ASTM B462-06

Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N 08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N 10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service[1]

1. Scope :-
   1.1 This specification[2] covers Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N 08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N 10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
   1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.
   1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to become familiar with all hazards including those identified in the appropriate Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.
2. Referenced Documents :-
   2.1 ASTM Standards :
   A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
   B 166 Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696), Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617), and Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674) Rod, Bar, and Wire
   B 335 Specification for Nickel-Molybdenum Alloy Rod
   B 408 Specification for Nickel-Iron-Chromium Alloy Rod and Bar
   B 472 Specification for Nickel Alloy Billets and Bars for Reforging
   B 473Specification for UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire
   B 574 Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
   B 581 Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Rod
   B 649 Specification for Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, UNS N08354, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire, and Ni-Cr-Fe-Mo-N Alloy (UNS N08936) Wire

B 691 Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire

B 880Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

E 8 Test Methods for Tension Testing of Metallic Materials

E 527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E 1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys

E 1916mGuide for Identification and Segregation of Mixed Lots of Metals

2.2 ANSI Standard :

B 16.5 Steel Pipe Flanges and Flanged fittings (for applicable alloy UNS N08020)[4]

2.3 Manufacturer's Standardization society of the valve and fittings industry Standard :

SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unious[5]

3. Terminology :-

3.1 Definitions of Terms Specific to This Standard :

3.1.1 forgings, n – the term forgings as used in this Specification shall be understood to cover one or all of the products mentioned in 1.1, either forged or rolled.

4. Ordering Information :-

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Example of such requirements include, but are not limited to, the following :

4.1.1 Quantity (weight or number of pieces),

4.1.2 Name of material or UNS number,

4.1.3 Forging sketch when required (5.2.4),

4.1.4 Forging sectioning, if required (5.2.3),

4.1.5 ASTM designation and year of issue,

4.1.6 Inspection (14.1),

4.1.7 Supplementary requirements, if any, and

4.1.8 If possible, the intended end use.

5. Materials and Manufacture :-

5.1 Discard – A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation. The material shall have a homogeneous structure as shown by the macroetch test in 7.3.

5.2 Manufacturing Practice :

5.2.1 Material for forging shall consist of a billet, bar, or forging produced in accordance with specification B 166, B 335, B 408, B 462, B 473, B 574, B 581, B 649, or B 691.

5.2.2 The material shall be forged by hammering, pressing, rolling, extruding, or upsetting; it shall be brought as nearly as practicable to the finished shape and size by hot working; and shall be so processed as to cause metal flow during the hot-working operation in the direction most favourable for resisting the stresses encountered in service.

5.2.3 When specified in the order, a sample forging may be sectioned and etched to show flow lines and the condition as regards internal imperfections. In such

cases, the question of acceptable and unacceptable character of metal flow shall be a subject for agreement between the manufacturer and the purchaser.

5.2.4 When specified in the order, the manufacturer shall submit for approval of the purchaser a sketch showing the shape of the rough forming before machining.

5.3 Heat Treatment :-

5.3.1 The product of UNS N08020 alloy shall be furnished in the stabilized-annealed condition. The product of UNS N08024 shall be furnished in the annealed condition. The product of UNS N06022, UNS n06035, UNS N08026, UNS N06030, UNS N 06200, UNS N 10276, UNS N10665, UNS N 10675, and UNS R20033 alloys shall be furnished in the solution annealed condition.

5.3.2 Alloy N08367 shall be furnished in the solution annealed condition.

5.3.2.1 The recommended heat treatment shall consist of heating to a minimum temperature of 2025 °F (1105 °C) and quenching in water, or rapidly cooling, by other means.

5.3.3 Heat treatment may be performed before machining.

6. Chemical Composition :-

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

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the requirements specified in Table 1 subject to the permissible tolerances in specification B 880.

7. Mechanical Properties and Other Requirements :-

7.1 Mechanical Properties – The material shall conform to the requirements as to mechanical properties prescribed in Table 2 at room temperature.

7.2 Hydrostatic tests – After machining, valve bodies, fittings, and other pressure-containing parts shall be tested to the hydrostatic shell-test pressure prescribed in ANSI B16.5 for the applicable alloy steel rating for which the forging is designed and shall show no leaks. Forgings ordered than those listed in the American National Standard ratings shall be tested to such pressures as may be agreed upon between the manufacture and the purchaser.

7.2.1 No hydrostatic test is required for welding neck or other flanges.

7.2.2 The forging manufacturer is not required to perform pressure tests on rough forgings that are to be finally machined by others. The fabricator of finished forged parts is not required to pressure test forgings that are designed to be pressure containing only after assembly by welding into a larger structure. However, the manufacturer of such forgings is responsible as required in accordance with 15.1 for the satisfactory performance of the forgings under the final test required in 7.2.

7.3 Macroetch tests – Etching of tests shall show sound and reasonably uniform material, free of injurious laminations, cracks, segregation, and similar objectionable defects. If, on successive tests, 10 % of any heat fails to pass the requirements of the macroetch test, all forgings from that heat shall be rejected.

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TABLE 1 Chemical Requirements

Composition, %					
Element	UNS N08026	UNS N08020	UNS N08024	UNS N08367	UNS R20033
Carbon, max	0.03	0.07	0.03	0.030	0.015
Manganese, max	1.00	2.00	1.00	2.00	2.0
Phosphorus, max	0.03	0.045	0.035	0.040	0.02
Sulfur, max	0.03	0.035	0.035	0.030	0.01
Silicon, max	0.50	1.00	0.50	1.00	0.50
Nickel	33.00-37.20	32.00-38.00	35.00-40.00	23.50 to 25.50	30.0-33.0
Chromium	22.00-26.00	19.00-21.00	22.50-25.00	20.00 to 22.00	31.0-35.0
Molybdenum	5.00-6.70	2.00-3.00	3.50-5.00	6.00 to 7.00	0.50-2.0
Copper	2.00-4.00	3.00-4.00	0.50-1.50	0.75 max	0.30-1.20
Columbium(Nb) + tantalum	.....	8 X carbon-1.00	0.15-0.35	.....	.....
Nitrogen	0.10-0.16	.....	.....	0.18 to 0.25	0.35-0.60
Iron	Remainder[A]	Remainder[A]	Remainder[A]	Remainder[A]	Remainder[A]

Element	UNS N06030	UNS N06022	UNS N06200	UNS N10276	UNS N10665	UNS R10675
Carbon, max	0.03	0.015	0.010	0.010	0.02	0.01
Manganese, max	1.5	0.50	0.50	1.0	1.0	3.0
Phosphorus, max	0.04	0.02	0.025	0.04	0.04	0.030
Sulfur, max	0.02	0.02	0.010	0.03	0.03	0.010
Silicon, max	0.8	0.08	0.08	0.08	0.10	0.10
Nickel	Remainder[A]	Remainder[A]	Remainder[A]	Remainder[A]	Remainder[A]	Remainder[A]
Chromium	28.0-31.5	20.0-22.5	22.0-24.0	14.5-16.5	1.0 max	1.0-3.0
Molybdenum	4.0-6.0	12.5-14.5	15.0-17.0	15.0-17.0	26.0-30.0	27.0-32.0
Copper	1.0-2.4	.....	1.3-1.9	.....	.....	0.20
Columbium(Nb) + tantalum	0.30-1.50	.....	.....	.....	.....	.....
Nitrogen	.....	.....	.....	.....	.....	.....
Iron	13.0-17.0	2.0-6.0	3.0 max	4.0-7.0	2.0 max	1.0-3.0
Cobalt, max	5.0	2.5	2.0	2.5	1.0	3.0
Tungsten	1.5-4.0	2.5-3.5	.....	3.0-4.5	.....	3.0 max
Vanadium, max	.....	0.35	.....	0.35	.....	0.20
Titanium, max	.....	.....	.....	.....	.....	0.2
Zirconium, max	.....	.....	.....	.....	.....	0.10
Columbium (Nb)	.....	.....	.....	.....	.....	0.20 max
Tantalum	.....	.....	.....	.....	.....	0.20 max
Nickel + Molybdenum	.....	.....	.....	.....	.....	94.0-98.0
Aluminium, max	.....	....	0.50	.....	.....	0.50

Element	UNS N06059	UNS N06686	UNS N08031	UNS N06045	UNS N06025	UNS N10629	UNS N06035
Carbon, max	0.010	0.010	0.015	0.05-0.12	0.15-0.25	0.01	0.050
Manganese, max	0.5	0.75	2.0	1.0	0.15	1.5	0.50
Phosphorus, max	0.015	0.04	0.020	0.02	0.02	0.040	0.030
Sulfur, max	0.010	0.02	0.010	0.010	0.010	0.010	0.015
Silicon, max	0.10	0.08	0.3	2.5-3.0	0.5	0.05	0.60
Nickel	Remainder[A]	Remainder[A]	30.0-32.0	45.0 min	Remainder[A]	Remainder[A]	Remainder[A]

Chromium	22.0-24.0	19.0-23.0	26.0-28.0	26.0-29.0	24.0-26.0	0.5-1.5	7.60-9.00
Molybdenum	15.0-16.5	15.0-17.0	6.0-7.0	.....	.....	26.0-30.0	0.30 max
Copper	0.50 max	.....	1.0-1.4	0.3 max	0.1 max	0.5	.....
Columbium(Nb) + tantalum	.....	.....	.....	.....	0.05-0.12	.....	.....
Nitrogen	.....		0.15-0.25	.....		.....	2.00 max
Iron	1.5 max	5.0 max	Remainder[A]	21.0-25.0	8.0-11.0	1.0-6.0	1.00
Cobalt, max	0.3	.....	.....	.....	.....	2.5	0.60 max
Tungsten	.....	3.0-4.4	.....	.....	.....	.....	0.20
Vanadium, max	.....	.....	.....	.....	.....	.....	.....
Titanium, max	.....	0.02-0.25	.....	.....	0.1-0.2	.....	.....
Zirconium, max	.....	.....	.....	.....	0.01-0.10	.....	.....
Columbium (Nb)	.....	.....	.....	.....	.....	.....	.....
Tantalum	.....	.....		.....	.....	.....	.....
Cerium	.....	.....		0.03-0.09	.....	.....	.....
Aluminium, max	0.1-0.4	.....		.....	1.8-2.4	0.1-0.5	0.40

TABLE 2 Mechanical Property Requirements

Alloy	Tensile Strength, min		Yield Strength, min		Elongation in 2 in. Or 50 mm, min, %	Reduction of area, min, %
	ksi	MPa	ksi	MPa		
UNS N08020, UNS N08024, and UNS N08026	80	551	35	241	30.0	50.0
UNS N08367	95	655	45	310	30.0	50.0
UNS R20033	109	750	55	380	40.0	...
UNS N06030	85	586	35	241	30	...
UNS N06022	100	690	45	310	45	...
UNS N06035	85	586	35	241	30	...
UNS N06200	100	690	45	310	45	...
UNS N10276	100	690	41	283	40	...
UNS N10665	110	760	51	350	40	...
UNS N10675	110	760	51	350	40	...
UNS N06059	100	690	45	310	45	...
UNS N06686	100	690	45	310	45	...
UNS N08031	94	650	40	276	40.0	...
UNS N06045	90	620	35	241	35	...
UNS N06025	98	680	39	270	30	...
UNS N10629	110	760	51	350	40	...

8. Dimensions and Permissible Variations
9. Workmanship, Finish, and Appearance
10. Sampling
11. Number of Tests
12. Specimen Preparation
13. Tests Methods

14. Inspection
15. Rejection and Rehearing
16. Certification :-

16.1 When specified in the purchaser order or contract, a producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. When specified in the purchaser order or contract, a report of the test results shall be furnished.

17. Product Marking
18. Keywords :-

18.1 forgings; UNS N06030; UNS N06022; UNS N 06035; UNS N06200; UNS N06059; UNS N06686; UNS N08020; UNS N08024; UNS N08026; UNS N08367; UNS N10276; UNS N10665; UNS N10675; UNS N10629; UNS N08031; UNS N06045; UNS N06025; UNS R20033

Supplementary Requirements :-

S1. Corrosion Tests for UNS N08020

S2. Positive Material Identification Examination