

9-07 REINFORCING STEEL**9-07.1 General****9-07.1(1) Acceptance by Manufacturer's Certification**

Reinforcing steel may be accepted by the Engineer based on the Manufacturer's Certificate of Compliance.

9-07.1(1)A Acceptance of Materials

Steel reinforcing bar manufacturers use either an English or a Metric size designation while stamping rebar. The actual size of the bar, whether stamped with an English or a Metric size designation is acceptable. The Contract plans and the standard plans will continue to use an English size designation. The table below shows the comparable reinforcing steel bar size designations in the both units of measure:

English Designation	Bar Diameter	Metric Designation
#3	(0.375-inches)	#10
#4	(0.500-inches)	#13
#5	(0.625-inches)	#16
#6	(0.750-inches)	#19
#7	(0.875-inches)	#22
#8	(1.000-inches)	#25
#9	(1.128-inches)	#29
#10	(1.270-inches)	#32
#11	(1.410-inches)	#36
#14	(1.690-inches)	#43
#18	(2.260-inches)	#57

9-07.1(2) Bending

Steel reinforcing bars shall be cut and bent by careful and competent workmen. They shall be bent cold to templates, which shall not vary appreciably from the shape and dimension shown in the Plans.

Hooks and bends of steel reinforcing bars shall be bent to the following inside diameters unless shown otherwise in the Plans:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	1½"	6 bar diameters
No. 4	2"	6 bar diameters
No. 5	2½"	6 bar diameters
No. 6	4½"	6 bar diameters
No. 7	5¼"	6 bar diameters
No. 8	6"	6 bar diameters
No. 9 through No. 11		8 bar diameters
No. 14 through No. 18		10 bar diameters

The supplementary requirements of AASHTO M 31 for bend tests shall apply to size No. 14 and No. 18 steel reinforcing bars which have hooks or bends.

9-07.1(3) Lengths

Net lengths of bent bars shown in the "LENGTH" column of the bar list in the plans are rounded to the nearest inch. Net length is the length of bar after all bend deductions are subtracted from the gross length.

The following bend deductions per 90 degrees bend have been subtracted from the gross length:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	$\frac{3}{4}$ "	1"
No. 4	1"	1 $\frac{1}{4}$ "
No. 5	1 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "
No. 6	1 $\frac{7}{8}$ "	1 $\frac{7}{8}$ "
No. 7	2 $\frac{1}{4}$ "	2 $\frac{1}{4}$ "
No. 8	2 $\frac{1}{2}$ "	2 $\frac{1}{2}$ "
No. 9		3 $\frac{3}{8}$ "
No. 10		3 $\frac{3}{4}$ "
No. 11		4 $\frac{1}{8}$ "
No. 14		5 $\frac{3}{4}$ "
No. 18		7 $\frac{5}{8}$ "

For bends other than 90 degrees, a direct proportion of these deductions will be used. The bend deductions listed will apply, except where bending radii are shown in the Plans.

For standard hooks on the ends of bars, the following hook lengths, in addition to the out to out detailed dimension, have been provided:

Bar Size	Length Added for One Hook				
	180° Hook		135° Hook		90° Hook
	All Bars	Seismic Ties	All Other Bars	Stirrup and Ties	All Other Bars
No. 3	5 $\frac{1}{8}$ "	4 $\frac{7}{8}$ "	3 $\frac{5}{8}$ "	2 $\frac{7}{8}$ "	5 $\frac{1}{8}$ "
No. 4	6"	6 $\frac{1}{2}$ "	4 $\frac{1}{2}$ "	3 $\frac{1}{2}$ "	6 $\frac{3}{4}$ "
No. 5	6 $\frac{7}{8}$ "	8"	5 $\frac{3}{8}$ "	4 $\frac{3}{8}$ "	8 $\frac{1}{2}$ "
No. 6	8 $\frac{1}{4}$ "	10 $\frac{3}{4}$ "	7 $\frac{3}{4}$ "	10 $\frac{1}{8}$ "	10 $\frac{1}{8}$ "
No. 7	9 $\frac{5}{8}$ "	1'-0 $\frac{1}{2}$ "	9"	11 $\frac{7}{8}$ "	11 $\frac{7}{8}$ "
No. 8	11"	1'-2 $\frac{1}{4}$ "	10 $\frac{1}{4}$ "	1'-1 $\frac{1}{2}$ "	1'-1 $\frac{1}{2}$ "
No. 9	1'-2 $\frac{7}{8}$ "				1'-3 $\frac{3}{8}$ "
No. 10	1'-4 $\frac{5}{8}$ "				1'-5 $\frac{7}{8}$ "
No. 11	1'-6 $\frac{1}{2}$ "				1'-7 $\frac{7}{8}$ "
No. 14	2'-1 $\frac{7}{8}$ "				2'-0 $\frac{3}{4}$ "
No. 18	2'-10 $\frac{1}{2}$ "				2'-9 $\frac{1}{8}$ "

9-07.1(4) Vacant**9-07.2 Deformed Steel Bars**

Deformed steel bars for concrete reinforcement shall conform to either AASHTO M 31 Grade 60, or ASTM A 706, except as otherwise noted. Steel reinforcing bar for the cast-in-place components of bridge structures (excluding sidewalks and barriers but including shafts and concrete piles), and for precast substructure components of bridge structures, shall conform to ASTM A 706 only. However, in computing the ultimate unit tensile stress from test data, the area may be corrected for mass per linear foot of the bar within the weight tolerances listed. No such correction for mass shall be used in calculating the yield stress; the nominal area of the bar, as given in Table 1 of AASHTO M 31 or ASTM A 706, shall be used in this computation.

Deformed steel bars are referred to in the Plans and Specifications by number: for example, No. 3, No. 4, No. 5, etc.

9-07.3 Epoxy Coated Steel Reinforcing Bars

Epoxy coated rebar shall be coated according to AASHTO M 284 with the additional following modifications:

1. The list of steel reinforcing bars acceptable for coating shall include ASTM A 06.
2. The Contractor shall furnish a written certification that properly identifies the material, the number of each batch of coating material used, quantity represented, date of manufacture, name and address of manufacturer, and a statement that the supplied coating material meets the requirements of AASHTO M 284.
3. Prior to coating the bars, the Contractor shall submit to the Engineer for review, the coating material manufacturer's recommendation on the proper use and application requirements of the coating material. For Pre Approved Epoxy Coating Facilities this information will be available to the Fabrication Inspector upon request.
4. A certification stating that all bars have been coated in accordance with the coating material manufacturer's recommendations and these Specifications shall be furnished with each shipment. This certification shall include for each bar size the preheat temperatures, cure times, thickness checks, holidays detected, and test results. Two copies of these certifications shall be furnished to the Engineer.
5. The Contractor shall give advance notice to the Engineer of the coating schedule in the coating plant so that Contracting Agency inspection may be provided. The Engineer may inspect the coated bars at the coating plant for approval.
6. The patching material, compatible with the coating material and inert in concrete, shall be supplied with each shipment.
7. For projects where epoxy coated steel reinforcing bars are used in the top mat of bridge decks only, the maximum amount of damage to the coating shall not exceed 0.25 percent of the surface area of each bar.
8. The thickness of epoxy coating shall be 10 mils plus or minus 2 mils.
9. Samples, when required, shall be shipped to the Washington State Department of Transportation, Materials Laboratory, 1655 South 2nd Ave, Tumwater, Washington 98504.

9-07.4 Plain Steel Bars

Where plain steel bars are specified, they shall conform to the chemical and physical properties of AASHTO M 31, Grade 60, unless specifically noted otherwise. Plain steel bars are indicated in the Plans and Specifications by fractions of an inch; for example, $\frac{3}{8}$ -inch \emptyset , $\frac{1}{2}$ -inch \emptyset , $\frac{5}{8}$ -inch \emptyset , etc.

9-07.5 Dowel Bars (For Cement Concrete Pavement)

Dowel bars shall be plain steel bars of the dimensions shown in the Standard Plans. They shall conform to AASHTO M 31, Grade 60 or AASHTO M 255, Grade 60 and shall be coated in accordance with ASTM A 934. The thickness of the epoxy coating shall be 10 mils plus or minus 2 mils. In addition, the requirements of Section 9-07.3, Items 2, 3, 4, 5, 6, and 9 shall apply.

9-07.6 Tie Bars (For Cement Concrete Pavement)

Tie bars shall conform to the requirements of the Standard Specifications for Deformed Billet Steel Bars for Concrete Reinforcement, AASHTO M 31, Grade 60 and shall be coated in accordance with AASHTO M 284.

The form of the deformed bar shall be subject to approval by the Engineer.

Tie bars shall be free from dirt, grease, or other defects affecting the strength or bond with the concrete.

9-07.7 Wire Mesh

Wire mesh for concrete reinforcement shall conform to the requirements of AASHTO M 55, Welded Steel Wire Fabric for Concrete Reinforcement or AASHTO M 221, Welded Deformed Steel Wire Fabric for Concrete Reinforcement. All wire mesh shall be of an approved kind and quality of manufacture.

9-07.8 Deformed Wire

Deformed wire shall conform to the requirements of AASHTO M 225, Deformed Steel Wire for Concrete Reinforcement.

Deformed wire is noted in the Plans and Specifications by the letter D, followed by a number indicating the cross sectional area of the wire; for example, D2, D5, D20, etc.

9-07.9 Cold Drawn Wire

Cold drawn wire shall conform to the requirements of AASHTO M 32, Cold Drawn Steel Wire for Concrete Reinforcement.

Cold drawn wire is noted in the Plans and Specifications by the letter W followed by a number indicating the cross sectional area of the wire; for example, W2, W5, W20, etc.

9-07.10 Prestressing Reinforcement Strand

Prestressing reinforcement shall be $\frac{1}{2}$ -inch diameter for precast-prestressed concrete piles and $\frac{1}{2}$ -inch or 0.6-inch diameter for pretensioned concrete girders, post-tensioned segmental precast concrete girders, or cast-in-place prestressed concrete.

Prestressing reinforcement shall be mill bright high tensile strength seven wire low relaxation strand conforming to the requirements of AASHTO M 203, Grade 270.

All prestressing reinforcement furnished for a given structural member shall have a maximum elongation differential of 3 percent at stress of 0.8 of the ultimate strength of the prestressing steel. Each reel of prestressing reinforcement shall be accompanied by a Manufacturer's Certificate of Compliance, a mill certificate, and a test report. The mill certificate and test report shall include the chemical composition, the yield and ultimate strengths, elongation at rupture, modulus of elasticity, and the stress strain curve for the actual prestress reinforcing intended for use. All values certified shall be based on test values and actual sectional areas of the material being certified.

For every 5 reels furnished, one sample, not less than 5-feet long, shall be sent to the Engineer for testing. Samples of the furnished reels with Manufacturer's Certificate of Compliance, a mill certificate, and test report may be shipped directly by the manufacturer to the Engineer. An independent inspector, approved by the Contracting Agency, shall be present during sampling and shall provide a written certification to the Engineer.

9-07.11 Prestressing Reinforcement Bar

High-strength steel bars shall conform to AASHTO M 275, Type II.

Nuts shall conform to either ASTM A 29 Grade C1045, or ASTM A 536 Grade 100-70-03, and shall be capable of developing the larger of either 100 percent of the minimum ultimate tensile strength (MUTS), or 95 percent of the actual ultimate tensile strength (AUTS), of the bar. The anchor nuts shall conform to the specified strength requirement while permitting a maximum 5 degree misalignment between the nut and the bearing plate. A minimum of three tests, each from a different heat, are required.

Couplers, if required, shall be AASHTO M 169 Grade 1144, or equivalent steel, developing the larger of either 100 percent of the MUTS, or 95 percent of the AUTS, of the bar. The test shall be performed with the coupler having a one inch unengaged segment between the two coupled bars. A minimum of three tests, each from a different heat, are required.

For unbonded bars under dynamic loading, the connections shall withstand at least 500,000 cycles from 60 percent to 66 percent MUTS followed by at least 50 cycles between 40 percent MUTS and 80 percent MUTS. A minimum of three tests, each from a different heat, are required.

The Contractor shall supply a Manufacturer's Certificate of Compliance in accordance with Section 1-06.3 for each bar. The Contractor shall supply a Manufacturer's Certificate of Compliance in accordance with Section 1-06.3 for all nuts and couplers confirming compliance with the specified strength requirement.

For each heat of steel for high-strength steel bar, the Contractor shall submit two samples, each not less than 5-feet long, to the Engineer for testing.