SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Steel reinforcing bars.

B. Galvanized reinforcing bars.

C. Epoxy-coated reinforcing bars.

D. Wire and spiral reinforcement.

E. Welded steel wire fabric.

F. Steel bar mats.

G. Tie wire.

H. Accessories

I. Welding Electrodes

J. Exothermic Metal-filled Sleeve

K. Mechanical Splice Coupler

1.02 RELATED SECTIONS

A. Reinforcing steel for shotcrete is specified in Section 03 37 13 - Shotcrete.

B. Reinforcing steel for prestressed concrete and precast concrete is specified in Section 03 05 18 - Prestressed Concrete, and Section 03 40 00 - Precast Concrete.

C. Reinforcement for masonry is specified in Section 04 22 00 - Concrete Unit Masonry.

D. Reinforcing steel for piles, drilled shaft foundations, portland cement concrete paving, concrete curbs, gutters, and walks, and utility structures is specified in their respective Sections.

1.03 MEASUREMENT AND PAYMENT

A. General: Measurement and payment for concrete reinforcement will be either by the lump-sum method or by the unit-price method as determined by the listing of the bid item for concrete reinforcement indicated in the Bid Schedule of the Bid Form.

B. Lump Sum: If the Bid Schedule indicates a lump-sum for concrete reinforcement, the lump-sum method of measurement and payment will be in accordance with Section 01 20 00 - Price and Payment Procedures, Article 1.03.

C. Unit Prices: If the Bid Schedule indicates a unit price for concrete reinforcement, the unit-price method of measurement and payment will be as follows:

1. Measurement:

a. Reinforcing steel bars, including galvanized and epoxy-coated reinforcements, and wire reinforcement will be measured for payment by the pound, complete in place.

1) Weights will be determined from computations based on the nominal weights listed in ACI 318, Appendix on Steel Reinforcement Information. For galvanized and epoxy-coated reinforcements, the weights of the zinc and epoxy coatings will not be included.

2) Laps of bars for splices indicated will be measured for payment. Splices for Contractor's convenience will not be measured for payment. When bars are spliced by welding, the weight for payment will be as computed for lapped splices.

b. Welded wire fabric will be measured for payment by the square yard of each configuration placed. Quantities will be the actual number of square yards measured complete in place, with no allowance for overlap.

c. The following concrete reinforcement will be measured for payment under this Section:

1) Reinforcing steel, including spirals, for drilled shaft foundations as specified in Section 31 63 29 - Drilled Concrete Piers and Shafts.

2) Reinforcing steel for concrete paving as specified in Section 32 13 13 - Concrete Paving.

3) All cast-in-place concrete structures and slabs as specified in Section 03 30 00 - Cast-In-Place Concrete, except as specified under Article 1.03.C.1.d herein.

4) Reinforcing steel for shotcrete as specified in Section 03 37 13 - Shotcrete.

5) Reinforcing steel for cast-in-place prestressed concrete (post-tensioned), except prestressing steel, as specified in Section 03 05 18 - Prestressed Concrete.

d. The following concrete reinforcement will not be measured separately for payment, but will be included in the unit measurement of the associated concrete work:

1) Reinforcing steel for concrete piles as specified in Section 31 62 00 - Driven Piles.

2) Reinforcing steel for concrete curbs, gutters, and walks as specified in Section 32 16 21 - Concrete Curbs, Gutters, and Walks.

2) Reinforcing steel for utility structures as specified in Section 33 05 16 - Utility Structures.

3) Prestressing steel for prestressed concrete, including concrete reinforcement for precast/prestressed concrete as specified in Section 03 05 18 - Prestressed Concrete.

4) Reinforcing steel for precast concrete as specified in Section 03 40 00 - Precast Concrete.

5) Reinforcing steel for concrete ductbanks as specified in Section 20 50 16 - Underground Ductwork and Structures for Facility Services.

e. The following reinforcement and accessory items will not be measured separately for payment:

1) Clips, ties, bar supports, dowels, spacers, chairs, or other devices for holding reinforcing steel in place, including zinc and epoxy coatings.

2) Additional reinforcing steel for splices permitted by the Engineer for Contractor's convenience.

3) Reinforcing steel and accessories, including zinc and epoxy coatings, required for lump sum items.

2. Payment:

a. Reinforcing steel bars, wire reinforcement, and welded wire fabric will be paid for at the indicated Contract unit prices for the computed quantities as determined by the measurement methods specified above.

b. Payment for reinforcement and accessory items listed under Article 1.03.C.1.e herein will be included in the Contract unit prices for the associated cast-in-place concrete work.

1.04 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 301 Specifications for Structural Concrete for Buildings

2. ACI 315 Details and Detailing of Concrete Reinforcement

3. ACI 318 Building Code Requirements for Structural Concrete

4. ACI 439.3R Mechanical Couplers

B. American Society for Testing and Materials (ASTM):

1. ASTM A82 Specification for Steel Wire, Plain, for Concrete Reinforcement

2. ASTM A184/ A184M Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

3. ASTM A185 Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement

4. ASTM A370 Test Methods and Definitions for Mechanical Testing of Steel Products

5. ASTM A496 Specification for Steel Wire, Deformed, for Concrete Reinforcement

6. ASTM A497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

7. ASTM A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

8. ASTM A706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement

9. ASTM A767/ A767M Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

10. ASTM A775/ A775M Specification for Epoxy-Coated Reinforcing Steel Bars

11. ASTM A884/ A884M Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

12. ASTM D3963/ D3963M Specification for Epoxy-Coated Reinforcing Steel

13. ASTM E8 Test Methods of Tension Testing of Metallic Materials

14. ASTM E165 Test Method for Liquid Penetrant Examination

C. American Welding Society (AWS):

1. AWS D1.4 Structural Welding Code - Reinforcing Steel

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI Manual of Standard Practice

2. CRSI, Placing Reinforcing Bars

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Shop Drawings:

1. Submit bar lists, bending diagrams and schedules, and placement plans and details for all reinforcing steel. Bar lists shall include weights.

2. Indicate descriptions, details, dimensions, arrangements and assemblies, and locations of reinforcing steel. Include number of pieces, sizes, and markings of reinforcing steel, laps and splices, supporting devices and accessories, and any other information required for fabrication and placement. Indicate any adjustments required as specified in Article 1.06.B.

3. Check Contract Drawings for anchor bolt schedules and locations, anchors, hangers, inserts, conduits, sleeves, blockouts, and any other items to be cast in concrete for possible interference with reinforcing steel. Indicate required clearances on Shop Drawings.

4. Detail reinforcing steel in accordance with requirements of the ACI 315. Indicate individual weight of each bar, total weight of each bar size, and total weight of all bars on the list. Base calculated weights upon nominal weights specified in ACI 318, Appendix on Steel Reinforcement Information.

5. For mechanical splice couplers furnish the following:

   a. Certified test reports showing that the couplers meet all of the specified requirements.

   b. Written assembly and installation instructions for each type, model and bar size for which the coupler is designed. Installation instructions shall include typical installation sequence, recommended installation tools, guidelines for laboratory testing of couplers and coupler size designations with corresponding range of bar sizes.

   c. Reports showing the results of all tests.

C. Product Data:

1. Submit manufacturers' product data and installation instructions for proprietary manufactured materials and reinforcement accessories.

2. Submit manufacturers' product data and installation instructions for proprietary exothermic metal splicing systems and proprietary mechanical coupler splicing systems when such splicing methods are permitted.

D. Samples:

1. When galvanized or epoxy-coated reinforcing bars are indicated, furnish two 12-inch long samples and two additional samples bent to minimum radius of the rebar from each size and lot shipped to the jobsite.

2. Samples shall be representative of the materials furnished. These samples, as well as any additional random samples taken by the Engineer, may be tested for specification compliance.

3. Failure of any sample to meet specification requirements shall be cause for rejection of that lot.

E. Certificates:

1. For each lot or load of reinforcing steel delivered to the jobsite, furnish mill affidavits or test reports of compliance or similar certification, certifying the grades and physical and chemical properties of the reinforcing steel and conformance with applicable ASTM Specifications, including ASTM A370, Method A9.

2. For galvanized and epoxy-coated reinforcing bars, furnish certificates of compliance with ASTM A767/A767M for galvanized bars and with ASTM A775/A775M and D3963/D3963M for epoxy-coated bars.

3. For welders, furnish welding certificates or affidavits attesting to the welders' qualifications to perform the indicated welding in accordance with applicable requirements of AWS D1.4.

4. For exothermic sleeve coupler splicing, furnish certificates or affidavits attesting to the crew's special qualifications to perform the splicing.

1.06 QUALITY CONTROL

A. Tolerances:

1. Fabrication: Fabricate bars to meet the following tolerances:

   a. Sheared length: plus or minus 1 inch.

   b. Depth of truss bars: plus 0, minus 1/2 inch.

   c. Overall dimensions of stirrups, ties and spirals: plus or minus 1/2 inch.

   d. All other bends: plus or minus 1 inch.

   e. Fabrication tolerances not indicated on the Contract Drawings or specified above shall comply with the applicable requirements of ACI 301 and CRSI Manual of Standard Practice, Chapter 7.

2. Placement: Place bars to the following tolerances:

a. Clear distance to formed surfaces: plus or minus 1/4 inch.

b. Minimum spacing between bars: minus 1/4 inch.

c. Top bars in slabs and beams:

1) Member 8 inches deep or less: plus or minus 1/4 inch.

2) Member greater than 8 inches, but less than 2 feet deep: plus or minus 1/2 inch.

3) Members 2 feet or more deep: plus or minus 1 inch.

d. Crosswise of members: spaced evenly within 2 inches.

e. Lengthwise of members: plus or minus 2 inches.

f. Placement tolerances not indicated on the Contract Drawings or specified above shall comply with the requirements of ACI 301, ACI 318, or CRSI Manual of Standard Practice, as applicable.

B. Adjustments: Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or in excess of the above tolerances, the resulting arrangement of bars shall require the Engineer's approval. Minimum spacings shall not be decreased, and the required number of bars shall be placed. Bars moved to permit access for cleanup operations shall be properly replaced and secured before the start of concrete placement.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcing bars to the fabricator in bundles, limited to one size and length of bar, securely tied and identified with plastic tags in an exposed position indicating the mill, the melt or heat number, and the grade and size of bars.

B. Deliver steel reinforcement to the jobsite, store, and cover in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease, oil, or other cause which might impair bond with concrete.

C. Deliver steel reinforcement to the jobsite properly tagged and identified, as specified herein in Article 2.03, in accordance with approved Shop Drawings.

D. Handle and store galvanized and epoxy-coated reinforcement in a manner which will prevent damage to the coatings. For epoxy-coated reinforcement, comply with the requirements of ASTM D3963/D3963M.

E. Maintain identification of steel reinforcement after bundles are broken.

F. Provide special facilities for the storage and handling of exothermic materials as recommended by the splicing system manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Reinforcing Bars:

1. Billet-Steel Bars: ASTM A615, except that the maximum yield strength shall be 78,000 psi, and the tensile strength shall be not less than 1.25 times the actual yield strength. ASTM A615 bars may be welded only if the more stringent requirements of ANSI/AWS D1.4 are followed.

2. Low-Alloy Steel Bars: ASTM A706.

3. Weights of Bars: Refer to ACI 318, Appendix on Steel Reinforcement Information.

4. See BART Facility Standards, Facility Design, Criteria, STRUCTURE, Reinforced Concrete for the application of types and grades of reinforcing steel to the BART facilities.

B. Galvanized Reinforcing Bars: ASTM A706 or ASTM A615, as applicable, galvanized in accordance with ASTM A767/A767M, Class I coating. Bars shall be cut and bent cold before galvanizing.

C. Epoxy-coated Reinforcing Bars: ASTM A706 or ASTM A615 , as applicable, epoxy-coated in accordance with ASTM A775/A775M and ASTM D3963/D3963M. Coating material shall conform to ASTM A775/A775M and ASTM D3963/D3963M, Annex A1, green in color. Furnish acceptance test reports for each lot of epoxy-coated bars delivered to the site.

D. Wire and Spiral Reinforcement: ASTM A82 for plain wire and ASTM A496 for deformed wire.

E. Welded Steel Wire Fabric - Plain Wire: ASTM A185, wire sizes and center-to-center spacings as indicated.

F. Welded Steel Wire Fabric - Deformed Wire: ASTM A497, wire sizes and center-to-center spacings as indicated.

G. Welded Steel Wire Fabric - Epoxy-Coated: ASTM A884/A884M, wire sizes and center-to-center spacings as indicated.

H. Steel Bar Mats - Deformed Bars: ASTM A184/A184M, using ASTM A706 deformed bars, sizes and spacings of members as indicated, welded or clipped at intersections.

I. Accessories: Provide reinforcement accessories, consisting of bar supports, spacers, hangers, chairs, ties, and similar items as required for spacing, assembling, and supporting reinforcement in place. Conform with CRSI referenced standards and the following requirements:

1. For footings, grade beams, and slabs on grade, provide supports with precast concrete or mortar bases or plates or horizontal runners where wetted base materials will not support chair legs.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms or are in close proximity to finish surfaces, provide supports with legs which are galvanized, plastic-protected, or stainless steel.

3. For galvanized reinforcement, provide all galvanized accessories.

4. For epoxy-coated reinforcement, provide accessories which are nylon-, epoxy, or plastic-coated.

J. Tie Wire: No. 16 gage or heavier, black or galvanized, soft or commercial grade steel tie wire. For galvanized reinforcement, provide zinc-coated wire. For epoxy-coated reinforcement, provide nylon-, epoxy-, or plastic-coated wire. Where tie wire is in close proximity to finish surfaces of exposed-to-view concrete, provide soft stainless steel wire.

K. Welding Electrodes: E90XX low hydrogen electrodes (for shielded metal arc welding.)

L. Exothermic Metal-Filled Sleeve Coupler:

1. System Description: Provide bar splicing connection, produced by a standard exothermic process whereby molten filler metal, contained by a high-strength steel sleeve of larger inside diameter than adjoining bars, is introduced into the annular space between the bars and the sleeve as well as between the ends of the bars. Splicing system shall produce complete fusion with 100 percent penetration of the joint.

2. Spliced Strength in Tension: 125 percent of the yield strength of connected reinforcing bars.

M. Mechanical Splice Coupler:

1. System Description: Provide bar-splicing connections, produced by threaded reinforcing bar ends and threaded coupler, or by sleeves hydraulically pressed or forged onto butt-ended reinforcing bars, or by other proprietary mechanical splicing method as proposed by the Contractor and approved by the Engineer. Mechanical splice couplers shall be capable of being installed in the clear space indicated and to provide the required clearances.

2. Spliced Strength in Tension: Minimum125 percent of the yield strength of connected reinforcing bars, unless otherwise indicated.

2.02 FABRICATION

A. Fabrication Standards: Fabrication of steel reinforcement shall be in accordance with the Contract Drawings and approved Shop Drawings. Where specific details are not indicated, comply with applicable requirements of ACI 301, ACI 318, and CRSI Manual of Standard Practice.

B. Cutting and Bending: Cutting and bending shall be performed at a central location, equipped and suitable for the purpose. Bars shall be accurately cut and bent as indicated. Bars shall be bent cold. Heating of bars for bending or straightening will not be permitted. Bars shall not be

bent or straightened in any manner which will injure the material. Label all bars in accordance with bending diagrams and schedules, and secure like pieces in bundles when appropriate.

C. Welding:

1. Welding of reinforcement, where indicated and approved, including preparation of bars, shall conform with applicable requirements of AWS D1.4. Welders shall be prequalified in accordance with AWS D1.4, Chapter 6.

2. Use full penetration butt welds by the electric-arc method unless otherwise indicated or approved. Weld splices shall develop 125 percent of the specified yield strength of the bars, or of the smaller bar in transition splices.

3. Clean bars of oil, grease, dirt, and other foreign matter and flame-dry before welding. Preheat bars before welding in accordance with AWS D1.4, Chapter 5. Stagger splices in adjacent bars a minimum of 48 inches.

D. Repair of Damaged Coatings: Bars for galvanized reinforcement shall be cut and bent cold before galvanizing. Galvanized and epoxy coatings damaged by shipping, handling, or cutting and bending shall be repaired as specified in ACI 301, and ASTM A767/A767M, ASTM A775/A775M, ASTM A884/A884M, and ASTM D3963/D3963M, as applicable.

2.03 IDENTIFICATION

A. Reinforcing steel shall be bundled and tagged with grades and sizes, heat numbers, and suitable identification marks for checking, sorting, and placing. Sizes and mark numbers shall correspond to placing Shop Drawings and schedules. Tags and markings shall be water-resistant and shall not be removed until steel reinforcement is placed in position.

2.04 REINFORCING STEEL FOR DUCT BANKS

A. Reinforcing steel shall be provided for duct banks. Longitudinal steel shall be provided with a minimum total cross sectional area of 0.0018 times the gross area of the duct bank. The maximum spacing of reinforcing bars shall be 18 inches, with a minimum of one bar provided in each corner. Tie bars in the transverse direction enclosing the longitudinal steel bars shall also be provided, with a minimum size of No. 3 bars at a minimum spacing of 12 inches. The minimum clear concrete cover over reinforcing steel shall be 3 inches where concrete is cast directly against earth, and 1-1/2 inches where concrete is cast directly against fabricated formwork.

B. Where duct banks enter rigid underground structures, reinforcing steel shall be provided to tie the duct bank to the structure. Details shall be provided showing methods used to prevent damage to duct banks due to differential settlement at these points.

PART 3 - EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that surfaces, over or against which concrete is to be placed, are clean and in proper condition for placing reinforcement.

B. Verify that items to be embedded in concrete inserts, sleeves, and block-outs are secured in place as required.

3.02 PLACING

A. Placing Standards: Reinforcing steel shall be placed in accordance with the Contract Drawings, approved Shop Drawings, and the applicable requirements of ACI 301, ACI 318, CRSI Manual of Standard Practice, and CRSI Placing Reinforcing Bars. Install reinforcement accurately and secure against movement, particularly under the weight of workers and the placement of concrete.

B. Reinforcing Supports: Bars shall be supported on metal or plastic chairs, spacers, and hangers, accurately placed and securely fastened to steel reinforcement in place. Support legs of accessories in forms without embedding in the form surface. Hoops and stirrups shall be accurately spaced and wired to the reinforcement.

C. Placing and Tying: Reinforcing steel shall be installed in place, spaced, and securely tied or wired with tie wire at all splices and at crossing points and intersections in the positions indicated. Comply with requirements of CRSI Placing Reinforcing Bars, Chapter 10. Welding to secure or support rebar replacement is prohibited. Snap ties are acceptable for intermediate intersections. Rebending of bars on the job to fit different conditions will not be permitted. Point ends of wire ties away from adjacent form surfaces.

D. Spacing: Center-to-center distance between parallel bars shall be in accordance with the Contract Drawings or, where not indicated, the minimum clear spacing shall be in accordance with ACI 318.

E. Longitudinal Location of Bends and Ends of Bar: A maximum of plus or minus 3 inches from the indicated location will be permitted, provided that specified protective concrete cover at ends of members is not reduced by more than 1/2 inch.

F. Splices:

1. Lapped Splices:

a. Laps of splices shall be securely tied together to maintain the alignment of the bars, to provide the required minimum clearances, and to transfer stress by bond. Lapped splices and development lengths not shown shall be detailed to develop Class B lapping lengths and development lengths in tension, respectively, in accordance with ACI 318.

b. Splices of alternate bars shall be staggered a minimum clear offset of 2 feet between splices. Splices shall be tied with tie wire, or splices may be lap welded in accordance with AWS D1.4. Lapped splices are not permitted for No. 14 and No. 18 bars, or when specifically excluded by Contract provisions regardless of size.

2. Exothermic Metal-Filled Coupler Splices: Conform with the product manufacturer's installation instructions and recommendations and with applicable requirements of AWS D1.4 for exothermic welding.

3. Mechanical Coupler Splices:

   a. Perform installation of coupler and tightening of joint assembly in accordance with the coupler manufacturer's installation instructions and recommendations.

   b. Reinforcing bars to be joined shall be shop threaded using special machinery to produce the required tapered threads. Where previously threaded bars must be cut or where threads are damaged, bars shall be replaced, or an alternate splicing system approved by the Engineer shall be substituted. Bars shall not be rethreaded, and damaged threads shall not be repaired in the field.

   c. Prior to joining, inspect all threads and assure that they have been properly made and are clean.

   d. Rotate coupler and bar initially by hand or wrench until snug (approximately 3-1/4 to 4 turns). Apply 24-inch minimum pipe wrench and turn coupler (or bar) until further turning is resisted with the application of a minimum torque of 200 foot-pounds. Suitably mark joint to indicate that tightening has been completed.

   e. For proprietary mechanical splicing systems not specified herein, installation shall conform with the manufacturer’s installation instructions.

4. Spiral Reinforcement Splices: Splices shall conform with applicable requirements of ACI 318.

G. Dowels: Provide dowels where indicated or required for connecting construction and for maintaining structural and reinforcement continuity. Dowels shall be tied securely in place before concrete is deposited. Provide additional bars for proper support and anchorage where required. Do not bend dowels after embedment.

H. Welded Wire Fabric:

1. Wire fabric shall be installed in lengths as long as practicable and shall be wire-tied at all laps and splices. End laps shall be offset in adjacent widths. Lap welded wire fabric in accordance with applicable requirements of ACI 318.

2. Where required welded wire fabric shall be secured in position with suitable supports, accessories, and tie wire as indicated and required to ensure against movement from workers and placement of concrete lift fabric as concrete is placed to assure proper embedment at position indicated.

3.03 PROTECTIVE CONCRETE COVER

A. Minimum concrete coverage for steel reinforcement shall be as specified in ACI 301, ACI 318, or CRSI Manual of Standard Practice. If there is a conflict between the standards specified, the thicker concrete coverage shall govern.

3.04 CLEANING:

A. Reinforcement at time of depositing concrete shall be free of corrosion and coatings that may impair bond with concrete, such as form oil, mill scale, or loose deposits of rust and other corrosion.

3.05 FIELD QUALITY CONTROL

A. In accordance with Section 01 45 00 - Quality Control, quality control inspections and tests to be performed by the Contractor include the following:

1. Placement of Reinforcing Steel: Visual inspection of reinforcing steel in place, including bar supports, tied laps and intersections, welded wire fabric, and bar mats.

2. Welds:

   a. Visual inspection of reinforcing bar welds.

   b. Tension tests of welded butt joints. Tests shall be performed on sample welds produced by the Contractor in accordance with ASTM E8.

   c. Nondestructive tests of installed welded butt joints shall be performed in accordance with ASTM E165.

   d. Inspections and tests shall be performed in accordance with the applicable requirements of AWS D1.4, Chapters 6 and 7.

3. Exothermic/Coupler Splices:

   a. Continuous visual inspection for the first eight hours, minimum, of the work as performed by any crew, and again by any replacement crew. All splices require visual inspection before concrete may be placed.

   b. Visual inspection shall be performed in accordance with the product manufacturer's instructions and recommendations for such inspection.

   c. Inspections shall measure and record all voids. Exothermic rebar splices shall be accepted, provided measured "void limits," per end, do not exceed manufacturer's specified "void limits."

   d. Splices indicating improper fill, slag at tap hole, or blowouts shall be rejected.

4. Mechanical Coupler Splices: Test 100 percent of the couplers, using a 24-inch click-type torque wrench calibrated to 200 foot-pounds. Minimum turning torque of 200 foot-pounds shall be applied to the extent that further turning is resisted. Where tests reveal failure of couplers to be properly tightened, couplers shall be removed and replaced.

B. For exothermic/coupler splices, the Contractor shall provide qualification splices for each position as follows:

1. One sister splice for the first 25 splices; thereafter, one sister splice for every 50 splices.

2. Sister splices shall be laboratory tested by the Engineer for strength in tension (125 percent of the yield strength of connecting bars).

END OF SECTION 03 20 00