

## SECTION 1002—REINFORCEMENT BARS

**1002.1 DESCRIPTION**—This work is the furnishing and placement of reinforcement bars for cement concrete construction.

### 1002.2 MATERIAL—

**(a) Reinforcement Steel.** Reinforcement bars, [Section 709.1](#). As indicated, provide epoxy coating for reinforcement bars as specified in [Section 709.1\(c\)](#). Galvanized reinforcement bars as specified in [Section 709.1\(e\)](#) may be substituted for epoxy-coated reinforcement bars.

**(b) Other Material.**

- Annealed Iron Wire—[ASTM A 684/A 684M](#)
- Cement—[Section 701](#)
- Water—[Section 720.1](#)
- Welding Material—[Section 1105.02\(t\)](#)

**(c) Mechanical Splice System.** From a manufacturer listed in [Bulletin 15](#) and conforming to the following physical requirements:

- |   |   |
|---|---|
| • Ultimate tensile strength of mechanical coupler system (California Test No. 670)  | 90% of ultimate tensile strength of reinforcement bars, minimum |
| • Allowable slip (California Test No. 670)  | 0.25 mm (0.0100 inch), maximum                                  |
| • Yield strength of mechanical coupler  | 125% of specified yield strength of reinforcement bars, minimum |
| • Fatigue resistance, allowable slip (California Test No. 670, +172 MPa to -172 MPa (+25 kips per square inch to -25 kips per square inch) for 10,000 cycles) | 1.25 mm (0.05 inch), maximum                                    |

Provide epoxy coating for mechanical splice systems according to applicable portions of AASHTO M 284/M 284M.

Certify as specified in [Section 106.03\(b\)3](#).

### 1002.3 CONSTRUCTION—

**(a) General.** Provide reinforcement bars free from injurious defects such as cracks and laminations. Provide reinforcement bars free from frost, dirt, oil, grease, paint, mortar, loose rust, mill scale, and other materials that would reduce bond. The Department will not reject reinforcement bars for bonded rust, surface seams, surface irregularities, or mill scale provided the minimum dimensions, cross-sectional area, and tensile properties of a hand wire brushed specimen meet the physical requirements for the size and grade of steel indicated.

Remove loose, scaly, or thick rust. A light powdery coating of rust, formed during project storage, does not require cleaning. The Representative will reject reinforcement bars with rusting that has caused detectable reduction in cross-

sectional area. Obtain the Representative's acceptance of in-place reinforcement bars before concrete is placed. Maintain the reinforcement bars in the correct position.

Verify the compatibility of the bar schedule with the structure plans and details. Make adjustments to the bar schedule, including reinforcement bar details and quantities, and obtain the Representative's acceptance before fabrication. The Department will not grant additional Contract time as a result of adjustments to the bar schedule or to reinforcement bars. With each shipment of reinforcement bars delivered to the project, have the material supplier furnish a bill of lading that provides an itemized listing, as shown on the bar schedule for individual structural units, of all bars in the shipment by quantity, size, length, mark, type, mass (weight), and bending dimensions, as indicated. Include general project identification information as well as any appropriate remarks and plan references (drawing number, description, etc.) on the bill of lading. Submit bills of lading to Department inspection personnel to verify and document field quantities and for the Department's project records.

**(b) Storage.** [Section 106.05\(d\)](#) and as follows:

Store reinforcement bars off the ground on platforms, skids, or other supports, and protect the reinforcement bars from mechanical injury and surface deterioration caused by exposure to conditions producing rust. Keep reinforcement bars free from frost, dirt, oil, grease, paint, mortar, loose rust, mill scale, and other materials that would reduce bond.

[Handle and store epoxy-coated reinforcement bars by methods that will not damage the epoxy coating.](#) Furnish all systems for handling epoxy-coated reinforcement bars with adequately padded contact areas if possible. Pad all bundling bands and lift all bundles with a strong back, multiple supports, or platform bridge to prevent bar-to-bar abrasion from sags in the bar bundle. Do not drop or drag bars or bundles. [Transport and store epoxy-coated reinforcement bars](#) on wooden or padded supports. For additional storage and handling requirements for epoxy-coated reinforcement bars see Section 1002.3(g)1.

For additional storage and handling requirement for galvanized reinforcement bars, see [Section 1002.3\(h\)2](#).

**(c) Field Adjustment.** Furnish bars with shapes and dimensions, as indicated. Do not field bend except to make minor adjustments when approved by the Representative. If field bending or straightening is required, see Table A. Do not field bend rail or axle steel.

**TABLE A (Metric)**  
**Bend and Straightening Requirements** <sup>(1)(2)</sup>

Bar Size	Carbon Equivalent	Bend Temp. °C	Straighten Temp. °C	Bar Size	Dia. of Former Millimeters Min.
10 15	Unknown	760-810	760-810	10 15	70 100
20	0.55 or less and A 706/ A 706M	20-40 or 760-810	20-40 or 760-810	20	120
25	Any	760-810	760-810	25	150
>25	Bending and straightening not recommended				

<sup>(1)</sup> Use temperature sticks.

<sup>(2)</sup> Avoid:

- 230 °C to 320 °C
- 1000 °C and greater

**TABLE A (English)**  
**Bend and Straightening Requirements** <sup>(1) (2)</sup>

Bar Size	Carbon Equivalent	Bend Temp. F	Straighten Temp. F	Bar Size	Dia. of Former Inches Min.
4 through 7	Unknown	1400-1500	1400-1500	4	3
	0.55 or less and A 706	70-100 or 1400-1500	70-100 or 1400-1500	5 6 7	4 5 6
8	Any	1400-1500	1400-1500	8	8
>8	Bending and straightening not recommended				

<sup>(1)</sup> Use temperature sticks.

<sup>(2)</sup> Avoid:

- 450F to 600F
- 1800F and greater

Note:

- A. Apply heat to sufficient area to encompass bend area.
- B. Apply heat for sufficient time to bring bar center to required temperature.
- C. Maintain temperature while bending and/or straightening.
- D. Allow free rotation.
- E. Bend with smooth continuous application of force.
- F. Straighten by moving hickey bar (if used) progressively around bend.

#### **(d) Placing and Fastening.**

**1. General.** Accurately place reinforcement bars as indicated and hold it firmly in position during the placing and settling of concrete using metal chairs or acceptable supports. Do not allow bar spacing to vary from the design spacing by more than 12 mm (1/2 inch). Do not allow the distance from the surface of the formwork to the bars to vary more than 6 mm (1/4 inch) from the design distance. Do not place reinforcement bars closer than 1.5 times the maximum nominal size of the aggregate used in the concrete mix design. Firmly tie bars with annealed iron wire or secure the bars with acceptable metal clips. Tie bars at all perimeter intersections and at all intersections on the top mat of bridge decks and in bridge barriers. For other intersections, when bar spacing is greater than or equal to 300 mm (12 inches), tie all intersections; when bar spacing is less than 300 mm (12 inches), either tie all intersections or tie alternate intersections in each direction to provide a [staggered tie layout](#). Tie bundled bars together at not more than 1800 mm (6-foot) centers. When reinforcement bars are tied together and lifted into place as a unit, ensure stability of the unit and maintain proper bar alignment during lifting and placement operations. For epoxy-coated reinforcement bars and galvanized reinforcement bars, provide plastic-coated tie wire, epoxy-coated tie wire, metal clips, or plastic clips. If fabric reinforcement is shipped in rolls, straighten it into flat sheets before placing it. Do not weld cross bars (tack weld) for assembly of reinforcement bars unless authorized in writing by the Representative.

**2. Support Systems.** Support reinforcement bars in its proper position by use of mortar blocks, wire bar supports, supplementary bars, or other devices. Supply such devices of proper height and at sufficiently frequent intervals to maintain the distance between the reinforcement bars and the formed surface or the top surface of deck slabs within 5 mm (1/4 inch) of that indicated.

Support platforms, supporting personnel and equipment during concrete placement, directly on the forms and not on the reinforcement bars.

**2.a Mortar Block Supports.** Furnish mortar blocks of the same class as the concrete in which they are to be embedded. Ensure that block faces in contact with forms for exposed surfaces do not exceed 50 mm x 50 mm (2 inches by 2 inches) in size, and that their color and texture will match the concrete surface. If used on vertical or sloping surfaces, provide such blocks with an embedded wire for securing the block to the reinforcement bars. If used in slabs, use either a tie wire or, if the gravitational force of the reinforcement bars is sufficient to firmly hold the blocks in

place, a groove in the top of the block. For epoxy-coated reinforcement bars or galvanized reinforcement bars, use plastic-coated or epoxy-coated tie wires.

**2.b Wire Supports.** Furnish wire bar supports, such as ferrous metal chairs and bolsters conforming to industry practice as described in the Manual of Standard Practice of the Concrete Reinforcing Steel Institute. Ensure that chairs or bolsters that bear against the forms for exposed surfaces are either Class 1 - Maximum Protection (Plastic Protected) or Class 2, Type B - Moderate Protection (Stainless Steel Tipped) for which the stainless steel conforms to [ASTM A 493](#), Type 430. For epoxy-coated reinforcement bars or galvanized reinforcement bars, provide plastic-coated, epoxy-coated, or galvanized wire bar supports and bar clips.

**2.c Plastic Supports.** Use chairs and bolsters that do not deflect more than 6 mm (1/4 inch) under the minimum point load requirement of 1.56 kN (350 pounds-force) as described in [PTM No. 430](#). Use supports molded in a configuration that does not restrict concrete flow.

**3. Adjustments.** Adjust reinforcement used in post-tensioned concrete, or relocate it during the installation of prestressing ducts or tendons, as required to provide planned clearances to the prestressing tendons, anchorages, and stressing equipment, as approved by the Representative.

**(e) Splicing and Lapping.** Furnish all reinforcement in the full lengths, as indicated, unless otherwise allowed by the Representative.

Do not splice bars, except as indicated or directed. If splicing is allowed, lap the reinforcement bars as shown on the [Standard Drawings](#) and as indicated, and wire together securely. Do not substitute alternate bars unless allowed by the Representative. Stagger splices as far as possible.

In lapped splices, place and wire the bars maintaining the minimum distance to the surface of the concrete as indicated. Do not use lapped splices for Nos. 45 and 55 (Nos. 14 and 18) bars, except as provided in Articles 5.11.5.2.1 and 5.11.5.5.1 of the AASHTO LRFD Specification.

As indicated, use welded splices or mechanical splice systems. For welded splices, use butt splices only. Stagger welded splices or mechanical splice system connections if possible.

Only use welded splices if indicated or if the Chief Bridge Engineer gives written authorization to do so. Ensure that welding conforms to the Structural Welding Code, Reinforcing Steel, AWS D1.4 of the American Welding Society and applicable special provisions.

Do not use welded splices on epoxy-coated reinforcement bars or galvanized reinforcement bars. Do not weld so close to epoxy-coated reinforcement bars to cause any heating of the coating.

Assemble mechanical splice systems according to the manufacturer's recommendations. Mark reinforcing bars with scribe marks or indelible ink before splice attachment to ensure equal embedment.

If mechanical splice systems are used, construct sample and actual splices in the presence of the Representative. The Representative will select, for each size of reinforcement bar used, three splices, either sample or actual, to be tested for verification of physical properties. Submit verification samples to the MTD within 7 days.

Use an epoxy-coated mechanical splice system to splice epoxy-coated reinforcement bars. Paint the entire splice area with compatible epoxy paint after the system is assembled.

Use a galvanized mechanical splice system to splice galvanized reinforcement bars. Galvanize mechanical splice system in accordance with [ASTM B 695](#) Class 50, Type II with a minimum thickness of 50  $\mu\text{m}$  (2 mils) or 355 grams per square meter (1.2 ounce per square foot). Chromate in accordance with [ASTM A767, Section 4.3](#)

Do not encase mechanical splices in concrete until visual examination and required testing have been completed and approved.

**(f) Epoxy-Coating Exposed Stirrups.** If stirrups in precast bridge elements are not epoxy-coated during fabrication, epoxy-coat the exposed portion of the bars. Wire brush the bars before applying the epoxy coating. If epoxy-coated stirrups are expected to be exposed for more than 6 months, cover with opaque polyethylene, or other suitable material, to prevent ultra-violet damage to the epoxy coating.

**(g) Epoxy-Coated Reinforcement Bars.** In addition to the above, the following requirements apply if using epoxy-coated reinforcement bars:

**1. Storage, Handling, and Placement.** Where possible, do not store epoxy-coated reinforcement bars at the jobsite for more than 2 months. If field storage on site is expected to exceed 2 months, cover the epoxy-coated reinforcement bars or bundles with opaque polyethylene or other protective material. Provide ventilation to prevent condensation from forming under the covering.

Store, handle, and place epoxy-coated reinforcement bars at the jobsite according to [ASTM D 3963/D 3963M](#). Inspect the bars before placement. If the epoxy coating is damaged and the damages do not exceed 2% of the surface area in any 0.3m (1-foot) section of the epoxy-coated reinforcement bars, repair all visible damage according to [ASTM D 3963/D 3963M](#) before bar placement. Replace epoxy-coated reinforcement bars if damage to the surface area exceeds 2% in any 0.3m (1-foot) section.

After placement, inspect the epoxy-coated reinforcement bars again and repair areas damaged during placement.

**2. Welding.** Do not weld.

**3. Appurtenances.** Use plastic-coated or epoxy-coated tie wire. Use epoxy-coated, plastic-coated, or galvanized chairs and metal supports. Submit any proposed alternate support devices for acceptance. Use appurtenances with a minimum coating thickness of 75 µm to 100 µm (3 mils to 4 mils).

**(h) Galvanized Reinforcement Bars.** In addition to the above, the following requirements apply if using galvanized reinforcement bars:

**1. Fabricate.** Fabricate reinforcement bars before galvanization. Use minimum bend diameters conforming to requirements given in Table 2 of [ASTM A 767/A 767M](#). Make adjustments to the bar schedule, including reinforcement bar details and quantities and obtain the Representative's acceptance before fabrication.

**2. Storage, Handling, and Placement.** Where possible, do not store galvanized reinforcement bars at the jobsite for more than 30 days. Store in accordance with [Section 1002.3\(b\)](#) to allow air circulation to prevent the formation of wet storage stain. If field storage is expected to exceed 30 days, cover bars with opaque polyethylene or other protective material.

Provide galvanized reinforcement bars having uniform appearance. Do not use reinforcement bars with visible corrosion deposits, uncoated spots, or acid, flux or black spots.

When handling, avoid bundle-to-bundle or bar-to-bar abrasion and use equipment with protected contact areas.

Do not field bend galvanized reinforcement bars except to make minor adjustments when approved by the Representative. Do not apply heat to bend or straighten galvanized reinforcement bars.

Do not place or store galvanized reinforcement bars in contact with uncoated reinforcement bars or other uncoated steel or stainless steel.

After placement, inspect the galvanized reinforcement bars and repair areas damaged during placement in accordance with [ASTM A 780/A 780M](#).

**3. Welding.** Do not weld.

**4. Appurtenances.** Use plastic-coated or epoxy-coated tie wire. Use epoxy-coated, plastic-coated, or galvanized chairs and metal supports. Submit any proposed alternate support devices for acceptance. Use appurtenances with a minimum coating thickness of 75 µm to 100 µm (3 mils to 4 mils).

## 1002.4 MEASUREMENT AND PAYMENT—

**(a) Reinforcement Bars.** Kilogram (Pound) or Lump Sum

As indicated for the type specified.

Galvanized coating mass (weight) is incidental to the mass (weight) of the reinforcement bar.

Annealed iron wire, chairs, and ties are incidental to the mass (weight) of the reinforcement bar.

**(b) Mechanical Splice System.** Each or Lump Sum

As indicated for the type specified.

Epoxy paint for painting the splice area after assembly is incidental, if epoxy-coated reinforcement bars and mechanical splice systems are used.