

Material	Mat Grp	Spec	Grade	Chem%	Mech YS-Mpa , UTS- Mpa EL-%	Forging Fittings		Wrought Fitting		Process / Consumable Electrodes				Preheat Min	Inter pass Max	Post Heat	Service	PWHT		Scope & Inspection Frequency									
						Grade	UTS Ksi	Grade	UTS Ksi	GTAW	SMAW	BC LHE-Min	Hold Temp					Temp	Holding Temp	Visual	MPT/	RT/UT	Hard	Hard	Impact				
Carbon Steel	P1	ASTM A106	Gr.B	C-0.30 Mn-0.29-1.06, P-0.035, S-0.035 , Si-0.10, Cr-0.40, C-0.40 Mo-0.15 , Ni-0.40, V-0.08	Ys-240 Uts-415 (60 Ksi) EL-25	A105N	70	A234-WPB	60-95	ER-70 S2	E-6010 E-7018	350 Deg C for 1 hrs or 250 Deg C for 2 hrs	150 Deg. C	Min 10 Deg. C Thk-25 mm 79 Deg. C	250 Deg. C	N/A	Non Sour	Up to t-20 mm- N/A t > 20 mm 593 -649 Deg C.	Min 1 Hrs. 1 Hr/ Inch	100%	5%	5%	N/A	N/A	N/A				
		Sour		100%	200 HB	N/A																							
		Amine & Caustic Carbonate	For all Dia & Thk upto 20 mm	N/A	N/A	N/A																							
				N/A	N/A	N/A																							
				N/A	N/A	- 46 Deg.C																							
LTCS		ASTM A333	Gr.06	C-0.30 Mn-0.29-1.06, P-0.025, S-0.025 , Si-0.10,	Ys-240 Uts-415 (60 Ksi) EL-30 L , 16.5 T	A350 - LF2	60	A420-WPB6	60	ER-70 S G	E-7018-1						Sour	Up to t-20 mm- N/A t > 20 mm 593 -649 Deg C.				100%	200 HB	- 46 Deg.C					
Low Alloy Steel (LAS)	P-4	ASTM A335	P 11	1.25 Cr-0.50 Mo	Ys-415 Uts-585 (85 Ksi) EL-20 L	A182-F11	60/70/75	A 234-WP11	60-85/70-95	ER-80S- B2	E-8018-B2	350 Dec C For 2 Hrs	150 Deg. C	150	250	300 Deg. C For 1/2 Hrs	A335-P11	704-746	Min 2 Hrs. 1 Hr/ Inch	100%	10%	100%	100%	225 HB	N/A				
	P-5A		P 22	2.25 Cr-1 Mo		A182-F22	60-75	A 234-WP22	60-85	ER-80S- B3	E-9018-B3			200	300		A335-P22	704-760		100%	10%	100%	100%	225 HB	N/A				
	P-5B		P 5	5 Cr 0.50 Mo		A182-F5	70	A 234-WP5	60-95	ER-80S- B6	E-8018-B6			250	350		A335-P5	704-760		100%	20%	100%	100%	241 HB	N/A				
	P-5B		P 9	9 Cr 1 Mo		A182-F9	85	A 234-WP9	60-85	ER-80S- B8	E-8018-B8			250	350		A335-P9	704-760		100%	20%	100%	100%	241 HB	N/A				
	P-15 E		P 91	9 Cr 1 Mo 0.18-0.25 V		A182-F91	85	A 234-WP91	85-110	ER-80S- B9	E-9018-B9			250	350		A335-P91	760-780		100%	20%	100%	100%	241 HB	N/A				
Stainless Steel	P-8	ASTM A 312	TP-304	18-20 Cr, 8-11 Ni	Ys-205 UTS-515 EL-35-L ,25-T	A182-F304	75	A 403-WP304	75	ER-308	E-308	250 Deg. C For 2 Hrs	150 Deg. C	N/A	175 Deg. C	N/A	TP-304	N/A	N/A	100%	10%	100%	N/A	N/A	N/A				
	P-8		TP-304 H			A182-F-304 H	75	A 403-WP304 H	75	ER-308 H	E-308 H						TP-304 H			100%	10%	100%	N/A	N/A	N/A				
	P-8		TP-304 L	18-20 Cr, 8-13 Ni	Ys-170 UTS-485 EL-35-L ,25-T	A182-F304 L	70	A 403-WP304 L	70	ER-308 L	E-308 L						TP-304 L			100%			N/A	N/A	N/A				
	P-8		TP-316	16-18 Cr, 11-14 Ni,2-3 Mo	Ys-205 UTS-515 EL-35-L ,25-T	A182-F316	75	A 403-WP316	75	ER-316	E-316						TP-316			100%	5%	5%	N/A	N/A	N/A				
	P-8		TP-316 H			A182-F316 H	75	A 403-WP316 H	75	ER-316 H	E-316 H						TP-316 H			100%	5%	5%	N/A	N/A	N/A				
	P-8		TP-316 L	16-18 Cr, 10-14 Ni , 2-3 Mo	Ys-170 UTS-485 EL-35-L ,25-T	A182-F316 L	70	A 403-WP316 L	70	ER-316 L	E-316 L						TP-316 L			100%	5%	5%	N/A	N/A	N/A				
	P-8		TP-321 OR	17-19 Cr, 9-12 Ni , 0.4-0.7 Ti	Ys-205 UTS-515 EL-35-L ,25-T	A182-F321		A 403-WP321		ER-321 OR ER-347	E-347						TP-321 OR			100%			N/A	N/A	N/A				
	P-8		TP-321 H			75		75			TP-321 H						100%			10%	100%	N/A	N/A	N/A					
	P-8		TP-347OR	17-19 Cr, 9-13 Ni , 0.8-1.0 Cb		A182-F347	75	A 403-WP347	75	ER-347	E-347						TP-347OR			100%			N/A	N/A	N/A				
	P-8		TP-347 H														TP-347 H			100%	10%	100%	N/A	N/A	N/A				
Baking :- As per Manufacturer								NOMINAL COMPOSITION								LAS								Colour Code					
Preheat / Postheat :- As per WPS								304	18 Cr-8 Ni																IBR	RED			
PWHT :- AS per ASME 31.3 Sec-331.1.3								316	16 Cr-12 Ni-Mo																LTCS	ORANGE			
WELD VISUAL :- AS per ASME 31.3 Sec-341.3.2								321	18 Cr-10 Ni-Ti																NACE	VIOLET			
NDT :- AS per ASME 31.3 Sec-331.3.4								347	18 Cr-10 Ni-Cb								IBR												
PREHEAT																													
To slow down cooling rate of deposited weld metal & HAZ																													
As per ASME 31.3 atleast 1 inch on both sides of joint																													
As per RIL Procedure 3 " or 1.5 " times of base metal thickness whichever is greater.																													
POSTHEAT																													
To increase the difussion of Hydrogen & other gas out of weld metal																													
Electrode Last Digit																													
0	Cellulose sodium , DCEP					Cellulose Electrode																							
1	Cellulose Potassium					Cellulose Electrode																							
2	Rutile Titanium sodium AC, DCEP, DCEN					Rutile Electrode																							
3	Rutile Titanium Potassium AC, DCEP, DCEN					Rutile Electrode																							
4	Iron powder Titanium																												
5	Low Hydrogen Sodium DCEP					Basic Electrode																							
6	Low Hydrogen Potassium AC, DCEP					Basic Electrode																							
7	Low Hydrogen, Iron Powder, Iron oxide					Basic Electrode																							
8	Low Hydrogen, Iron Powder					Basic Electrode																							
ASME SEC IX																													
Article-I	Welding General Riquirements					Iron-Fe																							
Article-II	Welding Procedure Qualification					C Carbon- Strength																							
Article-III	Welding Performance Qualification					M Manganese -Toughness																							
Article-IV	Welding Data					S Silicon- < 0.3% Deoxidiser																							
Article-V	Std. Welding Procedure Specification					Al Aluminium Grain refiner < .008 %																							
Ni Nickel - low temp application						Mo Molybdenum- 1% For Creep resistance																							
V Vanadium- Strength						S Sulphur-Residual element																							
Cu Copper - used for weathering steel						P Phosphorus- Residual element																							
Ti Titanium- Grain refiner Used as micro alloy element (Strength & Toughness)						Nb Niobium- Grain refiner Used as micro alloy element (Strength & Toughness)																							