This addendum is issued on February 15, 2019 prior to the bid due date to add, delete, modify, clarify and/or to respond to questions submitted by prospective offerors regarding the work included in the above referenced solicitation.

**QUESTIONS**

1. **Question:** Section 2.7 Fiber Reinforcement is specified:
   a. Since slabs have welded wire mesh will fiber still be required?

   **Response:** Fiber is required although WWF is being provided. Fiber is to prevent microcracking.

2. **Question:** Table of Contents – Division 08 – Openings – 08-42-29.23 Sliding Automatic Entrances
   a. No Spec Section is Included – Please provide.

   **Response:** Provided as attachment

3. **Question:** Section 088000 has two glazing makeups G1 & G2 and they are not identified on the drawings
   a. Please identify the glazing types on the plans.

   **Response:** Panels labeled as insulated glazing on AR05.01 below 2 feet off the concrete will be G1 (laminated) and glass above 2 feet will be G2.

4. **Question:** Drawing AR05.02 New Shelter Typical Elevations – depict insulated metal panels – the glazing specifications 088000 has no mention of an insulated metal panels.
   a. Please provide the kind of metal panel and make up.

   **Response:** Reference response to 28.b. in addendum #1

5. **Question:** Will there be a Phasing plan issued? The Summary 011000 indicates that the “owner intends to continue use of facility”.

   **Response:** Phasing plan to be provided by contractor and approved by architect/engineer/owner taking into consideration “owner intends to continue use of facility”
6. **Question:** Is the work by the CCTV vendor in the electrical contract?  
**Response:** Electrical Contractor is responsible for removal and installation of Wireless Equipment Pole only. Existing CCTV equipment removal and reinstallation to be by PPA CCTV vendor. Electrical Contractor to coordinate removal of equipment prior to removal of pole.

7. **Question:** Will specifications be issued for the exterior signage for this project?  
**Response:** See attached specification for illuminated signage above shelter. Reference response to question 32 in addendum #1.

8. **Question:** Is the cutting & patching for the electrical contractors work in the Electrical Primes Contract?  
**Response:** See question #14 response in this addendum #2.

9. **Question:** 011200-4-1.7-A-16-a Indicates the shelters are to be Pre-engineered structures but the specifications indicate them to be stick built. Which is correct?  
**Response:** The structures are not pre-engineered. Pre-engineered options can be submitted as long as the design intent remains.

10. **Question:** If the structures are to be pre-engineered what is the basis of design is and will specification be issued?  
**Response:** Reference response to question 9 in this addendum #2.

11. **Question:** 051200-2-17 Indicates AISC Install and Fabrication. Can these requirements be deleted?  
**Response:** The AISC requirements cannot be deleted or removed. If there is a hardship for this requirement submit in writing.

12. **Question:** Is the new ADA signage to be furnished & installed or is the existing signage to be reused?  
**Response:** New ADA signage shall be furnished and installed. Not reused.

13. **Question:** Can you please clarify who is responsible for saw cutting, removal & disposal of existing paving, excavation, concrete encasement for new underground conduits & backfill for both electrical & communications conduits?  
**Response:** See question #14 response in this addendum #2.

14. **Question:** Detail 4/EL09.01 shows new asphalt or concrete (by others), does that mean all repaving of the areas where new UG electrical & communications conduits/handholes is by others?  
**Response:** Electrical Contractor is responsible for patching all excavation work necessary for conduits, ductbanks, hand holes, etc. Detail 4/EL09.01 to read “NEW ASPHALT OR CONCRETE BY EC CONTRACTOR”.

15. **Question:** Detail 3/SS04.01.  
   a. Detail states to coordinate with CCTV contractor, who is the CCTV Contractor?  
   b. Show a 49” LCD display, mount, antenna & wiring, who furnished & installs these?  
**Response:**  
   a. PPA’s current CCTV maintenance contractor information to be provided by PPA at time of construction.  
   b. To be furnished by the electrical contractor.
16. **Question:** Details 1/SS03.01 & 2/SS03.01, can more details be provided for the CCTV pole that needs to be reinstalled?
   
   **Response:** See detail 5/AR08.01 for detail of existing pole to be modified and welded to Shelter structure.

17. **Question:** Detail 4/SS04.01, this detail shows us cutting the existing telephone conduit & looping the existing UTP cabling for extension when the new guard booth is built & conduits installed.
   
   a. Show a 49” LCD display, mount, antenna & wiring, who furnishes & installs these?
   
   b. What happens if this cable gets damaged during construction?
   
   c. What happens if this cable is too short to extend into the new shelter construction?

   **Response:**
   
   a. To be furnished by the electrical contractor
   
   b. Contractor to protect cable during construction. If damaged, contractor to replace cable in kind. Contractor has option to provide new cable for project.
   
   c. Cable excavation is to provide new splice box and install new cable from excavation point to new shelter. Refer to detail 2/SS04.01

18. **Question:** Drawing ARO4.01 Forms and Surfaces Site Furnishings
   
   1. For the Vector Backed Bench:
      1. Please provide Model Number for Each Bench or Bench Configuration
      2. Hardwood or Aluminum Slat Selection?
      3. May standard powdercoat color be provided?
      4. Will any LED accent lighting be required?
      5. Side panel material, finish and any required perforation pattern.
   
   b. For the Techno RS Leaning Rail (? Perch Model)
      1. Please provide Model Number for each section.
      2. May standard powdercoat color be provided?
   
   c. For Bevel Waste Receptacle:
      1. May standard powdercoat color be provided?
      2. How many liners per receptacle are to be provided?

   **Response:** See attached PDF markup of detail 1/AR04.01 for the furniture

   **Clarifications:**

   1. Mini-Power centers to be copper windings only. Specification provided for Mini-power center
   
   2. Specification for 260543 Underground Ducts and Raceways for Electrical Systems

   **END OF ADDENDUM TWO**
SECTION 262733
MINI-POWER CENTERS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the GENERAL REQUIREMENTS AND COVENANTS - DIVISION I, and the SPECIAL PROVISIONS - DIVISIONS IIA and IIB, which are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications for requirements and provisions affecting the Work of this Section.

1.2 SCOPE

A. The Contractor shall furnish and install three-phase general purpose individually mounted mini-power centers of the two-winding type, self-cooled, as specified herein and as shown on the contract drawings.

1.3 REFERENCES

A. The mini-power center and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL, ANSI and NEMA.

1.4 SUBMITTALS

A. The following information shall be submitted to the Engineer:

1. Dimension drawing weights
2. Transformer ratings including:
   a. KVA
   b. Primary and secondary voltage
   c. Taps
   d. Primary and secondary continuous current
   e. Insulation class and temperature rise
   f. Sound level

3. Component ratings including:
   a. Voltage
   b. Continuous current
c. Interrupting ratings

4. Cable terminal sizes
5. Product data sheets

1.5 SUBMITTAL – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final (as-built) drawings and information for items listed in Paragraph 1.04 and shall incorporate all changes made during the manufacturing process.
2. Connection diagrams
3. Installation information

1.6 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the secondary distribution equipment.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

1.7 REGULATORY REQUIREMENTS

A. The assembly and all components shall be U.L. listed.

1.8 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.
PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Rex Power Magnetics (Basis of Design)
B. Eaton
C. Schneider Electric
D. Siemens Energy & Automation, Inc.

E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to the bid date.

2.2 RATINGS
A. kVA and voltage ratings shall be as shown on the drawings
B. Units shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96
C. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
   1. 9 kVA and Less: 40 dB.
   2. 30 to 50 kVA: 45 dB.

2.3 CONSTRUCTION
A. Each mini-power center shall include a primary main breaker, an encapsulated dry-type transformer and a panelboard with secondary main breaker.
B. Primary main, secondary main and feeder breakers shall be enclosed with a padlockable hinged door.
C. Mini-power centers shall be suitable for service entrance application and labeled as such.
D. Insulation Systems
1. Transformers shall be insulated with a 180 degrees C insulation system and rated at 115 degrees C temperature rise
2. Required performance shall be obtained without exceeding the above-indicated temperature rise in a 40 degrees C maximum ambient, with a 30 degrees C average over 24 hours.
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

E. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum [copper optional] with continuous wound construction.
2. The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
3. The core of the transformer shall be grounded to the enclosure
4. Provide two (2) 5% FCBN taps

2.4 BUS

A. Secondary bus shall be copper

2.5 WIRING/TERMINATIONS

A. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer and distribution section shall be factory installed.

B. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

2.6 MAIN DEVICES

A. Each mini-power center shall include a primary main breaker with an interrupting rating of 14 kA at 480 volts; and a secondary main breaker with an interrupting rating of 10 kA at 120/208

2.7 FEEDER DEVICES
A. The secondary distribution section shall accommodate one-inch bolt on breakers with 10 kA interrupting capacity.

2.8 ENCLOSURE

A. The enclosure shall be totally enclosed, non-ventilated, NEMA 4X with lifting provisions

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA.

1. Ratio tests at the rated voltage connection and at all tap connections
2. Polarity and phase-relation tests on the rated voltage connection
3. Applied potential tests
4. Induced potential test
5. No-load and excitation current at rated voltage on the rated voltage connection

3.2 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

3.3 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage

3.4 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

January 2019

MINI-POWER CENTERS

Bid No. 19-01

262733 - 5
SECTION 260543
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Rigid nonmetallic duct.
   2. Duct accessories.

1.2 DEFINITIONS
A. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
B. Duct Bank:
   1. Two or more ducts installed in parallel, with or without additional casing materials.
   2. Multiple duct banks.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings:
   1. Precast or Factory-Fabricated Underground Utility Structures:
      a. Include plans, elevations, sections, details, attachments to other work, and accessories.
      b. Include duct entry provisions, including locations and duct sizes.
      c. Include reinforcement details.
      d. Include frame and cover design and manhole chimneys.
      e. Include grounding details.
      f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
      g. Include joint details.
1.4 INFORMATIONAL SUBMITTALS

A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Drawings shall be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. CANTEX INC.
7. ElecSys, Inc.
8. Electri-Flex Company.
9. Endot Industries Inc.
10. IPEX USA LLC.
11. Manhattan/CDT.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.2 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
Underground Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.
2. Elmhurst-Chicago Stone Co.
3. Oldcastle Precast, Inc.
4. Rinker Group, Ltd.
5. Riverton Concrete Products.
6. Utility Concrete Products, LLC.
8. Wausau Tile Inc.

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

F. Cover Legend: Molded lettering, "ELECTRIC."

G. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

H. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

1. Extension shall provide increased depth of 12 inches.
2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
I. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

J. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

K. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

L. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, concrete-encased unless otherwise indicated.

B. Underground Ducts Crossing Driveways Roadways: RNC Type EPC-40 PVC, encased in reinforced concrete.

C. Stub-ups: Concrete-encased GRC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:
1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO H-20, structural load rating.
2. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures. Restore per original condition.

3.5 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
B. Install duct according to NEMA TCB 2.
C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.
E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.

H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psi hydrostatic pressure.


L. Concrete-Encased Ducts and Duct Bank:
   1. Excavate trench bottom to provide firm and uniform support for duct.
   2. Width: Excavate trench 3 inches wider than duct on each side.
   3. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
   4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
   5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
   6. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.

8. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

10. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.

11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

3.6 INSTALLATION OF CONCRETE HANDHOLES

A. Precast Concrete Handhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Handhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Handhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below frost line, below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.
C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071353 "Elastomeric Sheet Waterproofing." After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

F. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.

2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.

3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.
3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump.
   1. Sweep floor, removing dirt and debris.
   2. Remove foreign material.

END OF SECTION 260543