



STEEL FORGINGS FOR THE FITTINGS INDUSTRY

ASME/ASTM SA-105/SA-105M-05
Carbon Steel Forgings for Piping Applications

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength	Yield Strength	Elongation	Reduction	Hardness	Heat
										MPa	(0,2%)Mpa	%	of Area %	HB	Treatment
K03504		s0,35	0,60-1,05	s0,035	s0040	0,10-0,35	\$0,40	s0,30	s0,12	2485	2250	230	230	187	A,N,NT,QT
		Other elements Cu0,40Vs0,08													

ASME/ASTM SA-181/SA-181M-06
Carbon Steel Forgings for General Purpose Piping

Grade	UNS	c	Mn	P	s	Si	Ni	Gr	Mo	Tensile Strength	Yield Strength	Elongation	Reduction	Hardness	Heat
										MPa	(0,2%)Mpa	%	of Area %	HB	Treatment
Class 60	K03502	\$0,35	\$1,10	\$0,05	s0,05	0,10-0,35	=	-	-	2415	2205	222	235	--	--
Class 70										2485	2250	18	224	--	--

ASTM SA-694/SA-694M-03
Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service

Grade	UNS	C	Mn	P	S	Si		Tensile Strength	Yield Strength	Elongation	Reduction	Hardness	Heat
								MPa	(0,2%)Mpa	%	of Area%	HB	Treatment
F42		\$0,26	s1,40	s0,025	s0,025	0,15-0,35	HEAT ANALYSIS	2415	2290	20	--	--	N, NT,QT
F46								2415	2315	220	--	--	N,NT,QT
F48								2425	2330	20	--	--	N, NT,QT
F50								2440	2345	20	--	--	N,NT,QT
F52								2455	2360	220	-	-	N, NT,QT
F56								2470	2385	220	--	--	N, NT,QT
F60								2515	2415	220	--	--	N, NT,QT
F65								2530	2450	20	--	--	N, NT, QT
F70								2565	2485	18	--	--	N,NT,QT
													PRODUCT ANALYSIS

ASME/ASTM SA-727/SA-727M-02(07)
Carbon Steel Forgings for Piping Components with inherent Notch Toughness

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength	Yield Strength	Elongation	Reduction	Hardness	Heat
										MPa	(0,2%)Mpa	%	of Area %	HB	Treatment
HEAT ANALYSIS		0,25	0,90-1,35	0,035	s0,025	0,15-0,30	\$0,40	0,30	0,12	415-585	250	22	230	-	N, NT,QT
PRODUCT ANALYSIS		0,28	0,84-1,41	0,043	0,033	0,13-0,32	s0,43	\$0,34	s0,13						
		Cu	Cb	V	(Cu+Ni+Cr+ Mo)1,00%;(Cr+Mo)0,32% ON HEAT ANALYSIS										
HEAT ANALYSIS		0,40	0,02	s0,05											
PRODUCT ANALYSIS		s0,43	\$0,03	0,055											

Heat Treatments:A Annealing, N Normalizing,NT Normalizing and Tempering, QT Quenching and Tempering



ASME/ASTM SA-182/SA-182M-07

Martensitic Stainless Steels.

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0,2%)Mpa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
F6a Class 1	S41000	0,15	\$1,00	s0,040	\$0,030	1,00	\$0,50	11,5-13,5	—	2485	2275	218	235	143-207	A, NT,T
F6a Class 2	S41000	\$0,15	1,00	0,040	0,030	1,00	s0,50	11,5-13,5	—	2585	2380	218	235	167-229	A, NT,T
F6a Class 3	S41000	0,15	\$1,00	\$0,040	0,030	1,00	\$0,50	11,5-13,5	—	2760	2585	15	235	235-302	A,NT
F6a Class 4	S41000	\$0,15	\$1,00	\$0,040	\$0,030	1,00	\$0,50	11,5-13,5	—	2895	760	12	235	263-321	A,NT
F6b	S41026	0,15	\$1,00	\$0,020	s0,020	\$1,00	1,00+-2,00	11,5-13,5	0,40-0,60	760-930	2620	216	245	235-285	A, NT
		Other elements Cus0,50													
F6NM	S41500	s0,05	0,50-1,00	\$0,030	\$0,030	\$0,60	3,5-5,5	11,5-14,0	0,50-1,00	2790	2620	215	245	s295	NT

Ferritic Stainless Steels

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0,2%)Mpa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
FXM-27Cb	S44627	\$0,010	\$040	\$0,020	\$0,020	\$0,40	\$0,50	25,0-275	0,75-1,50	2415	240	20	245	s190	A
		Other elements Cb 0,05-0,20Ns0,015Cus0,20(Ni+Cu)\$0,50													
F429	S42900	s0,12	\$1,00	s0,040	\$0,030	\$0,75	\$0,50	14,0-16,0	—	2415	2240	20	245	190	A
F430	S43000	\$0,12	\$1,00	s0,040	0,030	\$0,75	s0,50	16,0-18,0	—	2415	2240	20	245	\$190	A

Heat Treatments:A Annealing,N Normalizing,,TTempering, NT Normalizing and Tempering



ASME/ASTM SA-182/SA-182M-07
Low Alloy Steels for High Temperature Service

Grade	UNS	C	Mn	P	s	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0.2%)Mpa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
F1	K12822	\$0,28	0,60-0,90	0,045	\$0,045	0,15-0,35	--		0,44-0,65	2485	2275	220	230	143-192	A, NT
F2	K12122	0,05-0,21	0,30-0,80	0,40	\$0,40	0,10-0,60	--	0,50-0,81	0,44-0,65	2485	2275	220	230	143-192	A, NT
F5	K41545	0,15	0,30-0,60	\$0,030	0,030	\$0,50	s0,50	4,0-6,0	0,44-0,65	2485	2275	220	235	143-217	A, NT
F5a	K42544	\$0,25	\$0,60	\$0,40	\$0,030	\$0,50	s0,50	4,0-6,0	0,44-0,65	2620	2450	222	250	187-248	A, NT
F9	K90941	\$0,15	0,30-0,60	0,030	\$0,030	0,50-1,00	--	8,0-10,0	0,90-1,10	2585	2380	220	240	179-217	A, NT
F10	S33100	0,10-0,20	0,50-0,80	\$0,040	\$0,030	1,00-1,40	19,0-22,0	7,0-9,0	--	2550	2205	230	250		SQ
F91	K90901	0,08-0,12	0,30-0,60	0,020	\$0,010	0,20-0,50	\$0,40	8,0-9,5	0,85-1,05	2585	2415	220	240	s248	NT
		Other elements Cb 0,06-0,10N0,03-0,07Ak<0,02V0,18-0,25 Ti<0,01 Zr<0,01													
F92	K92460	0,07-0,13	0,30-0,60	\$0,020	\$0,010	\$0,50	\$0,40	8,50-9,50	0,30-0,60	2620	2440	220	245	s269	NT
		Other elements Cb 0,04-0,09 V0,15-0,25N0,030-0,070Al<0,02W1,50-2,00 B0,001-0,006													
F122	K91271	0,07-0,14	\$0,7	\$0,020	s0,010	0,50	0,50	10,00-11,50	0,25-0,60	2620	400	20	240	s250	NT
		Other elements Cb 0,04-0,10V0,15-0,30B0,005 N0,0040-0,100 Al0,02 Cu 0,30-1,70													
		W1,50-2,50 Ti s0,01 Zr s0,01													
F911	K91061	0,09-0,13	0,30-0,60	0,020	0,010	0,10-0,50	\$0,40	8,5-9,5	0,90-1,10	2620	2440	218	40	187-248	NT
		Other elements Cb0,060-0,10W0,90-1,10 Al0,02N0,04-0,09V0,18-0,25 B 0,0003-0,006													
		Ti s0,01 Zr s0,01													
F11 Class 1	K11597	0,05-0,15	0,30-0,60	\$0,030	s0,030	0,50-1,00	--	1,00-1,50	0,44-0,65	2415	2205	220	245	121-174	A, NT
F11 Class 2	K11572	0,10-0,20	0,30-0,80	\$0,040	s0,040	0,50-1,00	--	1,00-1,50	0,44-0,65	2485	2275	220	230	143-207	A, NT
F11 Class 3	K11572	0,10-0,20	0,30-0,80	0,040	\$0,040	0,50-1,00	--	1,00-1,50	0,44-0,65	2515	2310	220	230	156-207	A, NT
F12 Class 1	K11562	0,05-0,15	0,30-0,60	\$0,045	\$0,045	0,50MAX	--	0,80-1,25	0,44-0,65	2415	2220	220	245	121-174	A, NT
F12 Class 2	K11564	0,10-0,20	0,30-0,80	\$0,040	\$0,040	0,10-0,60	--	0,80-1,25	0,44-0,65	2485	2275	220	230	143-207	A, NT
F21	K31545	0,05-0,15	0,30-0,60	\$0,040	\$0,040	\$0,50	--	2,7-3,3	0,80-1,06	2515	2310	220	230	156-207	A, NT
F3V	K31830	0,05-0,18	0,30-0,60	\$0,020	\$0,020	\$0,10	--	2,8-3,2	0,90-1,10	585-760	2415	18	245	174-237	A, NT
		Other elements Ti 0,015-0,035V0,20-0,30 B0,001-0,003													
F3VCb	K31390	0,10-0,15	0,30-0,60	s0,020	\$0,040	\$0,10	\$0,25	2,7-3,3	0,90-1,10	585-760	2415	18	245	174-237	A, NT
		Other elements Cb0,015-0,07V0,20-0,30 Cu s0,25 Ca 0,0005-0,0150													
F22, Class 1	K21590	0,05-0,15	0,30-0,60	\$0,040	\$0,040	\$0,50	--	2,00-2,50	0,87-1,13	2415	2205	220	235	\$170	A, NT
F22, Class 3	K21590	0,05-0,15	0,30-0,60	\$0,040	\$0,040	\$0,50	--	2,00-2,50	0,87-1,13	2515	2310	220	230	156-207	A, NT
F22V	K31835	0,11-0,15	0,30-0,60	\$0,015	\$0,010	\$0,10	\$0,25	2,00-2,50	0,90-1,10	585-760	415	18	245	174-237	NT, QT
		Other elements Cbs0,07TiS0,030 CuS0,20V0,25-0,35BS0,002 Ca s0,015													
F23	K41650	0,04-0,10	0,10-0,60	0,030	\$0,010	\$0,50	--	1,90-2,60	0,05-0,30	2510	2400	220	240	s220	NT
		Other elements Cb0,02-0,08V0,20-0,30B0,0005-0,006 Ns0,03ALS0,030 W 1,45-1,75													
F24	K30736	0,05-0,10	0,30-0,70	\$0,020	\$0,010	0,15-0,45	--	2,20-2,60	0,90-1,10	2585	2415	20	40	248	NT
		Other elements Ti 0,06-0,10V0,20+-0,30N0,12Al sD,020 B 0,0015-0,0070													
FR	K22035	\$0,20	0,40-1,06	\$0,045	\$0,050	0,25-0,50	1,60-2,24	--	--	435	\$315	s25	S38	S197	A, N, NT
		Other elements Cu 0,75-1,25													
F36 CLASS 1	K21001	0,10-0,17	0,80-1,20	0,030	0,025	0,25-0,50	1,00-1,30	\$0,30	0,25-0,50	2620	440	15	--	252	NT
		Other elements Cb0,015-0,045N0,020Al0,050 Cu 0,50-0,80Vs0,02													
F36 CLASS 2	K21001	0,10-0,17	0,80-1,20	0,030	0,025	0,25-0,50	1,00-1,30	0,30	0,25-0,50	2660	460	15	--	\$252	NT, QT
		Other elements Cb 0,015-0,045 N0,020Al0,050 CU 0,50-0,80VS0,02													

Heat Treatments: A Annealing, N Normalizing, NT Normalizing and Tempering, QT Quenching and Tempering, SQ Solution Annealing and Quenching



ASMEIASTM SA-182/SA-182M-07
Austenitic Stainless Steels(1)

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0.2%)Mpa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
F304	S30400	\$0,08	\$2,00	0,045	0,030	\$1,00	8,0-11,0	18,0-20,0	—	2515	2205	230	250	—	SQ
		Other elements N0,10													
F304H	S30409	0,04-0,10	2,00	0,045	0,030	1,00	8,0-11,0	18,0-20,0	—	2515	2205	230	250	—	SQ
F304L	S30403	0,030	2,00	0,045	0,030	1,00	8,0-130	18,0-20,0	—	485	2170	30	50	--	SQ
		Other elements N s0,10													
F304N	S30451	\$0,08	\$2,00	\$0,045	s0,030	1,00	8,0-10,5	18,0-20,0	—	2550	240	230	50	—	SQ
		Other elements N 0,10-0,16													
F304LN	S30453	0,030	\$2,00	0,045	\$0,030	1,00	8,0-10,5	180-20,0	—	515	205	230	50	—	SQ
		Other elements N0,10-0,16													
F309H	S30909	0,04-0,10	2,00	\$0,045	\$0,030	1,00	12,0-15,0	22,0-24,0	—	2515	2205	230	50	--	SQ
F310	S31000	0,25	2,00	0,045	0,030	1,00	19,0-22,0	24,0-26,0	—	2515	2205	230	250	—	SQ
F310H	S31009	0,04-0,10	\$2,00	\$0,045	\$0,030	1,00	19,0-220	24,0-26,0	—	2515	2205	30	50	—	SQ
F310MOLN	S31050	\$0,030	\$2,00	\$0,030	\$0,015	\$0,40	21,0-23,0	24,0-26,0	2,00-3,00	2540	2255	230	40	—	SQ
		Other elements N 0,10-0,16													
F316	S31600	\$0,080	\$2,00	\$0,045	\$0,030	1,00	10,0-14,0	16,0-18,0	2,00-3,00	2515	2205	230	250	—	SQ
		Other elements N s0,10													
F316H	S31609	0,04-0,10	\$2,00	\$0,045	\$0,030	\$1,00	10,0-14,0	16,0-18,0	2,00-3,00	2515	2205	230	250	—	SQ
F316L	S31603	0,030	2,00	0,045	0,030	1,00	10,0-15,0	16,0-18,0	2,00-3,00	2485	2170	30	50	—	SQ
		Other elements N s0,10													
F316N	S31651	0,080	\$2,00	0,045	0,030	\$1,00	11,0-14,0	16,0-18,0	2,00-3,00	2550	2240	230	250	—	SQ
		Other elements N 0,10-0,16													
F316LN	S31653	0,030	2,00	0,045	s0,030	\$1,00	11,0-14,0	16,0-18,0	2,00-3,00	2515	2205	30	50	--	SQ
		Other elements N 0,10-0,16													
F316Ti	S31635	\$0,080	\$2,00	\$0,045	\$0,030	1,00	10,0-14,0	16,0-18,0	2,00-3,00	2515	2205	230	40	--	SQ
		Other elements N s0,105x(C+N)Ti0,70													
F317	S31700	0,080	2,00	0,045	0,030	1,00	11,0-15,0	11,0-15,0	3,0-4,0	2515	2205	230	50	--	SQ
F317L	S31703	\$0,030	2,00	0,045	\$0,030	1,00	11,0-15,0	18,0-20,0	3,0-4,0	2485	2170	230	50	--	SQ
F321	S32100	0,080	2,00	0,045	0,030	1,00	9,0-12,0	17,0-19,0		2515	2205	230	50	--	SQ
		Other elements 5xCTi0,70													
F321H	S32109	0,04-0,10	2,00	0,045	0,030	1,00	9,0-12,0	17,0-19,0		2515	2215	230	50	--	SQ
		Other elements 4xCTi0,70													
F347	S34700	0,080	2,00	0,045	\$0,030	1,00	9,0-13,0	170-20,0		2515	2205	230	50	--	SQ
		Other elements 10xCb1,10													
F347H	S34709	0,04-0,10	2,00	0,045	0,030	1,00	9,0-13,0	17,0-20,0		2515	2205	30	50	—	SQ
		Other elements 8xCb1,10													

Heat Treatment: SQ Solution Anneal and Quenching



ASMEIASTM SA-182/SA-182M-07
Austenitic Stainless Steels(2)

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0,2%)Mpa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
F348	S34800	\$0,080	2,00	0,045	0,030	1,00	9,0-13,0	17,0-20,0		515	2205	30	250		SQ
		Other elements Co s0,20 Tas0,1010xCsCb\$1,10													
F348H	S34809	0,04-0,10	2,00	\$0,045	\$0,030	1,00	9,0-130	17,0-20,0		2515	2205	230	250	-	SQ
		Other elements Cos0,20 Tas0,108xCCb1,10													
FXM-11	S21904	\$0,040	8,0-10,0	\$0,060	\$0,030	1,00	5,5-7,5	19,0-21,5		2620	2345	45	260	-	SQ
		Other elements N0,15-040													
FXM-19	S20910	\$0,060	4,0-6,0	\$0,040	\$0,030	\$1,00	11,5-13,5	20,5-23,5	1,5-3,0	2690	2380	235	255	-	SQ
		Other elements Cb 0,10-0,30N0,20-0,40V0,10-0,30													
F20	N08020	\$0,070	\$2,00	\$0,045	\$0,035	1,00	32,0-38,0	19,0-21,0	2,0-3,0	2550	240	230	250	-	SQ
		Other elements Cu3,0-4,0(8xC)Cb 1,00													
F44	S31254	s0,020	51,00	\$0,030	\$0,010	\$0,80	17,5-18,5	19,5-20,5	6,0-6,5	2650	2300	235	250	-	SQ
		Other elements Cu0,50-1,00N0,18-0,22													
F45	S30815	0,05-0,10	\$0,80	\$0,040	\$0,030	1,40-2,00	10,0-12,0	20,0-22,0		600	310	240	250	-	SQ
		Other elements N 0,14-0,20 Ce 0,03-0,08													
F46	S30600	s0,018	s2,00	\$0,020	\$0,020	3,7-4,3	14,0-15,5	17,0-18,5	\$0,20	2540	2240	240	250	-	SQ
		Other elements Cu s0,50													
F47	S31725	\$0030	\$2,00	0,045	0,030	\$0,75	13,0-17,5	18,0-20,0	4,0-5,0	2525	2205	40	250	-	SQ
		Other elements N s0,10													
F48	S31726	\$0,030	\$2,00	s0,045	s0,030	s0,75	13,5-17,5	17,0-20,0	4,0-5,0	2550	2240	240	250	-	SQ
		Other elements N 0,10-0,20													
F49	S34565	\$0,030	5,0-7,0	\$0,030	\$0,010	\$1,00	16,0-18,0	23,0-25,0	4,0-5,0	795	2415	235	240	-	SQ
		Other elements Cb s0,10 N 0,40-0,60													
F56	S33228	0,04-0,08	\$1,00	s0,020	s0,015	\$0,30	31,0-33,0	26,0-28,0		2500	2185	30	235	-	SQ
		Other elements Cb 0,6-1,0Ce 0,05-0,10 Als0,025													
F58	S31266	\$0030	2,04.0	\$0,035	\$0,020	\$1,00	21,0-24,0	23,0-25,0	5,2-6,2	2750	2420	235	250	-	SQ
		Other elements N0,35-060 Cu1,00-2,50W1,50-2,50													
F62	N08367	\$0,030	2,00	\$0,040	\$0,030	\$1,00	23,5-25,5	20,0-22,0	6,0-7,0	2655	2310	230	250	-	SQ
		Other elements N 0,18-0,25 Cu0,75													
F63	S32615	\$0070	2,00	\$0,045	\$0,030	4,8-6,0	19,0-22,0	16,5-19,5	0,30-1,50	2550	2220	25	-	\$192	SQ
		Other elements Cu 1,50-2,50													
F64	S30601	\$0,015	0,50-0,80	\$0,030	\$0,013	5,0-56	17,0-18,0	17,0-18,0	\$0,20	2620	275	235	250	217	SQ
		Other elements Cu s0,35 N0,05													
F904L	N08904	s0,020	2,00	0,040	\$0,030	1,00	23,0-28,0	19,0-23,0	4,0-5,0	2490	2215	235	-		SQ
		Other elements Cu 1,00-2,00N0,10													

Heat Treatment: SQ Solution Annealing and Quenching



ASME/ASTM SA-182/SA-182M-07
Ferritic-Austenitic Stainless Steels (Duplex)

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0.2%)Mpa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
F50	S31200	\$0,030	s2,00	s0,045	0,030	\$1,00	5,5-6,5	24,0-26,0	1,20-2,00	690-900	2450	225	250	—	SQ
		Other elements N 0,14-0,20													
F51	S31803	s0,030	s2,00	0,030	\$0,020	\$1,00	4,5-6,5	21,0-23,0	2,5-3,5	2620	2450	225	45	—	SQ
		Other elements N 0,08-0,20													
F52	S32950	\$0,030	s2,00	0,035	\$0,010	\$0,60	3,5-5,2	26,0-29,0	1,00-2,50	2690	2485	15	—	—	SQ
		Other elements N 0,15-0,35													
F53	S32750	s0,030	\$1,20	\$0,035	\$0,020	\$0,80	6,0-8,0	24,0-26,0	3,0-5,0	2800	2550	15	—	\$310	SQ
		Other elements N 0,24-0,32 Cu s0,50													
F54	S39274	\$0,030	1,00	0,030	s0,020	\$0,80	6,0-8,0	24,0-26,0	2,5-3,5	2800	2550	15	30	s310	SQ
		Other elements N 0,24-0,32 Cu 0,200,80W 1,50-250													
F55	S32760	\$0,030	\$1,00	s0,030	\$0,010	\$1,00	6,0-8,0	24,0-26,0	3,0-4,0	750-895	2550	225	245	—	SQ
		Other elements N 0,20-0,30 Cu0,50-1,00 W0,50-1,00													
F57	S39277	s0,025	s0,80	\$0,025	s0,002	\$0,80	6,5-8,0	240-26,0	3,0-4,0	2820	2585	25	250	—	SQ
		Other elements Cu 1,20-2,00 W0,80-1,20N0,23-0,33													
F59	S32520	s0,030	\$1,5	s0,035	s0,020	s0,80	5,5-8,0	24,0-26,0	3,0-5,0	2770	2550	225	240	—	SQ
		Other elements N0,20-0,35 Cu 0,50-3,00													
F60	S32205	\$0,030	s2,00	s0,030	\$0,020	\$1,00	4,56,5	22,0-23,0	3,0-3,5	2655	2485	225	245	—	SQ
		Other elements N 0,14-0,20													
F61	S32550	\$0,040	\$1,50	\$0,040	\$0,030	\$1,00	4,5-6,5	24,0-270	2,9-3,9	2750	2550	25	250	—	SQ
		Other elements Cu 1,50-2,50 N0,10-0,25													
F65	S32906	s0,030	0,80-1,50	\$0,030	\$0,030	s0,80	5,8-7,5	28,0-30,0	1,5-2,6	2750	2550	25	—	—	SQ
		Other elements Cus0,80N 0,30-0,40													

Heat Treatment: SQ Solution Annealing and Quenching



ASME/ASTM SA-350/SA-350M-03
Carbon and Low Alloy Steel Forgings For Low Temperature Service.

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Tensile Strength MPa	Yield Strength (0,2%)MPa	Elongation %	Reduction of Area %	Hardness HB	Heat Treatment
LF1	K03009	\$0,30	0,60-1,35	s0,035	\$0,040	0,15-0,30	0,40	\$0,30	\$0,12	415-585	2205	225	238	197	N,NT,QT
		Other elements Cus0,40Cbs0,02Vs0,08(Cu+Ni+Cr+V+Mo)S1,00(Cr+Mo)0,32													
LF2 Class 1	K03011	s0,30	0,60-1,35	s0,035	\$0,040	0,15-0,30	\$0,40	\$0,30	\$0,12	485-655	2250	222	230	\$197	N,NT,QT
LF2 Class 2		Other elements Cus0,40 Cb0,02Vs0,08(Cu+N+Cr+V+Mo)1,00(Cr+Mo)s0,32								485-655	2250	222	230	\$197	N,NT,QT
LF3 Class 1	K32025	\$0,20	\$0,90	s0,035	s0,040	0,20-0,35	3,3-3,7	\$0,30	\$0,12	485-655	250	222	235	197	N,NT,QT
LF3 Class 2		Other elements Cbs0,02V0,03(Cr+Mo)S0,32								485-655	2250	22	235	\$197	N,NT,QT
LF5 Class 1	K13050	s0,30	0,60-1,35	s0,035	s0,040	0,20-0,35	1,0-2,0	s0,30	\$0,12	415-585	2205	225	238	\$197	N,NT,QT
LF5 Class 2		Other elements Cbs0,02Vs0,03								485-655	250	222	235	\$197	N,NT,QT
LF6 Class 1	K12202	s0,22	1,15-1,50	s0,025	s0,025	0,15-0,30	\$0,40	s0,30	\$0,12	455-630	2360	22	240	\$197	N,NT,QT
LF6 Class 2		Other elements Cbs0,02V0,04-0,11 N0,01-0,030								515-690	2415	220	240	\$197	N,NT,QT
LF9	K22036	\$0,20	0,40-1,06	0,035	\$0,040		1,60-2,24	\$0,30	\$0,12	435-605	2315	25	238	\$197	N,NT,QT
		Other elements Cbs0,02Vs0,03													
LF787 Class 2	K20747	\$0,07	0,40-0,70	s0,025	\$0,025	\$0,40	0,70-1,00	0,60-0,90	0,15-0,25	450-585	2380	220	245	\$197	NP,QP
LF787 Class 3		Other elements Cbs0,02Vs0,03								515-655	2450	220	245	\$197	NP,QP

Heat Treatments: N Normalizing,NT Normalizing and Tempenng,QT Quenching and Tempenng,NP Normalized and Precipitation Heat Treated, QP Quenched and Precipitation Heat Treated

Charpy V-Notch Energy Requirements for Standard Size (10x 10 mm) Specimens

Grade	Test Temperature C	Minimum impact Energy Required for Average of Each Set of Three Specimens	Minimum impact Energy for One Specimen only of a Set
		Joules	Joules
LF1	-29	18	14
LF2 Class 1	-46	20	16
LF2 Class 2	-18	27	20
LF3 Class 1	-101	20	16
LF3 Class 2	-101	27	20
LF5 Class 1	-59	20	16
LF5 Class 2	-59	20	16
LF6 Class 1	-51	20	16
LF6 Class 2	-51	27	20
LF6 Class 3	-18	27	20
LF9	-73	18	14
LF787 Class 2	-59	27	20
LF787 Class 3	-73	27	20



STEEL FORGINGS FOR THE PRESSURE VESSEL INDUSTRY

ASME/ASTM A 266/A 266M-03

Carbon Steel Forgings for Pressure Vessel Components

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Cb	Ti	Tensile Strength MPa	Yield Strength (0,2%)Mpa	Elongation %	Reduction of Area %	Heat Treatment
1	K03506	\$0,30	0,40-1,05	s0,025	s0,025	0,15-0,35	---	---	---	---	---	415-585	2205	23	38	A,N,NT,QT
2	K03506	\$0,30	0,40-1,05	0,025	\$0,025	0,15-0,35	---	---	---	---	---	485-655	2250	20	33	A,N,NT,QT
3	K05001	\$0,35	0,80-1,35	s0,025	s0,025	0,15-0,35	---	---	---	---	---	515-690	2260	19	30	A,N,NT,QT
4	K03017	\$0,30	0,80-1,35	0,025	0,025	0,15-0,35	---	---	---	---	---	485-655	2250	20	33	A,N,NT,QT

ASME/ASTM A 336/A 336M-07

Alloy Steel Forgings for Pressure and High Temperature Parts

Grade	UNS	C	Mn	P	S	Si	Ni	Cr	Mo	Cb	Ti	Tensile Strength MPa	Yield Strength (0,2%)Mpa	Elongation %	Reduction of Area %	Heat Treatment
F1	K12520	0,20-0,30	0,60-0,80	s0,025	\$0,025	0,20-0,35	---	---	0,40-0,60	---	---	485-660	2275	20	40	A, NT,QT
F11, Class 2	K11572	0,10-0,20	0,30-0,80	\$0,025	\$0,025	0,50-1,00	---	1,00-1,50	0,45-0,65	---	---	485-660	2275	20	40	A, NT, QT
F11,Class 3	K11572	0,10-0,20	0,30-0,80	0,025	\$0,025	0,50-1,00	---	1,00-1,50	0,45-0,65	---	---	515-690	2310	18	40	A, NT QT
F11,Class 1	K11597	0,05-0,15	0,30-0,60	s0,025	\$0,025	0,50-1,00	---	1,00-1,50	0,45-0,65	---	---	415-585	2205	20	45	A,NT QT
F12	K11564	0,10-0,20	0,30-0,80	0,025	\$0,025	0,10-0,60	---	0,80-1,10	0,45-0,65	---	---	485-660	2275	20	40	A,NT QT
F5	K41545	\$0,15	0,30-0,60	0,025	\$0,025	\$0,50	s0,50	4,0-6,0	0,45-0,65	---	---	415-585	2250	20	40	A,NT,QT
F5A	K42544	\$0,25	\$0,60	\$0,025	\$0,025	\$0,50	\$0,50	4,0-6,0	0,45-0,65	---	---	550-725	2345	19	35	A,NT QT
F9	K90941	\$0,15	0,30-0,60	\$0,025	s0,025	0,50-1,00	---	8,0-10,0	0,90-1,10	---	---	585-760	2380	20	40	A, NT, QT
F6	S41000	\$0,12	\$1,00	\$0,025	s0025	\$1,00	0,50	11,5-13,5	---	---	---	585-760	2380	18	35	A, NT, QT
F21, Class1	K31545	0,05-0,15	0,30-0,60	0,025	\$0,025	\$0,50	---	2,7-3,3	0,80-1,06	---	---	415-585	2205	20	45	A,NT,QT
F21, Class 3	K31545	0,05-0,15	0,30-0,60	s0,025	s0,025	s0,50	---	2,7-3,3	0,80-1,06	---	---	515-690	2310	19	40	A,NT,QT
F22, Class1	K21590	0,05-0,15	0,30-0,60	0,025	\$0,025	\$0,50	---	2,00-2,50	0,90-1,10	---	---	415-585	2205	20	45	A, NT QT
F22, Class 3	K21590	0,05-0,15	0,30-0,60	0,025	\$0,025	\$0,50	---	2,00-2,50	0,90-1,10	---	---	515-690	2310	19	40	A, NT QT
F91	K90901	0,08-0,12	0,30-0,60	\$0,025	\$0,025	0,20-0,50	0,40	8,0-9,5	0,85-1,05	0,06-0,10	\$0,01	585-760	2415	20	40	A, NT,QT
		Other elements V0,18-0,25Ni0,03-0,07Als0,02 Zrs0,01														
F911	K91061	0,09-0,13	0,30-0,60	0,020	\$0,010	0,10-0,50	0,40	8,5-9,5	0,90-1,10	0,06-0,10	\$0,01	620-830	2440	20	40	A NT, QT
		Other elements V0,18-0,25Ni0,04-0,09Als0,02B0,0003-0,006W0,90-1,10Zr0,01														
F3V	K31830	0,10-0,15	0,30-0,60	0,020	\$0,020	0,10	---	2,7-3,3	0,90-1,10	---	0,015-0,035	585-760	2415	18	45	A, NT, QT
		Other elements V0,20-0,30 B0,001-0,003														
F3VCb	K31390	0,10-0,15	0,30-0,60	\$0,020	\$0,010	\$0,10	0,25	2,7-3,3	0,90-1,10	0,015-0,070	0,015	585-760	2415	18	45	A, NT QT
		Other elements V0,20-0,30Cu0,25 Ca 0,0005-0,0150														
F22V	K31835	0,11-0,15	0,30-0,60	0,015	\$0,010	\$0,10	0,25	2,00-2,50	0,90-1,10	0,07	0,030	585-760	2415	18	45	NT, QT
		Other elements V0,25-0,35B0,0020 Cu0,20 Ca \$0,015														

Heat Treatments:A Annealing, N Normalizing, NT Normalizing and Tempering, QT Quenching and Tempering



ALEACIONES DE ALTO CONTENIDO EN NIQUEL
HIGH NICKEL ALLOYS
ALLIAGES A HAUT CONTENU DE NICKEL
HOCHNICKEL LEGIERUNGEN

Alloy	UNS	DIN	Werkstoff	N	Cr	Fe	Si	Mo	Co	Nb	C	P	S	Al	Ti	N	Cu	Mn	Other elements
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Aleaciones resistentes a la corrosión/ Corrosion resistant alloys/ Alliages résistants à la corrosion/Korrosionbestandige

200	N02200	Ni99,2	24066	299,2		\$0,40	0,25	—	—		0,10		s0,005		0,10	—	0,25	0,35	Mgs0,15
201	N 02201	LC-Ni99	24068	2.99.0	—	0,40	025				0,02		\$0,005		\$0,10		0,25	0,35	Mg\$0,15
400	N 04400	NiCu30Fe	2.4360	263,0		1,0-2,5	0,50	—	—	—	\$0,15	—	\$0,020	0,5	0,30		28,0-34,0	2,00	Als0,50
K-500	N 05500	NiCu30Al	2.4375	263,0		0,50-2,0	0,50	—	—	—	\$0,20		\$0,015	2,20-350	0,30-1,00		27,0-340	1,50	
B-2	N 10665	NiMo28	2.4617	Balance	\$ 1.00	2,00	0,08	26,0-30,0	1,0		\$0,010	0,025	0,015		—		0,50	1,00	
B4	N10629	NiMo29Cr	2.4600	265,0	0,50-3,0	1,0-6,0	0,10	26,0-32,0	\$3.0	\$0,40	\$0,010	\$0,025	s0,015	0,10-050	0,20	—	0,50	3,00	Ws3,0Vs0,20
C-4	N 06455	NiMo16Cr16Ti	2.4610	Balance	14,0-18,0	33,0	0,08	14,0-17,0	2,0	—	\$0,015	0,025	s0,015		0,70	—	\$0,50	1,00	
617	N06617	NiCr23Co12Mo	2.4663	Balance	20,0-23,0	\$2,0	0,20	8,50-10,0	11,0-14,0		10,05-0,10	\$0,010	s0,010	0,70-1,40	0,20-0,60	—	0,50	0,20	B\$0,006
625	N 06625	NiCr22Mo9Nb	2.4856	258,0	20,0-23,0	\$5,0	\$ 0,50	8,0-10,0	\$ 1.00	3,15-4,15	\$0,10	\$0,020	s0,015	50,40	\$0,40	—	\$0,50	0,50	
59	N 06059	NiCr23Mo16Al	2.4605	Balance	22,0-24,0	\$1,5	0,10	15,0-17,0	\$0,30		\$0,010	\$0,025	\$0,015	0,10-0,40		—	\$0,50	0,50	
C-276	N10276	NiMo16Cr15W	24819	Balance	14,5-16,5	4,0-7,0	0,08	15,0-17,0	\$2,50		\$0,010	\$0,020	0,015	—	—	—	0,50	1,00	Ws3,00Vs0,35
C-22	N06022	NiCr21Mo14W	2.4602	Balance	20,0-22,5	2,0-6,0	\$ 0,08	12,5-14,5	\$ 2,50	—	\$ 0,010	s0,025	s0,015	—	—	—	52,50	0,50	Ws2,50Vs0,35
718	N07718	NiCr19NbMo	2.4668	50,0-55,0	17,0-21,0	Balance	\$0,35	2,80-3,30	\$ 1,00	4,70-5,50	0,02-0,08	\$0,015	80,015	0,30-0,70	0,60-1,20		\$0,30	0,35	B 0,002-0,006
600L	N06600	LC-NiCr15Fe	24817	272,0	14,0-17,0	6,0-10,0	0,50		\$1,00	—	\$0,025	\$0,020	s0,015	0,30	0,30	—	0,50	1,00	Bs0,006
825	N 08825	NiCr21Mo	2.4858	38,0-46,0	19,5-23,5	Balance	0,50	2,50-3,50	1,00		0,025	\$0,020	\$0,015	50,20	0,60-1,20	—	1,50-3,00	1,00	
20	N 08020	NiCr20CuMo	2.4660	32,0-38,0	19,0-21,0	Balance	1,00	2,00-3,00	1,50	28xC21,00	\$0,07	\$0,025	\$0,015	—	—	—	3,00-400	2,00	
31	N08031	X1NiCrMoCu 32287	1.4562	30,0-32,0	26,0-28,0	Balance	30,30	6,00-7,00	—	—	50015	\$0,020	\$0,010	—	—	0,15-0,25	1,00-1,40	2,00	
28	N 08028	X1NiCrMoCuN 31274	1.4563	30,0-32,0	26,0-28,0	Balance	0,70	3,00-4,00	—	—	\$0,020	\$0,030	s0,010	—	—	\$0,11	0,70-1,50	2,00	
926	N08926	NiCrMoCuN 25206	1.4529	24,0-26,0	19,0-21,0	Balance	050	6,00-7,00	—	—	\$0,020	\$0,030	\$0,010	—	—	0,15-0,25	0,50-1,50	51,00	
CuNi70/30	C 71500	CuNi30Mn1Fe	2.0882	30,0-32,0		0,4-1,0			—	—	—	—	—	—	—	—	Balance	0,50-1,00	
CuNi90/10	C70600	CuNi10Fe1Mn	2.0872	9,0-11,0	—	1,0-1,8	—	—	—	—	—	—	—	—	—	—	Balance	0,20-1,00	Zn\$0,5

Aleaciones resistentes al calor/ Heat resistant alloys /Hochwarmfeste legierungen/ Alliages pour utilisation a températures élevées

75	N06075	NiCr20Ti	2.4951	Balance	18,0-21,0	\$5,00	\$1,00	1,0	5,00	—	0,08-0,16	0,020	\$0,015	0,30	0,20-0,60	—	0,50	1,00	B\$0,006
600	N06600	NiCr15Fe	2.4816	272,0	14,0-17,0	6,00-10,00	0,50		1,00		10,05-0,10	\$0,020	\$0,015	0,30	\$0,30		0,50	1,00	B\$0,006
601	N 06601	NiCr23Fe	2.4851	58,0-63,0	21,0-25,0	\$18,00	\$0,50		\$1,00		10,03-0,10	s0,020	\$0,015	1,00-1,70	\$0,50	—	0,50	\$1,00	B\$0,006
DS		X8NiCrSi 38-18	1.4862	35,0-39,0	17,0-19,0	Balance	150-2,50			—	30,10	\$0,030	\$0,030	—	50,20	—	0,50	0,80-1,50	
330	N 08330	X12NiCrSi 36-16	1.4864	33,0-37,0	15,0-17,0	Balance	1,00-2,00	—			\$0,15	\$0,045	\$0,015			0,11	—	2,00	
80A	N 07080	NiCr20TiAl	2.4952	265,0	18,0-21,0	1,50	1,00	—	\$1,00	—	0,04-0,10	\$0,020	\$0,015	1,00-1,80	1,80-2,70	—	0,20	1,00	
602CA	N06025	NiCr25FeAlY	2.4633	Balance	24,0-26,0	8,00-11,00	0,50				0,15-0,25	\$0,020	s0,010	1,80-2,40	0,10-0,40	—	0,10	\$0,50	Y0,05-0,12Zr0,01-0,10
617	N 06617	NiCr23Co12Mo	2.4663	Balance	20,0-23,0	2,00	0,20	8,50-10,0	11,0-14,0	—	0,05-0,10	\$0,010	0,010	0,70-1,40	0,20-0,60		0,50	0,20	B 0,006
718	N07718	NiCr19Fe19Nb5Mo3	24668	50,0-55,0	17,0-21,0	Balance	0,35	280-3,30	\$1,00	4,70-5,50	0,02-0,08	\$0,015	\$0,015	0,30-0,70	0,60-1,20	—	0,30	0,35	B\$0,006
800HT	N08811	X8NiCrAlTi32-21	1.4959	30,0-34,0	19,0-22,0	Balance	0,70		0,50		0,05-0,10	\$0,015	\$0,010	0,20-0,65	0,25-0,65	0,030	0,50	\$1,50	
800H	N08810	X5NiCrAlTi 31-20	1.4958	30,0-32,5	19,0-22,0	Balance	0,70	—	\$0,50	0,10	0,03-0,08	0,015	0,010	0,20-0,50	0,20-0,40	\$0,030	0,50	1,50	
NiCr80/20	N 06003	NiCr80-20	2.4869	275,0	19,0-21,0	1,00	0,50-2,00		1,00	—	0,15	\$0,020	\$0,015	0,30		—	0,50	1,00	
NiCr70/30	N06008	NiCr70-30	24658	260,0	29,0-32,0	\$5,00	0,50-2,00		1,00	—	50,10	\$0,020	\$0,015	\$0,30	—	—	0,50	1,00	
36	K 93600	Ni36	1.3912	35,0-37,0		Balance	0,50	—	—	—	0,10	—	—	—	—	—	—	0,50	