Section 906. STRUCTURAL STEEL

906.01. General Requirements. Finished rolled shapes must be free from imperfections that affect strength and durability in accordance with ASTM A 6. Rolled shapes must have a smooth, uniform finish. Straighten rolled shapes in the mill, if necessary, before shipment. Comply with subsection 105.01 and subsection 105.10.

906.02. Testing. Structural steel materials testing will be in accordance with the specified ASTM, AASHTO or Department methods, as modified by this section.

Mechanical testing of structural steel products will be in accordance with ASTM A 6 and AASHTO T 244.

906.03. Mill Inspection. The Engineer will waive mill inspection, unless otherwise specified. If required, the Department will conduct mill inspection in accordance with Division 1, subsection 707.02, and subsection 906.01. Notify the Department before beginning rolling to ensure time for inspection. Provide mill test reports in accordance with subsection 707.02.

906.04. Structural Steel. Steel for use in highway structures must meet the requirements of the contract and this section.

Where impact tests are required, the producer must conduct and report the impact tests for heat qualification according to the sampling and testing procedures of AASHTO T 243. Use the (H) frequency, Heat Testing for Plates, Shapes, and Bars of AASHTO T 243 unless otherwise specified.

The Department considers the average flange thickness to be the governing thickness for beams, tees, and channels. The Department considers the required leg thickness to be the governing thickness for angles. Take test specimens for these sections at one-third the distance from the outer edge of the flange or leg to the web or heel of the section.

The Department may reject any structural steel covered by these requirements, which by subsequent impact testing, conducted at the option of the Department, fails to produce the required impact strength.

A. **AASHTO M 270 Grade 36 Structural Steel.** Primary member material must meet the longitudinal Charpy V-Notch impact test requirement of 15 foot-pounds at a test temperature of 40 °F. Lower the testing temperature for critical load carrying members by 30 °F, as required.

B. **High-Strength Structural Steel.** High-strength structural steel must meet the requirements of AASHTO M 270, for Grade 50, Grade 50W Type A, Type B, or Type C, Grade 50S, Grade HPS 50W, and Grade HPS 70W.

Primary member material must meet the longitudinal Charpy V-Notch impact requirements of 15 foot-pounds for 2-inch thick steel and mechanically fastened steel, or 20 foot-pounds for steel thicker than 2 inches, at the following yield points and corresponding testing temperatures:

1. No greater than 65 ksi at 40 °F,
2. From 65 ksi to 75 ksi at 25 °F,
3. From 75 ksi to 85 ksi at 10 °F, and
4. Greater than 85 ksi at −5 °F.

Lower the testing temperature for critical load carrying members by 30 °F, as required.

906.05. Foundation Piles. Ensure the manufacturer of the piling steel provides the Department with a certified mill test report showing the physical properties of the steel.

Foundation piles must meet the following requirements for the type of pile required. If the Engineer determines pile cutoffs are in good condition, the Engineer will accept pile cutoffs that meet size and thickness requirements without mill test reports. If submitting pile cutoffs without mill test reports, provide the Engineer with two copies of an affidavit stating that the material provided meets the contract requirements.

A. **Steel H-Piling and Special Sections.** Steel H-piling and special sections must meet the requirements of AASHTO M 270 Grade 36, Grade 50, or Grade 50W.

B. **Steel Shells for Cast-in-Place Concrete Piles.** Steel shells for cast-in-place concrete piles must have the nominal outside diameters and minimum shell metal thicknesses shown on the plans. Cylindrical pipe shells must meet the requirements of ASTM A 252 Grade 2 welded and seamless steel pipe piles.

C. **Pile Points.** Pile points must conform to the dimensions shown on the plans. Provide certification that the steel used for the fabrication of the points meets one of the following:

1. AASHTO M 270 Grade 36, Grade 50, or Grade 50W;
2. SAE Grade 1016 through Grade 1027; or
3. SAE Grade 1030.

906.06. Sheet Piles. For permanent sheet piling, ensure the piling steel manufacturer provides the Department with a certified mill test report that shows the physical properties of the steel.

Sheet piles must meet the following requirements for the type of pile required. If the Engineer determines pile cutoffs are in good condition, the Engineer will accept pile cutoffs that meet the size and thickness requirements without mill test reports. If submitting pile cutoffs without mill test reports, provide the Engineer with two copies of an affidavit stating that the material provided meets the contract requirements.

A. Temporary Steel Sheet Piling. Temporary steel sheet piling must meet the requirements of AASHTO M 202 or AASHTO M 270 Grade 36, Grade 50, or Grade 50W.

B. Permanent Steel Sheet Piling. Permanent steel sheet piling must meet the requirements of AASHTO M 270 Grade 50.

906.07. High-Strength Steel Bolts, Nuts, and Washers for Structural Joints. High-strength bolt fasteners for structural joints must meet the requirements of AASHTO M 164 Type 1 bolts. High-strength nuts for structural joints must meet the requirements of AASHTO M 291 Grade DH or AASHTO M 292 Grade 2H. High-strength washers for structural joints must meet the requirements of AASHTO M 293 Type 1 for circular, beveled, clipped circular, and clipped beveled washers.

Bolts, nuts, and washers must be hot dip galvanized in accordance with AASHTO M 232. Galvanized nuts must be tapped oversize in accordance with AASHTO M 291 and meet Supplementary Requirements S1, Lubricant and Rotational Capacity Test for Coated Nuts and S2, Lubricant Dye.

906.08. Pins and Link Plates for Steel Bridge Construction. Link plates for steel bridge construction must meet the requirements of AASHTO M 270 Grade 50 or Grade 50W, and pins must meet the requirements of ASTM A 276 UNS designation S21800 or S20161 annealed stainless steel with 50 ksi yield point. Washers and pins must be made from the same material.

The Longitudinal Charpy V-Notch impact values for pin and link plate materials in redundant structures must meet the requirements for high strength structural steel in subsection 906.04. Use the steel yield point stress value shown in the certified mill test report to determine the testing temperature. The steel may require heat treatment to meet the Charpy V-Notch impact requirements.

Perform notch toughness tests on specimens in accordance with Frequency (P) Piece Testing of AASHTO T 243.

The longitudinal Charpy V-Notch impact values for pin and link plate materials in non-redundant structures must average 30 foot-pounds when tested at the Lowest Anticipated Service Temperature (LAST) specified for the MDOT Region location of the structure in accordance with Table 906-1.

Table 906-1
Lowest Anticipated Service Temperatures by MDOT Region

Region	LAST
Superior	−25 °F
North	−20 °F
Grand and Bay	−15 °F
Southwest, University, and Metro	−10 °F

906.09. Shear Developers. Select shear connector studs from the Qualified Products List. Shear connector studs must be designed for end-welding to steel beams and girders with automatically timed stud welding equipment. Provide shear developers as shown on the plans.

Provide an arc shield (ferrule) with each stud. The arc shield must be made of a heat-resistant ceramic or material that will not adversely affect the welds, cause excessive slag, or crumble or break from thermal or structural shock during welding.

Furnish flux for welding with each stud, either attached to the end of the stud or combined with the arc shield for automatic application in the welding operation.

Shear connector studs must meet the requirements of AASHTO M 169, for cold-finished carbon steel, cold-drawn bar, Grade 1015 or Grade 1020, either semi-killed or fully-killed. If using flux-retaining caps, provide cold-rolled steel caps of a low carbon grade for welding, that meet the requirements of ASTM A 109.

Tensile properties, as determined by tests of bar stock after drawing or of finished studs, must conform to the minimum requirements shown in Table 906-2.

Table 906-2
Shear Connector Stud Tensile Properties

Property	Specification (minimum)
Tensile strength	60 ksi
Yield strength	50 ksi
Elongation	20% in 2 inches
Reduction of area	50%

906.09

Determine tensile properties in accordance with AASHTO T 244 for mechanical testing of steel products. Use the 0.2 percent offset method to determine the yield strength.

Finished studs must be uniform in quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other defects. Use cold drawing, cold rolling, or machining to finish.