Standard Specification for

Drainage, Sewer, Utility, and Related Castings

AASHTO Designation: M 306-10

AASHTO
THE VOICE OF TRANSPORTATION

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1. SCOPE

1.1. This specification is applicable to frames, grates, rings, and covers for inlets, manholes, and other structures for civil engineering use where items may be placed in traffic service and load bearing is a consideration.

1.2. The values stated in SI units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 105, Gray Iron Castings
- *AASHTO LRFD Bridge Design Specifications*, Sixth Edition

2.2. *ASTM Standards*:

- A 48/A 48M, Standard Specification for Gray Iron Castings
- A 536, Standard Specification for Ductile Iron Castings
- A 644, Standard Terminology Relating to Iron Castings

2.3. *Federal Specification*:

- CID A-A-60005, Frames, Covers, Gratings, Steps, Sump and Catch Basin Manhole

3. TERMINOLOGY

3.1. *Definitions of Terms Specific to This Standard*:

3.1.1. *manufacturer*—a producing foundry/facility where iron is melted and poured into molds.

3.1.2. *supplier*—an agent, representative, or organization that provides castings that it did not manufacture.

3.1.3. *purchaser*—the end user of the casting.

3.2. The preceding terms and definitions are specific to this specification. ASTM A 644 contains other terms and definitions relating to gray iron castings.

4. MATERIALS

4.1. Gray Iron Castings shall conform to the requirements of M 105 Class 35B or ASTM A 48 Class 35B.

4.2. Ductile Iron Castings shall conform to the requirements of ASTM A 536 Grade 80-55-06, unless otherwise specified by the customer.

5. MANUFACTURE

5.1. Castings shall be manufactured true to pattern and component parts shall fit together in a satisfactory manner. They shall be smooth and well cleaned by shotblasting. Circular manhole frames, covers, and grates shall be furnished with machined horizontal bearing surfaces unless otherwise specified. All square and rectangular units shall be furnished with an as-cast bearing surface unless otherwise specified.

5.2. *Permissible Variations*:

5.2.1. As-cast dimensions may vary one half the maximum shrinkage possessed by the metal or ±5.21 mm/m [$\pm^{1}/_{16}$ in./ft].

5.2.2. Mass [weight] ±5 percent drawing/specification mass [weight].

5.3. *Performance and other Requirements*:

5.3.1. The cover or grate shall not rock when rotated to any position in the frame.

5.3.2. The cover or grate shall sit down into the frame so that the top surface of the cover or grate will be flush with the top surface of the frame.

The difference in the level between the cover or grate shall not exceed 3.2 mm [$^{1}/_{8}$ in.] at any point when placed in the frame. The cover or grate shall not sit higher than 1.6 mm [$^{1}/_{16}$ in.] over more than one fourth of the circumference when placed in the frame.

5.3.3. *Welding, Plugging*—Not allowed.

5.3.4. *No Painting*—Unless specified by the customer.

5.4. *Quality and Appearance:*

5.4.1. The finished casting shall show careful finished workmanship in all particulars. Castings that have been damaged either during manufacture or shipping may be rejected. Among others, the following defects may be considered as constituting poor workmanship.

5.4.1.1. *Defects, Major (Items that may affect casting load bearing ability)*—Casting could be rejected or require proof that the defect is not injurious. Examples of such defects include: shrinkage, cracks, cold shuts, large cavities, major porosity episodes, or major sand inclusions.

5.4.1.2. *Defects, Minor (Items that may affect top surface appearance)*—Casting could be reworked and resubmitted. Examples of such defects include: dirt, scab, slag, minor surface porosity, or minor sand inclusions.

6. PROOF-LOAD TESTING

6.1. For first article inspection or when specified for quality conformance inspection, the frames and covers or gratings shall show no detrimental permanent deformation when a proof load of 178 kN [40,000 lb] is concentrated on a 229-by-229-mm [9-by-9-in.] area placed at the center of the cover or grate. To distribute the load evenly in testing, an intermediate layer of material (i.e., fiberboard, felt, rubber, etc.) can be placed between the test block and the casting to be tested. This layer shall

not be larger than the area of the test block. The load shall be applied at a constant rate between 45 kg/sec and 454 kg/sec [between 100 lb/sec and 1000 lb/sec]. The castings shall be tested in a frame. If the product is not installed with a frame, or if proof-load testing in a frame is unfeasible, the cover or grate shall be supported in such a fashion as to simulate how an item would be supported following installation. The specified load shall be applied and held for a period of 1 min by a suitable testing machine. Upon removal of the load, the cover or grating and frame shall be examined for cracks or detrimental permanent deformation. Permanent deformation shall not exceed 3.2 mm [$^1/_8$ in.]. Any cracks shall be cause for rejection. Any permanent deformation that exceeds 3.2 mm [$^1/_8$ in.] shall be cause for rejection. All testing shall occur in the United States on a testing machine calibrated in accordance with and traceable to National Institute of Standards and Technology (NIST) standards. All castings that are subjected to the proof-load test shall be destroyed.

For items that are smaller than a 229-by-229-mm [9-by-9-in.] footprint, or where a 229-by-229-mm [9-by-9-in.] footprint would transfer load directly to the frame, an alternate proof load test shall be used. For H-20 or HS-20 loading, the applied load shall be the product of 3.39 MPa [494 psi] multiplied by the area of the cover/grate, but not to exceed 178 kN [40,000 lb]. For H-25 or HS-25 loading, the applied load shall be the product of 4.23 MPa [617 psi] multiplied by the area of the cover/grate, but not to exceed 222 kN [50,000 lb]. The footprint size shall not exceed 229 mm [9 in.] in any direction and shall be smaller than the corresponding frame clear opening.

Example 1:

Given loading is H-20. Therefore, use 3.39 MPa [494 psi].

Given cover diameter is 203 mm [8 in.], which equates to a cover area of 0.0324 m^2 [50.3 $in.^2$].

Given frame has a clear opening of 152 mm [6 in.].

Therefore, the required loading is 0.0324 m2 [50.3 in.2] multiplied by 3.39 MPa [494 psi], or 110 kN [24,850 lb]. This value does not exceed the 178 kN [40,000 lb] specified in the standard; therefore, it shall be the applied load. The footprint size must be smaller than 152 mm [6 in.] in diameter for the given frame clear opening.

Example 2:

Given loading is HS-25. Therefore, use 4.23 MPa [617 psi].

Given grate size is 203 mm [8 in.] wide and 610 mm [24 in.] long, which equates to a grate area of 0.124 m^2 [192 $in.^2$].

Given frame has a clear opening of 152 mm [6 in.].

Therefore, the required loading is 0.124 m^2 [192 $in.^2$] multiplied by 4.23 MPa [617 psi], or 525 kN [118,465 lb]. This value exceeds the maximum allowed load of 222 kN [50,000 lb]. As a result, 222 kN [50,000 lb] shall be the applied load. The footprint size shall be smaller than 152 mm [6 in.] by 229 mm [9 in.]. Note that the footprint size cannot exceed 229 mm [9 in.] in any direction; consequently, even though the length is 610 mm [24 in.], the maximum value of 229 mm [9 in.] is used.

6.2. The 178-kN [40,000-lb] proof-load requirement listed in Sections 6.1 and 6.2 represents a safety factor of 2.5 for H-20 or HS-20 loading. A 222-kN [50,000-lb] proof load should be used in Sections 6.1 and 6.2, which represents a safety factor of 2.5 for H-25 or HS-25 loading.

6.3. *Precision and Bias*—No statement is made about the precision or the bias for the proof-load test method described in Sections 6.1 and 6.2 for measuring the ultimate strength of the casting. The result merely states whether there is conformance to the criteria for success specified in the procedure outlined in Sections 6.1 and 6.2.

7. MATERIAL TESTING

7.1. Test bar testing shall be conducted in accordance with the applicable inspection requirements of Section 8. Test bar preparation and tensile testing shall be in accordance with the applicable material specification listed in Section 4. Failure to meet the material specifications shall be cause for rejection.

8. INSPECTION

8.1. Unless otherwise specified in the contract or purchase order, the supplier/manufacturer shall be responsible for carrying out all the tests and inspections required by this specification, using purchaser approved reliable facilities, and he shall maintain complete records of all such tests and inspections. Such records shall be available for review by the purchaser. Three separate and alternative bases of acceptance are permitted: If the producing foundry is located within the United States of America, and operates in accordance with an acceptable Quality System approved by the purchaser, all castings must adhere to the inspection criteria listed in Sections 8.1.1 and 8.1.2. If the producing foundry is not located within the United States of America, or if the producing foundry is located within the United States of America and it is not operating in accordance with an acceptable Quality System approved by the purchaser, all castings must adhere to the inspection criteria listed in Sections 8.1.1 and 8.1.3.

8.1.1. *Acceptance on the Basis of Proof-Load Tests*—Acceptability of the castings produced in accordance with this specification shall be determined by the results of the proof-load test as listed in Sections 6.1, 6.2, and 6.3. The producing foundry shall provide information about the ultimate strength of the castings to the purchaser upon request.

8.1.2. *Acceptance on the Basis of Separately Cast Test Bar*—Before supplying any castings to a purchaser, the manufacturer must first submit to the purchaser for acceptance documentation that a Quality System is in place to ensure material compliance. Thereafter, acceptability of the castings produced in accordance with this specification shall be by certification of the results of material tests conducted on separately cast test bars, and by inspection of the finished castings for freedom from defects. The manufacturer shall provide certification that the test bars furnished for testing represent the castings furnished for the order. If there are more than three test-bar failures in one calendar year, the producing facility shall immediately report the three failing test results to the purchaser and shall discontinue supplying product. In order for the producing foundry to resume supplying product, documentation that a new Quality System is in place to ensure material compliance must be submitted to and accepted by the purchaser. The purchaser shall also have the option of allowing production under Section 8.1.3.

8.1.3. *Acceptance on the Basis of Cast-On Test Bars*—A test bar for determining the class of iron shall be cast on each member at a place where it can be easily broken off with a breakage pattern remaining on the member. Test bars are to be removed only after receipt of permission from the purchaser. Test bars shall be of sufficient size to produce a machined test specimen complying with the dimensional requirements for a Type B test bar as shown in Table 2 of M 105. For lots of 15 or fewer, 30 percent of the test bars selected at random from castings shall be tested by the supplier/manufacturer. For lots of 16 to 100, 10 percent or a minimum of 5 test bars, whichever is greater, selected at random from castings shall be tested by the supplier/manufacturer. For lots greater than 100, a minimum of 10 percent of all test bars selected at random from castings shall be tested by the supplier/manufacturer. All test bars shall conform to the strength requirements specified. If any of those test bars fail to conform to the strength requirements herein specified because of surface or internal defects, additional testing shall be performed at the direction of the purchaser. For lots of 15 or fewer, all remaining test bars must be tested. For larger lots, an additional 10 or 10 percent, whichever is greater, of the remaining test bars selected at random from the entire lot must be tested. All test results from this additional testing must conform to the

strength requirements of this specification for the lot of castings to be acceptable. Each casting that has a test bar removed from it and evaluated must be inspected for mass [weight] and dimensions by the supplier/manufacturer. If the casting does not conform to the mass [weight] and dimensional requirements, the casting will be rejected. If a casting fails to conform to the mass [weight] or dimensional requirements, all remaining castings shall be inspected and all must conform to the requirements for the lot of castings to be acceptable. If the purchaser elects to select a casting for verification of test results, the member shall be furnished by the supplier/manufacturer at no cost to the purchaser. All test specimen preparation and testing shall be paid for by the supplier/manufacturer.

9. CERTIFICATION

9.1. All shipments to the purchaser shall include appropriate certification from the producing foundry. The certification shall state that the castings have been produced in facilities operating in accordance with the applicable laws and regulations of the United States and the appropriate state, province, or local unit of government. This certification shall also state that all samples representing each lot have been tested, inspected, and have been found to meet the requirements of this specification and the applicable AASHTO or ASTM material specifications listed in Section 4. Certifications shall also state country of origin of the castings. If specified in the order, a report of the test results shall be furnished.

10. MARKING

10.1. *Each individual casting shall be identified by the foundry, showing the following*:

10.1.1. Name of producing foundry and country of manufacture preceded by the words “Made in,” such as “Made in USA”;

10.1.2. AASHTO designation or ASTM designation number;

10.1.3. Class by a number followed by a letter indicating the minimum tensile strength and size of test bar;

10.1.4. Heat identification and cast date (MM/DD/YY);

10.1.5. Casting lettering as required by the purchaser; and

10.1.6. Markings as required to meet federal requirements.

11. RECORDS

11.1. All test results as required by this specification shall be maintained by the producing foundry for seven years and shall be made available to the purchaser upon request.

11.2. Records of casting certifications issued by a producing foundry shall be maintained by the producing foundry for seven years and shall be made available upon request.