

Valve Forging Material Metallurgical Chemical & Mechanical Specification

Chemistry Elements % Composition	Mechanical Properties		Chemistry Elements % Composition	Mechanical Properties	
ASTM A105[†] Carbon Steel Where temperatures are moderate and corrosion resistance is not critical.			ASTM A182, Grade F5[†] – 4-6% Chromium, 1/2% Molybdenum For services with moderately corrosive fluids and in oil refineries where high temperature stability and oxidation resistance of the lower alloy steels are inadequate.		
C 0.35 Max	TS Min psi (MPa)	70,000 (485)	C 0.15 Max	TS Min psi (MPa)	70,000 (485)
Mn 0.60 - 1.05	YS Min psi (MPa)	36,000 (250)	Mn 0.30 - 0.60	S Min psi (MPa)	40,000 (275)
Si 0.10 - 0.35	EL Min (2")	22%	P 0.03 Max	EL Min (2")	20%
P 0.035 Max	RA Min	30%	S 0.03 Max	RA Min	35%
S 0.040 Max	Hardness, Bhn HBW	Max. 187	Si 0.50 Max	Hardness, Bhn	143-217
Cr 0.30 Max ^{AB}			Ni 0.50 Max		
Ni 0.40 Max ^A			Cr 4.00 - 6.00		
Mo 0.12 Max ^{AB}			Mo 0.44 - 0.65		
V 0.08 Max	A105/A105M - 2012: -				
Cb 0.02	^A The sum of copper, nickel, chromium, molybdenum and vanadium shall not exceed 1.00%				
Cu 0.40 Max ^A	^B The sum of chromium and molybdenum shall not exceed 0.32%				
Pb 0.02					
Total Residuals = 0.50					
ASTM A350, LF2[†] Where cold temperature -46°C (-50°F) impact strength is essential.			ASTM A182, Grade F9[†] – 9% Chromium For services where the higher chrome alloys are preferred and where high temperature stability and oxidation resistance of the lower alloy steels are inadequate.		
C 0.30 Max	TS psi (MPa)	70-95,000 (485-655)	C 0.15 Max	TS Min psi (MPa)	85,000 (585)
Mn 0.60 - 1.35	YS Min psi (MPa)	36,000 (250)	Mn 0.30 - 0.60	YS Min psi (MPa)	55,000 (380)
Si 0.15 - 0.30	EL Min (2")	22%	P 0.030 Max	EL Min (2")	20%
P 0.035 Max	RA Min	30%	S 0.030 Max	RA Min	40%
S 0.04 Max	Hardness, Bhn	Max 197	Si 0.50 - 1.00	Hardness, Bhn	179-217
Cr 0.30 Max ^{BC}	-50°F Charpy Energy - J (Ft./Lb.)		Cr 8.00 - 10.00		
Ni 0.40 Max ^B	Average of each set of 3	15 (20)	Mo 0.90 - 1.10		
Mo 0.12 Max ^{BC}	specimens for one specimen	12 (16)			
V 0.08 Max					
Cb 0.02 Max ^D	A350/A350M - 2012: -				
Cu 0.04 Max ^B	^B The sum of copper, nickel, chromium, vanadium and molybdenum shall not exceed 1.00% on heat analysis.				
Pb 0.02	^C The sum of chromium and molybdenum shall not exceed 0.32% on heat analysis.				
Total Residuals = 0.50	^D By agreement, the limit for columbium may be increased up to 0.05% on heat analysis and 0.06% on product analysis.				
ASTM A182, Grade F11[†] Class 2 – 1 1/4% Chromium 1/2% Molybdenum To minimise graphitisation encountered with carbon and carbon moly steels at high temperatures.			ASTM A182, Grade F22[†] Class 3 – 2 1/4% Chromium 1% Molybdenum Where elevated temperature, surface stability, and greater strength than F11 are needed.		
C 0.10 - 0.20	TS Min psi (MPa)	70,000 (485)	C 0.05 - 0.15	TS Min psi (MPa)	75,000 (515)
Mn 0.30 - 0.80	YS Min psi (MPa)	40,000 (275)	Mn 0.30 - 0.60	YS Min psi (MPa)	45,000 (310)
P 0.04 Max	EL Min (2")	20%	P 0.04 Max	EL Min (2")	20%
S 0.04 Max	RA Min	30%	S 0.04 Max	RA Min	30%
Si 0.50 - 1.00	Hardness, Bhn	143-207	Si 0.50 Max	Hardness, Bhn	156-207
Cr 1.00 - 1.50			Cr 2.00 - 2.50		
Mo 0.44 - 0.65			Mo 0.87 - 1.13		
ASTM A182, Grade F316H[†] – 18% Chromium 8% Nickel 2-3% Molybdenum For corrosion resistance applications where extreme high temperature service is expected. Has a restricted carbon range for high temperature strength above 538°C (1000°F).			ASTM A182, Grade F316[†]; Grade F316L[†] – 18% Chromium 8% Nickel 2-3% Molybdenum For corrosion resistance applications where high temperature strength is required. Has restricted carbon level to minimise sensitisation. Do not use for service temperatures above 538°C (1000°F).		
C 0.04 - 0.10	TS Min psi (MPa)	75,000 (515)	C 0.030 Max - (316L)	TS Min psi (MPa) - (316)	75,000 (515)
Mn 2.00 Max	YS Min psi (MPa)	30,000 (205)	C 0.08 Max - (316)	TS Min psi (MPa) - (316L)	70,000 (485)
P 0.045 Max	EL Min (2")	30%	Mn 2.00 Max	YS Min psi (MPa) - (316)	30,000 (205)
S 0.030	RA Min	50%	P 0.045 Max	YS Min psi (MPa) - (316L)	25,000 (170)
Si 1.00 Max			S 0.030 Max	EL Min (2")	30%
Ni 10.00 - 14.00			Si 1.00 Max	RA Min	50%
Cr 16.00 - 18.00			Ni 10.00 - 14.00 (316) 10.00 - 15.00 (316L)		
Mo 2.00 - 3.00			Cr 16.00 - 18.00		
			Mo 2.00 - 3.00		
ASTM A182, Grade F304[†]; Grade F304L[†] - 18% Chromium 8% Nickel For corrosion resistance applications where high temperature strength is required. Has restricted carbon level to minimise sensitisation. Do not use where chloride stress corrosion cracking may occur.					
C 0.030 Max - (304L)	TS Min psi (MPa) - (304)	75,000 (515)			
C 0.080 Max - (304)	TS Min psi (MPa) - (304L)	70,000 (485)			
Mn 2.00 Max	YS Min psi (MPa) - (304)	30,000 (205)			
P 0.045 Max	YS Min psi (MPa) - (304L)	25,000 (170)			
S 0.030 Max	EL Min (2")	30%			
Si 1.00 Max	RA Min	50%			
Ni 8.00 - 11.00 (304)					
Ni 8.00 - 13.00 (304L)					
Cr 18.00 - 20.00					

[†]As per ASTM A182/A182M - 2013, ASTM A105/A105M - 2012 and ASTM A350/A350M - 2012

Valve Trim Materials Metallurgical Chemical & Mechanical Specifications

Description & General Use	Chemistry Elements % Composition	Description & General Use	Chemistry Elements % Composition
13% Chromium Stainless Steel Type 410 (F6a)	C 0.10 - 0.15 Mn 1.00 Max. P 0.040 Max. S 0.030 Max.	Cobalt Base Hard Facing Materials ASME SFA 5.13 Hard facing materials, when used on seating surfaces of Gate, Globe, and Check Valves, give extended service life and trouble free operation. (Cobalt based Stellite #6 is the most common). Nickel base hard facing is sometimes also used.	C 0.9 - 1.4 Mo 0.0 Mn 1.0 W 3.5 - 5.5 Si 1.5 Fe 3.0 Ni 3.0 Others 0.50 Cr 27.0 - 31.0 Co Balance
ASTM A479 This stainless steel material lends itself readily to hardening by heat treatment and is excellent for contacting parts such as stems, gates, and discs.	Si 1.00 Max. Cr 11.5 - 13.5 Ni 0.50 Max.		
13% Chromium Stainless Steel Type 416	C 0.11 - 0.14 Mn 0.60 Max. P 0.060 Max. S 0.25 - 0.35	Nickel-Moly-Chromium ASTM B574, Grade N 10276 Hastelloy C-276 A high nickel alloy with exceptional resistance to corrosive attack by chlorine gas.	C 0.02 Max. Fe 4.00 - 7.00 Ni Balance Si 0.08 Max Co 2.5 Max. Mn 1.00 Max Cr 14.50 - 16.50 V 0.35 Max Mo 15.00 - 17.00 P 0.04 Max W 3.00 - 4.50 S 0.03 Max
ASTM A582 High quality stainless steel yoke nut material having excellent anti-galling characteristic for better operating threads.	Si 1.00 Max. Cr 12.00 - 14.00 Ni 0.60 Max.		
18% Chromium 8% Nickel, 2% Molybdenum Stainless Steel Type 316 Type 316L ASTM A182	C 0.030 Max. (316L) C 0.08 Max. (316) Mn 2.00 Max. P 0.045 Max. S 0.030 Max. Si 1.00 Max. Cr 16.00 - 18.00 Ni 10.00 - 15.00 Mo 2.00 - 3.00 N 0.10 Max.	Precipitation Hardened Stainless Steel A564, Gr. 630 17-4 PH Provides corrosion resistance and high strength for stems in NACE applications.	C 0.07 Max. Cr 15.00 - 17.50 Mn 1.00 Max. Ni 3.00 - 5.00 P .04 Max. Cu 3.00 - 5.00 S .03 Max. Cb 0.15 - 0.45 S 1.00 Max. + Ta
Provides excellent resistance to corrosive media at high temperatures and toughness for service at low temperatures.			
Nickel-Copper Monel Alloy K500	C 0.25 Max. Mn 1.50 Max. S 0.010 Max. Ni 63.00 - 70.00 Si 0.50 Max. Fe 2.00 Max. Al 2.3 - 3.15 Ti 0.35 - .85 Cu 27.0 - 33.0 P 0.020 Zn 0.020 Pb 0.006 Sn 0.006	S-Monel ASTM A-494, Grade M-25S Material used for Monel castings.	C 0.25 Max. Ni Balance Mn 1.5 Fe 2.5 Si 3.5 - 4.5 Cu 27.0 - 31.0 P 0.03
This wrought material is precipitation hardened and possesses excellent corrosion resistance, high strength properties and hardness for internal valve components			
Monel Alloy 400 ASTM B164 (N0400)	C 0.030 Max. Mn 2.00 Max. S 0.024 Max. Si 0.050 Max. Ni 63.00 - 70.00 Fe 2.50 Max. Cu 27.0 - 33.0	ASTM A-743, Grade CA-15 Material used for 13 CR castings, the cast equivalent to type 410 Stainless Steel.	C 0.15 Max. S .040 Max. Mn 1.00 Cr 11.50 - 14.00 Si 1.50 Max. Ni 1.0 Max. P 0.040 Mo 0.50 Max.
Non hardened alloy, unless by work hardened, that has high strength and toughness over a wide temperature range. Has excellent corrosion resistance in chlorine and alkylation service.			
ASTM A351 Grade CF8M	C .08 Max. Si 1.50 Max. Mn 1.50 Max. Cr 18.0 - 21.0 P 0.040 Max. Ni 9.0 - 12.0 S 0.040 Max. Mo 2.0 - 3.0		

For equivalent valve casting materials refer our cross reference chart. Also see separate chart for valve casting materials, mechanical & chemical compositions.

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