

TABLE 4 Continued

Grade Symbol	Electrodes ^A	Recommended Preheat and Interpass Temperature Range, °F [°C]	Post Weld Heat-Treatment Temperature, Minimum or Range, °F [°C]
F 49	2100 [1150] + WQ
F 58	E NiCrMo-10	...	2100 [1150] + WQ
F 62	E NiCrMo-3	NR	2025 [1105] + WQ
F 904L	E NiCrMo-3	NR	1920–2100 [1050–1150] + WQ
Ferritic-Austenitic Stainless Steels			
F 50	25 % Cr, 6 % Ni, 1.7 % Mo	NR	NR
F 51	22 % Cr, 5.5 % Ni, 3 % Mo	NR	NR
F 52	26 % Cr, 8 % Ni, 2 % Mo	NR	NR
F 53	25 % Cr, 7 % Ni, 4 % Mo	NR	NR
F 54	25 % Cr, 7 % Ni, 3 % Mo, W	NR	NR
F 55	25 % Cr, 7 % Ni, 3.5 % Mo	NR	NR
F 57	25 % Cr, 7 % Ni, 3 % Mo, 1.5 % Cu, 1 % W	NR	NR
F 59	E Ni CrMo-10	NR	NR
F 60	22 % Cr, 5.5 % Ni, 3 % Mo	NR	NR
F 61	26 % Cr, 9 % Ni, 3.5 % Mo	NR	NR
F 65	29 % Cr, 6.5 % Ni, 2 % Mo	NR	NR
F 66	22 % Cr, 2 % Ni, 0.25 % Mo	NR	NR
F 67	...	NR	NR

^A Except for Grades F 91, F 92, F 911, F 122, F 47, F 48, and F 49, electrodes shall comply with AWS Specifications A5.4/A5.4M, A5.5/A5.5M, A5.9/A5.9M, A5.11/A5.11M, A5.14/A5.14M, A5.23/A5.23M, or A5.28/A5.28M.

^B Purchaser approval required.

^C All repairs in F 91 shall be made with one of the following welding processes and consumables: SMAW, A5.5/A5.5M E90XX-B9; SAW, A5.23/A5.23M EB9 + flux; GTAW, A5.28/A5.28M ER90S-B9; and FCAW, A5.29/A5.29M E91T1-B9. In addition, the sum of the Ni+Mn content of all welding consumables shall not exceed 1.0 %.

^D All repairs in F 92, F 911, and F 122, shall be made using welding consumables meeting the chemical requirements for the grade in Table 2.

^E Preheat and PWHT are not required for this grade for forgings whose section thickness does not exceed 0.500 in. [12.7 mm].

^F NR = not required.

^G WQ = water quench.

^H Filler metal shall additionally have 0.04 % minimum carbon.

^I Matching filler metal is available.

^J Match filler metal is available. Fabricators have also used AWS A5.14/A5.14M, Classification ERNiCrMo-3 and AWS A5.11/A5.11M, Class E, ENiCrMo-3 filler metals.

15.1.3 Defects shall be completely removed prior to welding by chipping or grinding to sound metal as verified by magnetic-particle inspection in accordance with Test Method A275/A275M for the low alloy steels and ferritic, martensitic, or ferritic-austenitic stainless steels, or by liquid-penetrant inspection in accordance with Test Method E165 for all grades.

15.1.4 After repair welding, the welded area shall be ground smooth to the original contour and shall be completely free of defects as verified by magnetic-particle or liquid-penetrant inspection, as applicable.

15.1.5 The preheat, interpass temperature, and post-weld heat treatment requirements given in Table 4 shall be met. Austenitic stainless steel forgings may be repair-welded without the post-weld heat treatment of Table 4, provided purchaser approval is obtained prior to repair.

15.1.6 Repair by welding shall not exceed 10 % of the surface area of the forging nor $3\frac{1}{3}$ % of the wall thickness of the finished forging or $\frac{3}{8}$ in. [9.5 mm], whichever is less, without prior approval of the purchaser.

15.1.7 When approval of the purchaser is obtained, the limitations set forth in 15.1.6 may be exceeded, but all other requirements of Section 15 shall apply.

15.1.8 No weld repairs are permitted for F 6a Classes 3 and 4.

15.1.9 Post-weld heat treatment times for F 36 are: for Class 1, up to 2 in. [50 mm] in thickness, 1 h per in. [25 mm], 15 minutes minimum, and over 2 in. [50 mm], 15 minutes for each additional in. of thickness or fraction thereof; for Class 2, 1 h per in. [25 mm], $\frac{1}{2}$ h minimum.

16. Inspection

16.1 Inspection provisions of Specification A961/A961M apply.

17. Rejection and Rehearing

17.1 The purchaser shall comply with the provisions of Specification A961/A961M.

18. Certification

18.1 In addition to the certification requirements of Specification A961/A961M, test reports shall be furnished to the purchaser or his representative.

18.2 Test reports shall include certification that all requirements of this specification have been met. The specification designation included on test reports shall include year of issue and revision letter, if any. The manufacturer shall provide the following where applicable:

18.2.1 Type heat treatment, Section 7,

18.2.2 Product analysis results, Section 8 of Specification A961/A961M,

18.2.3 Tensile property results, Section 9 (Table 3), report the yield strength and ultimate strength, in ksi [MPa], elongation and reduction in area, in percent,

18.2.4 Chemical analysis results, Section 8 (Table 2),

18.2.5 Hardness results, Section 9 (Table 3, and for F23, Tables 2 and 3),

18.2.6 Grain size results, Section 10, and

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P-No.	Grp. No.	Spec. No.	Type, Grade, or UNS No.	P-No.	Grp. No.	Spec. No.	Type, Grade, or UNS No.
Steel and Steel Alloys <i>(Cont'd)</i>				Steel and Steel Alloys <i>(Cont'd)</i>			
9A	1	A/SA-350	LF5, Cl. 1	10H	1	A/SA-789	S31260
9A	1	A/SA-350	LF5, Cl. 2	10H	1	A/SA-789	S31500
9A	1	A/SA-350	LF9	10H	1	A/SA-789	S31803
9A	1	A/SA-352	LC2	10H	1	A/SA-789	S32003
9A	1	A/SA-420	WPL9	10H	1	A/SA-789	S32101
9A	1	A714	Gr. V	10H	1	A/SA-789	S32202
9A	1	A714	Gr. V, Tp. E	10H	1	A/SA-789	S32205
9B	1	A/SA-203	D	10H	1	A/SA-789	S32304
9B	1	A/SA-203	E	10H	1	A/SA-789	S32550
9B	1	A/SA-203	F	10H	1	A/SA-789	S32750
9B	1	A/SA-333	3	10H	1	A/SA-789	S32760
9B	1	A/SA-334	3	10H	1	A/SA-789	S32900
9B	1	A/SA-350	LF3, Cl. 2	10H	1	A/SA-789	S32906
9B	1	A/SA-352	LC3	10H	1	A/SA-789	S32950
9B	1	A/SA-420	WPL3	10H	1	A/SA-789	S39274
9B	1	A/SA-765	III	10H	1	A/SA-790	S31200
9C	1	A/SA-352	LC4	10H	1	A/SA-790	S31260
10A	1	A/SA-225	C	10H	1	A/SA-790	S31500
10A	1	A/SA-225	D	10H	1	A/SA-790	S31803
10A	1	A/SA-487	Gr. 1, Cl. A	10H	1	A/SA-790	S32003
10A	1	A/SA-487	Gr. 1, Cl. B	10H	1	A/SA-790	S32101
10A	1	SA/NF A 36-215	NJ4	10H	1	A/SA-790	S32202
10B	1	A/SA-213	T17	10H	1	A/SA-790	S32205
10C	1	A/SA-612	...	10H	1	A/SA-790	S32304
10H	1	A/SA-182	F53	10H	1	A/SA-790	S32550
10H	1	A/SA-182	F50	10H	1	A/SA-790	S32750
10H	1	A/SA-182	F51	10H	1	A/SA-790	S32760
10H	1	A/SA-182	F54	10H	1	A/SA-790	S32900
10H	1	A/SA-182	F55	10H	1	A/SA-790	S32906
10H	1	A/SA-182	S32202	10H	1	A/SA-790	S32950
10H	1	A/SA-182	F60	10H	1	A/SA-790	S39274
10H	1	A/SA-240	S31200	10H	1	A/SA-815	S31803
10H	1	A/SA-240	S31260	10H	1	A/SA-815	S32202
10H	1	A/SA-240	S31803	10H	1	A/SA-815	S32101
10H	1	A/SA-240	S32003	10H	1	A/SA-815	S32205
10H	1	A/SA-240	S32101	10H	1	A/SA-815	S32750
10H	1	A/SA-240	S32202	10H	1	A/SA-815	S32760
10H	1	A/SA-240	S32205	10H	1	A890	J93380
10H	1	A/SA-240	S32550	10H	1	A890	J92205
10H	1	A/SA-240	S32750	10H	1	A928	S32760
10H	1	A/SA-240	S32760	10H	1	A928	S32205
10H	1	A/SA-240	S32906	10H	1	A/SA-995	J93345
10H	1	A/SA-240	S32950	10H	1	A/SA-995	J93372
10H	1	A/SA-240	Type 329	10H	1	A/SA-995	J93380
10H	1	A/SA-276	S32205	10H	1	A/SA-995	J92205
10H	1	A/SA-351	CD3MWCuN	10I	1	A/SA-182	FXM-27Cb
10H	1	A/SA-479	S31803	10I	1	A/SA-240	S44635
10H	1	A/SA-479	S32202	10I	1	A/SA-240	Type XM-27
10H	1	A/SA-479	S32101	10I	1	A/SA-240	Type XM-33
10H	1	A/SA-479	S32205	10I	1	A/SA-268	25-4-4
10H	1	A/SA-479	S32550	10I	1	A/SA-268	TP446-1
10H	1	A/SA-479	S32750	10I	1	A/SA-268	TP446-2
10H	1	A/SA-479	S32906	10I	1	A/SA-268	TPXM-27
10H	1	A/SA-789	S31200	10I	1	A/SA-268	TPXM-33
				10I	1	A/SA-336	FXM-27Cb
				10I	1	A/SA-479	XM-27
				10I	1	A/SA-731	TPXM-27

ASTM/ASME		Type or grade	UNS No.	ASME/AWS		ISO/TR 15608:2005 ^[1] group	Nominal composition
Specification	No.			P or M No.	Group No.		
A/SA	182	F304N	S30451	8	1	8.1	18Cr-8Ni-N
A/SA	182	F310	S31000	8	2	8.2	25Cr-20Ni
A/SA	182	F310MoLN	S31050	8	2	8.2	25Cr-22Ni-2Mo-N
A/SA	182	F316	S31600	8	1	8.1	16Cr-12Ni-2Mo
A/SA	182	F316H	S31609	8	1	8.1	16Cr-12Ni-2Mo
A/SA	182	F316L	S31603	8	1	8.1	16Cr-12Ni-2Mo
A/SA	182	F316LN	S31653	8	1	8.1	16Cr-12Ni-2Mo-N
A/SA	182	F316N	S31651	8	1	8.1	16Cr-12Ni-2Mo-N
A/SA	182	F317	S31700	8	1	8.1	18Cr-13Ni-3Mo
A/SA	182	F317L	S31703	8	1	8.1	18Cr-13Ni-3Mo
A/SA	182	F321	S32100	8	1	8.1	18Cr-10Ni-Ti
A/SA	182	F321H	S32109	8	1	8.1	18Cr-10Ni-Ti
A/SA	182	F347	S34700	8	1	8.1	18Cr-10Ni-Cb
A/SA	182	F347H	S34709	8	1	8.1	18Cr-10Ni-Cb
A/SA	182	F348	S34800	8	1	8.1	18Cr-10Ni-Cb
A/SA	182	F348H	S34809	8	1	8.1	18Cr-10Ni-Cb
A/SA	182	F3V	K31830	5C	1	6.2	3Cr-1Mo-V-Ti-B
A/SA	182	F3VCb	—	5C	1	6.2	3Cr-1Mo-0.25V-Cb-Ca
A/SA	182	F429	S42900	6	2	7.2	15Cr
A/SA	182	F430	S43000	7	2	7.1	17Cr
A/SA	182	F44	S31254	8	4	8.2	20Cr-18Ni-6Mo
A/SA	182	F45	S30815	8	2	8.2	21Cr-11Ni-N
A/SA	182	F46	S30600	8	1	8.1	18Cr-15Ni-4Si
A/SA	182	F5	K41545	5B	1	5.3	5Cr-0.5Mo
A/SA	182	F50	S31200	10H	1	10.2	25Cr-6Ni-Mo-N
A/SA	182	F51	S31803	10H	1	10.1	22Cr-5Ni-3Mo-N
A/SA	182	F53	S32750	10H	1	10.2	25Cr-7Ni-4Mo-N
A/SA	182	F54	S39274	10H	1	10.2	25Cr-7Ni-3Mo-2W-Cu-N
A/SA	182	F55	S32760	10H	1	10.1	25Cr-8Ni-3Mo-W-Cu-N
A/SA	182	F5a	K42544	5B	1	5.3	5Cr-0.5Mo
A/SA	182	F6a, Cl. 1	S41000	6	1	7.2	13Cr
A/SA	182	F6a, Cl. 2	S41000	6	3	7.2	13Cr
A/SA	182	F6b	S41026	6	3	7.2	13Cr-0.5Mo
A/SA	182	F6NM	S41500	6	4	7.2	13Cr-4.5Ni-Mo