**SECTION 03 20 00**

**CONCRETE REINFORCING**

**BASED ON DFD MASTER SPECIFICATION DATED 9/10/2024**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**PART 1 - GENERAL**

**SCOPE**

Section includes concrete reinforcing including steel reinforcement bars and welded-wire reinforcement. The work under this section consists of providing all work, materials, labor equipment and supervision necessary to provide concrete reinforcing as required in these specifications and the drawings.

PART 1 - GENERAL

Scope

Related Work

References

Pre-Installation Meetings

Submittals

Quality Assurance

Delivery, Storage, and Handling

PART 2 - PRODUCTS

Performance Requirements

Steel Reinforcement

Fiber-Reinforced Polymer (FRP) Bars

Reinforcement Accessories

Fabricating Reinforcement

PART 3 - EXECUTION

Preparation

Steel Reinforcement Installation

Joints

Installation Tolerances

Field Quality Control

**RELATED WORK**

Applicable provisions of Division 1 govern work under this Section.

(The A/E to review all scope of work and determine other related work, work which impacts this section, or work is impacted by this section. A/E to add or remove sections below as needed. Examples may include site civil or utility work, interior flooring and finishes, coatings, etc.)

Related work specified elsewhere:

03 08 00 – Commissioning of Concrete

03 10 00 – Concrete Forming and Accessories

03 30 00 – Cast-In-Place Concrete

03 30 10 – Cast-In-Place Concrete for Site Work

04 20 10 - Unit Masonry

Section 00 00 00 – (Section Title)

Section 00 00 00 – (Section Title)

**REFERENCES**

Specifications

American Concrete Institute (ACI):

ACI SP-066 – ACI Detailing Manual

ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.

ACI 315 - Standards on Details and Detailing of Concrete Reinforcement.

ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

ACI 440.1R-15 (2015) “Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer Bars”, ACI Committee 440, American Concrete Institute

ACI 440.3R-12 (2012) “Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures” ACI Committee 440, American Concrete Institute

ACI 440.4R-04 (Reapproved 2011) “Prestressing Concrete Structures with FRP Tendons” ACI Committee 440, American Concrete Institute

ACI 440R-07 (2007) “Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures,” ACI Committee 440, American Concrete Institute

ACI 440.5-08 (2008) “Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bar”, ACI Committee 440, American Concrete Institute

ASTM International (ASTM):

ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A884 – Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.

ASTM A934 – Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.

ASTM A955 - Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

ASTM A1022 - Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement

ASTM A1055 - Standard Specification for Zinc and Epoxy Dual-Coated Steel Reinforcing Bars

ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

ASTM D3963 – Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.

ASTM D7957 (2017) “Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement”, American Society for Testing and Materials (ASTM International)

American Welding Society (AWS)

AWS D1.4 – Structural Welding Code – Reinforcing Steel

CRSI – Manual of Standard Practice

CRSI – Placing Reinforcing Bars

**PREINSTALLATION MEETINGS**

Preinstallation Conference: Conduct conference at [Project site] **<Insert location>**.

Review the following:

Special inspection and testing and inspecting agency procedures for field quality control.

Construction contraction and isolation joints.

Steel-reinforcement installation.

**SUBMITTALS**

Product Data: For each of the following:

Each type of steel reinforcement

Stud Rails

Epoxy repair coating

Zinc repair material

Bar supports

Mechanical splice couplers

Structural thermal break insulated connection system

Sustainable Design Submittals:

<Insert required sustainable design submittals>

Shop Drawings: Comply with ACI SP-066:

Include placing drawings that detail fabrication, bending, and placement.

Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

Construction Joint Layout: Indicate proposed construction joints required to build the structure.

Location of construction joints is subject to approval of Architect.

Delegated Design Submittal: For structural thermal break insulated connection system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

Qualification Statements: For delegated design engineer; and testing and inspection agency.

Delegated Design Engineer Qualifications: Include the following:

Experience providing delegated design engineering services of the type indicated.

Documentation that delegated design engineer is licensed in the State of WIin which Project is located.

Welding certificates.

Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

Material Certificates: For each of the following, signed by manufacturers:

Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

Material Test Reports: For the following, from a qualified testing agency:

Steel Reinforcement:

For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

Fiber-Reinforced Polymer (FRP) Bars:

Submit to the Engineer a certificate of analysis for each production LOT from the producer of the FRP reinforcing bars, confirming compliance with the requirements of this Section.

Mechanical splice couplers.

Stud Rails.

Field quality-control reports.

Minutes of preinstallation conference.

**QUALITY ASSURANCE**

Testing Agency Qualifications: An independent agency, acceptable to the AE and DFD , qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.

Build panel approximately **[**100 sq. ft. for formed surface**] <Insert area>** in the location indicated on Drawings or, if not indicated, as directed by Architect.

Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**DELIVERY, STORAGE, AND HANDLING**

Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.

Store reinforcement to avoid contact with earth.

Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

FRP Reinforcement:

Materials should be stored in a way to prevent damage or contamination from extreme temperatures, UV rays, excessive moisture, and any foreign substances.

Materials stored outdoors should be kept directly off the ground.

Protective gloves shall always be worn to prevent injury.

Damaged materials shall not be used, unless approved by an engineer.

Field cutting, if necessary, shall be done by sawing and in a manner that the ends of the bar does not damage. It is recommended that a reciprocating disk or cut off disk be used.

A dust mask and eye protection shall always be used while cutting.

**PART 2 - PRODUCTS**

**PERFORMANCE REQUIREMENTS**

Delegated Design: Engage a qualified professional engineer, to design structural thermal break insulated connection system, including attachment to building construction.

Structural Performance of Structural Thermal Break Insulating Connection System: Structural thermal break insulated connection system to withstand the following loads and stresses:

Dead Loads: As indicated on Drawings. **<confirm these loadings are on the drawings>**

Shear Load: As indicated on Drawings.

Bending Moment: As indicated on Drawings.

Live Loads: As indicated on Drawings.

Shear Load: As indicated on Drawings.

Bending Moment: As indicated on Drawings.

Seismic Performance of Structural Thermal Break Insulated Connection System: Structural thermal break insulated connection system to withstand the effects of earthquake motions determined according to **[**ASCE/SEI 7**] <Insert requirement>**.

Component Importance Factor: **<Insert requirement>**.

**STEEL REINFORCEMENT**

Reinforcing Bars: ASTM A615/A615M, **[Grade 60] [Grade 75] [Grade 80] [Grade 100]**, deformed.

Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

Headed-Steel Reinforcing Bars: ASTM A970/A970M.

Galvanized Reinforcing Bars:

Steel Bars: [ASTM A615/A615M, Grade 60] [ASTM A615/A615M, Grade 75] [ASTM A615/A615M, Grade 80] [ASTM A615/A615M, Grade 100] [ASTM A706/A706M] **<insert requirement>**, deformed bars.

Zinc Coating: ASTM A767/A767M, [**Class I**] [**Class II**] zinc coated after fabrication and bending.

Epoxy-Coated Reinforcing Bars:

Steel Bars: [ASTM A615/A615M, Grade 60] [ASTM A615/A615M, Grade 75] [ASTM A615/A615M, Grade 80] [ASTM A615/A615M, Grade 100] [ASTM A706/A706M] **<insert requirement>**, deformed bars.

Epoxy Coating: [ASTM A775/A775M] [or] [ASTM A934/A934M] **<insert requirement>** with less than 2 percent damaged coating in each 12-inch bar length.

Dual-Coated Reinforcing Bars: ASTM A1055/A1055M.

Steel Bars: [ASTM A615/A615M, Grade 60] [ASTM A615/A615M, Grade 75] [ASTM A615/A615M, Grade 80] [ASTM A615/A615M, Grade 100] [ASTM A706/A706M] **<insert requirement>**, deformed bars.

Zinc Coating: ASTM A1055/A1055M [Type I] [Type II] **<insert Type>**.

Epoxy Coating: **[**ASTM A775/A775M**] [or] [**ASTM A934/A934M**]** with less than 2 percent damaged coating in each 12-inch bar length.

Stainless Steel Reinforcing Bars: ASTM A955/A955M, [Grade 60] [Grade 75], [Type 304] [Type 316L] **<insert Grade and Type>**, deformed.

Steel Bar Mats: ASTM A184/A184M, fabricated from [ASTM A615/A615M, Grade 60] [ASTM A615/A615M, Grade 40] [ASTM A706/A706M] **<insert ASTM/ Grade>**, deformed bars, assembled with clips.

Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, [plain] [deformed] steel.

**FIBER-REINFORCED POLYMER (FRP) BARS**:

Use only solid, round, thermoset basalt fiber reinforced polymer (BFRP), glass fiber reinforced polymer (GFRP) or carbon fiber reinforced polymer (CFRP) reinforcing bars. Single or multi-wire CFRP strands are permitted as spirals for reinforcing in concrete piling where specified in the Contract Documents. Bars shall be manufactured using pultrusion, variations of pultrusion, or other suitable processes noted in the producer’s Quality Control Plan, subject to the approval of the Engineer. For BFRP and CFRP bars only vinyl ester or epoxy resin systems are permitted. For GFRP, use only bars manufactured using vinyl ester resin systems and glass fibers classified as E-CR or R that meet the requirements of ASTM D578.

**REINFORCEMENT ACCESSORIES**

Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.

Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

Mechanical Splice Couplers: ACI 318 [Type 1] [Type 2] **<insert Type>**, same material of reinforcing bar being spliced; **[**compression-only type] [tension-compression type] [dowel-bar type] [mechanical-lap type] **<insert Type>**.

Structural Thermal Break Insulated Connection System:

Tension Rods: [Carbon steel with crimped Type 316 stainless steel rods] [Carbon steel, welded with ASTM A276/A276M, Type 316 stainless steel] **<insert Type>**.

Shear Reinforcement Rods**:** [ASTM A276/A276M, Type 316 stainless steel tube] [Carbon steel, welded with ASTM A276/A276M, Type 316 stainless steel bar] **<insert Type>**.

Pressure pads: ASTM A276/A276M, Type 316 stainless steel.

Insulation body: Polystyrene.

Stud Rails:

Headed studs for stud rail assemblies shall be formed from low carbon steel conforming to ASTM A108, Grades 1010 through 1020, and shall meet the following physical requirements:

Yield Strength: 51,000 psi minimum

Tensile Strength: 65,000 psi minimum

Elongation: 20% in 2 inches, minimum

Reduction of area: 50% minimum

Rails for stud rail assemblies shall be cut from plates conforming to ASTM A36, and shall meet the following physical requirements:

Yield Strength: 44,000 psi minimum

Tensile Strength: 65,000 psi minimum

Elongation 20% in 8”, minimum

Completed stud rail reinforcement assemblies shall conform to the requirements of ASTM A1044.

Subject to meeting requirements noted above, acceptable products and manufacturers are as follows:

StudRails; DECON

Suncoast Stud Reinforcing System (SRS); Suncoast Post-Tension

DSA Reinforcing System; Peikko USA

Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

Finish: [Plain] [Galvanized] [ASTM A884/A884M, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch wire length] **<insert finish>.**

Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.

Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

Zinc Repair Material: ASTM A780/A780M.

Fiber Reinforcing Polymer (FRP) Reinforcing: Tie FRP reinforcing using self-locking plastic straps; or plastic-coated pliable steel wire that readily bends and twists without breaking and that provides a tie of sufficient strength to hold the FRP reinforcing in its proper position.

**FABRICATING REINFORCEMENT**

Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

**PART 3 - EXECUTION**

**PREPARATION**

Protection of In-Place Conditions:

Do not cut or puncture vapor retarder.

Repair damage and reseal vapor retarder before placing concrete.

Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

**STEEL REINFORCEMENT INSTALLATION**

Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

Accurately position, support, and secure reinforcement against displacement.

Locate and support reinforcement with bar supports to maintain minimum concrete cover.

Do not tack weld crossing reinforcing bars.

Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

Provide concrete coverage in accordance with ACI 318.

Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Splices: Lap splices as indicated on Drawings.

Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.

Stagger splices in accordance with ACI 318.

Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

Fiber Reinforcing Polymer (FRP) Reinforcing: Do not use mechanical couplers for FRP reinforcing. Use lap splices only

Install structural thermal break insulated connection system in accordance with manufacturer's instructions.

Install welded-wire reinforcement in longest practicable lengths.

Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.

Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

Lace overlaps with wire.

Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

Dual-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in accordance with ASTM A780/A780M.

Fiber Reinforcing Polymer (FRP) Reinforcing: No field fabrication of FRP reinforcing bars is permitted except tying and field cutting per ACI 440.5. Do not bend or straighten, couple, thermal cut, or shear cut FRP reinforcing bars.

**JOINTS**

Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

Place joints perpendicular to main reinforcement.

Continue reinforcement across construction joints unless otherwise indicated.

Do not continue reinforcement through sides of strip placements of floors and slabs.

Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

**INSTALLATION TOLERANCES**

Comply with ACI 117 and tolerances listed below.

**Reinforcement location**

Placement of non-prestressed reinforcement

When member depth (or thickness) is 4 in. or less

.....................................................±1/4 in.

When member depth (or thickness) is over 4 in. and not over 12 in.

...................................................±3/8 in.

When member depth (or thickness) is over 12 in.

.....................................................±1/2 in.

Concrete cover measured perpendicular to concrete surface

When member depth (or thickness) is 12 in. or less

...................................... –3/8 in.

When member depth (or thickness) is over 12 in.

..................................... –1/2 in.

Reduction in cover shall not exceed 1/3 the specified concrete cover.

Reduction in cover to formed soffits shall not exceed 1/4 in.

Vertical deviation for slab-on-ground reinforcement

...................................................... ±3/4 in.

Clearance between reinforcement or between reinforcement and embedment

One-quarter specified distance not to exceed

.......................................................±1 in.

Distance between reinforcement shall not be less than the greater of the bar diameter or 1 in. for unbundled bars.

For bundled bars, the distance between bundles shall not be less than the greater of 1 in. or a bar diameter derived from the equivalent total area of all bars in the bundle.

Spacing of non-prestressed reinforcement, measured along a line parallel to the specified spacing Except as noted below..........................±3 in.

Stirrups, the lesser of ±3 in. or ±1 in. per ft of beam depth

Ties, the lesser of ±3 in. or ±1 in. per ft of least column width

The total number of bars shall not be fewer than that specified.

Placement of prestressing reinforcement or prestressing ducts, measured from form surface

Horizontal deviation

Element depth (or thickness) 24 in. or less ...........±1/2 in.

Element depth (or thickness) over 24 in. .......... ±1 in.

Vertical deviation

Element depth (or thickness) 8 in. or less ........ ±1/4 in.

Element depth (or thickness) over 8 in. and not over 24 in. ................................................................ ±3/8 in.

Element depth (or thickness) more than 24 in..... ±1/2 in.

Longitudinal location of bends in bars and ends of bars

At discontinuous ends of corbels and brackets ... ±1/2 in.

At discontinuous ends of other elements ............ ±1 in.

At other locations................................................. ±2 in.

Embedded length of bars and length of bar laps

No. 3 through 11 bar sizes .................................. –1 in.

No. 14 and 18 bar sizes....................................... –2 in.

Bearing plate for prestressing tendons, deviation from specified plane

.................. ±1/4 in. per ft, but not less than ±1/8 in.

**Placement of smooth rod or plate dowels in slabs-on-ground**

Centerline of dowel, vertical deviation measured from bottom of concrete slab at the joint for element depth 8 in. or less................................±1/2 in.

When element depth is over 8 in. ........................±1 in.

Spacing of dowels, measured along a line parallel to the specified spacing...........................±3 in.

The total number of dowels shall not be fewer than that specified.

Centerline of dowel with respect to a horizontal line that is perpendicular to the plane established by the joint

Horizontal deviation ..........................................±1/2 in.

Vertical deviation...............................................±1/2 in.

Placement of embedded items, excluding dowels in slabs-on-ground

Clearance to nearest reinforcement shall be the greater of the bar diameter, largest aggregate size, or

.............................................................................. 1 in.

Centerline of assembly from specified location

Horizontal deviation ............................................. ±1 in.

Vertical deviation ................................................. ±1 in.

Surface of assembly from surface of element

Assembly dimension 12 in. or smaller

......................................................... ±1/2 in. per 12 in.

but not less than ............................................... ±1/4 in.

Assembly dimension greater than 12 in. .......... ±1/2 in.

Anchor bolts in concrete

Top of anchor bolt from specified elevation

Vertical deviation .............................................. ±1/2 in.

Centerline of individual anchor bolts from specified location

Horizontal deviation

for 3/4 in. and 7/8 in. bolts ............................ ±1/4 in.

for 1 in., 1-1/4 in., and 1-1/2 in. bolts ............. ±3/8 in.

for 1-3/4 in., 2 in., and 2-1/2 in. bolts ............. ±1/2 in.

**FIELD QUALITY CONTROL**

Special Inspections: Engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

Inspections:

Steel-reinforcement placement.

Steel-reinforcement mechanical splice couplers.

Steel-reinforcement welding.

FRP-reinforcement placement.

Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

**END OF SECTION 03 20 00**