

**SP-120198
(New)**



**SPECIAL PROVISIONS
FOR
ITS INFRASTRUCTURE INSTALLATION**

**Scott County
IM-074-1(226)5--13-82**

**Effective Date
October 21, 2014**

**THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING
MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL
PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

TABLE OF CONTENTS

I GENERAL REQUIREMENTS

- 1.01 Related Specifications and Standards
 - A. General
- 1.02 Local Requirements
 - A. General
 - B. Coordination of Work
 - C. Building Facilities
- 1.03 Contractor's Responsibility
 - A. Coordination with Utilities
 - B. One Call Locating
 - C. Material and Equipment Storage and Construction Site Access
 - D. Finishing Activities
- 1.04 Contractor Submissions
 - A. Materials List
 - B. Construction Schedule
 - C. Shop Drawings/Catalog Cuts
 - D. Materials Procurement
 - E. Warranty
- 1.05 As-Built Documentation
 - A. General
 - B. GPS Data Recording Staking Assistance
- 1.06 Charging of Working Days
 - A. Definition
 - B. Determination

II TECHNICAL PROVISIONS

- 2.01 General
- 2.02 Device Cabinets
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment
- 2.03 Fiber Termination Cabinets
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment
- 2.04 Cabinet Footings
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment
- 2.05 Handholes
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment
- 2.06 Meter Pedestals
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment

- 2.07 Power Connections
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment
- 2.08 Fiber Optic Cable
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment
- 2.09 Automated Ramp Gates
 - A. Materials
 - B. Construction
 - C. Method of Measurement & Basis of Payment

PART I GENERAL REQUIREMENTS

This part consists of the general provisions necessary when furnishing and installing the ITS Infrastructure as described in the project plans and these special provisions.

This project involves supplying and installing conduit, bridge attachments, handholes, building entrances, device poles and footings, device cabinets and footings, fiber termination cabinets and footings, tracer wire and pull tape, power supplies and cabling, and power terminations deemed necessary for a complete ITS Infrastructure installation designed for use with future proposed ITS fiber and device deployments and other uses planned by the Iowa DOT. The Iowa DOT plans to initiate separate contracts to install and terminate the fiber optic cable and place it in service (light the fiber network). Separate contracts will also be initiated to supply and install the cameras, sensors, and other ancillary equipment in or on the cabinets and poles, as well as other items required to provide a complete and functioning network of ITS devices.

The Contractor shall not take advantage of any apparent error, discrepancy or omission in the plans or specifications. Upon discovery of such an error, discrepancy or omission, the Contractor shall notify the Engineer immediately. The Engineer will then make such corrections or interpretations as necessary to fulfill the intent of the plans and specifications.

Materials or work described in words which, so applied, have known technical or trade meaning shall be held to refer to such recognized standards.

Figured dimensions on the plans shall be taken as correct but shall be checked by the Contractor before starting construction. Any errors, omissions, or discrepancies shall be brought to the attention of the Engineer and the Engineer's decision thereon shall be final. Correction of errors or omissions on the drawings or specifications may be made by the Engineer when such correction is necessary for the proper execution of the work.

The Contractor for this project shall coordinate work with the Contractor(s) working on the fiber optic cable and device deployment projects. The Iowa DOT will assist in the coordination and scheduling of work. The Contractor for this project shall assign a responsible staff member that will work with the Iowa DOT on decisions regarding order of work and scheduling as needed throughout the duration of this project.

1.01 Related Specifications and Standards

A. General

The work as detailed on the plans for the ITS Infrastructure Installation shall be completed in accordance with the plans, special provisions and all other contract documents including the documents listed below. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete project.

1. 2012 edition of the Standard Specifications of the Iowa Department of Transportation with GS-12005.
2. Latest published Supplements to Standard Specifications.
3. Specifications of the Underwriter's Laboratories, Inc.
4. National Electric Code.
5. Manual on Uniform Traffic Control Devices.
6. Iowa DOT Flagger's Handbook.
7. Iowa DOT Standard Road Plans Manual.

1.02 Local Requirements

A. General

Comply with any special requirements and limitations identified in the Plans.

B. Coordination of Work

Contractor for this project shall coordinate work with the Contractor(s) working on other Iowa DOT projects in the vicinity as noted in the plans. The Contractor shall provide the Engineer any requests to perform work during the dates of special events noted in the plans a minimum of 5 days prior to the event. The decision of the Engineer regarding a request shall be final.

C. Building Facilities

All work in or around any building facility shall be coordinated with the Engineer. Provide a minimum of 48 hours notice to the Engineer before performing any work in the immediate vicinity of a building or surrounding parking area.

1.03 Contractor's Responsibility

A. Coordination with Utilities

1. The Contractor is responsible for determining the exact location and elevation of all public utilities in proximity to any construction work and shall conduct all activities to ensure that public utilities are not disturbed or damaged.
2. The Contractor is fully liable for all expenses incurred as a result of failing to obtain required clearances, location of utilities, and any damage to utilities caused by construction.
3. Utility companies whose facilities are shown on the plans or known to be within the construction limits shall be notified by the Contractor of the starting construction date.

B. One Call Locating

Until final acceptance, the Contractor shall provide all utility locates of the work performed under this contract when requested through One-Call services or by the Engineer. The Contractor shall perform any such locations within twenty four (24) hours of receiving notice that such locations are needed.

C. Material and Equipment Storage and Construction Site Access

1. Contractor shall secure a designated material storage area for this project. Any request to store material in the right-of-way in order to complete the current work activity shall be approved by the Engineer.
2. Construction equipment may be stored within the right-of-way during non-working hours if it is outside of the roadway clear zone, as far from the traveled way as practical and as approved by the Engineer. No equipment shall be stored at the toe of any roadway slope.
3. No worker vehicles will be allowed to park in, or access a job site directly from an Interstate or Freeway facility. Access to the job site for both workers and materials shall only be via interchanges or intersecting roadways unless otherwise approved by the Engineer. Worker vehicles shall be parked off-site or at a location acceptable to the Engineer

D. Finishing Activities

Upon completion of the work at each project area, thoroughly clean the site and restore it to a condition at least equal to that existing prior to construction. Project area is defined as the approximate area disturbed during a normal week of work. During and after completion, employ appropriate measures for erosion control, where applicable. Seed and fertilize work areas upon completion of work in accordance with the contract documents.

1.04 Contractor Submissions

A. Materials List

The Engineer shall furnish a list of materials required for the project to each bidder with the proposal. Complete and submit one electronic pdf file of the materials list within 14 calendar days after award of the project contract. Include the name of the materials supplier and catalog number of each item listed.

B. Construction Schedule

1. Within 30 days after award of contract, the Contractor shall submit to the Engineer one electronic pdf file of the detailed construction schedule including dates of commencement for each major work item, duration of each major work item and completion of each major work item on each segment of the proposed construction.
2. Major items of work to be included on the schedule are installation of conduit, handholes, device poles and footings, device cabinets and footings, and electrical installations.
3. Upon acceptance of the schedule, the Contractor will be expected to adhere to these dates as proposed unless modified with the approval of the Engineer.
4. Submittal and approval of the proposed construction schedule by the Engineer is required before the Contractor can commence construction activities.

C. Shop Drawings/Catalog Cuts

1. Prior to construction and after approval of the Materials List, submit one electronic pdf file of the shop drawings or catalog cuts for the materials to the Iowa DOT for approval.
2. The Engineer shall review the shop drawings/catalog cuts for the purpose of assuring general conformance with the project design concept and contract documents.
3. Provide written notice of any deviations from the requirements of the plans or contract documents.
4. Engineer's approval of shop drawings/catalog cuts does not relieve the Contractor of responsibility for providing satisfactory materials complying with the contract documents. Errors not detected during review do not authorize the Contractor to proceed in error.
5. The Engineer shall provide approval before any materials are ordered.

D. Materials Procurement

1. Shop drawings, specification data, and samples for acceptance testing (when requested) shall be submitted to the Iowa DOT for approval and/or selection prior to the placing of orders for any equipment and materials.
2. The Contractor shall order all materials requiring production lead time greater than 4 weeks within 5 business days of receiving the approved shop drawing(s).
3. The Contractor shall submit to the Engineer proof of material purchase order in electronic pdf format.

E. Warranty

1. Transfer all required standard materials warranties on the date of final acceptance to the Iowa DOT.
2. Warranty periods shall not commence prior to final acceptance of the work.

1.05 As-Built Documentation

A. General

1. As-built record drawings will be the responsibility of, and completed by, an on-site representative of the Engineer. As such, it will be the responsibility of the Engineer's representative to coordinate directly with the Contractor to ensure that a master record set of the plans is maintained throughout construction to document all installations and any deviations from the design shown in the contract documents.
2. It is the responsibility of the Contractor to maintain written records of daily construction progress, areas worked and quantities installed to aid in the completeness of as-constructed documentation by the Engineer's on-site representative.

B. GPS Data Recording Staking Assistance

1. The Engineer's on-site representative will be responsible for collecting GPS data of all installations including, but not limited to: conduit routing, handholes, device poles, device cabinets, and power supplies. All efforts will be made by the Engineer's on-site representative to coordinate with the Contractor and collect construction progress daily.
2. The Contractor shall be responsible to coordinate and assist the Engineer's on-site representative in this effort by staking, flagging or otherwise locating all installed features until such time that the GPS data can be collected.

PART II TECHNICAL PROVISIONS

This part consists of the material requirements, construction details, and methods of measurement and basis of payment necessary to complete construction of the ITS Infrastructure project, in place, as described in the contract documents.

2.01 General

- A.** Supply only new materials from reputable suppliers and manufacturers approved by the Engineer. Provide any items, equipment, or materials not specifically addressed in the contract documents but required to provide a complete and functional installation. The level of quality shall be consistent with other specified items. All miscellaneous electrical equipment and materials shall be UL-approved. Securely store and protect all materials delivered to the project site. Provide appropriate material quantities for testing or verification at no additional cost when requested by the Engineer.

- B.** The Contractor shall expect some reasonable variation in location of the facilities shown due to unforeseen conflicts, changes in proposed work, installation difficulties, or other circumstances. The Engineer shall authorize any changes in location in writing before performing the installation. No additional compensation shall be provided for additional work associated with or resulting from unauthorized changes to the contract documents.

2.02 Device Cabinets

Furnish all work, apparatus, and materials to construct and install the device cabinets designed to house the control equipment required for the planned ITS system.

A. Materials

Furnish materials of new stock only.

1. General

- a.** Supply device cabinets, clean-cut in design and appearance
- b.** Cabinets shall be dimensioned as identified in the contract documents.
- c.** Cabinets shall be corrosion resistant, UL-50 approved, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 0.125 inch.
- d.** The cabinet structure shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- e.** All exterior seams for cabinet and doors shall be continuously welded. All edges shall be filed to a radius of 1/32 inch minimum.
- f.** All pole mount cabinets shall be equipped with top and bottom mounting flanges.

2. Cabinet Doors

- a.** The cabinet door shall be sturdy, torsionally rigid, and attached by a continuous heavy duty gauge aluminum butt hinge utilizing a stainless steel hinge. The door shall substantially cover the full area of the front of the cabinet and have a stainless steel, pad-lockable handle.
- b.** The cabinet door shall be provided with a door stop catch mechanism to hold the door open at three positions – 90 degrees, 120 degrees and 180 degrees, with plus or minus 10 degrees accuracy. Both the door and door stop mechanism shall be of sufficient strength to withstand a simulated wind load of five pounds per square foot of door area applied to both inside and outside surfaces.
- c.** A closed-cell neoprene gasket shall be provided to act as a permanent and weather resistant seal at the cabinet door facing. The gasket material shall be of a non-absorbent material and shall maintain its resiliency after long term exposure to the outdoor environment. The gasket shall have a minimum thickness of 1/3 inch. The gasket shall be located in a channel provided for this purpose either on the cabinet or on the door. An "L" bracket is acceptable in lieu of this channel if the gasket is fitted snugly against the bracket to insure a uniformly dust and weather resistant seal around the entire door facing.

- d. Cabinet light (incandescent) with light bulb provided operated by door switch.
- e. Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock. Two #2 keys for each tumbler lock shall be provided for each cabinet. All locks for the project shall be keyed identically to key pattern 9R46142 or as otherwise identified by the Engineer. Keys shall be given to the Engineer. Do not attach keys to the exterior of the cabinet at any time during storage or installation.
- f. A heavy-duty clear plastic envelope shall be provided, securely attached to the inside wall of the cabinet or cabinet door, for stowing cabinet wiring diagrams and equipment manuals. Minimum dimensions shall be 9 inches wide by 12 inches deep.

3. Power Panel, Connecting Cables and Wiring

- a. Provide cabinets equipped and configured with internal power components as shown in the contract documents.
- b. One 3 pole service entrance terminal block with tin plated aluminum connectors, nickel plated steel screws, and a current rating up to 70 Amps.
- c. One 20 Amp single pole breaker (Main).
- d. One 15 Amp single pole breaker (Equipment)
- e. One 15 Amp single pole breaker (Auxillary)
- f. A 120 VAC, 1 phase filtering surge protector with surge current at minimum of 20KA w/RF filtering, nanosecond response time, a 10A operating current, and an operating temperature of -40°C to +85°C.
- g. An auxiliary four terminal electrical block rated for a maximum 250 VAC RMS maximum voltage and 20 Amps current
- h. A 15 Amp GFCI receptacle in Ivory color
- i. An eight outlet Power Distribution Unit with built in surge suppressor (1800 Joules of surge/lightning protection) that includes a resettable circuit breaker and minimum cord length of 6 feet.
- j. One 7 TAP Ground Bar
- k. One 7 TAP Neutral Bar
- l. All miscellaneous wiring, harnesses connectors and attachment hardware
- m. All conductors used on the cabinet wiring shall be No. 14 AWG or larger with a minimum of 19 strands. Conductors shall conform to MIL SPEC MIL-W-168780, Type B or D. The insulation shall have a minimum thickness of 10 MILS. All wiring containing line voltage shall be a minimum size of No. 12 AWG.

4. Ventilation

a. Vents

- 1) Furnish cabinets containing a suitably designed rain tight vent or vents that:
 - Are equipped with suitable screens or dust filters, and
 - Allow the release of excessive heat and/or any explosive gases which may enter the cabinet.
- 2) Ensure when filters are utilized, positive retainment is provided on all sides to prevent warpage and entry of foreign matter around the edges.
- 3) The filters shall be dry type, easily removed and replaced, and standard dimensions commercially available.

b. Vent Fan

Meet the following requirements:

- A thermostatically controlled vent fan is furnished to provide air circulation within the cabinet.
- The thermostat controlling the fan is manually adjustable to turn on between 90°F and 150°F with a differential of not more than 10°F between automatic turn on and turn off.
- The fan is located with respect to the vent holes to direct the bulk of the air flow over the internal components within the cabinet.
- Ventilation fan shall be fused separately and wired after the main AC+ circuit breaker.

5. Grounding

- a. The cabinet internal ground shall consist of one or more ground bus-bars permanently affixed to the cabinet and connected to the grounding electrode.
- b. Use bare stranded No. 6 AWG copper wire between bus-bars and between the bus-bar and grounding electrode.
- c. Each copper ground bus-bar shall have a minimum of 20 connector points. Each connector point shall be capable of securing at least one No. 6 AWG conductor.
- d. AC neutral and equipment ground wiring shall return to bus-bars.

6. Pedestal

- a. Supply cabinet pedestals, clean-cut in design and appearance
- b. Cabinet pedestals shall be dimensioned as identified in the contract documents.
- c. Cabinet pedestals shall be corrosion resistant, UL-50 approved, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 0.125 inch.
- d. Cabinet pedestals shall be complete with all stainless steel hardware.
- e. Cabinet pedestals shall meet the requirements of ASTM B-209 for 5052 H-32 aluminum sheet. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
- f. The cabinet pedestal shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- g. All exterior seams for cabinet pedestals shall be continuously welded. All edges shall be filed to a radius of 1/32 inch minimum.

B. Construction

1. General

- a. Install cabinets in accordance with the contract documents and the manufacturer's recommendations.
- b. Do not penetrate the top of any cabinets without prior authorization by the Engineer.
- c. Do not allow screws used for mounting shelves or other mounting purposes to protrude beyond the outside wall of the cabinet.
- d. All connections shall be watertight.
- e. Contact the Engineer a minimum of 1 week in advance to arrange a field review prior to placing the cabinets.

2. Mounting

- a. Orientate cabinets as shown in the contract documents unless otherwise directed by the Engineer.
- b. Ensure sufficient clamps, nuts, hardware, etc., as required for the specified mounting type, are furnished with each cabinet.
- c. Seal all conduit openings in the controller cabinet with a sealing compound that meets the following requirements:
 - Readily workable, soft plastic
 - Workable at temperatures as low as 30°F, and
 - Does not melt or run at temperatures as high as 300°F.
- d. Do not install the controller cabinet on preplaced caulking material on the concrete base or place caulking material around the base of the cabinet after installation.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for device cabinets shall be paid for at the contract unit price per each for the bid item Cabinet, Furnish and Install, 36 Inch X 20 Inch X 15 Inch.
2. Payment is full compensation for:
 - The furnishing and installation of all pole mounted and pedestal mounted cabinets,
 - Including all internal components and accessories required to provide a complete cabinet installation per the contract documents,

- Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials, and
- Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.03 Fiber Termination Cabinets

Furnish all work, apparatus, and materials to construct and install the fiber termination cabinets designed to house the fiber equipment required for the planned ITS system.

A. Materials

Furnish materials of new stock only.

1. General

- a. Supply device cabinets, clean-cut in design and appearance.
- b. Cabinets shall be dimensioned as identified in the contract documents.
- c. Cabinets shall be corrosion resistant, UL-50 approved, NEMA Type 3R compliant.
- d. Cabinets shall be complete with all required internal components, fully wired, terminal strips, and stainless steel hardware.
- e. Cabinets shall be equipped with one 19 inch EIA rack with plated 10 gauge steel rack angles and tapped #10-32 holes.
- f. Cabinets shall be equipped with 8 watt fluorescent lights (two front fixtures, two rear fixtures) with 5 amp fuse and fuse holders.
- g. Cabinets shall screened vents in top lid with a crowned top to prevent standing water.
- h. Cabinets shall be equipped with sunshields attached with tamper resistant fasteners.
- i. Cabinets shall be equipped with 1 inch diameter lifting eyes that support weight up to 1000 pounds.
- j. Cabinets shall meet the requirements of ASTM B-209 for 5052 H-32 aluminum sheet. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
- k. The cabinet structure shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- l. All exterior seams for cabinet and doors shall be continuously welded. All edges shall be filed to a radius of 1/32 inch minimum.

2. Cabinet Doors

- a. Cabinets shall have both front and rear doors.
- b. The cabinet doors shall be sturdy, torsionally rigid, and attached utilizing stainless steel hinges.
- c. The doors shall have a stainless steel, pad-lockable handle.
- d. The doors shall have a three point door latching with stainless steel center cam, aluminum push rods & ball bearing nylon rollers for top and bottom strikers.
- e. The cabinet doors shall be provided with a door stop catch mechanism to hold the door open at two positions – 90 degrees and 120 degrees. Both the doors and door stop mechanisms shall be of sufficient strength to withstand a simulated wind load of five pounds per square foot of door area applied to both inside and outside surfaces.
- f. A neoprene door gasket and a top gasket support angle shall be provided to act as a permanent and weather resistant seal at the cabinet doors facing.
- g. Door switches (both doors).
- h. Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock. Two #2 keys for each door shall be provided for each cabinet. All locks for the project shall be keyed identically to key pattern 9R46142 or as otherwise identified by the Engineer. Keys shall be given to the Engineer. Do not attach keys to the exterior of the cabinet at any time during storage or installation.
- i. Each door shall have louvers with louvered filter covers for use in installation of air filters
- j. A heavy-duty clear plastic envelope shall be provided, securely attached to each cabinet door, for stowing cabinet wiring diagrams and equipment manuals. Minimum dimensions shall be 9 inches wide by 12 inches deep.

3. Power Panel, Connecting Cables and Wiring

- a. Provide cabinets equipped and configured with internal power components as shown in the contract documents.
- b. Power panel shall be rack mounted and wired to provide 30 Amp, 120 Vac, 3 Watt, single phase power.
- c. One 3 pole service entrance terminal block with tin plated aluminum connectors, nickel plated steel screws, and a current rating up to 70 Amps.
- d. One 20 Amp single pole breaker (Main).
- e. One 15 Amp single pole breaker (Equipment).
- f. One 15 Amp single pole breaker (Auxillary).
- g. A 120/240 Vac, 100kA rated surge suppressor for main power
- h. A 120 Vac, 15 Amp, GFCI receptacle in Ivory color (Auxiliary)
- i. Two 120 Vac, 15 Amp, duplex receptacles in Ivory color (Equipment)
- j. An eight outlet Power Distribution Unit with built in surge suppressor (1800 Joules of surge/lightning protection) that includes a resettable circuit breaker and minimum cord length of 6 feet configured for rack mounting.
- k. One 7 TAP Ground Bar
- l. One 7 TAP Neutral Bar
- m. All miscellaneous wiring, harnesses connectors and attachment hardware

4. Ventilation

a. Vents

- 1) Furnish cabinets containing a suitably designed rain tight vent or vents that:
 - Are equipped with suitable screens or dust filters, and
 - Allow the release of excessive heat and/or any explosive gases which may enter the cabinet.
- 2) Ensure when filters are utilized, positive retainment is provided on all sides to prevent warpage and entry of foreign matter around the edges.
- 3) The filters shall be dry type, easily removed and replaced, and standard dimensions commercially available.

b. Vent Fans

Meet the following requirements:

- Equipped with a fan plenum plate for dual 4 inch fans.
- Dual 4 inch fans, 120 Vac, 110 CFM, ball bearing type.
- A thermostatically controlled vent fan is furnished to provide air circulation within the cabinet.
- The thermostat controlling the fan is manually adjustable to turn on between 90°F and 150°F with a differential of not more than 10°F between automatic turn on and turn off.
- 1 Amp fuse with fuse holder for fans
- Noise suppressor R/C for fans

5. Grounding

- a. The cabinet internal ground shall consist of one or more ground bus-bars permanently affixed to the cabinet and connected to the grounding electrode.
- b. Use bare stranded No. 6 AWG copper wire between bus-bars and between the bus-bar and grounding electrode.
- c. Each copper ground bus-bar shall have a minimum of 20 connector points. Each connector point shall be capable of securing at least one No. 6 AWG conductor.
- d. AC neutral and equipment ground wiring shall return to bus-bars.

6. Pedestal

- a. Supply cabinet pedestals, clean-cut in design and appearance
- b. Cabinet pedestals shall be dimensioned as identified in the contract documents.

- c. Cabinet pedestals shall be corrosion resistant, UL-50 approved, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 0.125 inch.
- d. Cabinet pedestals shall be complete with all stainless steel hardware.
- e. Cabinet pedestals shall meet the requirements of ASTM B-209 for 5052 H-32 aluminum sheet. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
- f. The cabinet pedestal shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- g. All exterior seams for cabinet pedestals shall be continuously welded. All edges shall be filed to a radius of 1/32 inch minimum.

B. Construction

1. General

- a. Install cabinets in accordance with the contract documents and the manufacturer's recommendations.
- b. Do not penetrate the top of any cabinets without prior authorization by the Engineer.
- c. Do not allow screws used for mounting shelves or other mounting purposes to protrude beyond the outside wall of the cabinet.
- d. All connections shall be watertight.
- e. Contact the Engineer a minimum of 1 week in advance to arrange a field review prior to placing the cabinets.

2. Mounting

- a. Orientate cabinets as shown in the contract documents unless otherwise directed by the Engineer.
- b. Ensure sufficient clamps, nuts, hardware, etc., as required for the specified mounting type, are furnished with each cabinet.
- c. Seal all conduit openings in the controller cabinet with a sealing compound that meets the following requirements:
 - Readily workable, soft plastic
 - Workable at temperatures as low as 30°F , and
 - Does not melt or run at temperatures as high as 300°F.
- d. Do not install the controller cabinet on preplaced caulking material on the concrete base or place caulking material around the base of the cabinet after installation.

C. Method of Measurement & Basis of Payment

- 1. Measurement and payment for device cabinets shall be paid for at the contract unit price per each for the bid item Cabinet, Furnish and Install, 46 Inch X 24 Inch X 20 Inch.
- 2. Payment is full compensation for:
 - The furnishing and installation of all fiber termination cabinets,
 - Including all internal components and accessories required to provide a complete cabinet installation per the contract documents,
 - Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.04 Cabinet Footings

A. Materials

All concrete shall meet the requirements of Article 2403 of the Standard Specifications. Use Class C concrete for cabinet footings and all other non-paving concrete construction.

B. Construction

1. General

- a. Install cabinet footings in accordance with the contract documents and the manufacturer's recommendations.
- b. All cabinet footings shall include a full depth 4 feet concrete maintenance pad area that is cast and reinforced as a single unit with the cabinet footing.
- c. Prepare and submit for Engineer approval, design plans and details for all cabinet footings at no additional cost to the Engineer. Such plans and details shall be sealed by a professional engineer licensed in the State of Iowa.
- d. Contact the Engineer a minimum of 1 week in advance to arrange a field review prior to placing the cabinet footing.
- e. Notify the Engineer immediately if an obstruction conflicts with a footing. The Engineer is responsible for relocating or determining another effective means of supporting the structure to eliminate the conflict. Payment shall not be made for re-work or extra work as the result of an unauthorized relocation of a footing.

2. Installation Details

- a. Construct all footings as located by the Engineer. Securely rest all footings on firm undisturbed ground and set level and to the proper elevation.
- b. Form the upper portion of all concrete footings and for all instances where the excavation is irregular in shape to provide the proper dimensions. Forming materials shall be level and braced to avoid displacement, warping, or deflection from the specified pattern during construction and curing.
- c. Install and secure anchor bolts, conduits, and reinforcement before concrete placement. Use a rigid template to position anchor bolts in accordance with the appropriate pattern. The center of the template and the center of the concrete base shall coincide unless otherwise directed by the Engineer.
- d. Install a sufficient number of conduits sized as indicated in the contract documents. All conduits shall be located as indicated in the contract documents.
- e. Place all concrete within 90 minutes of batching and consolidate using a high-frequency vibrator during construction.
- f. Modification of a footing after construction is not allowed.
- g. Cover all anchor bolts to protect them against damage and to protect the public from possible injury until erecting poles.
- h. Allow a minimum of 7 calendar days curing of concrete footings before setting cabinets.

3. Improper Construction

Remove and reconstruct, at no additional cost to the Engineer, all footings improperly constructed or with improperly installed anchor bolts, conduit, or any other footing components as determined by the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for cabinet footings shall be paid for at the contract unit price per each for the bid items Cabinet Footing, Furnish and Install, 36 Inch X 20 Inch X 15 Inch and Cabinet Footing, Furnish and Install, 46 Inch X 24 Inch X 20 Inch.
2. Payment is full compensation for:
 - The furnishing and installation of all cabinet footings,
 - Including all surface excavations, repair or restoration of any nearby areas, concrete, steel reinforcement, and anchors, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.05 Handholes

A. Materials

1. General

- a. Supply handholes constructed of epoxy or polyester resin mortar with woven glass fiber reinforcement and an appropriate aggregate dimensioned as indicated in the contract documents.
- b. Handhole materials shall not support combustion when tested in accordance with "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position" ASTM D-635.
- c. Water absorption shall not exceed two percent of the original weight of material under test conditions per "Standard Test Method for Water Absorption of Plastics" ASTM D-570.
- d. The handhole shall be functional without failure throughout a temperature range of -50°F to +170°F.
- e. The handhole walls shall not deflect more than 0.024 inches per foot of length of box when installed and subject to an ASTM C-857 TIER 22 load.
- f. Handholes shall meet ANSI/SCTE 77 standards and be verified by a registered third party and stamped by a registered Professional Engineer.
- g. Handhole lid strength shall be tested to 22,500 pounds (Tier 15).
- h. Handhole lids shall be labeled as indicated in the plans or as directed by the Engineer.
- i. The Engineer shall provide approval prior to use of any handholes satisfying the contract documents requirements for structural, physical, and chemical properties.

2. Test Stations

- a. Supply Rhino part TVTI60OB5 or approved equivalent test stations at all Type Fiber Vault handholes.
- b. Test Stations shall be 60 inch triangular flexible orange plastic marker with five separate access terminals and set screw to hold terminal concealment cap on.
- c. Place custom warning decals on all sides, the Engineer shall provide prior approval of decals.

B. Construction

1. General

- a. Install the type and size of handholes at the locations indicated in the contract documents.
- b. Construct all Type Fiber Vault handholes as located by the Engineer
- c. Set handholes flush with the surface when constructing in a sidewalk or driveway. Set handholes approximately 1 inch above the finished surface of the surrounding ground when constructing in an earth embankment or non-paved surface.
- d. Install course aggregate bedding to a depth of 1 foot below the handhole.
- e. Conduit shall enter the handhole from the bottom and extend conduit ends between 4 and 6 inches above the aggregate bedding.
- f. Side penetrations of the handholes are not permitted.
- g. Terminate each tracer wire run in test stations at Handhole, Type Fiber Vault locations.
- h. Install ground rods at all Type Fiber Vault handholes as indicated in the contract documents.
- i. Plug all open conduit ends within the handhole in a manner acceptable to the Engineer.
- j. Rodent proof all handholes to the satisfaction of the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all handholes shall be paid for at the contract unit price per each for the bid items Handhole, Furnish and Install, Type I and Handhole, Furnish and Install, Type III.
2. Payment is full compensation for:
 - The furnishing and installation of all handholes,

- Including all surface excavations, repair or restoration of any nearby areas, concrete, proper water/moisture drainage materials, all necessary electric grounding materials and installation,
- Furnishing and installing all test stations at Handhole, Type Fiber Vault locations, and
- Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.06 Meter Pedestals

A. Materials

Meter pedestals shall comply with the requirements of the contract documents and all generally accepted standards and requirements for the electrical components entering and exiting the pedestal.

B. Construction

1. Install meter pedestals in accordance with the contract documents, Local Utilities, and all NEC requirements. Locate and orientate meter pedestals as directed by the Engineer.
2. Contractor shall provide all conduit and power cable from the meter pedestal to the device cabinet.
3. Unless otherwise directed by the Engineer, the Contractor shall install the meter pedestal at the location and obtain power from the electrical service location shown in the contract documents.
4. All electrical service cables shall be continuous runs with no splices between the meter pedestal and the cabinet.
5. All connections to power sources owned by the power providers, as identified in the contract documents, shall be completed by the individual power companies.
6. All riser conduits and line side feeder cables will be provided by the power companies at no expense to the Contractor.
7. The Contractor shall complete all required power terminations at the meter pedestal and device cabinet.
8. The Contractor is responsible for permits, coordinating and scheduling all locally required inspections of electrical work prior to putting a location into service.
9. The Contractor shall coordinate with the Engineer and power provider to request that electrical service at a device location be initiated.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all meter pedestals shall be paid for at the contract unit price per each for the bid item Meter Pedestal, Furnish and Install.
2. Payment is full compensation for:
 - The furnishing and installation of all meter sockets and meter pedestals,
 - Including the proper installation of the wire and cable into existing conduit and new conduit systems installed, supply and installation of cable splices and connectors, circuit breakers, and slack, coiled, or stored cables
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.07 Power Connections

A. Materials

Power connections shall comply with the requirements of NEC, the contract documents and all generally accepted standards and requirements for the electrical components and power terminations in the individual power source.

B. Construction

1. Install power connections in accordance with the contract documents and all NEC requirements.
2. Contractor shall coordinate installations in advance as noted on the contract documents.
3. Contractor shall provide all conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations and grounding in the power source.
4. Unless otherwise directed by the Engineer, the Contractor shall install the power connections as illustrated in the contract documents.
5. The Contractor is responsible for coordinating and scheduling all locally required inspections of electrical work prior to putting a location into service.
6. The Contractor shall coordinate with the Engineer and power provider to request that electrical service at a device location be initiated.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all power connections shall be paid for at the contract unit price per each for the bid item Power Connection.
2. Payment is full compensation for:
 - The furnishing and installation of all power connection accessories as shown in the contract documents,
 - Including the proper installation of the conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations, and grounding in the power source, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.08 Fiber Optic Cable

A. Materials

1. This work shall consist of furnishing and installing the fiber optic cable of the type, size, and number of fibers specified and all associated accessories.
2. The product provided shall meet the latest applicable standard specifications by American National Standards Institute (ANSI), Electronics Industries Association (EIA), and Telecommunications Industries Association (TIA) for the type mode cable of the size specified and the specifications herein.
3. Multimode Fiber - Grade Index
 - Core Diameter: 62.5 $\mu\text{m} \pm 1.0 \mu\text{m}$
 - Cladding Diameter: 125.0 $\mu\text{m} \pm 1.0 \mu\text{m}$
 - Core Concentricity: $\pm 1\%$

Max. Attenuation: 3.75 dB/km

4. Single-Mode Fiber

Typical Core Diameter: $8.3 \text{ } \mu\text{m} \pm 1.0 \text{ } \mu\text{m}$

Cladding Diameter: $125.0 \pm 1.0 \mu\text{m}$

Core Concentricity: $\pm 1\%$

Attenuation Uniformity: No point discontinuity greater than 0.1 μm at either 1300nm or 1550nm

Max. Attenuation: 0.25 dB/km

5. The coating shall be a dual layer UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically strip-able without damage to the fiber.
6. 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.
7. Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross section.
8. 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 filled with a water-swellable yarn or tape. Buffer tubes shall be stranded around the central member using reverse oscillation, or "SZ", stranding process.
9. The buffer tubes shall meet TIA/EIA-598A, "Color coding of fiber optic cables." The single mode cable shall include loose tubes with 12 fibers in each with a total number of tubes matching the number of fibers specified on the plans. The multi-mode cable shall include one loose tube with 12 fibers. The tube and fiber colors shall follow the industry color code (BL, OR, GR, BR, SL, WH, RD, BK, YL, VI, RS, AQ).
10. The cable tensile strength shall be provided by a high tensile strength aramid yarn and/or fiber glass.
11. All dielectric cables, without armoring, shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 1.4 mm. 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 meter marks or feet. The markings shall be repeated every meter. 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/km.
12. The cable shall be fabricated to withstand a maximum pulling tension of 600 pounds during installation (Short term) and 135 pounds upon installation (Long term).
13. The shipping, storing, installing and operating temperature range of the cable shall be -40°F to $+158^{\circ}\text{F}$. The manufacturer shall test at the 100% level all fiber optic cable for the following tests:
 - Each fiber shall be proof tested at a minimum load of 50 kpsi.
 - Each fiber shall be tested for attenuation and the reading shall be part of the cable labeling.
14. The cable shall meet the appropriate standard Fiber Optic Test Procedure for the following measurements:
 - Fluid Penetration
 - Compound Drip
 - Compressive Loading Resistance

- Cyclic Flexing
- Cyclic Impact
- Tensile Loading and Bending

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

B. Construction

1. General

- a. Cable end shall be secured inside the controller cabinet so that no load is applied to the exposed fiber strands.
- b. 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.
- c. 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.
- d. Slack shall be left in each handhole at the top of any conduit riser, junction box, and controller. 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.

2. Cabinet

a. Fiber Optic Terminations.

- 1) Only ST type terminations of ceramic ferrule and Physical Contact end finish shall be used to terminate multi-mode fibers to equipment. ST or mechanical terminations shall not be used to splice cables. ST type terminations of ceramic ferrule and Physical Contact end finish shall be used to terminate single-mode fibers to equipment.
- 2) Maximum attenuation per termination shall be 0.75 dB.

b. Fiber Optic Jumpers/Patch Cords.

- 1) Six fibers in each multi-mode fiber optic cable shall be terminated in the distribution unit with the traffic controller cabinet.
- 2) Duplex pigtail jumpers shall be used to branch traffic signal controller circuits from distribution panel in cabinet to controller FO OTR or to other communication equipment.
- 3) Length of pigtail jumpers will vary according distribution panel to NEMA controller FO OTR location. Length of jumper should provide for a minimum of 2 feet total slack between distribution panel and OTR connections.
- 4) Controller cabinet pigtail jumpers shall consist of factory-assembled patch cords, each of which shall contain two multi-mode fibers. Each such fiber shall have an ST compatible, Physical Contact connector with ceramic ferrule on one end (i.e., a total of four STPC connectors per cord). Each patch cord shall have a dielectric strength member and a durable outer jacket designed to withstand handling.

c. Fiber Optic Breakout Kits.

Breakout 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.

3. Fiber Optic Hub Cabinet

- a. The fiber optic hub cabinet shall be a Caltrans Model 336S.
- b. The splice cabinet shall be sturdy aluminum of clean cut design and appearance having no sharp edges, corners or projections. The size of the cabinet and accessories shall provide ample space for housing splice equipment to terminate all fibers. A hinged door, with an approved doorstop assembly, shall be provided permitting complete access to the interior of

the cabinet. When closed, the door shall fit closely to neoprene or other suitable gasketing material, making the cabinet weatherproof and dust-tight. The door shall be provided with a strong lock and two sets of keys. The door hinges and pins shall be of a non-corroding material.

- c. The cabinet shall be mounted on an aluminum riser.
- d. All fiber optic cable shall be suitably identified inside the cabinet.
- e. The base mounted cabinet shall be furnished with all of the hardware necessary for assembly and installation.

4. Cable Installation

- a. 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.
- b. 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, whichever 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.
- c. Cable shall not be pulled through any intermediate junction box, handhole, 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 handhole or controller cabinet to the immediate next downstream handhole 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.
- d. At each handhole the cable shall be visibly marked or tagged as "CITY SM/MM".

5. Testing

- a. Each fiber furnished and installed as part of the project shall be tested, both on-the-reel prior to installation and after installation using a high-resolution optical time domain reflectometer (OTDR).
- b. Single mode measurements shall be conducted at the 1550 ± 30 nanometer wavelength. Multi-mode measurements shall be conducted at 1300 ± 30 nanometer wavelength.
- c. The Contractor shall record the identification, location, length, and attenuation measurements of each tested fiber and shall furnish all test reports to the Engineer prior to installation of the cables. 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.

6. On-Reel Testing

- a. Prior to the installation, the Contractor shall perform on-site, on-reel testing. This testing shall be for both attenuation and continuity.
- b. The testing shall be performed using an OTDR by means of a pigtail splice. All test results shall be within $\pm 3\%$ of factory-supplied attenuation measurements.
- c. Testing shall be done in one direction only.

- d. 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.

7. Cable Segment Testing

- a. 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 and shall be tabulated and be included in the documentation package to be provided to the Engineer at the conclusion of the project.
- b. Overall loss for each link shall not exceed the cumulative specified maximum losses of the components. For example, at 850 nm, a one kilometer link with two splices and a connector on each end shall not exceed 4.9 dB:
 - km x 3.5 dB/km: 3.5 dB
 - 0.2 dB per splice x 2: 0.4 dB
 - 0.5 dB per connector x 2: 1.0 dB
 - Maximum allowable loss: 4.9 Db
- c. The 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 repaired or replaced by the Contractor at the Contractor's expense. The Contractor shall retest all fibers of any repaired or replaced cable segment. The Contractor shall submit complete documentation of the cable segment attenuation tests. Such documentation shall be submitted in either hardcopy (written) form or in Engineer-approved electronic format on diskette.

8. Final System Testing

- a. After the complete fiber optic system is installed and terminated, but excluding the capping of unused fibers, an OTDR reading shall be performed on all cables to insure that each section is in compliance with the issued specification.
- b. A hard copy of OTDR signature traces for all fibers for all sections shall be provided to the Engineer. Fibers which have been terminated shall be indicated in the report. In addition to the OTDR test report, the Contractor shall provide the test results of an Attenuation Test for the installed fibers using the insertion loss test procedure and the Transmitter/Receiver Power Level Test and the Continuity Test.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all fiber optic cable shall be paid for at the contract unit price per each for the bid items Single-Mode Fiber Optic OSP Cable, 144 Strand and Single-Mode Fiber Optic OSP Cable, 6 Strand.
2. Payment is full compensation for:
 - Furnishing and installing cable, all necessary slack, testing, documentation, fiber cable enclosures, cable labeling, fuses and fuse holders, and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.
 - Cable inside foundations, poles, pull boxes, cabinets, and other such devices or structures shall be subsidiary to those items and shall not be measured for payment.
 - Furnishing all materials, labor, equipment, and other items associated with all work zone traffic control necessary to meet the requirements of the contract documents.

2.09 Relocate Automated Gate

A. Materials

None

B. Construction

None

C. Method of Measurement & Basis of Payment

1. Measurement and payment for relocation of the automated gate shall be paid for at the lump sum contract unit price bid for the bid item Relocate Automated Ramp Management System.
2. Payment is full compensation for all preparatory work and operations for all items under the contract, including, but not limited to those necessary for:
 - All removal from original position and installation of the Automated Gate to proposed position, excavation and backfill; and for all labor, equipment, tools, materials, storage, and incidentals necessary to complete the work in accordance with the plans and these Special Specifications.
 - All removal from original position and installation of the LED Sign Pole to proposed position, excavation and backfill; and for all labor, equipment, tools, materials, storage, and incidentals necessary to complete the work in accordance with the plans and these Special Specifications.
3. The Engineer reserves the right to issue partial payment of this lump sum item based upon the estimated percentage of work completed as determined by the Engineer.