ITEM 711 STRUCTURAL STEEL AND STRUCTURE INCIDENTALS

711.01 Structural Steel. Provide structural steel conforming to ASTM A 709, Grade 36 (A36), 50 (A572), 50W (A588), or 70W.

Provide materials designated to meet notch toughness requirements having a minimum longitudinal Charpy V-Notch (CVN) energy absorption value as listed below. Sample and test in accordance with ASTM A 673/A 673M. Use the (H) frequency of heat testing and provide the test data as required by 501.06.

ASTM Designation	**Thickness and Connection Method**	**Value Min CVN**
A709 Gr. 36 (A36, A36M)	Up to 4 in (102 mm) mechanically fastened or welded	15 ft-lb @ 40 °F (20 J @ 4 °C)
A709 Gr. 50 (A 572/A 572M), A709 Gr. 50W (A 588/A 588M)	Up to 4 in (102 mm) mechanically fastened	15 ft-lb @ 40 °F[1] (20 J @ 4 °C)
A709 Gr. 50 (A 572/A 572M), A709 Gr. 50W (A 588/A 588M)	Over 2 to 4 in (51 to 102 mm) welded	20 ft-lb @ 40 °F[1] (20 J @ 4 °C)
A709 Gr. 50 (A 572/A 72M), A709 Gr. 50W (A 588/A 588M)	Up to 2 in (51 mm) welded	15 ft-lb @ 40 °F[1] (20 J @ 4 °C)
A709 Gr. 70W	Up to 4 in (100 mm) mechanically fastened or welded	2515 ft-lb @ -10 40 °F[1] (34 20 J @ -23 °C)

[1] If the yield point of the material exceeds 65 ksi (448 MPa), reduce the temperature of the CVN value for acceptability by 15 °F (8.3 °C) for each increment, or part of increment, of 10 ksi (69 MPa) above 65 ksi (448 MPa).

711.02 Galvanized Steel. Provide galvanize steel in accordance with ASTM A 123 after cutting, bending, and welding. At the discretion of the Engineer, replace, re-galvanize, or repair damaged galvanized material. If the City authorizes a repair, perform work in accordance with ASTM A 780 except the City will not allow aerosol spray applications of paints containing zinc dust.

Provide bolts, nuts, washers, and similar threaded fasteners galvanized in accordance with ASTM A 153 or F2329. The Contractor may mechanically zinc coat in accordance with ASTM B 695, Class 50. Except for ASTM A 325 (ASTM A 325M) bolts, the Contractor may electrogalvanize the coated items meeting the thickness coating requirements of ASTM A 153 or F2329.

Use a chromate treatment on all galvanized parts embedded in fresh concrete except chairs for reinforcing bar support in accordance with the American Hot Dip Galvanizers Association, Inc. recommendations. Ensure the galvanizer provides a certification for each lot of chromate treated steel.

711.03 Steel for Piling. Provide steel for H-piling conforming to ASTM A 572 Grade 50 / A 572M Grade 345. Provide steel for sheet piling in accordance with ASTM A 328/A 328M. Provide steel for cast-in-place reinforced concrete piles conforming to ASTM A 252, Type 2.

711.04 Cold Rolled Steel. Provide cold rolled steel in accordance with ASTM A 108, Grades 1016 through 1030 for pins, rollers, trunnions, and other similar parts.

711.07 Steel Castings. Provide steel castings in accordance with ASTM A 27/A 27M, Grade 65-35 or Grade 70-36, with the following modification:

Provide steel castings free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. The Engineer will not allow sharp, unfilleted angles or corners.

711.08 Arc-Welding Electrodes and Fluxes. The following applies to all steel, except for exposed bare ASTM A 242/A 242M and ASTM A709 Grade 50W (A 588/A 588M) steels. For exposed bare ASTM A 242/A 242M and A709 Grade 50W (A 588/A 588M) applications, see Table 711.08-1.

A. Manual shielded metal-arc welding.

1. AWS A5.1 Low Hydrogen Only
2. AWS A5.5 Low Hydrogen Only

B. Submerged Arc Welding

1. AWS 5.17[5]
2. AWS 5.23[5]

C. Gas metal-arc welding, AWS A 5.18[5]

D. Flux cored arc welding, AWS A5.20[5]

Comply with filler metal requirements for exposed bare applications of ASTM A 242/A 242M and ASTM A709 Grade 50W (A 588/A 588M) steel in the following table.

TABLE 711.08-1

Welding Process		
Shielded metal arc	**Submerged arc[5]**	**Gas metal arc or Flux cored arc[2],[4], [5]**
AWS A5.5	AWS A5.23	AWS A5.28 and 5.29
E8015, 8016, or 8018 electrodes that deposit weld metal meeting C1, C1L, C2, C2L, C3, or W analysis	All electrode-flux combinations that deposit weld metal with a Ni1, Ni2, Ni3, Ni4, or W analysis [2],[3]	All electrode-flux combinations that deposit weld metal with a Ni1, Ni2, Ni3, Ni4, or W analysis

[2] Provide deposited weld metal with a minimum impact strength of CVN 20 ft-lb (27 J) at 0 °F (-18 °C) (only applied to bridges).
[3] The Contractor may use of the same type filler metal having next higher mechanical properties as listed in AWS specification.
[4] Provide deposited weld metal with a chemical composition the same as that for any one of the weld metals in this table for the shielded metal arc welding process.
[5] In conformance with those classifications allowed under AWS D1.5 Bridge Welding Code, Tables 4.1 and 4.2.

The Laboratory will issue a list of approved electrodes and combinations of shielding. The Laboratory will include electrodes in the list when the City finds certified test data

submitted by the manufacturer in compliance with the specified requirements. The certification will cover either process qualification or quality control tests. To qualify, provide tests made within one year before the period covered. For each submission of certified test data, include the manufacturer's statement that the manufacturer will advise the Laboratory immediately of any change in materials or processing used in the manufacture of the electrodes made within one year from the date of the tests.

When using electrodes not included in the Laboratory's list of approved electrodes and combinations of shielding, submit certified test data as described above for each lot showing compliance with the specified requirements.

711.09 High-Strength Steel Bolts, Nuts, and Washers. Provide high-strength steel bolts, nuts, and washers in accordance with ASTM A 325 (ASTM A 325M), with the following modification:

11 If necessary for approval, obtain samples from material delivered to the project site or at other locations designated by the Laboratory.

Provide bolts for steel use in bare unpainted applications in accordance with A 325 (A 325M), Type 3.

When the specifications call for galvanized bolts, nuts, and washers, the Engineer will allow mechanical galvanizing.

Use galvanized bolts to fasten steel that has received an inorganic zinc prime coat in accordance with 514.

Provide high-strength steel bolts, nuts, and washers that also meet the requirements of ODOT Supplement 1080.

Provide samples to the Laboratory for acceptance.

711.10 Machine Bolts. Provide machine bolts in accordance with ASTM A 307, with the following modification:

If necessary for approval, obtain samples from material delivered to the project site or at other locations designated by the Laboratory.

The Engineer will allow mechanical galvanizing.

711.12 Gray Iron Castings. Provide gray iron casting in accordance with ASTM A 48, Class 30B, with the following modifications:

12 Submit two or more test bars with each lot of castings or; one pair of test bars may represent castings shipped to two or more projects provided both the bars and castings show the lot number or date cast or anchored into them.. Do not allow the identifying data or castings to interfere with the use of the casting.

9 Provide castings free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. Provide castings generously filleted at angles and the arrises are sharp and perfect.

17 Ship test bars with the lot or make test bars representing the lot available to the Laboratory at the place of manufacture or warehouse.

711.13 Ductile Iron Castings. Provide ductile iron castings in accordance with ASTM A 536, with the following modifications:

8.1 Provide castings free from pouring faults, sponginess, cracks, blowholes, and other defects in positions affecting their strength. Provide castings generously filleted at sharp and perfect angles and arises.

10.1 Send a keel block or Y-block specimen made in accordance with ASTM A 536 with the shipment for each heat number, ladle number, and date of casting.

14.1 Submit a certification stating that the Contractor prepared the test bars shipped with the castings in accordance with the specified requirements.

711.14 Gray Iron and Ductile Iron Castings. Provide gray iron and ductile iron castings in accordance with AASHTO M 306, Class 35B, with the following modifications:

Provide test bars as required in Section 711.12 and Section 711.13. In addition, submit certified test data for monthly proof load testing to the Laboratory with each inspection of castings from that month.

Design Approval. Submit designs for cast frames, grates and covers for manholes, catch basins and inlets that vary from the standard construction drawings to the City for approval. The City suggests that manufacturers seek approval for such non-standard designs well in advance of a project's bid opening date.

711.15 Sheet Copper. Provide sheet copper in accordance with in accordance with ASTM B 370.

711.16 Phosphor Bronze Plate. Provide phosphor bronze plate in accordance with ASTM B 100.

711.17 Cast Bronze. Provide cast bronze in accordance with ASTM B 22, Copper Alloy No. C91100, with the following modification:

Finish cast plates to plane surfaces and finish one plate of a pair at right angles to the other plate of the pair.

711.18 Leaded Bronze. Provide leaded bronze in accordance with in accordance with ASTM B 584, Copper Alloy No. C93700, with the following modification:

Finish cast plates to plane surfaces and finish one plate of a pair at right angles to the other plate of the pair.

711.19 Sheet Lead. Provide sheet lead in accordance with in accordance with ASTM B 29.

711.20 Aluminum for Railings. Provide aluminum other than permanent mold castings conforming to the following requirements:

Portion of Railing	ASTM Designation	Alloy	Condition or Temper (B296)
Sand castings	B 26/B 26M	356.0	T6
Shims	B 209 (B 209M)	1100	0
Washers	B 209 (B 209M)	Clad 2024 6061	T4 T6
Sheet and plate	B 209 (B 209M)	6061	T6
Drawn seamless tubes	B 210	6061 or 6063	T6
Bars, rods, wire	B 211 (B 211M)	6061	T6
Bolts, set screws	B 211 (B 211M)	2024[1] 6061	T4 T6
Nuts	B 211 (B 211M)	6061 6262	T6 T9
Extruded bars, rods, shapes	B 221 (B 221M)	6061 or 6063 6351	T6 T5
Extruded tubes	B 221(B 221M)	6061 or 6063 6351	T6 T5
Pipe	B 241/B 241M	6061 or 6063	T6
Rivets	B 316(B 316M)	6061	T6
[1] Requires an anodic coating.			

For permanent mold castings for bridge railing posts, provide aluminum in accordance with AASHTO M 193.

711.21 Preformed Bearing Pads. Composition. Provide preformed bearing pads consisting of a fabric and rubber body. Make the pad with new, unvulcanized, natural and/or synthetic rubber, and unused cotton and/or synthetic fabric fibers in proper proportion to maintain strength and stability.

Physical Properties. The City requires a surface hardness, expressed in standard rubber hardness figures, of 80 ± 10 Shore Durometer. The City will allow a minimum ultimate break down limit of pads under compressive loading of 10,000 pounds per square inch (69 MPa). Provide pads to specified dimensions and accurately locate and cleanly cut all bolt holes.

Provide materials in accordance with the City's QPL.

711.22 Buried Liner Waterproofing Membrane. Provide buried liner waterproofing membrane in accordance with ASTM D 7176-06, with the following modification:

The City only approves the use of Section 4.1.2 through Section 4.1.6.

Provide materials in accordance with the City's QPL.

711.23 Elastomeric Bearings. Provide bearing pads and elastomeric bearings conforming to *AASHTO Standard Specifications for Highway Bridges*, Division II, Construction, Chapter 18, Section 18.4.5.1 Grade 3 requirements. Fabricate elastomeric bearing pads according to Sections 18.5.6.1 and 18.5.6.2. Test pads and bearings in accordance with 18.7.1, 18.7.2.1, 18.7.2.3, 18.7.2.5, 18.7.2.6, 18.7.3, 18.7.4.5, and

18.10.3. Include testing in the contract unit price for the bearings. Provide certified material in accordance with ODOT Supplement 1081.

Provide bearing pads and laminated bearings consisting of neoprene cast in molds under pressure and heat. The City classifies a plain elastomeric bearing pad and steel load distribution plate combination as a laminated elastomeric bearing. Obtain test specimens in accordance with ASTM D 3182 or ASTM D 3183. For test specimens cut from the finished product, the Engineer will allow a 20 percent variation from the original physical properties. The Engineer will allow the use of compounds of nominal hardness between the values shown in Table 711.23-1 and will interpolate the test requirements.

TABLE 711.23-1

	Grade		
Physical Properties	**50**	**60**	**70**
Hardness, Durometer A, ASTM D 2240.	50 ± 5	60 ± 5	70 ± 5
Tensile Strength, min psi (MPa), ASTM D 412	2500 (17)	2500 (17)	2500 (17)
Elongation at break, min %	400	350	300
Accelerated Tests to Determine Long-Term Aging Characteristics, Over-Aged 70 hrs at 212 °F (100 °C), ASTM D 573:			
Hardness, points change, max	15	15	15
Tensile strength, % change, max	-15	-15	-15
Elongation at break, % change, max	-40	-40	-40
	Grade		
Physical Properties	**50**	**60**	**70**
Ozone 1 ppm in air by volume 20% strain, 104 °F (40 °C) ASTM D 1149, 100 hrs (Wipe samples with solvent before test to remove any traces of surface impurities)	No cracks	No cracks	No cracks
Compression set 22 hrs/212 °F (100 °C) ASTM D 395, Method B, % max	35	35	35
Adhesion, bond made during vulcanization ASTM D 429 Method B, lb/in (kN/m)	40 (7.0)	40 (7.0)	40 (7.0)

Provide individually molded bearing pads, cut from previously molded strips or slabs, or extruded and cut to length. Mold laminated bearings together into an integral unit with all edges of internal steel laminates covered by a 1/8-inch (3 mm) minimum thickness of elastomer. Fill indentations or grooves on the exterior surface of the bearings caused by external laminate restraining devices to a 1/8 inch (3 mm) minimum cover by a revulcanized patch; or by a silicon caulk conforming to Federal Specifications TT-S-001543A; or by an approved equal. Ensure that the bearing manufacturer patches the bearings.

Provide external connection or distribution plates of laminated bearings having the same material as the attached structural steel, similarly cleaned and coated. Provide internal plates in accordance with ASTM A 709 grade 36 or A 570/A 570M, Grade 36

or Grade 40With a minimum thickness for the internal plates of 0.074 inch (1.88 mm). Debur all plates.

Provide the bearing manufacturer's certified test data for the elastomer, base plate, steel laminates, and proof load.

The bearing manufacturer will produce one sample bearing for each bridge structure in the project plans. Provide the sample bearing for each bridge structure of the same design and materials as the bearings provided for that bridge structure. The bearing manufacturer will ship the completed sample bearings to an independent testing laboratory for destructive testing for the following physical properties:

Hardness, Durometer A	ASTM D2240
Tensile Strength	ASTM D412
Elongation at Break	ASTM D412
Adhesion bond made during vulcanization	ASTM D429, Method B

Submit to the Engineer the bearing manufacturer's certified test data for the sample bearings from the independent testing laboratory with the bearing manufacturer's certified test data for the elastomer, base plate, steel laminates, and proof load.

711.24 Waterproofing Fabric. Provide waterproofing fabric in accordance with ASTM D 173.

Provide materials in accordance with the City's QPL.

711.25 Type 2 Membrane Waterproofing.

Physical Properties	
Thickness ASTM D 1777	60 mils (1500 μm) min.
Width	36 inches (914 mm) min.
Pliability [180° bend over 1/4 inch (6 mm) mandrel @ -25 °F (-32 °C)] ASTM D 146	No Effect
Elongation ASTM D 412 (Die C)	300% min
Puncture Resistance-Membrane	
ASTM E 154	40 lb (18 kg) min.
Permeance (Grains/ft^2/hr/in Hg)	
ASTM E 96, Method B	0.1 max.
Water Absorption (% by Weight) ASTM D 570	0.2 max.
Adhesion to concrete ASTM D 903	5.0 min.
Submit certified test data and letter of certification to the Engineer.	

Provide materials in accordance with the City's QPL.

711.26 Structural Timber, Lumber and Piling. Provide structural timber, lumber and piling in accordance with 712.06, and AASHTO M 168, with the following modification:

Air-dry or kiln-dry timber and lumber to a moisture content not exceeding 19 percent by weight. Use lumber with size and grade conforming to American Lumber Standards.

Use only structural timber, lumber, and piling meeting the certification requirements of ODOT Supplement 1072.

711.27 Prestressing Steel Strands. Provide prestressing steel strands in accordance with ASTM A 416, with the following modification:

11 Sample and inspect as directed by the Laboratory.

711.28 Cellular Polyvinyl Chloride Sponge. Provide cellular PVC sponge in accordance with AASHTO M 153, Type I, and with a minimum density of 20 pounds per cubic foot (320 kg/m^3).

Provide materials in accordance with the City's QPL.

711.29 Type 3 Membrane Waterproofing. Provide Type 3 membrane waterproofing conforming to the following requirements.

Physical Properties	
Thickness	0.135 inches (3.43 mm) min.
Width	36 inches (914 mm) min.
Weight	0.8 lb/ft2 (3.875 kg/mm^2) min.
Tensile strength (machine direction)	
ASTM D 882	275 lb/in (48.1 N/mm)
Modified[1]	200 psi (13.8 MPa)
Tensile strength ASTM D 882 (90° machine direction)	
	150 lb/in (26.2 N/mm)
Modified[1]	1000 psi (6.9 MPa)
Elongation at break ASTM D 882	
Modified[1]	100%
Brittleness ASTM D 517	Pass
Softening point (mastic) ASTM D 36	200 °F (93 °C) min.
Peel adhesion ASTM D 413[1]	2.0 lb/in (0.35 N/mm)
Cold flex ASTM D 146	No cracking
2 × 5 inch (50 × 125 mm) Specimen-180° bend over 2 inch (50 mm) mandrel	
Heat stability	No dripping or delamination
2 × 5 inch (50 × 125 mm) specimen vertically suspended in a mechanical convection oven 2 hr @ 190 °F (88 °C)	
[1] 12 inches (300 mm)/minute test speed and 1 inch (25 mm) initial distance between the grips.	

Submit certified test data and letter of certification to the Engineer.

Provide materials in accordance with the City's QPL.

711.30 Aluminum for Steps. Provide aluminum for steps in accordance with ASTM B 221 (ASTM B 221M), Alloys 6061-T6 or 6005-T5.

Provide materials in accordance with the City's QPL.

711.31 Reinforced Propylene Plastic Manhole Steps. Provide reinforced propylene plastic manhole steps conforming to the details shown on the plans and in accordance with ASTM C 478.

Provide steel rod in accordance with 709.01, Grade 60, continuous through the entire length of legs and tread. Coat the steel in accordance with ASTM A 934/A 934M. Submit the manufacturer's written certification to the Engineer. Provide propylene plastic in accordance with ASTM D 4101, Table B 33430. Submit to the Engineer the manufacturer's certified test data for the propylene plastic used in each lot of steps.