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Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application[1]

This standard is issued under the fixed designation A890/A890M; 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 a group of cast duplex stainless steels (austenitic/ferritic).

1.2 The duplex stainless steel alloys offer a combination of enhanced mechanical properties and corrosion resistance when properly balanced in composition and properly heat treated. Ferrite levels are not specified, but these alloys will develop a range of approximately 30 to 60 % ferrite with the balance austenite. It is the responsibility of the purchaser to determine which grade shall be furnished depending on design and service conditions, mechanical properties, and corrosion-resistant characteristics.

NOTE 1—Because of the possibility of precipitation of embrittling phases, the grades included in this specification are not recommended for service at temperatures above ~~600°F [315°C].~~600 °F [315 °C].

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

1.3.1 Within the text, the SI units are shown in brackets.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

~~A370 Test Methods and Definitions for Mechanical Testing of Steel Products~~

~~A732/A732M Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures~~

A781/A781M Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use

~~E29~~A957/A957M ~~Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications~~Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use

E562 Test Method for Determining Volume Fraction by Systematic Manual Point Count

E1245 Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis

3. Ordering Information

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

3.1.1 Description of casting by pattern or drawing number (dimensional tolerance shall be included on the casting drawing),

3.1.2 Specification designation and grade, including year of issue,

3.1.3 Options in the specification ~~(See~~(see 9.1), and

3.1.4 Supplementary requirements desired, including the standards of acceptance.

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

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[2] 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.

***A Summary of Changes section appears at the end of this standard**

4. Process

4.1 The steel shall be made by the electric furnace process, with or without separate refining such as argon-oxygen-decarburization (AOD).

5. Heat Treatment

5.1 Castings shall be heat treated in accordance with the requirements in Table 1.

NOTE 2—Proper heat treatment of these alloys is usually necessary to enhance corrosion resistance and, in some cases, to meet mechanical properties. Minimum heat-treat temperatures are specified; however, it is sometimes necessary to ~~heat-treat~~ heat treat at higher temperatures, hold for some minimum time at temperature, and then rapidly cool the castings in order to enhance the corrosion resistance and meet mechanical properties.

6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 2.

7. General Requirements

7.1 Material furnished to this specification shall conform to the requirements of Specification A781/A781M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of

TABLE 1 Heat Treatment Requirements

Grade	Heat Treatment
~~1B, 1C~~	~~Heat to 1900°F [1040°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.~~
1B, 1C	Heat to 1900 °F [1040 °C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.
~~2A~~	~~Heat to 2050°F [1120°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.~~
2A	Heat to 2050 °F [1120 °C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.
~~3A~~	~~Heat to 1950°F [1070°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.~~
3A	Heat to 1950 °F [1070 °C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.
~~4A~~	~~Heat to 2050°F [1120°C] minimum for sufficient time to heat casting uniformly to temperature and water quench, or the casting may be furnace cooled to 1850°F [1010°C] minimum, hold for 15 min minimum and then water quench. A rapid cool by other means may be employed in lieu of water quench.~~
4A	Heat to 2050 °F [1120 °C] minimum, hold for sufficient time to heat casting uniformly to temperature, and water quench, or the casting may be furnace cooled to a temperature no lower than 1850 °F [1010 °C], hold for 15 min minimum and then water quench. A rapid cool by other means may be employed in lieu of water quench.
~~5A~~	~~Heat to 2050°F [1120°C] minimum, hold for sufficient time to heat casting to temperature, furnace cool to 1910°F [1045°C] minimum, quench in water or rapid cool by other means.~~
5A	Heat to 2050 °F [1120 °C] minimum, hold for sufficient time to heat casting to temperature, furnace cool to a temperature no lower than 1910 °F [1045 °C], then quench in water or rapid cool by other means.
~~6A~~	~~Heat to 2010°F [1100°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or cool rapidly by other means.~~
6A	Heat to 2010 °F [1100 °C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or cool rapidly by other means.
~~7A~~	~~Heat to 2065°F [1130°C] minimum, hold for sufficient time to heat casting to temperature, furnace cool to 1940°F [1060°C] minimum, quench in water or rapid cool by other means.~~
7A	Heat to 2065 °F [1130 °C] minimum, hold for sufficient time to heat casting to temperature, furnace cool to a temperature no lower than 1940 °F [1060 °C], then quench in water or rapid cool by other means.

TABLE 2 Chemical Requirements

~~Grade~~	~~1B[A]~~	~~1C[B]~~	~~2A~~
~~Type~~	~~25Cr-5Ni-M0-Cu-N~~	~~25Cr-6Ni-Mo-Cu-N~~	~~24Cr-10Ni-Mo-N~~
~~UNS~~	~~J93372~~	~~J93373~~	~~J93345~~
~~ACI~~	~~CD4MCuN~~	~~CD3MCuN~~	~~CE8MN~~
~~Composition:~~			
~~Carbon, max~~	~~0.04~~	~~0.030~~	~~0.08~~
~~Manganese, max~~	~~1.0~~	~~1.20~~	~~1.00~~
~~Silicon, max~~	~~1.0~~	~~1.10~~	~~1.50~~
~~Phosphorus, max~~	~~0.04~~	~~0.030~~	~~0.04~~
~~Sulfur, max~~	~~0.04~~	~~0.030~~	~~0.04~~
~~Chromium~~	~~24.5–26.5~~	~~24.0-26.7~~	~~22.5–25.5~~
~~Nickel~~	~~4.7–6.0~~	~~5.6-6.7~~	~~8.0–11.0~~
~~Molybdenum~~	~~1.7–2.3~~	~~2.9-3.8~~	~~3.0–4.5~~
~~Copper~~	~~2.7–3.3~~	~~1.40-1.90~~	~~. . .~~
~~Tungsten~~	~~. . .~~	~~. . .~~	~~. . .~~
~~Nitrogen~~	~~0.10–0.25~~	~~0.22-0.33~~	~~0.10–0.30~~

~~Grade~~	~~3A~~	~~4A~~	~~5A[B]~~	~~6A[B]~~	~~7A[C]~~
~~Type~~	~~25Cr-5Ni-Mo-N~~	~~22Cr-5Ni-Mo-N~~	~~25Cr-7Ni-Mo-N~~	~~25Cr-7Ni-Mo-N~~	~~27Cr-7Ni-Mo-W-N~~
~~UNS~~	~~J93371~~	~~J92205~~	~~J93404~~	~~J93380~~	~~J93379~~
~~ACI~~	~~CD6MN~~	~~CD3MN~~	~~CE3MN~~	~~CD3MWCuN~~	~~CD3MWN~~
~~Composition:~~					
~~Carbon, max~~	~~0.06~~	~~0.03~~	~~0.03~~	~~0.03~~	~~0.030~~
~~Manganese, max~~	~~1.00~~	~~1.50~~	~~1.50~~	~~1.00~~	~~1.00-3.00~~
~~Silicon, max~~	~~1.00~~	~~1.00~~	~~1.00~~	~~1.00~~	~~1.00~~
~~Phosphorus, max~~	~~0.040~~	~~0.04~~	~~0.04~~	~~0.030~~	~~0.030~~
~~Sulfur, max~~	~~0.040~~	~~0.020~~	~~0.04~~	~~0.025~~	~~0.020~~
~~Chromium~~	~~24.0–27.0~~	~~21.0–23.5~~	~~24.0–26.0~~	~~24.0–26.0~~	~~26.0–28.0~~
~~Nickel~~	~~4.0–6.0~~	~~4.5–6.5~~	~~6.0–8.0~~	~~6.5–8.5~~	~~6.0–8.0~~
~~Molybdenum~~	~~1.75–2.5~~	~~2.5–3.5~~	~~4.0–5.0~~	~~3.0–4.0~~	~~2.0–3.5~~
~~Copper~~	~~. . .~~	~~1.00, max~~	~~. . .~~	~~0.5–1.0~~	~~1.00, max~~
~~Tungsten~~	~~. . .~~	~~. . .~~	~~. . .~~	~~0.5–1.0~~	~~3.0–4.0~~
~~Nitrogen~~	~~0.15–0.25~~	~~0.10–0.30~~	~~0.10–0.30~~	~~0.20–0.30~~	~~0.30–0.40~~
~~Boron~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~0.0010-0.0100~~
~~Barium~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~0.0002-0.0100~~
~~Ce + La~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~0.005–0.030~~

TABLE 2 Chemical Requirements[A,B]

Material Grade Type UNS	Element, %											
	Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Tungsten	Other
CD4MCuN (1B)[C] 25Cr-5Ni-M0-Cu-N J93372	0.04	1.0	0.04	0.04	1.0	24.5–26.5	4.7–6.0	1.7–2.3	0.10–0.25	2.7–3.3	. . .	. . .
CD3MCuN (1C)[D] 25Cr-6Ni-Mo-Cu-N J93373	0.030	1.20	0.030	0.030	1.10	24.0–26.7	5.6–6.7	2.9–3.8	0.22–0.33	1.40–1.90	. . .	. . .

CE8MN (2A) 24Cr-10Ni-Mo-N J93345	0.08	1.00	0.04	0.04	1.50	22.5–25.5	8.0–11.0	3.0–4.5	0.10–0.30	. . .	. . .	. . .
CD6MN (3A) 25Cr-5Ni-Mo-N J93371	0.06	1.00	0.040	0.040	1.00	24.0–27.0	4.0–6.0	1.75–2.5	0.15–0.25	. . .	. . .	. . .
CD3MN (4A) 22Cr-5Ni-Mo-N J92205	0.03	1.50	0.04	0.020	1.00	21.0–23.5	4.5–6.5	2.5–3.5	0.10–0.30	1.00	. . .	. . .
CE3MN (5A)[D] 25Cr-7Ni-Mo-N J93404	0.03	1.50	0.04	0.04	1.00	24.0–26.0	6.0–8.0	4.0–5.0	0.10–0.30	. . .	. . .	. . .
CD3MWCuN (6A)[E] 25Cr-7Ni-Mo-N J93380	0.03	1.00	0.030	0.025	1.00	24.0–26.0	6.5–8.5	3.0–4.0	0.20–0.30	0.5–1.0	0.5–1.0	. . .
CD3MWN (7A)[F] 27Cr-7Ni-Mo-W-N J93379	0.030	1.00–3.00	0.030	0.020	1.00	26.0–28.0	6.0–8.0	2.0–3.5	0.30–0.40	1.00	3.0–4.0	B: 0.0010–0.0100 Ba: 0.0002–0.0100 Ce + La: 0.005–0.030

[A] All values are maximums, except where a range is provided.
[B] Where ellipses (…) appear in this table, there is no requirement, and the element need not be analyzed for or reported.
[C] ~~CD4MCu~~ CD4MCu has been removed from ~~the~~this standard. CD4MCuN is an acceptable substitute for CD4MCu.
[D] ~~% Cr + 3.3 % Mo + 16 % N ≥ 40.~~ %Cr + 3.3 × %Mo + 16 × %N ≥ 40.
[E] ~~%Cr+3.3(%Mo+0.5%W)+16%N ≥ 45.~~ %Cr + 3.3 × (%Mo + (0.5 × %W)) + 16 × %N ≥ 40.
[F] %Cr + 3.3 × (%Mo + (0.5 × %W)) + 16 × %N ≥ 45.