KRG INDUSTRIES
A KRG GROUP COMPANY

Providing Contract Manufacturing Services on a Worldwide Scale
From Design to Manufacture, KRG Know How

KRG Industries Weld Procedures

PQR	WPS	REVISION	MATERIAL	TRAVEL SPEED	CODES	PROCESS	THICKNESS	PWHT	PQR RESULTS	APPROVAL	ABB VETCO equivalent	COOPER CAMERON equivalent
PQR 001	WPS 014	0	ASTM A106 GRADE B		EN 288	MAN GTAW / SMAW	BM: 12mm min, 4/7 Passes	N/A	Tensile: 78ksi Hardness: Vickers 160/206	Approved for 24mm max **ANSON approved**		
PQR 002	WPS 014	0	ASTM A106 GRADE B		EN 288	MAN GTAW	BM: 5mm min, 1/4 Passes	N/A	Tensile: 68ksi Hardness: Vickers 118/183	Approved for 12mm max		
PQR 003	WPS 001 WPS 002 WPS 006	0 0 1	ASTM A312 GRADE TP316L		EN 288	MAN GTAW / SMAW	BM: 7.1mm min, 1/5 Passes	N/A	Tensile: 92ksi Hardness: Vickers 168/203	Approved for 15mm max		
PQR 003	WPS CR006	0	ASTM A312 GRADE TP316L		EN 288	MAN GTAW	BM: 7.1mm min, 1/5 Passes	N/A	Tensile: 92ksi Hardness: Vickers 168/203	Approved for 3 - 6mm **Specific to KOPL 316 s/steel manifolds only**		
PQR 004	WPS 006	1	ASTM A312 GRADE TP316L		EN 288	MAN GTAW	BM: 3 - 6mm	N/A	Tensile: 92ksi Hardness: Vickers 139/181	Approved for 12mm max		
PQR 005	WPS 003 WPS 004	1 2	BS 4360 50D		EN 288	SMAW	BM: 15.0 mm min, 1/14 Passes	N/A	All Weld Tensile: 85ksi Hardness: Vickers 154/238 Impacts:42/278@-20C **For non API applications and Non NACE. e.g non pressure containing. Stuctural welds only.**	Approved for 30mm max **FMC approved ABB VETCO approved KVAERNER approved (for non Norsok applications only) ANSON**		
PQR 006 Rev o	WPS 011	2	625 Overlay on 8630	16-18ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	655C +/-14 for 6 hrs	Tensile: 83.1ksi Yield, Impacts @ -46C, Hardness: 21.0 HRC max Fe Cont: 3.43% (2 pass)	Approved for 625 overlay on 8630 CL60-80. Meets API temperature Class L . Not suitable for temperture class K **KVAERNER approved FMC approved ABB VETCO approved Approved by ANSON for 85K yield**	VGS 7.0003.1.4	
PQR 010 Rev o	WPS 010	2	625 overlay on 4130	7-9ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	650C +/-14 for 2 hrs	Tensile: 74.0ksi Yield, Impacts @ -46C, Hardness: 21.5 HRC max Fe Cont: 5.0% (2 pass)	Approved for 625 overlay on 4130 CL60-75. Meets API temperature Class L **Kvaerner approved Cooper Cameron approved FMC approved ABB Vetco approved**	VGS 7.0002.1.2	
PQR 011 Rev o	WPS 013	2	625 Overlay on F6NM	16-18ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	675C/10hrs 615C/10hrs	Tensile: 79.8ksi Yield, Impacts @ -46C, Hardness: 22.0 HRC max Fe Cont: 1.5% (2 pass)	Approved for 625 overlay on F6NM CL60-75. Meets API temperature class L. **KVAERNER approved COOPER CAMERON approved FMC approved ABB VETCO approved**	VGS 7.0006.1.6	

PQR 012 Rev 0	WPS 017	2	625 overlay on 8630 modified material	7-9ipm	ASME IX, API 6A, NORSOK specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	605 C +/-14 for 6 hrs	All Weld Tensile 90ksi and Tensile:118ksi Yield; Impacts @ -46 deg C; Hardness 314 Vickers max; Fe Cont 0.55; 2 passes	**Approved for non Nace materials KVAERNER approved**		
PQR 013 Rev 0	WPS 009	1	625 Overlay on 2-1/4 CR-1MO GR. F-22 Low Carbon Steel	16-18ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	650C +/-14 for 2 hrs	Tensile: 80.6ksi Yield, Impacts @ -46C, Hardness: 22.0 HRC max Fe Cont: 6.5% (2 pass)	Requires approveal for each specific application **COOPER CAMERON approved**		
PQR 014 Rev 0	WPS 012	1	625 Overlay on 2-1/4 CR-1MO GR. F-22 Low Carbon Steel	7-9ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	650C +/-14 for 2 hrs	Tensile: 81.2ksi Yield, Impacts @ -46C, Hardness: 22.0 HRC max Fe Cont: 4.22% (2 pass)	Approved for 625 overlay on F22 CL60-80. Meets API temperature class L. **KVAERNER approved ABB VETCO approved COOPER CAMERON approved FMC approved**		
PQR 015 Rev 0	WPS 005	1	Inconel 625 overlay on AISI API 5L x 52 (Group 1 mat'ls)	16-20ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	N/A	Tensile: 75 ksi Yield, Impacts @ -46C, Hardness: 21.0 HRC max Fe Cont: 1.8% ASTM G48 Pass (2 pass)	Approved for 625 overlay on PI materials **FMC approved ABB Vetco aproved (if required)**		
PQR 016 Rev 0	WPS 007	1	625 overlay on 410 S/S	7-9ipm 16-18ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	1st Soak 670C +/-14 for 4 hrs 2nd Soak for 650 C+/-14 for 4 hrs	All Weld Tensile and Tensile:85ksi Yield; Impacts @ -46 deg C; Hardness 22 HRC max; Fe Cont 2.31; 2 passes	**COOPER CAMERON approved FMC approved**		
PQR 017 Rev 0	WPS 008	1	625 Overlay on 2-1/4 CR-1MO GR. F-22 Low Carbon Steel, Modified	7-9ipm 16-18ipm	ASME IX, API 6A	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	630 C +/-14 for 14 hrs	All Weld Tensile 91ksi and base Tensile: 88.5ksi Yield; Impacts @ -46 deg C; Hardness 21 HRC max; Fe Cont 0.10; 2 passes	**Approved for non nace materials.** Weld overlay may be considered as part of the design criteria. Use 70,000 psi minimum yield strength for design calculations. Temp.class K,L,P,R,S,T,U,V **COOPER CAMERON approved**		
PQR 018 Rev 0 & rev 1	WPS 016	1	Base material N/A Repair Procedure 625 Overlay	7-9ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	N/A	All Weld Tensile: 75ksi Yield, Impacts @ -59C, Hardness: 22.0 HRC max Fe Cont: 0.8% (2 pass)	Approved for 625 overlay on all materials **KVAERNER approved COOPER CAMERON approved FMC approved ABB VETCO approved**	VGS 7.0009.1.6	
PQR 020 Rev 0	WPS 015	2	625 overlay on 4140 modified material	7-9ipm	ASME IX, API 6A, NORSOK specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	560 C +/-14 for 6 hrs	All Weld Tensile 79ksi and base mat'l Tensile:131 ksi Yield; Impacts @ -46 deg C; Hardness 336 Vickers max; Fe Cont 1.41; 2 passes	**Non Nace mat'l.** Weld overlay may be considered as part of the design criteria. Use 70,000 psi minimum yield strength for design calculations.		
PQR 021 Rev 0	WPS 021	0	Manual Weld Repair of Inconel 625 through to base material AISA 8630	6-8.6ipm	ASME IX, API 6A, NACE MR 0175 specification	Man GTAW	BM: 23mm min, 1/8" min deposit, 2 Pass min	660 C +/-14 @ 6 hrs	All Weld Tensile 80ksi and base mat'l Tensile:82.8 ksi Yield; Yield Point 90 ksi, Impacts @ -59 deg C; Hardness 22 HRC max; Fe Cont 4.70; 2 passes min.	Weld overlay may be considered as part of the design criteria. Use 85,000 psi minimum yield strength for design calculations. **FMC approved**		
PQR 022 Rev 0	WPS 022	0	Manual Weld Repair of Inconel 625 through to base material F6NM	6-8.6ipm	ASME IX, API 6A, NACE MR 0175 specification	Man GTAW	BM: 23mm min, 1/8" min deposit, 2 Pass min	Double Cycle 1st Soak 665 +/-10 deg C for 10Hrs, 2nd Soak @ 600 +/-10 deg C for 10 Hrs	All Weld Tensile 81ksi and base mat'l Tensile: 71.4 ksi Yield; Impacts @ -59 deg C; Hardness 23 HRC max; Fe Cont 0.33%, 2 passes min.	Weld overlay may be considered as part of the design criteria. Use 70,000 psi minimum yield strength for design calculations. **FMC approved**		

PQR 023 Rev 0	WPS 023	1	Inconel 625 overlay on AISI 4130	15-17ipm	ASME IX, API 6A, API 17D,NACE MR 0175, NORSOK M-601 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	630 deg C +/- 10 for 2hrs	All Weld Tensile 86ksi and base mat'l Tensile: 75.1 ksi Yield; Impacts @ -60 deg C; Fe Count 0.02%; 2 passes min.	Weld overlay may be considered as part of the design criteria. Use 70,000 psi minimum yield strength for design calculations. **COOPER CAMERON approved FMC approved ABB VETCO approved ANSON WELLSTREAM approved**		
PQR 024 Rev 0	WPS 024	0	Manganese Molibmium buttering on F22 base mat'l	15-17ipm	ASME IX, API 6A, NACE MR 0175, BS 7448-2 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	645 deg C +/- 5 for 2.5hrs	Cross Weld Tensile 92ksi;	**Approved by BEL VALVES only**		
PQR 025 Rev 0	WPS 025	1	Inconel 625 overlay on AISI 8630	15-17ipm	ASME IX, API 6A, NACE MR 0175, NORSOK M-601 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	665 deg C +/- 5 for 6- 6.5hrs	All Weld Tensile 95ksi and base mat'l Tensile: 80 ksi Yield; Impacts @ -20 deg C; Fe Count 2.47%, 2 passes min.	**KVAERNER approved FMC approved**		
PQR 026 Rev 0	WPS 026	1	Inconel 625 overlay on F22	15-17ipm	ASME IX, API 6A, API 17D NACE MR 0175, NORSOK M-601 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	650 deg C +/- 10 for 2-2.5hrs	All Weld Tensile 81ksi and base mat'l Tensile: 85.4 ksi Yield; Impacts @ -80 deg C; Fe Count 3.09%, 2 passes min.	**ABB Vetco approved@-80 deg C FMC approved @ -46 C Kvaerner approved @ -80 C Cooper Cameron approved@-80C ANSON**	VGS 7.0004.1.2	
PQR 027 Rev 0	WPS 027	0	Inconel 625 overlay on ASTM A694 GRADE F52	15-17ipm	ASME IX, API 6A, NACE MR 0175, PSL3 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	NO PWHT REQUIRED	Base mat'l Tensile: 62 ksi Yield; Impacts @ -46 deg C; Fe Count 2.95%, 2 passes min.	Not suitable for API temperture class K. **Approved by VECTOR ABB VETCO approved FMC approved**		
PQR 028 Rev 0	WPS 028	0	Inconel 625 overlay on 410 s/s	7-9ipm	ASME IX, API 6A, API 17D, NACE MR 0175 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	Double Cycle: 1st Soak 670 +/-10 deg C for 4 - 4.5Hrs, 2nd Soak @ 650 +/-10 deg C for 4 - 4.5 Hrs	All Weld Tensile 87ksi and base mat'l Tensile: 83.7 ksi Yield; Impacts @ -46 deg C; Fe Count 3.09%, 2 passes min.	Not suitable for API temperture class K. **ABB VECTO approved FMC approved COOPER CAMERON approved**	VGS 7.0006.1.9	
PQR 029 Rev 1	WPS 029	1	Inconel 625 overlay on AISI 8630	6.3 - 8.6 ipm	ASME IX, API 6A, API 17D, NACE MR 0175, NORSOK M-601	SMAW	BM: 22mm min to unlimited. 1/8" min deposit, minimum two passes	665 deg C +/- 5 for 6- 6.5hrs	Base mat'l Tensile: 85 ksi Yield; Impacts @ -20 deg C; Fe Count 6% 2 passes min.	**KVAERNER approved ABB VETCO approved**		
PQR 030 Rev 0	WPS 030	0	AISI 8630 to same	6.3 - 9ipm	ASME IX, API 6A, API 17D, NACE MR 0175, NORSOK M-601	SMAW	BM: 1" min to 2 7/8" max	665 deg C +/- 5 for 6- 6.5hrs	All weld tensile : 75.4 ksi yield, Base mat'l Tensile: 87.6 ksi Yield; Impacts @ -20 deg C.	**Approved by KVAERNER**		
PQR 031 Rev 0	WPS 031	0	Inconel 625 overlay to same	3.6 - 4.1ipm	ASME IX, API 6A, API 17D NACE MR 0175 specification	Man GTAW	BM: 1" min to unlimited	NO PWHT REQUIRED	Base mat'l Tensile: 89.4 ksi Yield; Impacts @ -20 deg C; Fe Count 2.06%	**Approved by KVAERNER ABB VETCO approved FMC approved**		
PQR 032 Rev 0	WPS 032	0	Inconel 625 overlay to Duplex	7 - 9ipm	ASME IX, API 6A, API 17D NACE MR 0175 specification	Auto GTAW (HOT WIRE)	BM: 1" min to unlimited	NO PWHT REQUIRED	Base mat'l Tensile: 78 ksi Yield. Impacts @ -60deg C;HAZ hardness 254 vickers max, 21.5 HRC max, Fe Count 2.26%. 2 passes min.	**ABB VETCO will review for specific application**		

PQR 033 Rev 0	WPS 033	0	Inconel 625 overlay to F22 normalised base mat'l	7.5 - 9.5ipm	ASME IX, API 6A, API 17D NACE MR 0175 specification	Auto GTAW (HOT WIRE)	BM: 1" min to unlimited	Quench @ 920 deg C +/- 14 for 1hr. Temper @ 650 +/- 10 deg C for 3hrs.	Base mat'l Tensile: 86.4 ksi Yield; Allweld tensile: 75.1ksi yield. Impacts @ -59deg C;HAZ hardness 247 vickers max, 21 HRC max, Fe Count 2.95%. 2 passes min.	**Approved by COOPER CAMERON ONLY**		
PQR 034 Rev 0	WPS 034	0	Inconel 625 overlay to F65 base mat'l	15 -17ipm	ASME IX, API 6A, API 17D NACE MR 0175 specification	Auto GTAW (HOT WIRE)	BM: 1" min to unlimited	NO PWHT REQUIRED	Base mat'l Tensile: 69 ksi Yield. Impacts @ -46deg C;HAZ hardness 242 vickers max, 22 HRC max, Fe Count 4.27%. 2 passes min.	**ABB VETCO approved FMC approved VECTOR approved**	VGS 7.0001.1.2	
PQR 035 Rev 0	WPS 035	0	Inconel 625 overlay to AISI 8630 base mat'l	7 - 9ipm	ASME IX, API 6A, API 17D NACE MR 0175 specification	Auto GTAW (HOT WIRE)	BM: 1" min to unlimited	655 deg C +/- 10 for 6 - 6.5hrs	Base mat'l tensile: 80.1 ksi yield. Impacts @ -60 deg C. Haz hardness= 22 HRC max (251 Vickers max). Fe count = 2.8%. 2 passes min.	**FMC approved**		
PQR 036 Rev 0	WPS 036	2	Inconel 625 overlay on F22	15-17ipm	ASME IX, API 6A, ISO 10423, NACE MR 0175, SPC-0000024453, BLK 18-GP-K-MT-SPE-0219, WDS-0000014 specification	Auto GTAW (HOT WIRE)	BM: 22mm min, 4mm min deposit, 2 Pass min	650 deg C +/- 10 for 4hrs	All Weld Tensile 78.7ksi and base mat'l Tensile: 85.9 ksi Yield; Impacts @ -46 deg C; Fe Count 4.9%, 2 passes min.	**BEL VALVES approved**		
PQR 006 Rev 0	WPS CR 011SR	0	625 Overlay on 8630	16-18ipm	ASME IX, API 6A, NACE MR0175	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	655C +/-14 for 6 hrs	Tensile: 83.1ksi Yield, Impacts @ -46C, Hardness: 21.0 HRC max Fe Cont: 3.43% (2 pass)	Approved for 625 overlay on 8630 CL60-80. Meets API temperature Class L . Not suitable for temperture class K **FMC approved This WPS is specific to the Rosa project**		
PQR 037	WPS 037	0	316, 316L S/S OR SIMILAR TO SAME	N/A	BS EN288, BS EN15614, AWS D1.1, ASME IX, API 6A	SMAW	BM THICKNESS RANGE: 4mm - 203mm	NOT REQ'D	Base metal traverse tensile: 76.1 Hv 10: HAZ-168 max	**KVAERNER (Aberdeen) approved**		
PQR 038 Rev 0	WPS 038	1	Inconel 625 overlay on F22	15-17ipm	ASME IX, API 6A, API 17D NACE MR 0175, NORSOK M-601 specification	Auto GTAW (HOT WIRE)	BM: 1" min, 1/8" min deposit, 2 Pass min	635 deg C +/- 10 for 6-6.5hrs	All Weld Tensile 79.1ksi and base mat'l Tensile: 85.4 ksi Yield; Impacts @ -46 deg C; Fe Count 2.69%, 2 passes min. Max Hv10 HAZ = 247	**Approved by COOPER CAMERON ONLY (Chevron Tahiti project)**		
PQR 039 Rev 0	N/A		F22 base mat'l	N/A	ASME IX, API 6A, API 17D NACE MR 0175 specification	N/A	N/A	635 deg C +/- 10 for 6-6.5hrs	Base mat'l Tensile: 83.8 ksi Yield; Impacts @ -46 deg C. Max Hv10 HAZ = 249	**Approved by COOPER CAMERON ONLY (Chevron Tahiti project)**		
PQR 040 Rev 0	WPS 040	0	AISI 4130 80K base mat'l	15-17ipm	ASME IX, API 6A, API 17D NACE MR 0175, NORSOK M-601	Auto GTAW (HOT WIRE)	BM: 1" min, 3mm min deposit, 2 Pass min	640 deg C +/- 10 for 5-5.5hrs	All Weld Tensile 83ksi and base mat'l Tensile: 83.4 ksi Yield; Impacts @ -46 deg C; Fe Count 4.82%, 2 passes min. Max Hv10 HAZ = 245	**Approved by ANSON Approved by Drilquip (if PWHT soak time is restricted to 3 - 3.5hrs)**		
PQR 041	WPS 041	0	BS 4360 50D to Weldox 700		ASME IX	GTAW SMAW	BM: 4.8 mm min BM: 203mm max	N/A	All Weld Tensile: 66.9ksi Base mat'l tensile: 78.8K UTS HAZ Hardness: Hv10= 357 max Impacts: @-46C **For non API applications and Non NACE. e.g non pressure containing. Stuctural welds only.**	**Approved by TESCO**		

PQR 042 Rev 0	N/A		F22 base mat'l	N/A	ASME IX, API 6A, API 17D NACE MR 0175 specification	N/A	N/A	650 deg C +/- 10 for 2-2.5hrs	Base mat'l Tensile: 82.4 ksi Yield; Impacts @ -46 deg C. Max Base mat'l Hv10 = 237	**Approved for a maximum of three separate PWHT cycles after weld repair on F22 base mat'l. Approved by Vetco only.**		
PQR 043 Rev 0	WPS 043	0	AISI 4130 75K base mat'l	12 -14ipm	ASME IX, API 6A, API 17D NACE MR 0175, ISO 15156 specification	Auto GTAW (HOT WIRE)	BM THICKNESS RANGE: 20mm - 203mm	640 deg C +/- 10 for 2.5-3hrs	All Weld Tensile 82.9ksi, transvrse all weld tensile- 77.1ksi. Base mat'l Tensile: 75.4 ksi Yield, base transvrse tensile- 73.5ksi Impacts @ -46 & -59 deg C. Max Hv10 HAZ = 249	**Approved by COOPER CAMERON**		