressed cable connections and a re-enterable gasket.

PART IV
EQUIPMENT REQUIREMENTS

This part consists of the equipment requirements necessary for the construction of a traffic signal installation complete, in place, and operative as described in the project plans and these Special Provisions.

4.1 TYPE 170, TRAFFIC SIGNAL CONTROLLER SYSTEM

A. Related Specifications: Unless otherwise stated herein, all equipment furnished under this specification shall be new, meeting the requirements of "California/New York Type 170, Traffic Signal Controller System-Hardware Specification," U.S. Department of Transportation, Publication FHWA-IP-78-16, December 1978, with the following exceptions:

1. Any reference to the State of California shall mean the Jurisdiction.

2. Chapter 1, Section II "General" paragraph 3, the second sentence shall be deleted.

3. Chapter 1, Section VIII "Electrical, Environmental and Testing Requirements" shall be modified as follows:
   a. Any reference to the Contractor shall mean equipment manufacturer or supplier.
   b. Paragraph 5.2 shall be changed to read "Two manuals containing the flow chart, listing, and instructions of the test program shall be furnished to the Jurisdiction when the controller unit is delivered."
   c. Paragraph 6.1 the words "State Approval" shall be deleted.
   d. Paragraph 6.2 shall be deleted.
   e. Paragraph 6.3.6 shall be deleted.

4. When specified, the Model 332A Cabinet furnished for the project shall meet the requirements of Chapter 11 "Specifications for Cabinet Model 332A," and the Model 336 Cabinet shall meet the requirements of "Specifications for Cabinet Model 336" dated February 1982, except that the color specified in Section 1, paragraph 3 shall be changed to silver. Molex Flash Blocks shall be provided for all eight vehicle phases to program either red or yellow flashing indications. A detector input panel shall be provided on the rear left side of the cabinet. Cabinet locks as specified in Section I, paragraph 4 shall be changed to Corbin Type 2 locks. An aluminum cabinet shall be furnished.

   The aluminum surface shall have an anodic coating applied. The anodic coating and anodic coating process shall meet the requirements of Section 2.4.1 and 2.4.2 of the "Traffic Signal Control Equipment Specifications," California Business, Transportation and Housing Agency, Department of Transportation, January 1989. Alternative aluminum surface treatments, which produce an equivalent uniformly textured surface, may be substituted as approved by the Engineer.

5. All loop detector amplifier units furnished for this project shall be Model 222, Two-Channel Loop Detector Sensor Units meeting the requirements of Chapter 4 with the following exceptions:

a. Digital design capable of normal operation when operated with a grounded loop.
b. Shall comply with all performance requirements when connected to an inductance of from 50 to 1500 microhenries.
c. Each detector channel shall respond to an absolute inductance change (Delta L) rather than as a percentage of the total inductance (Delta L/L).

6. In Chapter 11, Section III "Cabinet Accessories" paragraph 4, a new subsection will be added "Each vehicular and each pedestrian phase shall be provided with a separate switch pack."

a. A model 412C prom module shall be provided, configured to the following table:

Memory Socket	Address Range	Device Type	Chip No.*
U1	8000-FFFF	32K EPROM	INT 27256A
U2	3000-4FFF	8K ZPRAM	DAL 1225
U3	7010-7FFF	8K ZPRAM	DAL 1225
U4	1000-2FFF	8K RAM	HD 6264

*or approved equal

7. A Model 242 Two-Channel Isolator shall be provided to introduce stop timing to the controller from the conflict monitor and the manual flash switch.

8. The Model 2010eclip Monitor Unit shall be provided.

9. A "PDA-2" Power Distribution Assembly shall be provided in lieu of the PDA-1 and the 24 volt D.C. Supply.

10. A standard print shelf drawer shall be provided and installed above the input file.

11. Four ACIA ports shall be provided.

12. One Model 400 internal modem shall be supplied for each controller when twisted pair communications is specified in the plans.

13. All components supplied shall be on CalTrans Qualified Product Listing and operate successfully with McCain 233 software.

14. Each cabinet shall include two fluorescent lighting fixtures mounted inside the front and back portion of the cabinet. These fixtures shall include a cool white lamp with protective cover and shall operate by a normal power UL listed ballast. Two door actuated switches shall be installed to turn on the cabinet light when the door is open, front door front light back door back light. Each switch should work each individual light.

15. Each cabinet shall be provided with devices to protect the control equipment form surges and over voltages. This shall include incoming power lines, the Input File, the Output File, and communication lines.

Each inductive loop detector input wire shall be protected with a 30V MOV with (30 Joule Rating) P/n ERZ-C20 KE 470 or equal. The output of all load switch outputs shall be protected with a 150V MOV (80 Joule Rating). P/n ERZ-C20 DK 241U or equal. The MOVs shall be connected from the AC positive field terminal to the chassis ground.

For the 332A cabinet, appropriate input surge protection shall be mounted on the Lower Input Termination Panel (LIP). The power distribution assembly (PDA#2) of each controller cabinet shall include a surge protection unit on the AC Service Input. The protector shall be installed between the applied line voltage and earth ground. The surge protector shall be capable of reducing the effect of lightning transient voltages applied to the AC line. The protection device shall be a two stage series parallel device. It shall include the following features and functions:

a. Maximum AC line voltage: 140 VAC.

b. Twenty pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to 1/2 the peak: 20,000 Amperes.

c. The protector shall be provided with the following terminals:
   1) Main line (AC line first stage terminal).
   2) Main Neutral (AC Neutral input terminal).
   3) Equipment Line Out (AC Line second stage output terminal, 10 Amps.).
   4) Equipment Neutral Out (Neutral terminal to protected equipment).
   5) GND (Earth connection).
   6) The Main AC line in and the Equipment Line out terminals shall be separated by a 200 Microhenry (minimum) inductor rated to handle 10 Amp AC Service. The first stageclamp shall be between Main Line and Ground terminals.
   7) The second stage clamp shall be between Equipment Line out and Equipment Neutral.
   8) The protector for the first and second stage clamp must have a MOV or similar solid state device rate at 20 KA and be of a completely solid stage design (i.e., no gas discharge between tubes allowed).
   9) The Main Neutral and Equipment Neutral Out shall be connected together internally and shall have an MOV similar solid state device or gas discharge tubes rated at 20 KA between Main Neutral and Ground terminals.
   10) Peak clamp voltage: 350 Volts at 20 KA (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together.). Voltage shall never exceed 350 volts.
   11) The Protector shall be epoxy encapsulated in a flame retardant material.
   12) Continuous service current, 10 Amps at 120 VAC RMS.

13) The Equipment Line Out shall provide power to the Type 170 and to the 24 V power supply.
14) Provide communications line protector with a mounting connector for incoming and outgoing communication line.

B. Manufacturers: The controller units, cabinets, and auxiliary control equipment furnished under this specification shall be from a manufacturer whose Type 170 Controller System has been approved and purchased by either the State of California or the State of New York. The Engineer may allow exceptions to this requirement provided that the equipment to be furnished has been successfully operated on the street by a public agency for more than one year and has been certified by an independent testing laboratory as meeting the requirements of Chapter 1, Section VIII, U.S. Department of Transportation, Publication FHWA-IP-78-16.

C. Software: The software for this project will be provided by the Engineer. The Contractor shall supply two blank 27256 PROM chips per controller.

D. Auxiliary Control Equipment:

1. Cabinets shall be furnished with all necessary auxiliary control equipment to properly operate eight signal phases and four pedestrian phases, which includes conflict monitor unit, isolation modules, detector sensing units as specified on contract documents, and load switch packs.

2. A heavy-duty clear plastic envelope, minimum dimensions of 9 inch by 12 inch, shall be attached inside the cabinet for storing timing and maintenance records, electrical prints, etc.

E. Certification: In addition to the testing certification required in Chapter 1, Section VIII "Electrical, Environmental and Testing Requirements," paragraph 6, the Engineer shall be furnished with a certification from the equipment manufacturer or supplier stating that the equipment furnished under this specification complies with all provisions of this specification. With prior approval of the Jurisdictional Engineer, minor exceptions to this specification may be allowed, provided these exceptions are detailed on the certification.

F. Warranty: All Type 170 Controllers and auxiliary equipment furnished under this specification shall be provided with a standard industry warranty. Any parts found to be defective shall, upon concurrence of the defect by the manufacturer, be replaced free of charge.

G. Manufacturer or Supplier: A representative from the manufacturer and/or supplier of the Type 170 Controllers shall be at the project site when the controllers are ready to be turned on, to provide technical assistance including, as a minimum, programming of all necessary input data. All required signal timing data shall be provided by the Engineer.

A minimum of one week prior to the scheduled "turn-on", the Contractor or supplier shall deliver the controller(s), (not including the cabinets), to the Traffic Signal Shop located at 2000 SE Scott. It is the responsibility of the deliverer to call ahead to schedule delivery.

The City of Des Moines will install and verify the specified software and timings. Should any controllers be found faulty at the shop, the person/company who delivered the equipment will be

contacted. The Signal Shop is not responsible for trouble shooting this equipment nor is any part of this process intended to replace "burn-in" responsibilities of the manufacturer.

The Contractor/Supplier is responsible for picking up the controller(s) from the Signal Shop and is solely responsible for bringing the controller(s) to full operation at the intersection(s). No assistance will be provided by the Signal crew once the software is working correctly and the signal timings have been verified in the Signal Shop. Having a knowledgeable representative at the project site(s) when the controller(s) is ready to be turned on is paramount to the safety and efficiency of this operation.

4.2 FIBER OPTIC DATA LINK OR ETHERNET CARD

A. Fiber Optic Data Link

When specified in the plans, a fiber optic data link shall be provided. It shall be of the type that will install in Type 170 controller chassis and provide a dual mode, double duplex, multi-drop communications link designed to interconnect traffic control equipment. Data links shall include the following functional requirements:

1. Master or Local operation mode set by board mounted switch.

2. Two sets of front mounted fiber optic receptacles with ST type connectors.

3. Accommodate 850nm, Multimode fiber optic cable.

4. Complies with 170 and NEMA Environmental specifications.

5. Includes a rechargeable NiCad battery backup to maintain communications in case of power disruption. Battery assembly shall be secured to board and charge circuit shall be built in.

6. Expansion port, which will allow for up to two additional fiber optic ports for directional branching of communication circuits.

7. Status LED’s which provide visual signal indicators associated with communications between the modems and can be easily viewable by a maintenance technician. Signals displayed shall include:

    a. Transmit Data 1 (TD-1)
    b. Receive Data 1 (RD-1)
    c. Transmit Data 2 (TD-2)
    d. Receive Data 2 (RD-2)
    e. Power (PWR)
    f. Built-In Test Fail (Fault)

B. Ethernet Card

When specified in the plans, an internal 170 Ethernet Card shall be provided to allow for Ethernet connection via the City’s network. It shall be of the type that will install in a Type 170 controller chassis, connecting via RJ45 cable to an Ethernet switch located

elsewhere within the controller cabinet. It shall include the following functional requirements:

1. Network interface to provide the following:

   a. 10Base-T/100Base-TX Ethernet Connection
   b. RJ45 connector
   c. Protocols: TCP/IP, UDP/IP, ARP, SNMP, TFTP, Telnet, DHCP, BOOTP, HTTP, and AutoIP

2. Serial interface to provide the following:

   a. 300 to 230, 400 bps data rate
   b. Seven or eight data bit characters
   c. Parity – odd, even, none
   d. Stop bits: one or two
   e. Control Signals: RTS/DCD, CTS
   f. Flow Control: XON/XOFF, RTS/CTS

3. Temperature hardened (-40º to 167º F)

4. Password protection with 256 bit AES encryption for secure communications

5. Power requirements to be +12 volts and 12 volts $\pm$ 5% @A 75mA

6. Embedded webserver

7. E-mail alert capability

8. Full TCP/IP protocol stack

9. Provide two serial ports that communicate via a single communications channel. The host Interface connects through the card edge to the local controller. The Auxiliary Port utilizes a DB9 connector and can be used to bring copper or wireless communications into the main data stream. The Auxiliary Posrt is to be switch selectable, so that it can operate as either a DCE or DTE interface. IN DCE mode, it will operate in parallel with the Host interface, and can be used to configure the Etherport via a PC terminal program. In DTE mode, it will provide an external interface for the host which can be connected to another DCE device such as a FSK modem. Full “handshaking” is to be provided to facilitate interoperability across different transmission systems.

10. Management shall be SNMP, Telnet, serial, internal Web server, and Microsoft Windows®-based utility configuration.

11. Indicators shall be provided to show 10Base-Tconnection, 100Base-T connection, and link & activity-full/half duplex.

4.3 VEHICULAR TRAFFIC SIGNAL HEADS

The purpose of the specification is to describe minimum acceptable design and operating requirements for vehicular traffic signal heads with including all fittings and brackets as specified on the Plans. All vehicular signal heads shall be light emitting diode (LED).

A. Main body Assembly:

Each section shall be complete with a one-piece, hinged door with water tight gaskets and two stainless steel locking devices. All screws, latching bolts, and hinge pins shall be stainless steel to prohibit rust and corrosion.

All sections of the vehicle signal head housings shall be of the black in color including the visor and door. The black color shall be permanently molded into the components.

B. Traffic Signal Mounting Brackets:

The traffic signal mounting bracket shall universally adjustable. It shall include internal wiring capability, and three axes of traffic signal adjustment, as well as vertical height adjustment. All necessary hardware for complete installation on a mast arm shall be included. The mounting assembly shall be of a cable type.

4.4 PEDESTRIAN SIGNAL HEADS

The purpose of this specification is to describe minimum acceptable design and operating requirements for pedestrian traffic signal heads including all fittings and brackets, as specified on the plans.

All pedestrian signal heads shall be light emitting diode (LED).

The signal head shall be designed so that all components are readily accessible from the front by opening the signal door.

The housing shall be one piece, 16 inch by 16 inch in size. The housing case shall include four integrally- cast, hinged lug pairs; two at the top and two at the bottom of each case. The case, when properly mated to other pedestrian signal components and mounting hardware, shall provide a dustproof and weatherproof enclosure and shall provide for easy access to and replacement of all components.

The door frame shall be one piece, complete with two hinged lugs cast at the bottom and two latch slots cast at the top of each door. The door shall be attached to the case by means of two,type 304 stainless steel spring pins.

All screws, latching bolts, and hinge pins shall be stainless steel to prohibit rust and corrosion.

The countdown pedestrian indicator unit shall fit in a traditional 16 inch by 16 inch pedestrian signal head housing.

4.5 ALUMINUM TRAFFIC SIGNAL PEDESTALS

The purpose of this specification is to describe minimum acceptable design, material, and fabrication requirements for aluminum traffic signal pedestals and/or aluminum shafts.

Bases shall have a four bolt pattern uniformly spaced on a 133/4 inch diameter bolt circle.

4.6 GALVANIZED STEEL TRAFFIC SIGNAL SUPPORTS

The purpose of this specification is to describe minimum acceptable design, material, and fabrication requirements for galvanized steel traffic signal supports.

The mast arms shall be of the length specified and shall be designed to support traffic signals as shown in the standard load detail on the plans. All mast-arms shall have a 4% rise when in-place and fully loaded.

Mast arms shall be continuous to 50 feet in length. Vertical pole configuration shall provide for two-piece combination pole with internal tapped plate connection to allow for addition or removal of luminaire pole extension. Poles shall be vertical under normal load.

4.7 PEDESTRIAN PUSH-BUTTON DETECTORS

The purpose of this specification is to describe minimum acceptable design and operating requirements for side-of-pole mount, pedestrian push-button detectors, including all fittings and brackets as specified on the plans.

A. Construction: Pedestrian push-button detectors shall be of the direct push type without levers, handles, or toggle switches. Each detector shall consist of a solid state electronic switch with no moving plunger or moving electrical contacts. The case shall have one outlet for a 1/2 inch pipe. The operating button shall be made of stainless steel and shall be of sturdy design. This button shall not protrude out from the case. The entire assembly shall be weather tight, secure against electrical shock and of such construction as to withstand continuous hard usage. The contact shall be normally open and no current flowing except at the moment of actuation. The push-buttons supplied shall be ADA accessible push button assembly with momentary LED indicator. The push-button casing shall be black in color, oval with a raised directional arrow.

B. Accessible Pedestrian Signal Pushbutton (APS): When APS pushbuttons are specified in the plans they shall meet the following specification. Pushbutton assembly shall be black in color, have an integrated R10-4b sign and ADA compliant pushbutton with raised directional arrow. The pushbutton shall provide confirmation through latching LED light, sound and tactile bounce. Pushbutton shall provide the option of sounds or messages during the WALK interval as well as vibration, sounds during the clearance interval, adjustable volume locator tone during the DON'T WALK interval, direction of travel messages, and special messages determined by the user. The pushbutton shall have a control unit that mounts in the associated pedestrian signal head. All wiring and components to create a functional system are included in the unit price for this item.

4.8 MICROWAVE RADAR PRESENCE DETECTION SYSTEM

A. General: This item shall govern the purchase and installation of an above-ground radar presence detector (RPD) system. An RPD detects bicycles/vehicles by transmitting electromagnetic radar signals through the air. The signals bounce off bicycles/vehicles in their paths and part of the signal is returned to the RPD. The returned signals are then processed to determine traffic parameters.

B. Sensor Outputs: The RPD shall present real-time presence data for the approach to be detected. It shall support a minimum of eight zones and a minimum of four channels. The RPD algorithms shall mitigate detections from wrong way or cross traffic.

The RPD system shall have fail-safe mode capabilities for contact closure outputs if communication is lost.

C. Detectable Area: The RPD shall be able to detect and report presence individually in all approach lanes The RPD shall be able to detect and report presence in up to six lanes. It shall be able to detect and report presence in curved lanes and areas with islands and medians.

D. System Hardware: For each approach to be detected, one RPD shall be used. Each RPD shall have either a traffic cabinet preassembled backplate with AC/DC power conversion, surge protection, terminal blocks for cable landing, and communication connection points; or a rack-mounted sensor interface board that operates on 24VDC with communications to the sensing unit via an Ethernet interface with Power-over-Ethernet (POE).

Any preassembled backplate for the RPD shall be a cabinet side mount or rack mount.

The RPD shall use contact closure input file cards with two or four channel capabilities. The contact closure input file cards shall be compatible with industry standard detector racks.

E. Maintenance: The RPD shall not require cleaning or adjustment to maintain performance. It shall not rely on battery backup to store configuration information, thus eliminating any need for battery replacement.

Once the RPD is calibrated, it shall not require recalibration to maintain performance unless the roadway configuration changes.

The mean time between failures shall be 10 years, which is estimated based on manufacturing techniques.

F. Physical Properties: The RPD unit shall not exceed 6 pounds in weight. The general dimensions of the unit shall not exceed 13.2 inches by 10.6 inches by 8 inches in its physical dimensions.

All external parts of the RPD shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration. The enclosure shall be rated for outdoor weatherability in accordance with UL standards. The unit shall be classified as watertight.

The RPD enclosure shall include a connector that meets the UL standards for outdoor weatherability connections. The connector shall provide contacts for all data and power connections.

G. Electrical: The RPD shall consume less than 10 W. It shall operate with a DC input between 9 VDC and 28 VDC and have onboard surge protection.

H. Communications Ports: The RPD system shall have a communication port, allowing it to be used for configuration, verification and traffic monitoring without interrupting communications on the dedicated data port serving the controller operation. The RPD shall support the upload of new firmware into the RPD's nonvolatile memory over either communication port.

I. Radar Design: The RPD shall be designed to provide detection over a large area and to discriminate lanes. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

During operation, the RPD shall strictly conform to FCC requirements and the radar signal quality shall be maintained for precise algorithmic quality. The RPD must not experience unacceptable frequency variations which may cause it to transmit out of its FCC allocated band and thus will be non-compliant with FCC regulations.

The RPD shall transmit a signal with a bandwidth of at least 245 MHz. This translates directly into radar resolution, which contributes directly to detection performance.

The RPD shall provide at least five RF channels so that multiple units can be mounted in the same vicinity without causing interference between them.

The RPD shall have a self-test that is used to verify correct hardware functionality. It shall also have a diagnostics mode to verify correct system functionality.

J. Configuration: The RPD shall have a method for defining traffic lanes, stop bars and zones. It may have an auto-configuration process that would execute on a processor internal to the RPD. If equipped, the auto-configuration process shall work under normal intersection operation and may require several cycles to complete.

The auto-configuration method shall not prohibit the ability of the user to manually adjust the RPD configuration.

The RPD shall support the configuring of lanes, stop bars and detection zones in 1foot increments.

The RPD shall include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic representation.

The graphical interface shall operate on Windows Mobile, Windows XP, Windows Vista and Windows 7 in the .NET framework.

The software shall support the following functionality:

- Operate over a TCP/IP connection
- Give the operator the ability to save/back up the RPD configuration to a file or load/restore the RPD configuration from a file
- Allow the backed-up sensor configurations to be viewed and edited
- Provide zone and channel actuation display
- Provide a virtual connection option so that the software can be used without connecting to an actual sensor
- Local or remote sensor firmware upgradability

K Operating Conditions: The RPD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk. Its operation shall continue in rain up to 1 inch per hour. It shall be capable of continuous operation over an ambient temperature range of -40°F to 165.2°F, and over a relative humidity range of 5% to 95% (non-condensing).

L. Testing: Each RPD shall be certified by the Federal Communications Commission (FCC) under CFR 47, part 15, section 15.249 as an intentional radiator. The FCC certification shall be displayed on an external label on each RPD according to the rules set forth by the FCC. The RPD shall comply with FCC regulations under all specified operating conditions and over the expected life of the RPD.

The RPD shall comply with the applicable standards stated in the NEMA TS 2-2003 standard.

M. Manufacturing: The RPD shall undergo a rigorous sequence of operational testing to insure product functionality and reliability. Testing shall include the following:

- Functionality testing of all internal sub-assemblies
- Unit level burn-in testing of 48 hours' duration or greater
- Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided for each purchased RPD by serial number, upon request.

N. Support: The RPD manufacturer shall provide both training and technical support services. The manufacturer-¬provided training shall be sufficient to fully train installers and operators in the installation, configuration, and use of the RPD to insure accurate RPD performance.

Manufacturer¬-provided technical support shall be available according to contractual agreements, and a technical representative shall be available to assist with the physical installation, alignment, and configuration of each supplied RPD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of RPDs should such services be required.

O. Documentation: RPD documentation shall include an instructional training guide and a comprehensive user guide as well as an installer quick-reference guide and a user quick-reference guide.

P. Warranty: The RPD shall be warranted free from material and workmanship defects for a period of 18 months from date of shipment.

Q. Installation Requirements: The RPD shall be mounted directly onto a mounting assembly fastened to a mast arm, pole or other solid structure. The mounting assembly shall provide the necessary degrees of rotation to ensure proper installation. The mounting assembly shall be constructed of weather-resistant materials and shall be able to adequately support the sensor unit provided.

The RPD shall be mounted at a height that is within the manufacturer's recommended mounting heights. The UNIT shall be mounted at an offset from the first lane that is consistent with the RPD's minimum offset. It shall be mounted so that at least 20 feet along the farthest lane to be monitored is within the field view of the RPD.

The RPD shall be mounted with its cable connector down and shall be tilted so that the RPD is aimed at the center of the lanes to be monitored.

The RPD shall be mounted on a vertical signal pole or on the horizontal mast arm, and mounted so that its field of view is not occluded by poles, signs or other structures.

RPDs must be capable of being configured to operate on different RF channels.

The cable end connector shall be an environmentally sealed shell that offers excellent immersion capability. All conductors that interface with the connector shall be encased in a single jacket, and the outer diameter of this jacket shall be within a weatherproof cover to ensure proper sealing. The cable shall have a strain relief with enough strength to support the cable slack under extreme weather conditions.

The cable shall be terminated only on the two farthest ends of the cable.

Both communication and power conductors can be bundled together in the same cable.

The input file cards shall meet the following specifications:

The input file cards shall be compatible with 170, 2070, NEMA TS 1, and NEMA TS 2 style input racks.

The input file card shall translate data packets from the RPD into contact closure outputs.

The input file card shall support presence detection.

The input file card shall comply with the NEMA TS 2-1998 Traffic Controller Assemblies with NTCIP Requirements (Section 2.8 spec).

PART VII

SCHEDULE OF UNIT PRICES
TRAFFIC SIGNALIZATION
Park Avenue Widening
SW 56th St. to SW 63rd St.
06-2011-005

ITEM	UNIT	TOTAL QUANTITY	UNIT COST	EXTENSION
8 Phase Controller, 332 Cabinet, Aux Panel and Access.	EACH	1		
Controller Cabinet Riser	EACH	1		
Controller Cabinet Split Riser	EACH	2		
Pedestrian Pushbutton with Sign - APS	EACH	3		
2 ch. Inductive Loop Detector - Card Rack	EACH	20		
12" RA, YA, FYA, GA left w/backplate, m.a. mount, LED	EACH	3		
12" RA, YA, FYA, GA right side of pole mount, LED	EACH	1		
12" RA, YA, GA left w/backplate, mast arm mount, LED	EACH	1		
12" RA, YA, GA left, side of pole mount, LED	EACH	3		
12" RA, YA, GA right w/backplate, mast arm mount, LED	EACH	1		
12" RA, YA, GA right side of pole mount, LED	EACH	1		
12" R, Y, G w/backplate, mast arm mount, LED	EACH	15		
12" R, Y, G side of pole mount, LED	EACH	10		
16" Hand/Walking Person with Countdown Timer, LED	EACH	4		
Type I	EACH	9		
Type III	EACH	4		
Type IV	EACH	1		
Signal - 16c #14	LIN FT	1330		
Signal - 12c #14	LIN FT	102		
Signal - 7c #14	LIN FT	240		
Signal - 5c #14	LIN FT	1130		
Signal - 2c #14	LIN FT	338		
Detector - 1c #14 Loop	LIN FT	5552		

SCHEDULE OF UNIT PRICES
TRAFFIC SIGNALIZATION
Park Avenue Widening
SW 56th St. to SW 63rd St.
06-2011-005

ITEM	UNIT	TOTAL QUANTITY	UNIT COST	EXTENSION
Detector - 2c #14	LIN FT	5334		
Power - 1c #6	LIN FT	10		
Ground - 1c #6	LIN FT	1273		
Tracer - 1c #10, orange	LIN FT	6426		
Pull Tape	LIN FT	6426		
Fiber - 12 count multi mode	LIN FT	3670		
Fiber - 48 count single mode	LIN FT	4659		
1" PVC	LIN FT	487		
2" PVC	LIN FT	206		
3" PVC	LIN FT	5040		
2' Dia. X. 15' Footing	EACH	2		
Controller Cabinet Footing	EACH	1		
15' pedestal pole	EACH	2		
~~Combination~~ Signal Mast Arm - 34'	EACH	1		
~~Combination~~ Signal Mast Arm - 52'	EACH	1		
Street Name Sign - 18" x varies, Park Av	EACH	4		
Street Name Sign - 18" x varies, SW 63rd St	EACH	1		
Street Name Sign - 18" x varies, SW 56th St	EACH	2		
Traffic Sign - 36" x 36", R3-8L	EACH	1		
Traffic Sign - 30" x 36", R3-5L	EACH	5		
Traffic Sign - 30" x 36", R3-5R	EACH	1		
FO Termination Unit (closet)	EACH	1		
Multi Mode Fiber Terminations	EACH	60		
Locate Box	EACH	3		

SCHEDULE OF UNIT PRICES
TRAFFIC SIGNALIZATION
Park Avenue Widening
SW 56th St. to SW 63rd St.
06-2011-005

ITEM	UNIT	TOTAL QUANTITY	UNIT COST	EXTENSION
Signal Head/Pushbutton Removals	LS	1		
	TOTAL SIGNALIZATION COST			

SP-151008
(New)

SPECIAL PROVISIONS
FOR
WATER MAIN

Polk County
STP-U-1945(796)--70-77

Effective Date
November 15, 2016

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

I. GENERAL INFORMATION

A. Submittals

The Des Moines Water Works (DMWW) will review all shop drawings for materials related to water main construction. Shop drawings shall be provided to DMWW 2 weeks prior to any water main construction. The Contractor shall submit these shop drawings to:

Des Moines Water Works
Attn.: Katie Kinsey
2201 George Flagg Parkway
Des Moines, Iowa 50321

B. Preparation

Notify DMWW (515-283-8729) 48 hours prior to the start of any water main related construction.

Notify DMWW (515-283-8729) 48 hours prior to and after lowering cathodic test stations to verify cathodic system has not been damaged due to construction.

Verify proposed grades prior to construction to ensure adequate finished cover will be provided over all water mains.

The Contractor shall arrange with DMWW for all valves and hydrants to be operated only by DMWW's personnel.

II. WARRANTY

The Contractor shall protect and save harmless the Des Moines Water Works' Board from claims and damages of any kind caused by the operation of the Contractor, warranty materials and quality of work to be free of defects for a period of 2 years after the date of successful completion of testing as stated in Sections 02674 and 02675, and Part 3.7 of Section 02220 all contained within this Special Provision and shall otherwise in all respects comply with Chapter 573, Code of Iowa. Should defects be discovered during this period, the Contractor shall repair the defect at its sole cost and expense upon notice from DMWW.

Submit written report stating intentions and schedule for completing repairs within 7 calendar days after being notified of need for repairs.

If Contractor fails to make needed repairs, DMWW will contact the Office of Contracts and their bidding qualifications may be jeopardized according to Article 1102.03 of the Standard Specifications.

DMWW reserves the right to make emergency repairs that are necessary to keep the water main facilities serviceable or to provide immediate action to prevent further damage to the water main or surrounding area. The Contractor shall reimburse the cost incurred by DMWW for any emergency repairs.

III. BASIS OF PAYMENT

No other payment will be made for work covered by this Special Provision, but will be considered incidental to the contract unit price bid for the individual items for which the work was done. Payment for each item shall be considered full compensation for furnishing all material, equipment, tools, labor, and warranty for the construction of each item including excavation, backfill, compaction, and other incidental work to complete the construction in accordance with the contract documents.

SECTION 02220 EXCAVATING, BACKFILLING, AND COMPACTING FOR WATER MAINS

INDEX

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Part 1 General

1.1 Summary of Work

A. Excavating, backfilling, and compacting specifications as applicable for installation of water main and appurtenances.

1.2 Related Sections

A. Section 02610 – Ductile Iron and Polyvinyl Chloride Pipe for Water Mains.
B. Section 02640 – Valves and Hydrants.
C. Section 02660 – Water Service Transfers.

1.3 References

A. American Society for Testing and Materials (ASTM) D2922 – Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
B. American Society for Testing and Materials (ASTM) D3017 – Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
C. American Society for Testing and Materials (ASTM) D698 – Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3).
D. Federal Register – Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards - Excavations.

1.4 Submittals (Not used)

1.5 Measurement and Payment

A. Stabilization Materials: per ton, based on quantities shown on material delivery tickets provided to Engineer.
   1. Include cost for all material, equipment, labor, and associated work necessary to complete work associated with stabilization materials in the unit bid price for Foundation Rock on the Proposal.
   2. Estimated quantity shown on Proposal for Foundation Rock is not to be used as an indication of site conditions that will be encountered during the course of the Work.
B. Special Pipe Embedment and Encasement Material: per cubic yard, based on quantities shown on material delivery tickets provided to Engineer.
   1. Include cost for all material, equipment, labor, and associated work necessary to complete work associated with special pipe embedment and encasement material in the unit bid price for Utility Embedment Material on the Proposal.
   2. Estimated quantity shown on Proposal for Utility Embedment Material is not to be used as an indication of site conditions that will be encountered during the course of the Work.

Part 2 Products

2.1 Excavated Materials

A. Topsoil shall be stripped, grubbed, and stockpiled for finished grading.
B. Backfill material shall be:
   1. Approved for use by the Engineer.
   2. Selected material taken from the excavation or select borrow material, if sufficient quantities of compliant excavated material are not available.
   3. Inorganic clays, clayey sands, or inorganic and clayey silts, compatible with and having an obtainable density no less than adjacent soils.
   4. Free of lumps or clods over 3 inches in the largest dimension.
   5. Free of foreign debris including rocks, organic materials, and man-made debris.
   6. Material that is not frozen.

2.2 Bedding Material

A. Steel Pipe: Bed pipe using sand free of frozen material, foreign debris, including rocks, organic materials, and man-made debris.
B. Ductile iron pipe, prestressed concrete cylinder pipe, polyvinyl pipe, and corrugated steel pipe: Bed pipe using material taken from the excavation with the following characteristics:
   1. Inorganic clay, clayey sand, or inorganic and clayey silt.
   2. Free of lumps or clods over 2 inches in the largest dimension.
   3. Free of foreign debris including rocks, organic materials, and man-made debris.
   4. With a soil moisture range of optimum moisture to 4% above optimum moisture content.
   5. Material that is not frozen.

2.3 Stabilization Material

A. When required by field conditions, stabilization material shall be crushed limestone, dolomite, or quartzite generally meeting the following characteristics:
   1. 2 inch nominal maximum size.
   2. 95% retained on a 3/4 inch screen.
   3. Generally free from deleterious substances as determined by the Engineer.

2.4 Borrow Materials

A. If sufficient quantity of suitable material is not available from excavations, material shall be obtained from approved off-site sources. Off-site sources must hold a National Pollutant Discharge Elimination System (NPDES) permit from the IDNR for storm water discharge associated with construction activity.
B. Borrow materials, including topsoil and backfill material, shall conform to specifications for excavated materials in Part 2.1.
C. Topsoil borrow material shall be:
   1. Natural loam and humus with characteristics consistent with the existing topsoil on site.

2. Finely graded and free of clumps larger than 2 inches in the largest dimension.
3. Free of man-made materials and debris.
4. Free of rock or organic matter, including wood and roots, greater than 3/4 nch, in the largest dimension.
5. Comprised of less than 0.5% clay.

2.5 Special Pipe Embedment and Encasement Material

A. When directed by Engineer, Contractor shall install controlled low-strength material to provide support to existing utilities.
   1. Controlled Low-Strength Material (CLSM):
      a. Approximate quantities per cubic yard:
         (1) Cement: 50 pounds.
         (2) Fly ash: 250 pounds.
         (3) Fine aggregate: 2910 pounds.
         (4) Water: 60 gallons.
      b. A compressive strength of at least 50 psi compressive strength at 28 calendar days.
      c. Comply with material requirements of Article 2506.02 of the Standard Specifications.

Part 3 Execution

3.1 General

A. Quality Assurance
   1. The Engineer shall be given the opportunity to review excavated or borrowed soils prior to placement as backfill.
   2. The Contracting Authority will commission and compensate a qualified soils engineer to develop Proctor curves indicating moisture-density relationships for all soil types used as backfill.
   3. Proctor curves and soil analysis information shall be used in determining proper compaction of the soils placed.

B. General Safety
   1. Blasting shall not be permitted.
   2. Safety and protection:
      a. Provide shoring, sheeting, and bracing, as required, to protect the Work, adjacent property, private or public utilities, and workers.
      b. Strictly observe laws and ordinances regulating health and safety measures.
      c. Excavations that Contracting Authority's personnel are required to enter shall comply with OSHA standards.

C. Soil Testing
   1. Field tests for density and moisture content shall be performed by the soils engineer, defined in Part 3.1.B above, to ensure that the specified density is being obtained. Testing shall be done using ASTM D2922 nuclear methods or another method approved by the Engineer.
   2. Density tests shall be taken at finished grade, at 3 feet below finished grade, and as directed by the Engineer under special conditions. Test locations shall be selected by the Engineer immediately prior to performing tests. Excavate, as directed by the Engineer, for tests at intermediate depths. As a minimum, density tests shall be taken at approximately 200-foot intervals along the trench. Additional tests shall be required at the following locations:
      a. Over jacking pits where casing was installed.
      b. Immediately adjacent to all structures.
   3. When test results indicate compaction is not as specified:
      a. Additional tests will be required in both directions from the failed test until satisfactory results are obtained.
      b. All material between the satisfactory tests shall be removed, replaced, and recompacted in lifts to meet specifications. Compaction corrections shall be made at no expense to the Contracting Authority.

c. Recompacted areas shall receive density tests provided at the same frequency as the original tests. Testing of recompacted areas shall be at the Contractor's expense.

4. If petroleum-based materials are detected in the soils, the Contractor shall notify the Engineer. Appropriate action will be taken by the Contracting Authority.
5. Tests that are not conducted in the presence of the Engineer, or are conducted at locations not selected by the Engineer, will be rejected.

D. Protection of Utility Lines
1. Conduct trenching operations to avoid damaging underground utilities.
2. Underground utilities that are shown on the Drawings, located or identified for the Contractor prior to trenching, shall be protected. Damage resulting from trenching or backfilling shall be repaired by the Contractor or utility company at Contractor's expense.
3. Underground utilities discovered by the Contractor shall be protected.

3.2 Disposal of Excavated Material

A. Remove excess material excavated for the water main trench from the site and in compliance with environmental regulations.
B. Backfill consisting of suitable material, which comes from an off-site source, must conform to Part 2.1.

3.3 Trench Excavation

A. Strip and stockpile topsoil for finished grading. A minimum of 12 inches of topsoil must be segregated from other materials in agricultural areas.
B. Trenches shall be excavated so as to:
1. Follow lines and grades as indicated on the plans.
2. Provide uniform bearing on undisturbed soil and continuous support along the entire length of the pipe.
3. Prevent over-excavation in locations where suitable subgrade conditions exist.
4. Provide vertical trench walls to an elevation no less than 12 inches above the pipe.

C. Unstable trench bottoms, as determined by the Engineer, shall be corrected as follows:
1. Over-excavate the trench to stable soil or to a maximum of to 2 feet below the bottom of the pipe.
2. If stable soil is reached, the trench shall be brought back to grade using suitable backfill material or bedding material compacted to 90% Standard Proctor Density.
3. If stable soil is not reached after 2 feet of over-excavation, 1 foot of the specified trench stabilization material shall be placed in the trench bottom and compacted. The trench shall then be brought back to grade using suitable backfill material or bedding material compacted to 90% Standard Proctor Density.
4. Pipe shall be placed only after the trench bottom has been fully stabilized.

D. Remove stones encountered during excavation. When large rocks are encountered, they shall be broken away to an elevation 6 inches below the bottom of the proposed improvement. Voids created through removal of stones shall be filled with approved backfill material and thoroughly compacted to 90% Standard Proctor Density.
E. Trench bottoms shall be excavated deeper at the location of bell joints to permit the body of the pipe to rest uniformly supported upon the trench bottom. Bell holes shall be no longer than is necessary for practical installation of the pipe.
F. The length of trench to be opened at one time shall be as follows:
1. In extended runs, open trench length shall not exceed 100 feet.
2. In street crossings, trench shall not be open in more than one lane at a time, unless specified differently in traffic control plan.
3. Backfill driveways and entrances immediately after placement of pipe.

G. Excavated material shall be placed:
1. As approved by the Engineer when this Special Provisions does not apply.
2. Compactly along sides of excavation.
3. To provide continuous access to fire hydrants and utility valves.
4. To provide as little inconvenience as possible to public travel.
5. To minimize damage to adjacent lawns and planted areas.

3.4 Pipe Bedding

A. Bed pipe with 4 inch thick layer of specified bedding material for pipes 20 inch and larger.
B. Place bedding alongside of the pipe to an elevation above the springline (no lower than half the height of the pipe).
C. Compact bedding to a minimum of 90% Standard Proctor Density.
D. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.
E. Do not damage pipe coating or wrapping system during bedding placement and compaction.

3.5 Backfilling

A. Backfilling of trenches shall be done only after pipe installation, jointing, and bedding are complete, inspected, and approved.
B. Backfill material shall comply with Part 2 above.
C. Backfill shall be mechanically tamped with impact or vibrating compaction equipment.
D. Place backfill in layers and compact to the required density.
E. Backfill shall be:
    1. Compacted to 90% Standard Proctor Density to a level 1 foot above the pipe.
    2. For the remainder of the trench:
        a. Public rights-of-way shall be compacted to 95% Standard Proctor Density.
        b. Easement areas shall be compacted to 90% Standard Proctor Density.
    3. Within a soil moisture range of optimum moisture to 4% above optimum moisture content.
F. Protect pipe coating or pipe wrapping system from damage during backfill operations.
G. Hydraulic compaction or water jetting of the pipe trenches shall not be permitted.
H. Adjust moisture content of material that exceeds optimum moisture range, but is otherwise acceptable, by spreading and aerating or otherwise drying as necessary until moisture content is within required moisture range and required compaction can be obtained.
I. Adjust moisture content of material that is below optimum moisture, but is otherwise acceptable, by wetting as necessary until moisture content is within required moisture range and required compaction can be obtained.

3.6 Grading

A. Finish-grade surfaces with a well-compacted, free-draining uniform surface without obstructive protrusions or depressions.
B. Place topsoil at a uniform depth equal to the surrounding topsoil, but not less than 4 inches.
C. Place topsoil to a minimum depth of 6 inches when ample native topsoil is available.
D. Place topsoil only under lawn and planted areas.

3.7 Control of Water

A. Install pipe in the dry.
B. Dewater as necessary to prevent water from entering the pipe or rising around the pipe.
C. Water pumped or diverted from the excavation site shall not be:
    1. Pooled anywhere on the site.
    2. Removed in such a manner as to disperse silt.
    3. Placed on surfaces heavily traveled by pedestrian traffic.
D. Installed pipe shall not be used as a conduit for trench dewatering.
E. Surface water shall be controlled as follows:
    1. Divert surface water to prevent entry into the pipe trenches.
    2. Remove surface water accumulated in the pipe trenches and other excavations prior to continuation of excavation work.
    3. Remove surface water saturated soil from the excavation.
F. Control groundwater as follows:
    1. Where groundwater is encountered, trenches and other excavations shall be dewatered, as necessary, to permit the proper execution of the Project.
    2. When large quantities of groundwater are encountered, trenches shall be stabilized with the specified stabilization material and pipe shall be bedded as specified.

3.8 Disposal of Unsuitable or Excess Material

A. Surplus material and material not suitable for backfill shall be disposed of off-site at a location provided by Contractor.
    1. Off-site disposal locations must hold a National Pollutant Discharge Elimination System (NPDES) permit from the IDNR for storm water discharge associated with construction activity.
    2. Transportation of such material shall be provided by Contractor.

3.9 Cleanup and Restoration

A. The site in and around the excavation shall be cleared of mud and construction debris to a condition equal to, or better than, that existing prior to trenching work.
B. Remove construction remnant materials from the site.
C. Damage to adjacent property suffered during installation work shall be repaired to a condition equal to, or better than, that existing prior to trenching work.

SECTION 02600 PROTECTION OF WATER SUPPLY

INDEX

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Part 1 General

1.1 Summary of Work

A. This Section describes Iowa Department of Natural Resources (IDNR) requirements for protection of water supply systems from the Standard Specifications on file with IDNR dated October 10, 2014.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Mains.
B. Section 02610 – Ductile Iron and Polyvinyl Chloride Pipe for Water Mains.
C. Section 02640 – Valves and Hydrants.
D. Section 02674 – Pressure Testing Water Mains.
E. Section 02675 – Disinfection of Water Distribution Systems.

1.3 References

A. Iowa Wastewater Facilities Design Standards.

1.4 Submittals (Not used)

1.5 Measurement and Payment (Not used)

Part 2 Products

Not used.

Part 3 Execution

3.1 General Installation Requirements

A. Lay water mains to avoid high points where air can accumulate. Grade piping so that proposed hydrants will be at the highest points.
B. Do not locate hydrants within 10 feet of sanitary sewers or storm drains.
C. Plug hydrant drain ports in areas where groundwater rises above the water main and pump the hydrant barrel dry following construction.

D. Pressure test and disinfect new water mains prior to placing them in service.

3.2 Separation Distance

A. Horizontal separation of water mains from gravity sewers:
   1. Provide a horizontal separation distance of at least 10 feet between water mains and gravity sewer mains, unless both of the following conditions can be met:
      a. The bottom of the water main is at least 18 inches above the top of the sewer.
      b. The water main is placed in a separate trench with a minimum 3 foot horizontal separation.
   2. When it is impossible to obtain the required 3 foot horizontal clearance and 18 inch vertical separation, the sewer must be replaced with water main quality materials having a minimum pressure rating of 150 psi and meeting the requirements of Section 02610. In no case shall the linear separation be less than 2 feet.

B. Horizontal separation of water mains from sewer force mains:
   1. Provide a horizontal separation distance of at least 10 feet between water mains and sewer force mains, unless both of the following conditions can be met:
      a. The force main is constructed of water main quality materials having a minimum pressure rating of 150 psi and meeting the requirements of Section 02610.
      b. The water main is laid at least 4 linear feet from the sewer force main.

C. Vertical separation of water mains from sanitary sewer crossovers:
   1. Provide a vertical separation of at least 18 inches from the bottom of the water main to the top of the sanitary sewer whenever possible where water mains cross over sanitary sewers. If 18 inches cannot be met, provide a minimum vertical separation of 6 inches and place the water main inside 20 feet of a larger diameter polyvinyl chloride water main casing pipe with no casing chocks centered on the sanitary sewer.
   2. Provide a vertical separation of at least 18 inches from the bottom of the sanitary sewer to the top of the water main in cases where water mains cross under the sanitary sewer. Place the water main inside 20 feet of a larger diameter polyvinyl chloride water main casing pipe with no casing chocks centered on the sanitary sewer.
   3. Adequately support both water and sanitary sewer pipes and provide watertight joints.

D. Vertical separation of water mains from storm sewer crossovers:
   1. Provide a vertical separation of at least 18 inches from the bottom of the water main to the top of the storm sewer whenever possible where water mains cross over storm sewers. If 18 inches cannot be met, provide a minimum vertical separation of 6 inches and construct one of the following:
      a. Verify the storm sewer has gasketed joints.
      b. The water main shall be 20 feet of ductile iron pipe material with nitrile gaskets.
      c. Encase the storm sewer.
      d. Encase the water main.
   2. Provide a minimum vertical separation of at least 18 inches from the bottom of the storm sewer to the top of the water main in cases where water mains cross under storm sewer mains and construct one of the following:
      a. Verify the storm sewer has gasketed joints.
      b. The water main shall be 20 feet of ductile iron pipe material with nitrile gaskets.
      c. Encase the storm sewer.
      d. Encase the water main.
   3. Adequately support both water and storm sewer pipes and provide watertight joints.

E. Separation of water mains from sewer manholes:
   1. No water pipe shall pass through or come in contact with any part of a sewer manhole.
   2. Provide a horizontal separation distance of at least 10 feet between water mains and sewer manholes.

F. Advise Engineer should physical conditions exist such that exceptions to Part 3.2 of this Section are necessary.

3.3 Water Crossings

A. Above-water crossings:

1. Adequately support and anchor pipe used for above-water crossings.
2. Protect pipe from damage and freezing.
3. Ensure pipe is accessible for repair or replacement.

B. Underwater crossings:
   1. Use restrained joint pipe for water mains entering or crossing streams.
      a. Place the top of the water main a minimum of 5 feet below the natural bottom of the streambed.
      b. Securely anchor the water main to prevent movement of the pipe and provide easily accessible shutoff valves located outside the floodway at each end of the water crossing.
      c. Backfill the trench with crushed rock or gravel.
      d. Seed, sod, or otherwise protect the streambank from erosion upon completion of the Project.
   2. For smaller streams, the same requirements shall apply except that shutoff valves do not need to be located immediately adjacent to the water crossing.
   3. Water crossings in areas where no evidence of erosion exists are excluded from these requirements.

3.4 Depth of Cover and Width of Trench

A. Provide 5 feet minimum depth of cover from the top of the pipe to the ground surface.
B. Where possible, provide an additional 1 foot of cover under pavement.
C. Insulate water mains where conditions prevent adequate earth cover.
D. Provide a trench width adequate to lay and joint pipe properly but not more than 12 inches on either side of the pipe.

SECTION 02610 DUCTILE IRON AND POLYVINYL CHLORIDE PIPE FOR WATER MAINS

INDEX

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Part 1 General

1.1 Summary of Work

A. This Section includes water mains, fittings, and specials as shown on the plans, complete with accessories.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Mains.
B. Section 02600 – Protection of Water Supply.
C. Section 02640 – Valves and Hydrants.
D. Section 02660 – Water Service Transfers.
E. Section 02674 – Pressure Testing Water Mains.
F. Section 02675 – Disinfection of Water Distribution Systems.
G. Section 13210 – Cathodic Protection for Small Diameter (8”-16”) Water Mains.

1.3 References

A. American National Standards Institute (ANSI) B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
B. American Society for Testing and Materials (ASTM) A320 – Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
C. American Society for Testing and Materials (ASTM) A536 – Standard Specification for Ductile Iron Castings.
D. American Water Works Association (AWWA) C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

E. American Water Works Association (AWWA) C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
F. American Water Works Association (AWWA) C110 – Ductile-Iron and Gray-Iron Fittings.
G. American Water Works Association (AWWA) C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
H. American Water Works Association (AWWA) C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
I. American Water Works Association (AWWA) C150 – Thickness Design of Ductile Iron Pipe.
J. American Water Works Association (AWWA) C151 – Ductile Iron Pipe, Centrifugally Cast.
K. American Water Works Association (AWWA) C153 – Ductile-Iron Compact Fittings.
L. American Water Works Association (AWWA) C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
M. American Water Works Association (AWWA) C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
N. American Water Works Association (AWWA) C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In., for Water Transmission and Distribution.
O. American Water Works Association (AWWA) C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In, for Water Transmission and Distribution.

1.4 Submittals

A. The following items shall be submitted for materials provided by the Contractor:
   1. Manufacturer's certification that materials furnished is in compliance with the applicable requirements of the referenced standards and this Specification.
   2. Drawings and manufacturer's data showing details of the pipe and fittings to comply with this Specification.
   3. Class of pipe and fittings.
   4. Restrained joint details for Engineer's approval.
   5. List of at least ten projects similar to this Project. Include project name, scope, duration of Project, and references with phone numbers.
B. Provide dimensional drawings, fabrication details, functional description, and properly identified catalog data on pipe and equipment to prove complete compliance with Contract Documents.

1.5 Measurement and Payment

A. Water main shall be measured in linear feet, along centerline of the pipe.
B. Install regular joint pipe items by open trench. Include costs for material, equipment, and labor for Work included in this Section.
C. Install lock joint pipe items by horizontal directional drilling. Include costs for material, equipment, and labor for Work included in this Section.

Part 2 Products

2.1 Ductile Iron Pipe (12 Inches and Smaller)

A. Special Thickness Class 52 per AWWA C150.
B. Manufacture pipe in accordance with AWWA C151.
C. Provide asphaltic outside coating per AWWA C151, 1 mil in thickness.
D. Cement Mortar Lining:
   1. Provide pipe with standard thickness cement mortar lining per AWWA C104.
   2. Seal-coat cement mortar lining in accordance with AWWA C104.

2.2 Polyvinyl Chloride Pipe C-900

A. Manufacture 12 inch and smaller pipe in accordance with AWWA C900.
B. Pipe shall be Class 235 (DR 18) with ductile iron pipe equivalent outside diameters.
C. Pipe installed utilizing horizontal directional drilling shall be restrained joint PVC.
D. Pipe shall be blue in color.

2.3 Polyvinyl Chloride Pipe C-905

A. Manufacture 16 inch pipe in accordance with AWWA C905.
B. Pipe shall be Class 235 (DR 18) with ductile iron pipe equivalent outside diameters.
C. Pipe installed utilizing horizontal directional drilling shall be restrained joint PVC.
D. Pipe shall be blue in color.

2.4 Fittings for Ductile Iron and Polyvinyl Chloride Pipe

A. Fittings shall be compact in accordance with AWWA C153, or full size in accordance with AWWA C110.
B. Material of construction shall be ductile iron in accordance with AWWA C110.
C. Joints
    1. Mechanical in accordance with AWWA C111 and shall be restrained.
        a. T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
            (1) Material: low carbon alloy weathering Cor-Ten steel.
            (2) Coating: Cor-Blue fluorocarbon resin.
            (3) Color: blue.
    2. Flanged in accordance with AWWA C115, as indicated on the plans, with ANSI Class 125 full-faced flange.
        a. Gaskets: of thickness compatible with machining tolerances of flange faces. Minimum thickness: 1/8-inch.
        b. Nuts and bolts: stainless steel in accordance with ASTM A320, Type 304.
D. Pressure rating:

Size (Inches)	Pressure Rating (psi)
3 – 24	350
30 – 48	250
54 – 64	150

E. Provide asphaltic outside coating per AWWA C110, 1 mil in thickness.
F. Cement Mortar Lining:
    1. Provide standard thickness cement mortar lining per AWWA C104.
    2. Seal-coat cement mortar lining in accordance with AWWA C104.

2.5 Joints for Ductile Iron and Polyvinyl Chloride Pipe

A. Joints shall be push-on using an integral bell with an elastomeric or nitrile gasket in accordance with AWWA C111, mechanical in accordance with AWWA C111, or restrained as needed for thrust restraint.
B. Follower glands for mechanical joints shall be ductile iron.
C. Solvent cement joints are strictly prohibited.
D. T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
    1. Material: low carbon alloy weathering Cor-Ten steel.
    2. Coating: Cor-Blue fluorocarbon resin.
    3. Color: blue.

2.6 Restrained Joints

A. Mechanical Joint
    1. Incorporate restraint for all mechanical joints into the design of the follower gland.
    2. Retainer gland design shall impart multiple wedging actions against the pipe, increasing its resistance as pressure increases.
    3. Restrained joints to consist of a mechanical joint with retainer gland or manufacturer's proprietary-restrained joint.
    4. Dimensions shall conform to the requirements of AWWA C111 and AWWA C153.
    5. Pressure rating:
        a. Minimum of 235 psi for PVC pipe.
        b. Minimum of 350 psi for ductile iron pipe for sizes 16 inch and smaller.

c. Minimum of 250 psi for ductile iron pipe for sizes 18 inch and larger.

6. Color:
   a. Red for PVC pipe.
   b. Black for ductile iron pipe.
7. Materials for construction:
   a. Body, wedge segments, and break-off bolt assemblies: Grade 65-45-12 ductile iron as specified by ASTM A536.
   b. Coating to be electrostatically applied and heat cured.
      (1) Approved manufacturers:
         (a) MEGA-BOND by Ebaa Iron, Inc.
         (b) CORRSAFE by Sigma.
         (c) Starbond by Star Products.
         (d) Resicoat R2-ES by Tyler Union.
         (e) EZ Shield by SIP Industries.
         (f) Or approved equal.
8. Minimum factor of safety of 2.
9. Ductile iron retainer wedge segments shall be heat treated to a minimum Brinell Hardness Number of 370.
10. Twist-off nuts, the same size as hex-head nuts for T-bolts, shall be incorporated into the design to ensure proper actuating torque is applied during installation.
11. Approved manufacturers for PVC pipe:
    a. Megalug by EBAA Iron Inc. Series 2000PV.
    b. One-Lok by Sigma Series SLCE.
    c. Stargrip by Star Products Series 4000.
    d. TUFGrip by Tyler Union Series 2000.
    e. EZ Grip by SIP Industries Series EZP.
    f. Or approved equal.
12. Approved manufacturers for ductile iron pipe:
    a. Megalug by EBAA Iron Inc. Series 1000.
    b. One-Lok by Sigma Series SLDE.
    c. Stargrip by Star Products Series 3000.
    d. TUFGrip by Tyler Union Series 1000.
    e. EZ Grip by SIP Industries Series EZD.
    f. Or approved equal.

B. PVC Pipe Joints:
   1. Restraint for in-line PVC pipe joints shall be provided through the use of groove and spline pipe and couplings.
   2. Restraint joints to have a minimum pressure rating of 150 psi.
C. Ductile Iron Pipe Joint
   1. Restraint for in-line ductile iron pipe shall consist of the manufacturer's proprietary-restrained joint.
   2. Restraint joints to have a minimum pressure rating of 250 psi.

2.7 Polyethylene Pipe Encasement Material (Ductile Iron Pipe and Fittings)

A. Polyethylene encasement shall be manufactured in accordance with AWWA C105.
B. Linear low-density polyethylene film.
C. Minimum thickness shall be 8 mils.
D. Color: Blue.
E. Physical Properties:
   1. Tensile strength 3600 psi, minimum.
   2. Elongation 800%, minimum.
   3. Dielectric strength 800 V/mil, minimum.
   4. Impact resistance 600 g, minimum.
   5. Propagation tear resistance 2550 gf, minimum.
F. Flat-width tubing of the following sizes shall be used:

Pipe Size	Tubing Width
3 inches	14 inches
4 inches	14 inches
6 inches	16 inches
8 inches	20 inches
12 inches	27 inches
16 inches	34 inches
20 inches	41 inches
24 inches	54 inches
30 inches	67 inches
36 inches	81 inches

G. Markings shall contain the following information spaced every 2 feet apart:
   1. Name of manufacturer.
   2. Year of manufacture.
   3. ANSI/AWWA C150-A21.5.
   4. 8 mil linear low-density polyethylene (LLDPE).
   5. Applicable range of nominal pipe diameter.
   6. Warning – Corrosion Protection – Repair Any Damage.

H. Sheet material can be used to wrap irregular-shaped valves and fittings.

I. 2 inch wide, 10 mil thick pressure-sensitive polyethylene tape shall be used to close seams and hold overlaps.

2.8 Tracer System

A. Tracer Wire:
   1. Open Cut:
      a. No. 14 AWG high-strength copper clad steel (HS-CCS) manufactured by Copperhead Industries, or pre-approved equal.
         (1) Insulation: 30 mil, high-density, high molecular weight polyethylene (HDPE) and rated for direct burial at 30 volts.
         (2) HW-CCS Conductor: 21% conductivity for locates purposes with a minimum 282 pounds break load.
         (3) Origin of copper clad steel manufacture is required and steel core must be manufactured in the United States.
         (4) Color: Blue.
   2. Directional Drilling/Boring:
      a. No. 12 AWG extra-high-strength copper clad steel conductor (EHS-CCS) manufactured by Copperhead Industries for directional drilling and boring applications, or pre-approved equal.
         (1) Insulation: 45 mil, high-density, high molecular weight polyethylene (HDPE) and rated for direct burial at 30 volts.
         (2) EHS-CCS Conductor: 21% conductivity for locates purposes with a minimum 1150 pounds break load.
         (3) Origin of copper clad steel manufacture is required and steel core must be manufactured in the United States.
         (4) Color: Blue.
      b. Tracer wire on pipe installations with a combination of open cut and directional drilling shall be installed to meet directional drilling requirements.

B. Anode Ground Rod:
   1. 1 pound by 1.315 inches D by 18.5 inches L, magnesium drive-in anode manufactured by Copperhead Industries, or pre-approved equal.
   2. Cap installed on one end of anode ground rod to be HDPE.
   3. Provide a beveled pointed end on anode ground rod opposite of the cap to aid in hammering into the ground.
   4. Wire from cap for anode ground rod to tracer wire connection:

a. No. 14 AWG copper clad steel (HS-CCS) manufactured by Copperhead Industries or approved equal.
b. Insulation: 30 mil, high-density, high molecular weight polyethylene (HDPE) and rated for direct burial at 30 volts.
c. Length: 10 feet.
(1) HS-CCS Conductor: 21% conductivity for locates purposes with a minimum 250 pounds break load.
d. Color: Red.

C. Wire Splice Connector:
1. Tracer wire splices shall only be used to connect the anode ground rod to the tracer wire.
2. Tracer wire splices will not be allowed between anode ground rods and connection terminal.
3. Splices used for tracer wire repair must be approved by the Engineer.
a. Splice Kit: 3M Scotchcase 3832 Buried Service Wire Splice Kit with Burndy KS15 8-14 AWG Splice Bolt.
b. Or approved equal.

D. Tracer Wire Connection:
1. Rhino TriView TracerPed, or approved equal.
a. Three internal terminals with two shunts.
b. 5-foot white plastic triangular post.
c. Removable top cap with lock.
d. Three 2 7/8 inch by 14 inch custom vinyl decals No. SD-5594K.
e. Tri-grip anchor.

Part 3 Execution

3.1 Handling, Storage, and Shipping

A. Handle pipe carefully.
B. Blocking and hold-downs shall be used during shipment to prevent movement or shifting.
C. Pipe with damage to the cement mortar lining will be rejected with field-patching not permitted.
D. For shipment and storage, small pipe shall not be telescoped inside larger pipe.
E. Handle pipe materials by use of slings, hoists, skids, or other approved means.
F. Dropping or rolling of pipe material is not permitted.
G. PVC pipe shall not be stored in direct sunlight for prolonged periods of time.
H. Pipe shall be protected to prevent dirt entering the pipe.

3.2 General Pipe Installation

A. Protect pipe joints from injury while handling and storing.
B. Use no deformed, defective, gouged, or otherwise impaired pipe.
C. Excavate and prepare trench as specified in Section 02220.
D. Install ductile iron pipe in accordance with AWWA C600.
E. Install PVC pipe in accordance with AWWA C605.
F. Prepare the trench bottom with sufficient exactness before the pipe is installed so that only minor movement of the pipe will be necessary after installation.
G. Clean pipe interior prior to placement in the trench.
H. Install pipe to the line and grade shown on the plans with an allowable tolerance of 6 inches, plus or minus.
I. Maintain uniform bearing along the full length of the pipe barrel at all times. Blocking the pipe up will not be acceptable. Excavate trench bottoms deeper at the location of bell joints to permit the body of the pipe to rest uniformly supported upon the trench bottom.
J. Bell holes shall be no longer than is necessary for practical installation of the pipe.
K. Clean joint surfaces of dirt and foreign matter using a wire brush before jointing pipe.
L. Lubricate gasket and pipe bell. Furnish a vegetable-soap lubricant meeting manufacturer's recommendations. Lubricant shall be approved for use with potable water.
M. Make joints in strict accordance with manufacturer's recommendations.

N. Joint deflections shall be within the manufacturer's specifications for maximum deflections.
O. Bolts on mechanical joints shall be tightened evenly around the pipe by alternating from one side of the pipe to the other.
P. Cut pipe in a neat manner, without damage to the pipe or the cement mortar lining, if any. Leave a smooth end at right angles to the axis of the pipe. Cut pipe ends shall be beveled for push-on-type joints in accordance with manufacturer's recommendations.
Q. No pipe shall be installed in water, nor shall water be allowed to rise in the trench around the pipe.
R. Place watertight bulkheads on the exposed ends of the pipe at all times when the pipe installation is not actually in progress.
S. Backfill and compact around pipe as outlined in Section 02220.

3.3 Installation of Polyethylene Pipe Encasement Material

A. Use polyethylene encasement material on buried ductile iron pipe, fittings, rods, and appurtenances in accordance with AWWA C105, Method A.
B. Use polyethylene tubing to encase pipe.
C. Cut tubing 2 feet longer than pipe section. Overlap tubing 1 foot at each end of pipe.
D. Gather and lap tubing to provide a snug fit.
E. Secure lap at quarter points with polyethylene tape. Secure each end of tube with a complete wrap of polyethylene tape.
F. The polyethylene encasement shall prevent contact between the pipe and bedding material, but is not intended to be a completely airtight and watertight enclosure.
G. Repair damaged polyethylene encasement material using polyethylene tape, or replace the damaged section.

3.4 Thrust Blocks

A. Provide concrete thrust blocks or collars at changes in alignment, tees, and dead ends.
B. Carry thrust blocks or collars to undisturbed soil that will provide adequate bearing.
C. The bearing area of thrust blocks or collars, in square feet, shall be as shown on the plans. Minimum thickness for any thrust block shall be 1.5 times outside pipe diameter or 18 inches, whichever is greater.
D. Hold thrust blocks or collars back 3 inches from all bolts, nuts, glands, or other jointing materials. Ensure joints could be remade without disturbing thrust block or collar.
E. Provide bond breaker between thrust block or collar and pipe. Polyethylene encasement material will be considered an acceptable bond breaker.
F. Provide thrust blocks at all connections to existing water mains.

3.5 Tracer System Installation

A. Install tracer wire with buried piping.
B. Duct tape tracer wire to the pipe every 5 feet in the 3 or 9 o’clock position opposite of the anode beds to prevent damage to the wire during backfill and future construction exposure.
C. Install anode ground rods adjacent to connections to existing piping and at each fire hydrant.
D. Terminate tracer wire in tracer wire connection next to each fire hydrant or other locations directed by Engineer.
E. Wire splice connectors can only be used to connect ground rods to tracer wire. Wire splice connectors are not allowed at any other locations unless approved by Engineer. Provide long enough roll of tracer wire to not need the use of wire splices connectors
F. Allow Engineer to inspect underground splices prior to backfilling.
G. Tracer wire installation is considered incidental to water main installation.

3.6 Testing and Chlorination

A. Perform hydrostatic and leakage tests in accordance with Section 02674.
B. Disinfect all water mains in accordance with Section 02675.
C. A tracer wire test will be conducted by the Des Moines Water Works prior to acceptance of the Project. Discontinuities found in the tracer system shall be corrected by the Contractor at the Contractor’s expense.

SECTION 02640 VALVES AND HYDRANTS

INDEX

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Part 1 General

1.1 Summary of Work

A. This Section includes valves and hydrants as shown on the plans, complete with accessories.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Mains.
B. Section 02610 – Ductile Iron and Polyvinyl Chloride Pipe for Water Mains.

1.3 References

A. American National Standards Institute (ANSI) B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
B. American Society for Testing and Materials (ASTM) A320 – Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
C. American Society for Testing and Materials (ASTM) B584 – Copper Alloy Sand Castings for General Applications.
D. American Water Works Association (AWWA) C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
E. American Water Works Association (AWWA) C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
F. American Water Works Association (AWWA) C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
G. American Water Works Association (AWWA) C153 – Ductile Iron Compact Fittings.
H. American Water Works Association (AWWA) C502 – Dry-Barrel Fire Hydrants.
I. American Water Works Association (AWWA) C509 – Resilient-Seated Gate Valves for Water

Supply Service.

J. American Water Works Association (AWWA) C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
K. American Water Works Association (AWWA) C550 – Protective Interior Coatings for Valves and Hydrants.
L. American Water Works Association (AWWA) C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.4 Submittals

A. Submit manufacturer's certification that materials furnished is in compliance with the applicable requirements of the referenced standards and this Section.
B. Provide dimensional drawings, fabrication details, functional description, and properly identified catalog data on all items to prove complete compliance with Drawings and specifications.

1.5 Measurement and Payment

A. All material, equipment, and labor necessary to comply with this Section shall be incidental to the unit price bids on the Proposal.

Part 2 Products

2.1 Gate Valves

A. Provide resilient-seated gate valves manufactured in accordance with AWWA C509 or AWWA C515.
    1. Type of service: buried service handling potable water with a pH range of 9.5 to 9.8.
    2. Minimum pressure rating: 250 psi.
    3. Furnish valves with non-rising stem.
    4. Provide 2 inch by 2 inch wrench operating nut that opens valves when turned in clockwise direction (open to the right), unless noted otherwise on the Drawings.
    5. Valve gearing for 20 inch to 48 inch valves:
        a. Provide valve with gear box.
        b. Provide vertical valve unless otherwise specified on the Drawings.
        c. The following gear ratios shall be used for the corresponding sizes:

Valve Size	Gear Ratio
20”	3 to 1
24”	3 to 1
30”	6 to 1
36”	6 to 1
42”	8 to 1
48”	8 to 1

        d. Totally enclosed type, oil-filled, and designed for buried and submerged service.
        e. Materials of construction:
            (1) Gear housing: ductile iron.
            (2) Gears: carbon steel.
            (3) Pinion shaft: 304 stainless steel.
            (4) Input shaft shall be designed with a ball bearing and sealed with o-rings.
            (5) Exposed hex nuts and bolts: 304 stainless steel.
B. Materials of Construction:
    1. Body and bonnet: ductile iron.
    2. Gate: cast or ductile iron fully encapsulated with synthetic rubber.
    3. Stem and stem nut: bronze.
    4. O-rings: Buna-N.
    5. Exposed hex bolts and nuts: 304 stainless steel.
    6. Joints:
        a. Mechanical in accordance with AWWA C111.

(1) Gaskets: Buna-N or nitrile.
(2) Nuts and bolts:
(a) All T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
(b) Material: low carbon alloy weathering Cor-Ten steel.
(c) Coating: Cor-Blue fluorocarbon resin.
(d) Color: blue.
(e) Approved Manufacturers:
1) Birmingham Fastener Manufacturing Fluorocarbon Coated T-Head Bolt.
2) Or approved equal.

b. Flanged in accordance with AWWA C115, as indicated on the plans, with ANSI Class 125 full-faced flange.
(1) Gaskets: Buna-N or nitrile, of thickness compatible with machining tolerances of flange faces. Minimum thickness: 1/8 inch.
(2) Nuts and bolts: 304 stainless steel.

C. Design valve to:
1. Allow replacement of upper O-ring while valve is under pressure in the full-open position.
2. Not permit metal-to-metal contact between gate and body.
3. Accommodate full-size tapping machine shell cutter.

D. Horizontal valves shall consist of a cleaning system on both sides of the gate. The cleaning system shall consist of materials that will not cause corrosion.

E. Interior and exterior valve coating shall be minimum 10 mil thick fusion-bonded epoxy per AWWA C550.

F. Operating valve through 500 cycles at rated pressure must not result in disbondment or degradation of the coating. Certification will be required for manufacturers not listed below.

G. Indicate manufacturer, casting year, size, working pressure, and body material (ductile iron) in valve casting.

H. Manufacturers' Models for 4 inch to 16 inch valves:
1. Clow Model 2638.
2. American Flow Control Series 2500.
3. Mueller 2300 Series.
4. M & H Style 4067.
5. Approved equal.

I. Manufacturers' Models for 20 inch to 48 inch valves:
1. Clow Model 2638.
2. American Flow Control Series 2500.
3. Mueller 2300 Series.
4. Approved equal.

2.2 Hydrants (Des Moines)

A. Hydrants shall be manufactured in accordance with AWWA C502.

B. Hydrants shall be dry-barrel, breakaway type designed to break near the ground line on impact. Breaking ring or flange shall be one piece or split and shall contact retaining ring for its full circumference.

C. Provide flanged connections for head and base to hydrant barrel.

D. Provide 6-inch mechanical joint shoe with harnessing lugs.

E. Provide 4 1/2 inch minimum diameter main valve with bronze seat ring. Thread seat ring directly to bronze bushing or drain ring that is securely locked to hydrant shoe.

F. Provide pentagon-shaped operating nut with weather cap. Dimension from point to flat at top of operating nut: 1 3/16 inch.

G. Provide two 2 1/2 inch hose nozzles and one 4 inch pumper nozzle with caps; nozzle caps shall have nut with dimensions identical to operating nut:
1. Hose nozzle threads
a. Outside diameter of male thread: 3 1/16 inches
b. Diameter at root of male thread: 2 7/8 inches
c. Threads per inch: 7 1/2

d. Length of nozzle threads: 1 inch
e. Cut off at top of threads: 1/4 inch

2. Pumper nozzle threads
a. Outside diameter of male thread: 4 31/32 inches
b. Diameter at root of male thread: 4 19/32 inches
c. Threads per inch: 4
d. Length of nozzle threads: 1 1/2 inches
e. Cut off at top of threads: 1/4 inch

H. Provide markings cast-in-bonnet that indicate direction of opening. Hydrants shall open clockwise (to the right).
I. Provide anti-thrust washers for ease of operation.
J. Provide grease chamber or oil reservoir, sealed by means of O-rings, for lubrication of operation threads. Provide lubricant suitable for contact with potable water.
K. Painting:
1. Prepare surfaces to be coated according to SSPC-SP6, commercial blast cleaning.
2. Coat hydrant in accordance with AWWA C502 and coating manufacturer's instructions.
3. Tnemec epoxy paint system
a. Interior surfaces, other than machined surfaces, shall be coated with asphaltic coating.
b. Exterior surfaces below grade shall be coated with two coats of asphaltic coating.
c. Exterior surfaces above grade shall be primed using a polyamide epoxy system, Tnemec Series 20, FC20 or 66, and painted using an aliphatic acrylic polyurethane system, Tnemec Series 75, or approved equal. Provide total dry mil thickness of 5 to 7 mils.
d. Exterior surfaces above grade shall have 2 to 4 mils dry thickness of clear coat applied after paint has been allowed to dry thoroughly.
e. Color:
(1) Asphaltic coating: Black.
(2) Primer: White (AA83).
(3) Paint: Bright Yellow (SC02).
(4) Bonnet: Safety Green (SC07).
(5) Caps: Bright Yellow (SC02).
4. TGIC Protective Coating only with prior approval from Des Moines Water Works.
a. Color:
(1) Asphaltic coating: Black.
(2) Base coat: Red Oxide Epoxy IF1947T.
(3) Paint: Dandelion Yellow TGIC.
(4) Bonnet: Des Moines Water Works Green TGIC.
(5) Caps: Dandelion Yellow TGIC.
5. Approved equal.
a. System must be approved by DMWW prior to bid opening.
L. Materials of Construction:
1. Breakaway stem coupling: steel, cast iron, or stainless steel.
2. Bonnet barrel, shoe, gate, and nozzle caps: cast iron.
3. Threaded internal components exposed to water, valve seats, and nozzles: bronze.
4. Cotter pins, drive pins, bolts, and screws exposed to water: stainless steel or brass.
5. Exterior bolts, nuts, set screws, and other miscellaneous fasteners: stainless steel or bronze. Any metal component in contact with water shall comply with the requirements of ASTM B584 copper alloy UNS No. C89520 or UNS No. C89833. Residual lead levels of the metal shall not exceed 0.25% by weight as cast or extruded.
M. Manufacturers:
1. Clow Medallion.
2. Mueller Centurion.
3. Approved equal.

2.3 Joints for Valves and Hydrants

A. Joints shall be mechanical in accordance with AWWA C111, or restrained as indicated on the plans.
B. Follower glands for mechanical joints shall be ductile iron.
C. Bolts:
    1. All T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
        a. Material: low carbon alloy weathering Cor-Ten steel.
        b. Coating: Cor-Blue fluorocarbon resin.
        c. Color: blue.
        d. Approved Manufacturers:
            (1) Birmingham Fastener Manufacturing Fluorocarbon Coated T-Head Bolt.
            (2) Or approved equal.
    2. All bolts and hex nuts for flanged joints shall be 304 stainless steel.
D. Flange joints shall have 1/8 inch rubber ring gaskets for nominal diameters of 24 inches or less and 1/8 inch rubber ring gaskets for nominal diameter greater than 24 inches.
E. Gaskets shall be elastomeric or nitrile in accordance with AWWA C111.

2.4 Retainer Glands

A. Incorporate restraint for all mechanical joints into the design of the follower gland.
B. Retainer gland design shall impart multiple wedging actions against the pipe, increasing its resistance as pressure increases.
C. Restrained joints to consist of a mechanical joint with retainer gland or manufacturer's proprietary-restrained joint.
D. Dimensions shall conform to the requirements of AWWA C111 and AWWA C153.
E. Pressure rating:
    1. Minimum of 235 psi for PVC pipe.
    2. Minimum of 350 psi for ductile iron pipe for sizes 16-inch and smaller.
    3. Minimum of 250 psi for ductile iron pipe for sizes 18-inch and larger.
F. Color:
    1. Red for PVC pipe.
    2. Black for ductile iron pipe.
G. Materials for construction:
    1. Body, wedge segments, and break-off bolt assemblies: Grade 65-45-12 ductile iron as specified by ASTM A536.
    2. Coating to be electrostatically applied and heat cured.
        a. Approved manufacturers:
            (1) MEGA-BOND by Ebaa Iron, Inc.
            (2) CORRSAFE by Sigma.
            (3) Starbond by Star Products.
            (4) Resicoat R2-ES by Tyler Union.
            (5) EZ Shield by SIP Industries.
            (6) Or approved equal.
H. Minimum factor of safety of 2.
I. Ductile iron retainer wedge segments shall be heat treated to a minimum Brinell Hardness Number of 370.
J. Twist-off nuts, the same size as hex-head nuts for T-bolts, shall be incorporated into the design to ensure proper actuating torque is applied during installation.
K. Approved manufacturers for PVC pipe:
    1. Megalug by EBAA Iron Inc. Series 2000PV.
    2. One-Lok by Sigma Series SLCE.
    3. Stargrip by Star Products Series 4000.
    4. TUFGrip by Tyler Union Series 2000.
    5. EZ Grip by SIP Industries Series EZP.
    6. Or approved equal.
L. Approved manufacturers for ductile iron pipe:
    1. Megalug by EBAA Iron Inc. Series 1000.
    2. One-Lok by Sigma Series SLDE.

3. Stargrip by Star Products Series 3000.
4. TUFGrip by Tyler Union Series 1000.
5. EZ Grip by SIP Industries Series EZD.
6. Or approved equal.

2.5 Valve Boxes

A. Provide cast iron screw-type adjustable heavy-duty valve box with cast iron stay-put cover marked "WATER" for each buried valve.
B. Minimum inside diameter of valve boxes shall be 5 1/8 inches.
C. Weight of valve box assembled, top and bottom, without valve box lid shall be as follows:

Extension Height (in)	Weight (lbs)
27-37	71
33-43	78
39-50	85
36-52	93
39-60	100

D. Tyler No. 6850 29-U Domestic, or approved equal.
E. For an approved equal, provide proof that all parts of the proposed valve box can be interchangeable with Tyler No. 6850 29-U Domestic.
F. Valve boxes shall be installed upon the valve with the use of a rubber Valve Box Adapter II as manufactured by Adaptor Inc., or approved equal.

2.6 Polyethylene Encasement Material

A. Polyethylene encasement shall be manufactured in accordance with AWWA C105.
B. Linear low-density polyethylene film.
C. Minimum thickness shall be 8 mils.
D. Color: Blue.
E. Physical Properties:
   1. Tensile strength 3600 psi, minimum.
   2. Elongation 800%, minimum.
   3. Dielectric strength 800 V/mil, minimum.
   4. Impact resistance 600 g, minimum.
   5. Propagation tear resistance 2550 gf, minimum.
F. Sheet material can be used to wrap irregular-shaped valves and fittings.
G. 2 inch wide, 10 mil thick pressure-sensitive polyethylene tape shall be used to close seams and hold overlaps.

Part 3 Execution

3.1 Handling, Storage, and Shipping

A. Handle valves and hydrants carefully.
B. Use blocking and hold-downs during shipment to prevent movement or shifting.

3.2 General Installation Requirements

A. Protect valves and hydrants from injury while handling and storing.
B. Use no defective, damaged, or otherwise impaired materials.
C. Prepare excavation as outlined in Section 02220.
D. Install valves and hydrants in accordance with AWWA C600.
E. Clean interior of valve or hydrant prior to placement in the trench.
F. Install valves and hydrants to the line and grade as shown on the plans.
G. Install valves and hydrants plumb.
H. Clean joint surfaces of dirt and foreign matter using a wire brush before jointing.
I. Lubricate gasket and bell. Furnish a vegetable-soap lubricant meeting manufacturer's recommendations. Lubricant shall be approved for use with potable water.
J. Make joints in strict accordance with manufacturer's recommendations.

K. Bolts on mechanical joints or flanged joints shall be tightened evenly around the pipe by alternating from one side of the pipe to the other. Follow manufacturer's installation specifications for electrical isolation flanges to prevent damage during bolt torquing.
L. Backfill and compact around hydrants and valves as outlined in Section 02220.

3.3 Valve Installation

A. Do not support valves off of piping.
B. Ensure that valve box is centered over operating nut.

3.4 Hydrant Installation

A. Anchor auxiliary valve to hydrant tee.
B. Install hydrant with break flange more than 1 inch and less than 7 inches above finished grade.
C. The use of hydrant extensions will not be allowed to set hydrant to the appropriate height unless approved by Engineer. Hydrant extensions, if approved, must be from same manufacture as the fire hydrant.
D. Use restrained joints in hydrant branch.
E. Set hydrant on a solid concrete cinder block not smaller than 8 inches by 16 inches by 4 inches.
F. Provide poured concrete thrust blocks behind hydrant and hydrant tee.
G. Ensure hydrant drain is free-flowing and unobstructed in areas where normal groundwater level is below the drain opening.
H. Provide not less than 1 cubic yard of open-graded granular fill around base of hydrant for drainage.

3.5 Installation of Polyethylene Pipe Encasement Material

A. Polyethylene encasement material shall be used on buried valves and the buried portion of hydrants in accordance with AWWA C105.
B. Wrap valves using polyethylene sheet material to prevent contact with bedding. Secure sheet to adjacent pipe and just below valve operation nut using polyethylene tape.
C. Wrap buried portions of hydrants using 24 inch flat-width polyethylene tubing. Secure tubing to hydrant barrel just below grade using polyethylene tape.
D. The polyethylene encasement shall prevent contact with bedding material, but is not intended to be an airtight and watertight enclosure.
E. Damaged polyethylene encasement material shall be repaired using polyethylene tape, or the damaged section shall be replaced.

3.6 Thrust Blocks

A. Provide concrete thrust blocks at hydrants and hydrant tees.
B. Carry thrust blocks to undisturbed soil that will provide adequate bearing.
C. The bearing area of thrust blocks, in square feet, shall be as shown on the plans. Minimum thickness for any thrust block shall be 1.5 times outside pipe diameter or 18 inches, whichever is greater.
D. Hold thrust blocks back 3 inches from bolts, nuts, glands, or other jointing materials. Ensure joints could be remade without disturbing thrust block.
E. Provide bond breaker between thrust block and pipe or hydrant. Polyethylene encasement material will be considered an acceptable bond breaker.

3.7 Removal of Abandoned Fire Hydrants and Valve Boxes

A. Surface restoration items including pavement removal and replacement, seeding, or sodding, needed to remove abandoned fire hydrants or valve boxes shall be paid in accordance with appropriate bid item in contract.
B. All other items related to removal of abandoned fire hydrants and valve boxes including repairs to traffic loops and lawn irrigations systems shall be incidental to contract.
C. Abandoned fire hydrants shall be removed by disconnecting the pipe from the fire hydrant at the shoe.

D. Abandoned fire hydrants shall be returned to Des Moines Water Works at 408 Fleur Drive unless Engineer approves their disposal.
E. All excavations for fire hydrant removals shall be backfilled and restored according to Sections 02220 of these specifications.
F. Abandoned valve boxes shall have the entire top section of the valve box removed and the lower section and excavation backfilled and restored according to Sections 02220 of these specifications.

SECTION 02674 PRESSURE TESTING WATER MAINS

INDEX

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Part 1 General

1.1 Summary of Work
A. Pressure-test water mains in accordance with this Section.

1.2 Related Sections
A. Section 02610 – Ductile Iron and Polyvinyl Chloride Pipe for Water Mains

1.3 References
A. American Water Works Association (AWWA) C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
B. American Water Works Association (AWWA) C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

1.4 Submittals (Not used)

1.5 Measurement and Payment
A. Work under this Section incidental to Contract.

Part 2 Products
Not used.

Part 3 Execution

3.1 Pressure Testing
A. Perform Work in accordance with AWWA C600 and AWWA C605.
B. Test piping at 150 psi or as indicated on the plans for 2 hours.
C. Fill and flush new piping with potable water, ensuring that all trapped air is removed.
D. Isolate new piping from the existing system.
E. Pressure test new piping in sections by isolating each section using the in-line gate valves. Relieve pressure on non-test side of the gate valve.
F. Pressurize the new piping to the test pressure at the lowest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the lowest point in the isolated system.
G. Monitor pressure in the line being tested for a period of not less than 2 hours.

H. If at any point during that 2 hour period the pressure drops to 5 psi below the test pressure, re-pressurize by pumping water into the line in sufficient quantity to bring the pressure back to between the test pressure and 5 psi above the test pressure. Accurately measure the amount of water required to re-pressurize the main.
I. At the end of the 2 hour period, if pressure in the line has dropped below the test pressure, re-pressurize to the test pressure. Accurately measure the amount of water required to re-pressurize the main.
J. Allowable leakage, in gallons, per hour of testing shall equal (LD(P)½) / 148,000.
    L = length of pipe section being tested in feet
    D = nominal diameter of pipe in inches
    P = average test pressure in psig
K. Leakage equals the total amount of water required to keep the line pressurized during the 2 hour test period and re-pressurize the line at the end of the test period.
L. If the average leakage per hour is less than the allowable leakage, the pressure test is acceptable.
M. If the average leakage per hour is more than the allowable leakage, the pressure test is not acceptable. Locate and make approved repairs as necessary until leakage is within the specific allowance.
N. If pressure in the isolated line never drops to the test pressure, having started no more than 5 psi above the test pressure, the pressure test is acceptable.
O. If pressure in the isolated line never drops to the test pressure, having started no more than 5 psi above the test pressure, the pressure test is acceptable.
P. Repair visible leaks regardless of the amount of leakage.

SECTION 02675 DISINFECTION OF WATER DISTRIBUTION SYSTEMS

INDEX

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Part 1 General

1.1 Summary of Work
A. Disinfect water mains and 2 inch and larger water services in accordance with this Section.

1.2 Related Sections
A. Section 02220 – Excavating, Backfilling, and Compacting for Water Mains.
B. Section 02610 – Ductile Iron and Polyvinyl Chloride Pipe for Water Mains.
C. Section 02660 – Water Service Transfers.

1.3 References
A. American Water Works Association (AWWA) B300 – Hypochlorites.
B. American Water Works Association (AWWA) B301 – Liquid Chlorine.
C. American Water Works Association (AWWA) C651 – Disinfecting Water Mains.

1.4 Submittals (Not used)

1.5 Measurement and Payment
A. Work under this Section incidental to Contract.

Part 2 Products

2.1 Chlorine
A. Calcium hypochlorite granules conforming to AWWA B300.
B. Liquid chlorine conforming to AWWA B301.

2.2 De-chlorination Chemicals
A. Vita-D-Chlor (Ascorbic Acid) by Integra Chemical Company.
B. Vita-D-Chlor, Neutral (Sodium Ascorbate) by Integra Chemical Company.
C. No-Chlor (Ascorbic Acid) by Measurement Technologies.
D. Approved equal.

Part 3 Execution

3.1 Examination

A. Water for disinfection will be provided by DMWW for two disinfection attempts. If additional attempts are necessary, the Contractor will be billed for water used at the normal rate set for industrial customers.
B. Disinfection of piping shall take place only after satisfactory pressure testing.
C. Ensure piping to be disinfected is isolated from portion of the distribution system that is in service.
D. Review procedures and coordinate disinfection with DMWW.
E. Perform Work in accordance with AWWA C651.
F. Bacteriological samples shall be taken and tested by DMWW to ensure satisfactory disinfection.

3.2 Chlorination of Piping

A. Provide equipment and materials necessary to complete chlorination.
B. Use the continuous feed method as outlined in AWWA C651.
C. Prior to feeding chlorine, fill and flush new piping to remove trapped air and particulates. Provide equipment and materials necessary to obtain a minimum flushing velocity of 2.5 fps in piping to be disinfected. When flushing velocities of 2.5 fps cannot be obtained, the pipe shall be swabbed until the pipe is free of debris. Type of swab and procedures for use shall be approved by DMWW prior to its use.
D. Induce flow of potable water through the new piping at required flushing velocity. Make provisions for diverting and disposing of flushing water in manner that does not damage surroundings. Repair any damage caused by flushing activities.
E. At a point within five pipe diameters of the connection to the existing distribution system, introduce highly chlorinated water in sufficient quantity to provide at least 25 mg/L free chlorine in the new piping. Provide all metering and feed equipment and temporary chlorination taps. Remove the temporary chlorination taps and cap the main once the main passes.
F. Introduce highly chlorinated water continuously until the entire section of new piping contains a minimum of 25 mg/L free chlorine. Do not exceed 100 mg/L free chlorine.
G. Isolate the newly chlorinated piping for a contact period of at least 24 hours, and not more than 48 hours, taking care not to backflow chlorinated water into the existing potable water system.
H. After the contact period, water in the new piping must have a residual-free chlorine content of not less than 10 mg/L. If the residual is less than 10 mg/L, rechlorinate as outlined above.

3.3 Flushing Chlorinated Piping

A. After the contact period, flush the recently chlorinated piping with potable water.
B. Continue flushing until the chlorine residual in the new piping is equal to the chlorine residual in the existing distribution system.
C. Isolate the new piping from the existing distribution system for a period of not less than 24 hours.
D. Chlorinated water, which is flushed from the new piping, shall be dechlorinated and disposed of so not to cause damage to the environment. Conform to state and federal requirements.
E. De-chlorinate all water from flushing activities and testing before it is released into the ground, stream, or storm sewers. Method to be approved by the DMWW prior to any flushing activities.

3.4 Bacteriological Testing

A. Immediately following flushing of pipelines and again at least 24 hours after flushing pipelines, samples will be taken and tested by DMWW.
B. DMWW reserves the right to take and test additional samples 48 hours after flushing.
C. Approximately one sample will be taken for each 1200 feet of new water main.
D. Additional samples may be taken at the discretion of the DMWW.

E. Samples must show the absence of coliform organisms and other contaminants and meet requirements of the Iowa Department of Natural Resources to be considered acceptable.
F. If any sample is not satisfactory with either sampling, the piping represented by that sample must be flushed and rechlorinated by the Contractor at the discretion of, and as directed by, DMWW.