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Designation:A487/A487M-93 (Reapproved 2007) Designation: A487/A487M – 93 (Reapproved 2012)

Standard Specification for Steel Castings Suitable for Pressure Service¹

This standard is issued under the fixed designation A487/A487M; 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 specification² covers low-alloy steels and martensitic stainless steels in the normalized and tempered, or quenched and tempered, condition suitable for pressure-containing parts. The weldability of the classes in this specification varies from readily weldable to weldable only with adequate precautions, and the weldability of each class should be considered prior to assembly by fusion welding.

1.2 Selection will depend on design, mechanical, and service conditions. Users should note that hardenability of some of the grades mentioned may restrict the maximum size at which the required mechanical properties are obtained.

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 must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification. Inch-pound units are applicable for material ordered to Specification A487 and SI units for material ordered to Specification A487M.

2. Referenced Documents

2.1 ASTM Standards:³

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A488/A488M Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel

A703/A703M Specification for Steel Castings, General Requirements, for Pressure-Containing Parts

E165 Practice for Liquid Penetrant Examination for General Industry

E709 Guide for Magnetic Particle Testing

2.2 American Society of Mechanical Engineers:

ASME Boiler and Pressure Vessel Code, Section IX 487/A487M-93(2012)

2.3 Manufacturers Standardization Society of the Valve and Fittings Industry Standards:⁵ SP-55 Quality Standard for Steel Castings-Visual Method

3. General Conditions for Delivery

3.1 Material furnished to this specification shall conform to the requirements of Specification A703/A703M including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A703/A703M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A703/A703M, this specification shall prevail.

4. Ordering Information

4.1 The inquiry and order should include or indicate the following:

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

Current edition approved Nov:<u>March</u> 1, 2007.2012. Published November 2007.<u>April 2012</u>. Originally approved in 1963. Last previous edition approved in 20032007 as A487/A487M– 93 (2003).(2007). DOI: 10.1520/A0487_A0487M-93R0712.

² For ASME Boiler and Pressure Vessel Code applications see related Specifications SA-487 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.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http:// www.asme.org.

⁵ Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

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4.1.1 A description of the casting by pattern number or drawing (dimensional tolerances shall be included on the casting drawing),

4.1.2 ASTM designation and year of issue,

4.1.3 Grade and class of steel,

4.1.4 Options in the specification, and

4.1.5 The supplementary requirements desired including the standard of acceptance.

5. Heat Treatment

5.1 All castings shall receive a heat treatment indicated in Table 1. Preliminary heat treatment prior to final heat treatment as well as multiple tempering is permitted.

5.2 Heat treatment shall be performed after the castings have been allowed to cool below the transformation range.

5.3 The furnace temperature for heat treating shall be effectively controlled by use of recording-type pyrometers.

6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 2. Product analysis tolerance shall conform to the product analysis tolerance shown in Specification A703/A703M. Product analysis tolerances for stainless grades are not presently applicable pending development of these limits.

Grade	Class	Austenitizing Temperature, min, °F [°C]	Media ^A	Quenching Cool Below °F [°C]	Tempering Temperature, °F [°C] ^{<i>B</i>}	
1	А	1600 [870]	A	450 [230]	1100 [595]	
1	В	1600 [870]		500 [260]	1100 [595]	
1	С	1600 [870]	A or L	500 [260]	1150 [620]	
2	А	1600 [870]		450 [230]	1100 [595]	
2	В	1600 [870]	L	500 [260]	1100 [595]	
2	С	1600 [870]	A or L	500 [260]	1150 [620]	
4	А	1600 [870]	A or L	500 [260]	1100 [595]	
4	В	1600 [870]	L	500 [260]	1100 [595]	
4	С	1600 [870]	A or L	500 [260]	1150 [620]	
4	D	1600 [870]		500 [260]	1150 [620]	
4	E	1600 [870]	L	500 [260]	1100 [595]	
6	А	1550 [845]	A	500 [260]	1100 [595]	
6	В	1550 [845]	Last	500 [260]	1100 [595]	
7	А	1650 [900]	<u>A487/A487</u> M-93(2012	600 [315]	1100 [595]	
tps://standards.it	eh.ai/caalog/s	standard 1750 [955] 1750 [955]	2d47-4bcc <mark>A</mark> 4634-b5c2	-912 ⁵⁰⁰ [260]	1250 [675] 1250 [675] 487m-9320	
8	C	1750 [955]	L	500 [260]	1250 [675]	
9	Ă	1600 [870]	A or L	500 [260]	1100 [595]	
9	В	1600 [870]	L	500 [260]	1100 [595]	
9	С	1600 [870]	A or L	500 [260]	1150 [620]	
9	D	1600 [870]	L	500 [260]	1150 [620]	
9	E	1600 [870]	L	500 [260]	1100 [595]	
10	А	1550 [845]	А	500 [260]	1100 [595]	
10	В	1550 [845]	L	500 [260]	1100 [595]	
11	А	1650 900	А	600 [315]	1100 595	
11	В	1650 [900]	L	600 [315]	1100 [595]	
12	А	1750 [955]	А	600 [315]	1100 [595]	
12	В	1750 [955]	L	400 [205]	1100 595	
13	А	1550 [845]	А	500 [260]	1100 595	
13	В	1550 [845]	L	500 260	1100 595	
14	А	1550 [845]	L	500 [260]	1100 [595]	
16 (J31200)	А	1600 [870] ^C	А	600 [315]	1100 595	
CA15	А	1750 [955]	A or L	400 [205]	900 [480]	
CA15	В	1750 [955]	A or L	400 [205]	1100 595	
CA15	С	1750 [955]	A or L	400 [205]	1150 [620] ^{DE}	
CA15	D	1750 [955]	A or L	400 [205]	1150 [260] ^{DE}	
CA15M	А	1750 [955]	A or L	400 [205]	1100 595	
CA6NM	А	1850 [1010]	A or L	200 [95]	1050-1150 [565-620]	
CA6NM	В	1850 [1010]	A or L	200 [95]	1225–1275 [665–690] ^{<i>E,F</i>} 1050–1150 [565–620] ^G	

TABLE 1 Heat Treat Requirement

 A A = air, L = Liquid.

^C Double austenitize.

^D Double temper with the final temper at a lower temperature than the intermediate temper.

^E Air cool to below 200°F [95°C] after first temper.

F Intermediate.

^G Final.

^B Minimum temperature unless range is specified.

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TABLE 2	Chemical	Requirements	(Maximum	Percent	Unless	Range is	Given)
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Grade	1.	2.	4.	6.	7.	8.	9.	10.	11.	12.
Class Type	ABC Vanadium	ABC Manganese- Molyb- denum	ABCDE Nickel- Chromium- Molybdenum	AB Manganese Nickel- Chromium- Molybdenum	A Nickel- Chromium- Molybdenum- Vanadium ⁴	ABC Chromium- Molyb- denum	ABCDE Chromium- Molyb- denum	AB Nickel- Chromium- Molybde- num	AB Nickel- Chromium- Molybdenum	AB Nickel- Chromium Molybdenu
Carbon	0.30	0.30	0.30	0.05–0.38	0.05-0.20	0.05-0.20	0.05–0.33	0.30	0.05–0.20	0.05-0.20
langanese	1.00	1.00-1.40	1.00	1.30-1.70	0.60-1.00	0.50-0.90	0.60-1.00	0.60 to 1.00	0.50-0.80	0.40-0.70
hosphorus	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Sulfur	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
ilicon	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60
lickel			0.40-0.80	0.40-0.80	0.70-1.00			1.40-2.00	0.70-1.10	0.60-1.0
hromium			0.40-0.80	0.40-0.80	0.40-0.80	2.00–2.75	0.75–1.10	0.55-0.90	0.50-0.80	0.50-0.9
lolybdenum		0.10-0.30	0.15-0.30	0.30-0.40	0.40-0.60	0.90-1.10	0.15-0.30	0.20-0.40	0.45-0.65	0.90-1.2
anadium	0.04–0.12				0.03-0.10					
oron					0.002-0.006					
Copper					0.15-0.50					
Residual Elements:					0.15-0.50					
Copper	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Nickel	0.50	0.50					0.50			
Chromium	0.35	0.35								
Mo + W	0.25									
Tungsten		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vanadium		0.03	0.03	0.03		0.03	0.03	0.03	0.03	0.03
valiaululli		0.03	0.03	0.03		0.03	0.03	0.03	0.03	0.03
	1.00	1 00	0.60	0.60	0.60	0.60	1 00	0.60	0.50	0.50
Total content of residual elements	1.00	1.00	0.60	0.60	0.60	0.60	1.00	0.60	0.50	0.50
Total content of residual		1.00		0.60	0.60	o.60 rds	1.00 CA15	0.60 CA15M		0.50 6NM
Total content of residual elements	3		iTe ps://s			rds			CA Mart Chro	
Total content of residual elements Grade Class Ty carbon	3	13. (htab Nicke Molybde 0.30	iTe ps://s al- anum M poctu	14. Nickel- tolybdenum	16 A Low Carb Manganes Nickel (J31200 0.12 ^g	rds on itch se- M C D) VIEW 0.1	CA15 ABCD artensitic hromium	CA15M A Martensitic Chromium 0.15	CA Mart Chrc Ni 0.06	6NM AB ensitic omium
Total content of residual elements Grade Class Ty Carbon tanganese	3	13. (htab Nicke Molybde 0.30 0.80–1.		14. Nickel- folybdenum	16 A Low Carb Manganes Nickel (J31200 0.12 ^B 2.10 ^B	rds on iteh se- M oview	CA15 ABCD artensitic thromium	CA15M A Martensitic Chromium 0.15 1.00	CA Mart Chro Ni 0.06 1.00	6NM AB ensitic omium
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Total content of residual elements Grade Class Ty arbon langanese hosphorus ulfur standards.itu licon ickel	у /pe	13. (htab Nicke Molybde 0.30 0.80–1. 0.04 0.045 0.60 1.40–1.	iTe ps://s enum 10 10 4s/sist/32 0 0 75	14. Nickel- Nolybdenum	16 A Low Carb Manganes Nickel (J31200 0.12 ^B 2.10 ^B 0.02 0.02 0.02 0.02 0.02 0.02 0.50 1.00–1.40	nds on item se- M 0.1 0.1 0.2012) 0.0 0.5 0.2012) 0.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1	CA15 ABCD artensitic thromium	CA15M A Martensitic Chromium 0.15 1.00 0.040 0.65 1.0	CA Mart Chrc Ni 0.06 1.00 0.04 7-a4870.03 1.00 3.5-4	6NM AB ensitic mium ckel 32012 .5
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Total content of residual elements Grade Class Ty Carbon Manganese hosphorus Sulfur Choron Carbon Manganese hosphorus Sulfur Choron Copper Nickel	у /pe	13. Nicke Molybde 0.30 0.80–1. 0.04 0.60 1.40–1. 0.20–0.3 0.50 	iTe ps://s al- anum 10 _	14. Nickel- lolybdenum 1.55 1.80–1.10 1.04 1.60 1.04 1.04 1.04 1.04 1.04 1.04 1.04 1.0	16 A Low Carb Manganes Nickel (J31200 0.12 ^B 2.10 ^B 0.02 0.02 0.02 0.02 1.00–1.40 0.20 	0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	CA15 ABCD artensitic hromium 15 00 040 240 70 15 00 15 15 15 15 15 15 15 15 15 15	CA15M A Martensitic Chromium 0.15 1.00 0.040 0.040 0.65 1.0 11.5–14.0 0.15–1.0 0.50 	CA Mart Chrc Ni 0.06 1.00 0.04 7-a4870.03 1.00 3.5-4 11.5- 0.4-1 0.50 	6NM AB ensitic mium ckel 32012 .5 14.0
Total content of residual elements Grade Class Ty Carbon Manganese Phosphorus Sulfur Chromium Molybdenum Molybdenum Molybdenum Soron Copper Residual Elements Copper Nickel Chromium	у /pe	13. Nicke Molybde 0.30 0.80–1. 0.04 0.60 1.40–1. 0.20–0.3 0.50 0.40	iTe ps://s pnum 0 10 AST 0 ds/sist/32 0 75 1 30 0	14. Nickel- lolybdenum 1.55 1.80–1.10 0.04 1.60 1.04 1.04 1.04 1.04 1.04 1.04 1.04 1.0	16 A Low Carb Manganes Nickel (J31200 0.12 ^B 2.10 ^B 0.02 0.140 0.02 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.10	0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	CA15 ABCD artensitic hromium 15 00 040 040 040 040 040 040 040	CA15M A Martensitic Chromium 0.15 1.00 0.040 0.65 1.0 11.5–14.0 0.15–1.0 0.50 0.50 0.10	CA Mart Chrc Ni 0.06 1.00 0.04 7-a4870.03 1.00 3.5-4 11.5- 0.4-1 0.50 	6NM AB ensitic mium ckel 32012 .5 14.0
Total content of residual elements Grade Class Ty Carbon Manganese Phosphorus Sulfur ctandards.ite Carbon Manganese Phosphorus Sulfur ctandards.ite Carbon Molybdenum Boron Copper Residual Elements Copper Nickel Chromium Molybdenum	/pe eh.ai/catal	13. Nicke Molybde 0.30 0.80–1. 0.04 0.60 1.40–1. 0.20–0.3 0.50 0.40 	iTe ps://s pos://s	14. Nickel- Iolybdenum .55 .80–1.10 .04 .045 .40–1.75 .20–0.30 .50 	16 A Low Carb Manganes Nickel (J31200 0.12 ^B 2.10 ^B 0.02 0.02 0.02 0.02 0.02 0.02 1.00–1.40 0.20 0.20 0.10	0.5 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	CA15 ABCD artensitic hromium 15 00 040 040 040 040 040 040 040 040 05	CA15M A Martensitic Chromium 0.15 1.00 0.040 0.051 1.0 11.5–14.0 0.15–1.0 0.50 	CA Mart Chro Ni 0.06 1.00 0.04 1.00 0.04 1.00 0.04 1.00 0.04 1.5- 0.4-1 0.50	6NM AB ensitic mium ckel 32012 .5 14.0

^A Proprietary steel composition.

^B For each reduction of 0.01 % below the specified maximum carbon content, an increase of 0.04 % manganese above the specified maximum will be permitted up to a maximum of 2.30 %.

7.Tensile Requirements

7. Tensile Requirements Tensile Requirements

7.1 Tensile properties of steel used for the castings shall conform to the requirements prescribed in Table 3.

8. Quality

8.1 The surface of the casting shall be free of adhering sand, scale, cracks, and hot tears as determined by visual examination. Other surface discontinuities shall meet the visual acceptance standards specified in the order. Visual Method SP-55 or other visual standards may be used to define acceptable surface discontinuities and finish. Unacceptable visual surface discontinuities shall be