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Standard Specification for Ductile Iron Castings for Paper Mill Dryer Rolls^{1, 2}

This standard is issued under the fixed designation A476/A476M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers ductile iron castings for use in pressure containing paper mill dryer rolls at temperatures up to 450°F [230°C].

1.2 No precise quantitative relationship can be stated between the properties of the iron in various locations of the same casting or between the properties of a casting and those of a test specimen cast from the same iron (see [Appendix X1](#)).

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards*:³

[A644 Terminology Relating to Iron Castings](#)

[E8 Test Methods for Tension Testing of Metallic Materials](#)

[E10 Test Method for Brinell Hardness of Metallic Materials](#)

[E94 Guide for Radiographic Examination](#)

[E446 Reference Radiographs for Steel Castings Up to 2 in.](#)

[\[51 mm\] in Thickness](#)

¹ This specification is under the jurisdiction of ASTM Committee A04 on Iron Castings and is the direct responsibility of Subcommittee A04.02 on Malleable and Ductile Iron Castings.

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² For ASME Boiler and Pressure Vessel Code Applications see related Specifications SA-467 in Section II of that Code.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Terminology

3.1 Definitions for many terms common to iron castings are found in Terminology [A644](#).

4. Ordering Information

4.1 Orders for material purchased to the requirements of this specification should include the following information:

4.1.1 Quantity,

4.1.2 Specification number and date of issue,

4.1.3 Description of casting by pattern number or drawing,

4.1.4 Heat treatment, if required (see [5.1](#)),

4.1.5 Type of test coupon (see [9.2](#)),

4.1.6 Certification, if required (see [13.1](#)),

4.1.7 Marking location (see [14.1](#)), and

4.1.8 Additional requirements.

5. Heat Treatment

5.1 The castings may be stress relieved at a temperature not to exceed 1200°F [650°C].

6. Chemical Requirements

6.1 The castings shall conform to the following chemical requirements:

| | |
|----------------------|------|
| Total carbon, min, % | 3.0 |
| Silicon, max, % | 3.0 |
| Phosphorus, max, % | 0.08 |
| Sulfur, max, % | 0.05 |

6.2 The castings shall have a carbon equivalent of 3.8 to 4.5 inclusive.

NOTE 1—The carbon content equivalent is calculated as follows:
Total carbon + 0.3 (silicon + phosphorus)

6.3 The chemical analysis for total carbon shall be made on either chilled cast pencil-type specimens or on thin wafers approximately $\frac{1}{32}$ in. [0.8 mm] thick, cut from test coupons. Drills shall not be used due to attendant loss of graphite.

7. Mechanical Properties

7.1 The iron represented by test coupons shall conform to tensile requirements prescribed in **Table 1**.

7.2 The yield strength prescribed in **Table 1** may be determined by any of the approved procedures described in 7.3 of Test Methods **E8**.

7.3 The Brinell hardness of the material shall be a minimum of 201 HB. Hardness tests shall be conducted in accordance with Test Method **E10**, using a 3000-kgf load. The test may be made on either the casting or on a test coupon representing the casting.

8. Workmanship, Finish, and Appearance

8.1 The castings shall conform to the dimensions on the drawings furnished by the purchaser, or if no drawing has been provided, to the dimensions predicated by the pattern supplied by the purchaser. Surfaces of the castings shall be free of adhering sand. Runners, risers, fins, and other extraneous metal shall be removed.

9. Sampling

9.1 Test coupons shall be poured from the same iron as the castings represented.

9.2 Test coupons shall be cast either to the “Y” block size and shape shown in **Fig. 1** or to the dimensions of the 1-in. [25-mm] keel block shown in **Fig. 2**. The type of test coupon and, when selected, the size of the “Y” block shall be specified by the purchaser.

9.3 The test coupons shall be cast in open molds made of suitable core sand with a minimum 1½ in. [38 mm] of sand for the 1-in. [25 mm] size and 3 in. [75 mm] of sand for the 3-in. [75-mm] size. The coupons shall be left in the mold until black.

9.4 **Table 2** shows the equivalent geometrical shapes with various dimensions and the equivalent “Y” block, based on cooling rates, and may be used as a guide for selection of the proper “Y” block to be specified to represent the casting.

9.5 When the castings are heat treated, the test coupons shall be heat treated with the castings they represent.

10. Tension Test

10.1 Tension test specimens shall be obtained from test coupons shown in either **Fig. 1** or **Fig. 2**, and machined to the dimensions shown in **Fig. 3**. Test coupons cast as “Y” blocks (**Fig. 1**) shall be sectioned as shown in **Fig. 4**.

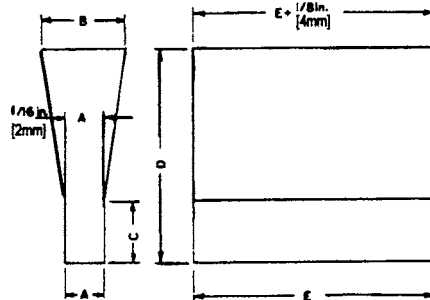
10.2 One tension test shall be performed for each casting.

10.3 If any specimen shows defective machining or flaws, it may be discarded and another substituted from the same casting represented.

10.4 If an apparently sound test specimen fails to conform to the tensile requirements, two retests may be made. If either retest fails to conform to the requirements specified, the castings shall be rejected.

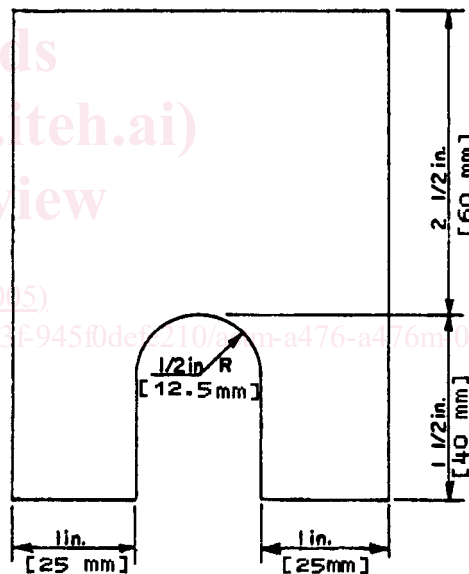
TABLE 1 Tensile Requirements

| Test Coupon Section Thickness | 1 in. [25 mm] | 3 in. [75 mm] |
|-------------------------------------|---------------|---------------|
| Tensile strength, min, ksi [MPa] | 80 [555] | 80 [555] |
| Yield strength, min, ksi [MPa] | 60 [415] | 60 [415] |
| Elongation in 2 in. [50 mm], min, % | 3.0 [3.0] | 1.0 [1.0] |



| Dimensions | “Y” Block Size | |
|------------|--------------------------------------------------------------|------------------------------------------------------------|
| | For Castings of Thickness ½ in. to 1½ in. [12.5-40 mm] | For Castings of Thickness of 1½ in. [40 mm] and Over |
| | in. [mm] | in. [mm] |
| A | 1 [25] | 3 [75] |
| B | 1½ [55] | 5 [125] |
| C | 3 [75] | 4 [100] |
| D | 6 [150] | 8 [200] |
| E | 7 [175] approx | 7 [175] approx |

FIG. 1 “Y” Blocks for Test Coupons



NOTE 1—The length of keel block shall be 6 in. [150 mm].

FIG. 2 Keel Block for Test Coupons

TABLE 2 Equivalent Geometric Shapes Corresponding to “Y” Blocks

| “Y” Block Size, in. [mm] | Infinite Plate Thickness, in. [mm] | Round Diameter, in. [mm] | Cube Edge, in. [mm] |
|--------------------------|------------------------------------|--------------------------|---------------------|
| 1 [25] | 0.9 [22.5] | 1.75 [44] | 2.75 [44] |
| 3 [75] | 1.6 [40] | 3.1 [78] | 4.8 [120] |

11. Repairs

11.1 Castings made to this specification that leak on subsequent hydrostatic testing may be repaired by using threaded plugs provided the following requirements are met.