Designation: A 608 – 91a (Reapproved 1998)

An American National Standard

Standard Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures[1]

This standard is issued under the fixed designation A 608; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers iron-chromium-nickel, high-alloy tubes made by the centrifugal casting process intended for use under pressure at high temperatures.

1.2 The grades of high alloys detailed in Table 1 are intended for applications requiring strength and resistance to corrosion and scaling at high temperatures.

1.3 Optional Supplementary Requirements S1 to S11 are provided; these call for additional tests to be made if desired.

1.4 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 342 Test Methods for Permeability of Feebly Magnetic Materials[2]

A 488/A488M Practice for Steel Castings, Welding, Qualification of Procedures and Personnel[3]

A 530/A530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe[4]

E 8 Test Methods of Tension Testing of Metallic Materials[5]

E 21 Test Methods for Elevated-Temperature Tension Tests of Metallic Materials[5]

E 94 Guide for Radiographic Testing[6]

E 139 Practice for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials[5]

E 142 Method for Controlling Quality of Radiographic Testing[6]

E 151 Practice for Tension Tests of Metallic Materials at Elevated Temperatures with Rapid Heating and Conventional or Rapid Strain Rates[5]

E 165 Test Method for Liquid Penetrant Examination[6]

3. Ordering Information

3.1 Orders for material to this specification should include the following, as required, to describe the desired material adequately:

3.1.1 Quantity (feet, centimetres, or number of lengths),

3.1.2 Name of material (centrifugally cast tubing),

3.1.3 Specification number and grade (Table 1),

3.1.4 Size (outside or inside diameter and minimum wall thickness, see Section 8).

3.1.5 Condition (see Section9, as cast or as cast with machining on outside or inside surfaces, or machined; see 5.1, 8, and 9),

3.1.6 Length (specific or random), (Permissible Variations in Length Section of Specification A 530/A 530M),

3.1.7 End finish (Ends Section of Specification A 530/A 530M),

3.1.8 Optional requirements (see 8.2.3 regarding the manufacturer's wall thickness allowance for as cast tubing and Supplementary Requirements S1 to S11),

3.1.9 Test report required (see Section 13), and

3.1.10 Special requirements to be added to the specification.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 530/A 530M, unless otherwise provided herein.

5. Materials and Manufacture

5.1 The tubing may be supplied in the as cast condition or as cast with machining on the outside or inside surfaces, or machined, as agreed upon between the manufacturer and the purchaser.

5.2 Heat treatment of the tubing shall not be required under this specification.

6. Chemical Requirements

6.1 The material shall conform to the requirements as to chemical composition as prescribed in Table 1.

7. Tensile Properties

7.1 Tension tests at room temperature are not recommended

[1] This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel, and Related Alloys, and is the direct responsibility of Subcommittee A01.18 on Castings.

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[2] *Annual Book of ASTM Standards*, Vol 03.04.

[3] *Annual Book of ASTM Standards*, Vol 01.02.

[4] *Annual Book of ASTM Standards*, Vol 01.01.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

[6] *Annual Book of ASTM Standards*, Vol 03.03.

TABLE 1 Chemical Requirements

Grade	Composition, %							
	Carbon	Manganese	Silicon	Chromium	Nickel	Phosphorus	Sulfur	Molybdenum
HC30	0.25–0.35	0.5–1.0	0.50–2.00	26–30	4.0 max	0.04 max	0.04 max	0.50 max
HD50	0.45–0.55	1.50 max	0.50–2.00	26–30	4–7	0.04 max	0.04 max	0.50 max
HE35	0.30–0.40	1.50 max	0.50–2.00	26–30	8–11	0.04 max	0.04 max	0.50 max
HF30	0.25–0.35	1.50 max	0.50–2.00	19–23	9–12	0.04 max	0.04 max	0.50 max
HH30	0.25–0.35	1.50 max	0.50–2.00	24–28	11–14	0.04 max	0.04 max	0.50 max
HH33[A]	0.28–0.38	1.50 max	0.50–2.00	24–26	12–14	0.04 max	0.04 max	0.50 max
HI35	0.30–0.40	1.50 max	0.50–2.00	26–30	14–18	0.04 max	0.04 max	0.50 max
HK30	0.25–0.35	1.50 max	0.50–2.00	23–27	19–22	0.04 max	0.04 max	0.50 max
HK40	0.35–0.45	1.50 max	0.50–2.00	23–27	19–22	0.04 max	0.04 max	0.50 max
HL30	0.25–0.35	1.50 max	0.50–2.00	28–32	18–22	0.04 max	0.04 max	0.50 max
HL40	0.35–0.45	1.50 max	0.50–2.00	28–32	18–22	0.04 max	0.04 max	0.50 max
HN40	0.35–0.45	1.50 max	0.50–2.00	19–23	23–27	0.04 max	0.04 max	0.50 max
HT50	0.40–0.60	1.50 max	0.50–2.00	15–19	33–37	0.04 max	0.04 max	0.50 max
HU50	0.40–0.60	1.50 max	0.50–2.00	17–21	37–41	0.04 max	0.04 max	0.50 max
HW50	0.40–0.60	1.50 max	0.50–2.00	10–14	58–62	0.04 max	0.04 max	0.50 max
HX50	0.40–0.60	1.50 max	0.50–2.00	15–19	64–68	0.04 max	0.04 max	0.50 max

[A]Manufacturing control should ensure that this composition contain a minimal amount of ferrite. See Supplementary Requirement S5.

as acceptance criteria under this specification since the alloys are intended for elevated-temperature service, and room-temperature tests do not have a dependable relationship to elevated-temperature properties. (Where the design of the tubing is based on an assumption of certain minimum creep-rupture properties, one of the supplementary requirements of this specification may be stipulated on the order to ascertain the ability of the material to meet the design properties.)

8. Permissible Variation in Dimensions

8.1 *Machined Tubing (Tubing Machined on Inside and Outside)*:

8.1.1 The tolerances given in Specification A 530/A 530M shall govern, except that the wall thickness shall not vary over the specified minimum wall thickness by more than 10 % or 1⁄16 in., whichever is greater. There shall be no variation under the specified minimum wall thickness.

8.2 *As-Cast Tubing (No Machining or Machined on Inside or Outside)*:

8.2.1 *Outside Diameter (For Tubes Ordered to Outside Diameter)*:

8.2.1.1 Tubes machined on the outside shall meet the requirements of Specification A 530/A 530M.

8.2.1.2 Tubes not machined on the outside shall meet the permissible variations of Table 2.

8.2.2 *Inside Diameter (For Tubes Ordered to Inside Diameter)*:

8.2.2.1 Tubes machined on the inside shall meet the requirements of Specification A 530/A 530M.

TABLE 2 Permissible Variations in As-Cast Outside Diameter

Specified Outside Diameter of Tubing		Permissible Plus or Minus Variations from Specified Outside Diameter	
in.	mm	in.	mm
From 2 to 4	50 to 100	0.08	2.0
Over 4 to 12	100 to 300	0.10	2.5
Over 12 to 24	300 to 600	0.12	3.0
Over 24 to 36	600 to 900	0.16	4.1
Over 36 to 54	900 to 1350	0.25	6.4

8.2.2.2 Tubes not machined on the inside shall have permissible variations as agreed upon by the purchaser and the manufacturer.

8.2.3 *Wall Thickness*—The wall thickness shall not exceed the calculated minimum as cast wall thickness by more than the limits shown in Table 3. The calculated minimum wall thickness shall be equal to the specified minimum wall thickness plus the manufacturer's allowance for "inside surface feed metal" and outside surface roughness. Upon request, the manufacturer's allowance shall be furnished to the purchaser. There shall be no variation under the calculated minimum as cast wall thickness. For tubes over 24 to 54 in. (600 to 1350 mm) in diameter the "permissible variations over specified minimum as cast wall thickness" shall be agreed upon by the manufacturer and the purchaser.

8.2.4 *Length*—If definite lengths are ordered, no length of tubing shall be under the length specified and not longer than the tolerance shown in Table 4.

9. Finish

9.1 *Machined Tubing*—All tubes shall be reasonably straight and free of rejectable indications. All visual irregularities shall be explored for depths. When the depth encroaches on the specified minimum wall thickness, such irregularities shall be considered rejectable indications.

9.2 *As-Cast Tubing*:

9.2.1 The outside surface shall be adequately cleaned (such as by shotblasting, sandblasting, wire brushing, grinding, or machining). The metal surface so revealed shall be visually inspected and shall be free of linear discontinuities or other

TABLE 3 Permissible Variations in As-Cast Wall Thickness

Specified Outside Diameter of Tubing		Permissible Variations over Calculated Minimum As-Cast Wall Thickness	
in.	mm	in.	mm
From 2 to 6	50 to 150	0.08	2.0
Over 6 to 12	150 to 300	0.10	2.5
Over 12 to 24	300 to 600	0.13	3.3