



DETAILS OF WELDING, INSPECTION & TESTING
RUBBER LINED PIPING PACKAGE

ANNEXURE-B TO PEMC-07395
JOB SPECIFICATION FOR RUBBER LINED PIPING PACKAGE
TCL MITHAPUR

TD-201 Rev No. 00	Form No.  HYDERABAD.	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION.		GT 57124 Rev No. 03 Page 1 of 6	
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company. DETAILS OF WELDING, INSPECTION & TESTING FOR BALANCE OF PLANT PIPING 1.0.0 WELDING DETAILS : 1.1.0 To reduce number of welding procedure qualifications required, base metals have been assigned, P-NUMBERS, and GROUP NUMBERS. The assignments are based on comparable base metal characteristics such as composition, weld quality and mechanical properties (as per ASME SEC-IX) All fusion faces shall be as per plant standard HY06205599 for butt welds; Fillet welds shall be as per Drg. No.3-38101-00033. Selection of P-Number and Group Number for the materials shall be as per Table-1. For electrodes, heat treatment and other details, refer relevant Welding Procedure Specification (WPS) as given in Table-2. Table-2 lists out WPS number for welding between the various combinations of group numbers / P- Numbers. 1.2.0 STEP BY STEP PROCEDURE : <u>STEP-1</u>: Select material of two components to be welded. <u>STEP-2</u>: Identify the P-NUMBER for the each component from Table-1. <u>STEP-3</u>: Follow appropriate WPS from Table-2. 1.3.0 EXAMPLE : Welding shall be done between material A106 GrB. (CS) and A132 TP321 (SS). Service natural gas. Pipe thickness is 8.0 mm. <u>STEP-1</u> : Welding is between CS & SS materials. <u>STEP-2</u> : P-NUMBER for A106 Gr. B is P1 and for A312 TP321 is P8. i.e., welding between P1 & P8 <u>STEP-3</u> : From Table-2 for t > or =5.0 use WPS NO WE 315 for root weld, WE 046 for the remaining passes.					
Ref. Doc	Revisions : Refer to record of revisions :		Prepared : Kishor	Approved : K.Srinivas	Date :

	Form No.		PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION.		GT 57124
					Rev No. 03

COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company .	TABLE-1																																						
	<table border="1"> <thead> <tr> <th>MATERIAL</th> <th>P- NUMBER</th> <th>GROUP NO.</th> </tr> </thead> <tbody> <tr> <td>SA 106 Gr.B</td> <td rowspan="3">1</td> <td rowspan="3">1</td> </tr> <tr> <td>SA 234 WPB</td> </tr> <tr> <td>SA 672 Gr.B60</td> </tr> <tr> <td>SA 105 Gr.II</td> <td rowspan="2">1</td> <td rowspan="2">2</td> </tr> <tr> <td>SA 216 WCB</td> </tr> <tr> <td>SA 182 F304</td> <td rowspan="9">8</td> <td rowspan="9">1</td> </tr> <tr> <td>SA 182 F321</td> </tr> <tr> <td>SA 312 TP304</td> </tr> <tr> <td>SA 240 TP304</td> </tr> <tr> <td>SA 403 WP321</td> </tr> <tr> <td>SA 403 WP304</td> </tr> <tr> <td>SA 312 TP321</td> </tr> <tr> <td>SA 312 TP316</td> </tr> <tr> <td>SA 351 CF8</td> </tr> <tr> <td>SA 335 P11</td> <td rowspan="5">4</td> <td rowspan="5">1</td> </tr> <tr> <td>SA 182 F11</td> </tr> <tr> <td>SA 234 WP11</td> </tr> <tr> <td>SA 387 Gr12</td> </tr> <tr> <td>SA 217 WC6</td> </tr> <tr> <td>SA 335 P22</td> <td rowspan="4">5</td> <td rowspan="4">1</td> </tr> <tr> <td>SA 182 F22</td> </tr> <tr> <td>SA 217 WC9</td> </tr> <tr> <td>SA 234 WP22</td> </tr> </tbody> </table>	MATERIAL	P- NUMBER	GROUP NO.	SA 106 Gr.B	1	1	SA 234 WPB	SA 672 Gr.B60	SA 105 Gr.II	1	2	SA 216 WCB	SA 182 F304	8	1	SA 182 F321	SA 312 TP304	SA 240 TP304	SA 403 WP321	SA 403 WP304	SA 312 TP321	SA 312 TP316	SA 351 CF8	SA 335 P11	4	1	SA 182 F11	SA 234 WP11	SA 387 Gr12	SA 217 WC6	SA 335 P22	5	1	SA 182 F22	SA 217 WC9	SA 234 WP22		
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	SA 217 WC9																																						
	SA 234 WP22																																						
	Ref. Doc																																						

TABLE-2

Sr no.	WELDING BETWEEN	GROUP	THICKNESS (mm)	WPS NO.	REMARK
1	CS to CS (P1 to P1)	1 & 2	Up to 5.0	WE 301	Only GTAW
			> 5.0 to (=)18.0	WE 003	GTAW + SMAW
			> 18.0 to (=) 38.0	WE 004	GTAW + SMAW
			> 38.0 to (=) 200.0	WE 001	SMAW
2	SS to SS (P8 to P8)	1	Up to 5.0	WE 313-ER 347 WE 314-ER 308L	Only GTAW (WPS SELECTION BASED ON FILLER METAL USE.)
			> 5.0 to (=) 50.0	WE313+WE042/ 045	GTAW + SMAW (WE 045 instead of 042 for E347 Electrode)
3	CS to SS (P1 to P8)	1 & 2 to 1	Up to 5.0	WE 315	Only GTAW
			> 5.0 to (=) 38.0	WE 315 + WE 046	GTAW + SMAW
4	P11 to P11 (P4 to P4)	1	Up to 5.0	WE 312	Only GTAW
			> 5.0 to (=) 50.0	WE 343	GTAW + SMAW
5	CS to P11 (P1 to P4)	1&2 to 1	Up to 5.0	WE 311	Only GTAW
			> 5.0 to (=) 50.0	WE 345	GTAW + SMAW
6	CS to P22 (P1 to P5)	1&2 to 1	> 4.8 to(=) 28.0	WE 024	SMAW
7	P22 to P22 (P5 to P5)	1	> 5.0 to (=) 200.0	WE 159	GTAW + SMAW
8	P11 to P22 (P4 to P5)	1	> 4.8 to (=) 28.0	WE 023	SMAW

Form No. बी एच ई एल  HYDERABAD		PRODUCT STANDARD		GT 57124
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company . 2.00 I NSPECTI ON & TESTI NG : 2.1.0 PI PI NG CLASSI FI CATI ON: For rationalizing the testing and inspection procedure, piping may be classified into following groups based on the critical nature of the service conditions. GROUP-A: I BR purview piping like a. Main Steam Lines b. Auxiliary Steam Lines c. Boiler Feed Water Lines GROUP-B: Non-I BR piping like a. Natural Gas Lines b. Refinery Gas Lines c. Naphtha Lines d. Natural Gasoline Lines e. HSD Lines f. LSHS Lines g. Furnace Oil Lines h. Polished Water Lines i. Condensate Lines j. DM Water Lines. k. Instrument Air Lines l. Lube oil Lines. GROUP-C : Utility piping like a. Cooling Water Lines b. Service Water Lines c. Plant / Service Air Lines d. Nitrogen lines 2.2.0 HYDRAULI C TESTI NG: Hydraulic testing shall be conducted for all the lines except the atmospheric lines vents, flares & drains at a pressure of 1.5 times of the design pressure.				
Ref. Doc				

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company .		2.3.0 INSPECTI ON (FOR WELD JOI NTS) : 2.3.1 For Alloy steel piping. 100% radiography shall be conducted. 2.3.2 (a) Group-A piping: Inspection of IBR piping shall be done as per IBR class 360-D with latest amendments. For IBR class-1 pipes (steam pressure> 17.6 ATA or Temp 218° C) <u>Radiography for pipe bore 102 mm and above:</u> 10% welds/welder with min 2 welds/welder selected at random <u>Radiography for pipe bore 38 mm upto 102 mm:</u> 2% of welds/welder with min. of 1 weld /welder selected at random 100% DP test shall be conducted for all fillet welds For IBR Class-II pipes (Design parameters less than class-I) - On completion of first 10 welds / welder, one of the weld shall be cut or a separate specimen be prepared for visual examination and bend test 2% of the remainder welds / welder cut for test purpose or a separate test specimen be prepared for visual examination and bend test 10% DP test shall be conducted for fillet welds 2.3.2. (b) Group-B piping: 100% visual inspection 20% DP check for fillet welds. - Radiography for 10% of butt welds with min. of two welds / welder 2.3.2. (c) Group-C piping: 100% visual inspection. 10% DP check for fillet welds. - Radiography for 2% of butt welds with min of one welds / welder		
	Ref. Doc			

TD-106-3	Rev. No.	Form No.		PRODUCT STANDARD		GT 57124					
				PROJECT ENGINEERING & SYSTEMS DIVISION.		Rev No. 03					
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RECORD OF REVISIONS											
							Rev. No.	Date	Revision Details	Revised By	Approved By
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.							00	08.04.93	First issue.	---	---
							01	10.10.95	WPS Changed from WE 14 to WE 13.	---	---
							02	23.07.97	100% RT for alloy steel pipe incorporated.	---	---
							03	15.12.11	Table-2 Updated.	Kishor	K.Srinivas.
Ref. Doc.											

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)																							
Welding Procedure Specification No.: <u>WE 001</u> Date: <u>02-04-84</u> Supporting PQR No.: <u>185+21</u> Revision No.: <u>02</u> Date: <u>15-09-93</u> Welding Process (es) : <u>SMAW</u> Type (s) : <u>MANUAL</u>																							
JOINTS (QW 402) Joint Design : <u>As per manufacturing drawing (groove / fillet)</u> Backing (Yes) : <u>for double side and backing strip groove welds</u> (No) : <u>for single side groove welds</u> Backing Material (Type) : <u>Base metal / Weld metal</u> Metal : <u>Yes</u> Non-Fusing Metal : <u>No</u> Retainer : <u>No</u>																							
BASE METALS (QW – 403) P. No. : 1 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2 OR Specification type & grade : --- to Specification type & grade : --- OR Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ---- Thickness Range : Base Metal : Groove: <u>4.8 mm to 200 mm</u> Fillet : <u>all sizes</u> Pipe Dia. Range : Groove: <u>all dia</u> Fillet : : <u>all sizes</u> Other : <u>Root spacing for backing strip joints : 8 - 10 mm</u> <u>For others : 2 ± 1 mm</u>																							
Filler Metals (QW – 404) <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Spec. No. (SFA)</td> <td><u>5.1</u></td> </tr> <tr> <td>AWS NO (CLASS)</td> <td><u>E-7018</u></td> </tr> <tr> <td>F. No.</td> <td><u>4</u></td> </tr> <tr> <td>A. No.</td> <td><u>1</u></td> </tr> <tr> <td>Size of Filler Metals</td> <td><u>Dia 2.5; 3.15; 4.0; 5.0; 6.3 mm</u></td> </tr> <tr> <td colspan="2">Deposited Weld Metal</td> </tr> <tr> <td>Thickness Range: Groove:</td> <td><u>200 mm Max.</u></td> </tr> <tr> <td>Fillet :</td> <td><u>ALL</u></td> </tr> <tr> <td>Electrode Flux (Class)</td> <td><u>Basic</u></td> </tr> <tr> <td>Consumable Insert</td> <td><u>No</u></td> </tr> <tr> <td>Max. Bead Thickness</td> <td><u>5 mm</u></td> </tr> </table>		Spec. No. (SFA)	<u>5.1</u>	AWS NO (CLASS)	<u>E-7018</u>	F. No.	<u>4</u>	A. No.	<u>1</u>	Size of Filler Metals	<u>Dia 2.5; 3.15; 4.0; 5.0; 6.3 mm</u>	Deposited Weld Metal		Thickness Range: Groove:	<u>200 mm Max.</u>	Fillet :	<u>ALL</u>	Electrode Flux (Class)	<u>Basic</u>	Consumable Insert	<u>No</u>	Max. Bead Thickness	<u>5 mm</u>
Spec. No. (SFA)	<u>5.1</u>																						
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Fillet :	<u>ALL</u>																						
Electrode Flux (Class)	<u>Basic</u>																						
Consumable Insert	<u>No</u>																						
Max. Bead Thickness	<u>5 mm</u>																						

Rev 02 : Changes in non essential variables

POSITIONS (QW-405)			POSTWELD HEAT TREATMENT (QW-407)			
Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL			Temperature Range : 600 – 650°C Time Range : <i>As per UCS 56</i>			
PREHEAT (QW-406)			GAS (QW-408)			
Preheat Temp Min : 18 ° C UPTO 31 mm 100° C FROM 31 – 100 mm 150° C ABOVE 100 mm Interpass Temp Max : 350 ° C Preheat Maintenance : Nil			NOT APPLICABLE			
ELECTRICAL CHARACTERISTICS (QW-409)						
Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>ELECTRODE POSITIVE</u>						
Amps [Range] : <u>60 to 300 A</u> Volts Range : <u>22-26 V</u>						
TECHNIQUE (QW-410)						
String or Weave Bead : <u>string and weave (max 3D)</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>by air arc gouging / grinding</u> Multiple or Single Pass : <u>multiple pass / single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>not allowed</u>						
Clean weld area to remove oil, rust, grease, etc. prior to welding.						
Weld Layer (s)	Process	Filler Metal		Current		Other
		Class	Dia mm	Type Polar	Amp Range	
Root and subsequent layers	SMAW	E - 7018	2.5	DC +	60-90	STRING & WEAVE (MAX 3 x Electrode Dia)
	SMAW	E - 7018	3.15	DC +	90-140	
	SMAW	E - 7018	4.0	DC +	140-180	
	SMAW	E - 7018	5.0	DC +	180-240	
	SMAW	E - 7018	6.3	DC +	240-300	



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED

Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)Welding Procedure Specification No.: WE 003 Date: 02-04-84 Supporting PQR No.: 209Revision No.: 03Date: 14-08-2004Welding Process (es) : GTAW + SMAWType (s) : MANUAL**JOINTS (QW 402)**Joint Design: As per manufacturing drawing (groove / fillet)Backing (Yes) : for double side welds and backing strip joints(No) : for single side weldsBacking Material (Type) : Base metal / Weld metalMetal: YesNon-Fusing Metal: NoRetainer: No**BASE METALS (QW – 403)**

P. No. : 1 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2

OR

Specification type & grade: --- to Specification type & grade: ---

OR

Chemical Analysis & Mechanical Properties: --- to Chemical Analysis & Mechanical Properties: ----

Thickness Range :Base Metal : Groove: 4.8 mm to 24 mm Fillet : all sizesPipe Dia. Range : Groove: all dia Fillet : : all sizesOther : Root spacing for backing strip joints : 8 - 10 mmFor others : 2 ± 1 mmQW403.13 : Not applicable**Filler Metals (QW – 404)**

	GTAW	SMAW
Spec. No. (SFA)	<i>5.18</i>	<i>5.1</i>
AWS NO (CLASS)	<i>ER 70S2</i>	<i>E 7018</i>
F. No.	<i>6</i>	<i>4</i>
A. No.	<i>1</i>	<i>1</i>
Size of Filler Metals	<i>Dia 2.4 mm</i>	<i>Dia 3.15, 4.0, 5.0</i>
Deposited Weld Metal		
Thickness Range:	<i>4 mm Max.</i>	<i>20 mm Max.</i>
Groove:	<i>All sizes</i>	<i>All sizes</i>
Fillet:		
Electrode Flux (Class)	<i>NA</i>	<i>Basic</i>
Consumable Insert	<i>No</i>	<i>No</i>
Max. Bead Thickness	<i>3 mm</i>	<i>5 mm</i>

Rev 03: Changes in non essential variables

WPS: WE 003

POSITIONS (QW-405)				POSTWELD HEAT TREATMENT (QW-407)			
Position(s): ALL POSITIONS Welding Progression: UP for Vertical Down --- Position (s) Fillet: ALL				Temperature Range: <u>NONE</u> Time Range: NA			
PREHEAT (QW-406)				GAS (QW-408)			
Preheat Temp Min: 10 ° C Interpass Temp Max: 350 ° C Preheat Maintenance: Nil				Percent Composition: <i>Single Gas</i> Gas (es) Flow Rate Shielding: <i>Argon</i> <i>6-10 LPM</i> Trailing: <i>No</i> <i>--</i> Backing: <i>No</i> <i>--</i> <i>Closed chamber: no</i>			
ELECTRICAL CHARACTERISTICS (QW-409)							
Current AC or DC : <u>DIRECT CURRENT</u> Polarity : GTAW : <i>Straight (ELECTRODE NEGATIVE)</i> SMAW: <i>Reverse (ELECTRODE POSITIVE)</i>							
Amps [Range] : <u>80 to 240 A</u> Volts Range : GTAW : <u>12-22 V</u> SMAW: <u>22-32 V</u>							
Tungsten Electrode Size and Type : <u>Dia 2.4 mm 2% Thoriated</u> Pulsing : <u>No</u>							
TECHNIQUE (QW-410)							
String or Weave Bead : <u>string and weave</u> Orifice or Gas Cup Size : <u>8-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>not allowed</u>							
Clean weld area to remove oil, rust, grease, etc. prior to welding.							
Weld Layer (s)	Process	Filler Metal		Current		Voltage Range	Other
		Class	Dia mm	Type Polar	Amp Range		
Root	GTAW	ER 70S2	2.4	DC -	80-120	12-22	String of horizontal; Others Weave (Max 3 x Electrode Dia)
Subsequent layers	SMAW	E 7018	3.15	DC +	80-140	22-32	
	SMAW	E 7018	4.0	DC +	140-180	22-32	
	SMAW	E 7018	5.0	DC +	180-240	22-32	

HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED

Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)Welding Procedure Specification No.: WE 004 Date: 01-08-84 Supporting PQR No.: 21 +213Revision No.: 02Date: 15.09.1993Welding Process (es) : GTAW + SMAWType (s) : MANUAL**JOINTS (QW 402)**Joint Design : As per manufacturing drawing (groove / fillet)Backing (Yes) : for double side welds and backing strip joints(No) : for single side weldsBacking Material (Type) : Base metal / Weld metalMetal : YesNon-Fusing Metal : NoRetainer : No**BASE METALS (QW – 403)**

P. No. : 1 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2

OR

Specification type & grade : --- to Specification type & grade : ---

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :Base Metal : Groove: 1.6 mm to 38 mm Fillet : all sizesPipe Dia. Range : Groove: all dia Fillet : : all sizesOther : Root spacing for backing strip joints : 8 - 10 mmFor others : 2 ± 1 mm403.13 : not applicable**Filler Metals (QW – 404)**

	GTAW	SMAW
Spec. No. (SFA)	<i>5.18</i>	<i>5.1</i>
AWS NO (CLASS)	<i>ER 70SG</i>	<i>E 7018</i>
F. No.	<i>6</i>	<i>4</i>
A. No.	<i>1</i>	<i>1</i>
Size of Filler Metals	<i>Dia 2.4 mm</i>	<i>Dia 3.15, 4.0, 5.0</i>
Deposited Weld Metal		
Thickness Range:Groove: Fillet :	<i>4 mm Max. All sizes</i>	<i>38 mm Max. All sizes</i>
Electrode Flux (Class)	<i>NA</i>	<i>Basic</i>
Consumable Insert	<i>No</i>	<i>No</i>
Max. Bead Thickness	<i>3 mm</i>	<i>5 mm</i>

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : <u>600-650° C</u> Time Range : <i>As per UCS 56 of ASME secVIII division 1</i>			
PREHEAT (QW-406) Preheat Temp Min : 10 ° C upto 31 mm 							

HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED Ramachandrapuram, Hyderabad – 502 032.	
QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)	
Welding Procedure Specification No.: <u>WE 023</u> Date: <u>02-04-84</u> Supporting PQR No.: <u>WE / SP2(156)</u> Revision No.: <u>01</u> Date: <u>01-03-89</u> Welding Process (es) : <u>SMAW</u> Type (s) : <u>MANUAL</u>	
JOINTS (QW 402) Joint Design : <u>As per manufacturing drawing (groove / fillet)</u> Backing (Yes) : <u>for double side and backing strip joints</u> (No) : <u>for single side joints</u> Backing Material (Type) : <u>Base metal / Weld metal</u> Metal : <u>Yes</u> Non-Fusing Metal : <u>No</u> Retainer : <u>No</u>	
BASE METALS (QW – 403) P. No. : 5 Group No. : 1 TO P. No.: 4 Group No.: 1 OR Specification type & grade : --- to Specification type & grade : --- OR Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ---- <u>Thickness Range :</u> Base Metal : Groove: <u>4.8 mm to 28 mm</u> Fillet : <u>all sizes</u> Pipe Dia. Range : Groove: <u>all dia</u> Fillet : : <u>all sizes</u> Other : <u>Root spacing for backing strip joints : 8 - 10 mm</u> <u>For others : 2 ± 1 mm</u> <u>403.13 : not applicable</u>	
Filler Metals (QW – 404)	
Spec. No. (SFA)	5.5
AWS NO (CLASS)	<u>E-9018 B3</u>
F. No.	<u>4</u>
A. No.	<u>4</u>
Size of Filler Metals	<u>Dia 2.5 to 5.0 mm</u>
Deposited Weld Metal	
Thickness Range: Groove:	<u>28 mm Max.</u>
Fillet :	<u>ALL</u>
Electrode Flux (Class)	<u>Basic</u>
Consumable Insert	<u>No</u>
Max. Bead Thickness	<u>5 mm</u>

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : 700 – 720°C Time Range : <i>UCS 56 of ASME Sec VIII div.1</i>			
PREHEAT (QW-406) Preheat Temp Min : 250° C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				GAS (QW-408) NOT APPLICABLE			
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u><i>DIRECT CURRENT</i></u> Polarity : <u><i>ELECTRODE POSITIVE</i></u> Amps [Range] : <u>60 to 240 A</u> Volts Range : <u>22-30V</u>							
TECHNIQUE (QW-410) String or Weave Bead : <u>string and weave (max 3D)</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass / single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.							
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other
		Class	Dia mm	Type Polar	Amp Range		
<i>1</i>	<i>SMAW</i>	<i>E 9018B3</i>	<i>2.5</i>	<i>DC +</i>	<i>60-90</i>	<i>22-26</i>	<i>String Weave(Max3 x elec dia)</i> ,, ,,
<i>2</i>	<i>SMAW</i>	<i>E 9018B3</i>	<i>3.15</i>	<i>DC +</i>	<i>90-140</i>	<i>22-26</i>	
<i>3</i>	<i>SMAW</i>	<i>E 9018B3</i>	<i>4.0</i>	<i>DC +</i>	<i>140-180</i>	<i>22-28</i>	
<i>4</i>	<i>SMAW</i>	<i>E 9018B3</i>	<i>5.0</i>	<i>DC +</i>	<i>180-240</i>	<i>22-30</i>	



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED

Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)Welding Procedure Specification No.: WE 024 Date: 02-04-84 Supporting PQR No.: WE / SP2(156)Revision No.: 02Date: 14-08-04Welding Process (es) : SMAWType (s) : MANUAL**JOINTS (QW 402)**Joint Design : As per manufacturing drawing (groove / fillet)Backing (Yes) : for double side and backing strip joints(No) : for single side jointsBacking Material (Type) : Base metal / Weld metalMetal : YesNon-Fusing Metal : NoRetainer : No**BASE METALS (QW – 403)**

P. No. : 5 Group No. : 1 TO P. No.: 1 Group No.: 1 & 2

OR

Specification type & grade : --- to Specification type & grade : ---

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :Base Metal : Groove: 4.8 mm to 28 mm Fillet : all sizesPipe Dia. Range : Groove: all dia Fillet : all sizesOther : Root spacing for backing strip joints : 8 - 10 mmFor others : 2 ± 1 mm403.13 : not applicable**Filler Metals (QW – 404)**

Spec. No. (SFA) 5.5

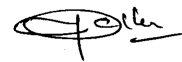
AWS NO (CLASS) E-9018 B3

F. No. 4

A. No. 4

Size of Filler Metals Dia 2.5 to 5.0 mm**Deposited Weld Metal**Thickness Range: Groove: 28 mm Max.Fillet : ALLElectrode Flux (Class) BasicConsumable Insert NoMax. Bead Thickness 5 mm**Rev 02: Changes in non essential variables**

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : 680 – 720°C Time Range : <i>UCS 56 of ASME Sec VIII div.1</i>			
PREHEAT (QW-406) Preheat Temp Min : 250° C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				GAS (QW-408) NOT APPLICABLE			
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>ELECTRODE POSITIVE</u> Amps [Range] : <u>60 to 240 A</u> Volts Range : <u>22-30V</u>							
TECHNIQUE (QW-410) String or Weave Bead : <u>string and weave (max 3D)</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass / single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.							
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other
		Class	Dia mm	Type Polar	Amp Range		
Root	SMAW	E -9018B3	2.5	DC +	60-90	22-26	String
Root / subseq uent layers	SMAW	E -9018B3	3.15	DC +	90-140	22-26	Weave(Max3 x elec dia)
	SMAW	E -9018B3	4.0	DC +	140-180	22-28	„
	SMAW	E -9018B3	5.0	DC +	180-240	22-30	„



HEAD / WELDING ENGG

Ramachandrapuram, Hyderabad – 502 032.

Welding Procedure Specification No.: WE 042 Date: 02-04-84 Supporting PQR No.: 258

Revision No.: 03

Date: *14-08-2004*

Welding Process (es) : *SMAW*

Type (s) : *MANUAL*

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : *for double side and backing strip groove welds*

(No) : for single side groove welds

Backing Material (Type) : *Base metal / Weld metal*

Metal : *Yes*

Non-Fusing Metal : No

Retainer : *No*

P.No. : 8 Group No. : 1 TO P.No.: 8 Group No.: 1

OR

Specification type & grade : --- to Specification type & grade : ----

OR

Chemical Analysis & Mechanical Properties : --- **to** Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : **Groove:** *4.8 mm to 200 mm* **Fillet :** *all sizes*

Pipe Dia. Range : Groove: all dia

Fillet : : all sizes

Other : Root spacing for backing strip joints : 8 - 10 mm

For others : 2 ± 1 mm

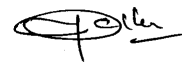
403.13 : not applicable

Filler Metals (QW – 404)

Spec. No. (SFA)	5.4
AWS NO (CLASS)	E308L-15
F. No.	5
A. No.	8
Size of Filler Metals	Dia 2.5 to5.0 mm
Deposited Weld Metal	
Thickness Range:Groove: Fillet :	200 mm Max ALL
Electrode Flux (Class)	Basic
Consumable Insert	No
Max. Bead Thickness	5 mm

Rev 03: Changes in non essential variables

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : Nil Time Range :			
PREHEAT (QW-406) Preheat Temp Min : 10° C Interpass Temp Max : 200 ° C Preheat Maintenance : Nil				GAS (QW-408) NOT APPLICABLE			
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>POSITIVE</u> Amps [Range] : <u>60 to 180 A</u> Volts Range : 22-30							
TECHNIQUE (QW-410) String or Weave Bead : <u>string and weave (max 2D for vertical)</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> (Use stainless steel tools) Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass / single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.							
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other
		Class	Dia mm	Type Polar	Amp Range		
1	SMAW	E 308L-15	2.5	DC+	60-80	22-24	String
2	SMAW	E 308L-15	3.15	DC +	90-110	22-26	„
3	SMAW	E 308L-15	4.0	DC +	120-140	22-28	„
4	SMAW	E 308L-15	5.0	DC +	140-180	22-30	„



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE 045 Date: 06.01.75 Supporting PQR No.: 19

Revision No.: 01

Date: 01.03.89

Welding Process (es) : SMAW

Type (s) : MANUAL

JOINTS (QW 402)

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : for double side and backing strip groove welds

(No) : for single side groove welds

Backing Material (Type) : Base metal / Weld metal

Metal : Yes

Non-Fusing Metal : No

Retainer : No

BASE METALS (QW – 403)

P. No. : 8 Group No. : 1 TO P. No.: 8 Group No.: 1

OR

Specification type & grade : --- to Specification type & grade : ----

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : Groove: 4.75 mm to 50 mm Fillet : all sizes

Pipe Dia. Range : Groove: all dia Fillet : : all sizes

Other : Root spacing for backing strip joints : 8 - 10 mm

For others : 2 ± 1 mm

403.13 : not applicable

Filler Metals (QW – 404)

Spec. No. (SFA)	5.4
AWS NO (CLASS)	E-347-15
F. No.	5
A. No.	8
Size of Filler Metals	Dia 2.5 to 5.0 mm
Deposited Weld Metal	
Thickness Range: Groove:	50 mm Max
Fillet :	ALL
Electrode Flux (Class)	Basic
Consumable Insert	No
Max. Bead Thickness	5 mm

Rev 01: Changes in non essential variables

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : Nil Time Range :			
PREHEAT (QW-406) Preheat Temp Min : 10° C Interpass Temp Max : 200 ° C Preheat Maintenance : Nil				GAS (QW-408) NOT APPLICABLE			
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>POSITIVE</u> Amps [Range] : <u>60 to 180 A</u> Volts Range : 22-30							
TECHNIQUE (QW-410) String or Weave Bead : <u>string and weave (max 2D for vertical)</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> (Use stainless steel tools) Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass / single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.							
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other
		Class	Dia mm	Type Polar	Amp Range		
Root and subsequent layers	SMAW	E 347-15	2.5	DC+-	60-80	22-24	String
	SMAW	-do-	3.15	DC +	90-110	22-26	„
	SMAW	-do-	4.0	DC +	120-140	22-28	„
	SMAW	-do-	5.0	DC +	140-180	22-30	„



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED

Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE 046 Date: 30-12-86 Supporting PQR No.: 517

Revision No.: 04

Date: 27.05.2010

Welding Process (es) : SMAW

Type (s) : MANUAL

JOINTS (QW 402)

Joint Design : As per manufacturing drawing (groove / fillet)

Root Spacing : Backing strip joints : 6 - 10 mm

For others : 1-3 mm

Backing (Yes) : for double side and backing strip joints

(No) : for single side joints

Backing Material (Type) : Base metal / Weld metal

Metal : Yes

Non-Fusing Metal : No

Retainer : No

BASE METALS (QW – 403)

P. No. : 8 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2

OR

Specification type & grade or UNS Number: --- to Specification type & grade or UNS Number: ----

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : Groove: 5.0 mm to 50 mm Fillet : all sizes

Maximum Pass thickness : ≤ 13mm

Other : ---

Filler Metals (QW – 404)

Spec. No. (SFA)	<u>5.4</u>
AWS NO (CLASS)	<u>E309-15 & E309-16</u>
F. No.	<u>5</u>
A. No.	<u>8</u>
Size of Filler Metals	<u>Dia 2.5 to 5.0 mm</u>
Filler Metal Product Form	<u>Flux Coated Electrode</u>
Supplemental Filler Metal	<u>N.A</u>
Deposited Weld Metal	
Thickness Range: Groove:	<u>38 mm Max</u>
Fillet :	<u>ALL</u>
Electrode Flux (Class)	<u>Basic</u>

Rev 04 : Clause 403.13 deleted

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL Other :				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : Nil Time Range : Other :			
PREHEAT (QW-406) Preheat Temp Min : 10° C upto 31mm 							



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED Ramachandrapuram, Hyderabad – 500 032.			
QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)			
Welding Procedure Specification No.: WE 159		Date: 20.07.2010. Supporting PQR No.: 518	
Revision No.: 00		Date: 20.07.2010	
Welding Process (es) : GTAW+ SMAW		Type (s) : MANUAL	
JOINTS (QW 402)		Details	
Joint Design :		As Per Manufacturing Drawing	
Backing (Yes) :		For double side joint's (No) : For single side joint's	
Backing Material (Type) :		Base Metal /Weld metal	
Metal : ✓		Non-Fusing Metal : --	
Retainer : No			
BASE METALS (QW – 403)			
P. No. : 5A Group No. : 1		TO P. No. : 5 A Group No. : 1	
OR			
Specification type & grade :			
to Specification type & grade :			
OR			
Chemical Analysis & Mechanical Properties :			
to Chemical Analysis & Mechanical Properties :			
Thickness Range :			
Base Metal :		Groove : 5.0 –200mm	Fillet : All
Pipe Dia. Range : ---		Groove : ALL DIA	Fillet : ALL
Other :			
Filler Metals (QW – 404)			
GTAW		SMAW	
Spec. No. (SFA)		5.28	5.5
AWS No. (Class)		ER 90 SG	E 9018-B 3
F. No.		6	4
A. No.		--	--
Size of Filler Metals		DIA 2.4mm	DIA 3.15, 4.0,5.0 mm
Deposited Weld Metal			
Thickness Range:	Groove	6 mm max	Balance
	Fillet	All	All
Electrode Flux (Class)		NA	Basic
Flux Trade Name		NIL	NIL
Consumable Insert		NO	NO
Max. Bead Thickness		3 mm	5 mm max

POSITIONS (QW-405)				POSTWELD HEAT TREATMENT (QW-407)			
Position(s) Groove : All				Temperature Range : 680 -710°C			
Welding Progression : Up For “V” Position (s) Fillet : All				Time Range : As per UCS-56 of ASME Sec VIII Div.1			
PREHEAT (QW-406)				GAS (QW-408)			
Preheat Temp Min : 250°C				Percent Composition: 99.995 %			
Interpass Temp Max : 350°C				Gas (es) [Mixture] Flow Rate			
Preheat Maintenance : post heat at 220 -280°C for 2 hrs on Completion of welding & on interruption				Shielding : Argon 8 – 12 lpm			
				Trailing : NA-			
				Backing : NA			
ELECTRICAL CHARACTERISTICS (QW-409)							
Current AC or DC : DC				Polarity : EN For GTAW EP For SMAW			
Amps [Range] : 80 – 240 A				Volts Range : 10-30V			
Tungsten Electrode size and type :				EWTh – 2 ; Dia 2.4 mm			
Mode of Metal Transfer for GMAW :				NA			
Electrode wire feed speed range :				NA			
Pulse CURRENT :				NA			
TECHNIQUE (QW-410)							
String or Weave Bead : STRING				Orifice or Gas Cup Size : 6/9			
Initial and Interpass Cleaning : Chipping, Brushing & Grinding							
Method of Back Gouging : Grinding				Oscillation : NA			
Contact Tube to Work Distance : NA				Multiple or Single Pass : Multiple			
Multiple or Single Electrodes : Single				Travel Speed (Range) : NA			
Peening : NO				Electrode Spacing : NA			
Other : Clean Weld Area To Remove, Grease, Rust. Paint etc. Prior to welding							
Weld Layer (s)	Process	Filler Metal		Current		Travel Speed Range mm/min	Other
		Class	Dia mm	Type Polar	Amp Range		
ROOT	GTAW	ER 90 SG	2.4	DC EN	80 – 110	NA	NIL
Sub	SMAW	E9018-B3	3.15	DC EP	90 – 140	NA	NIL
sequent	SMAW	E9018-B3	4.0	DC EP	140 – 180	NA	NIL
layers	SMAW	E9018-B3	5.0	DC EP	190 - 240	NA	NIL

APPROVED BY



Head / Welding Engg

Ramachandrapuram, Hyderabad – 502 032.

Welding Procedure Specification No.: WE 301 Date: 09-09-77 Supporting PQR No.: WE/RRC/23

Revision No.: 01

Date: 01-03-89

Welding Process (es) : GTAW

Type (s) : *MANUAL*

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : *for double side and backing strip joints*

(No) : for single side joints

Backing Material (Type) : *P1 for backing strip & weld metal for double side joints*

Metal : *Yes*

Non-Fusing Metal : No

Retainer : *No*

P. No. : 1 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2

OR

Specification type & grade : ----- to Specification type & grade : -----

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : **Groove: 1.6 to 11.2 mm**

Fillet : *all sizes*

Pipe Dia. Range : Groove: all dia

Fillet : : all dia

Other : Root spacing for backing strip joints : 8 - 10 mm

For others : 2 ± 1 mm

403.13 : not applicable

Spec. No. (SFA)	5.18
------------------------	-------------

5.18

AWS NO (CLASS)

ER70SG /ER70S-2

F. No.

6

A. No.

1

Size of Filler Metals

Dia 2.4 mm

Other

Filler wire : TGS – 50 of KOBE STEEL (JAPAN)

Deposited Weld Metal

Thickness Range:	Groove:	11.2 mm Max.
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Fillet :

...

Electrode Flux (Class)

...

Consumable Insert

No

Max. Bead Thickness

4 mm

Rev 01 : Changes in non essential variables

POSITIONS (QW-405)				POSTWELD HEAT TREATMENT (QW-407)			
Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				Temperature Range : Nil Time Range : ---			
PREHEAT (QW-406)				GAS (QW-408)			
Preheat Temp Min : 10 ^o C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				Percent Composition : Gas(es) Mixture Flow Rate Shielding : Argon, 99.9% 6-10 LPM Trailing : No -- Backing : No --			
ELECTRICAL CHARACTERISTICS (QW-409)							
Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>ELECTRODE NEGATIVE</u> Amps [Range] : <u>110 to 160 A</u> Volts Range : <u>14 – 20 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm, 2% Thoriated</u> Pulsing : <u>No</u>							
TECHNIQUE (QW-410)							
String or Weave Bead : <u>string</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.							
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other
		Class	Dia mm	Type Polar	Amp Range		
I-n	GTAW	ER70S	2.4	DC -	110-160	14-20	String only



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE 311 Date: 02.04.1984 Supporting PQR No.: 105
Revision No.: 02 Date: 10.03.1995
Welding Process (es) : GTAW Type (s) : MANUAL

JOINTS (QW 402)

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : for double side welds and backing strip joints
(No) : for single side welds

Backing Material (Type) : Base metal / Weld metal

Metal : Yes

Non-Fusing Metal : No

Retainer : No

BASE METALS (QW – 403)

P. No. : 4 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2

OR

Specification type & grade : --- to Specification type & grade : ---

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : Groove: 1.6 mm to 8.0 mm Fillet : all sizes

Pipe Dia. Range : Groove: all dia Fillet : : all sizes

Other : Root spacing for backing strip joints : 8 - 10 mm

For others : 2 ± 1 mm

403.13 : not applicable

Filler Metals (QW – 404)

	GTAW	
Spec. No. (SFA)	5.28	
AWS NO (CLASS)	ER 80S-B2	
F. No.	6	
A. No.	3	
Size of Filler Metals	Dia 1.6, 2.4 mm	
Deposited Weld Metal		
Thickness Range:Groove:	8 mm Max.	
Fillet :	All sizes	
Electrode Flux (Class)	NA	
Consumable Insert	No	
Max. Bead Thickness	4 mm	

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : <u>660-680° C</u> Time Range : 1Hr for every 25mm upto 50mm (minimum 30 minutes)															
PREHEAT (QW-406) Preheat Temp Min : 150 ° C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				GAS (QW-408) Percent Composition : Single Gas <table><tr><td></td><td>Gas(es)</td><td>Flow Rate</td></tr><tr><td>Shielding :</td><td>Argon</td><td>6-10 LPM</td></tr><tr><td>Trailing :</td><td>No</td><td>--</td></tr><tr><td>Backing :</td><td>No</td><td>--</td></tr></table>					Gas(es)	Flow Rate	Shielding :	Argon	6-10 LPM	Trailing :	No	--	Backing :	No	--
	Gas(es)	Flow Rate																	
Shielding :	Argon	6-10 LPM																	
Trailing :	No	--																	
Backing :	No	--																	
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>Straight (ELECTRODE NEGATIVE)</u> Amps [Range] : <u>70 to 130 A</u> Volts Range : <u>12-18 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm 2% Thoriated</u> Pulsing : <u>No</u>																			
TECHNIQUE (QW-410) String or Weave Bead : <u>string</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>not allowed</u> Closed Chamber : <u>No</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																			
Weld Layer (s)	Process	Filler Metal		Current		Voltage Range	Other												
		Class	Dia mm	Type Polar	Amp Range														
	GTAW	ER 80S-B2	1.6	DC -	70-100	12-16	String												
	GTAW	ER 80S-B2	2.4	DC-	100-130	12-18	do												



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE 312 Date: 02.04.1984 Supporting PQR No.: 105
Revision No.: 02 Date: 10.03.1995
Welding Process (es) : GTAW Type (s) : MANUAL

JOINTS (QW 402)

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : for double side welds and backing strip joints
(No) : for single side welds

Backing Material (Type) : Base metal / Weld metal

Metal : Yes

Non-Fusing Metal : No

Retainer : No

BASE METALS (QW – 403)

P. No. : 4 Group No. : 1&2 TO P. No.: 4 Group No.: 1&2

OR

Specification type & grade : --- to Specification type & grade : ---

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : Groove: 1.6 mm to 8.0 mm Fillet : all sizes

Pipe Dia. Range : Groove: all dia Fillet : : all sizes

Other : Root spacing for backing strip joints : 8 - 10 mm

For others : 2 ± 1 mm

403.13 : not applicable

Filler Metals (QW – 404)

GTAW		
Spec. No. (SFA)	5.28	
AWS NO (CLASS)	ER 80S-B2	
F. No.	6	
A. No.	3	
Size of Filler Metals	Dia 1.6, 2.4 mm	
Deposited Weld Metal		
Thickness Range:Groove:	8 mm Max.	
Fillet :	All sizes	
Electrode Flux (Class)	NA	
Consumable Insert	No	
Max. Bead Thickness	4 mm	

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : <u>660-680° C</u> Time Range : 1Hr for every 25mm upto 50mm (minimum 30 minutes)															
PREHEAT (QW-406) Preheat Temp Min : 150 ° C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				GAS (QW-408) Percent Composition : Single Gas <table><tr><td></td><td>Gas(es)</td><td>Flow Rate</td></tr><tr><td>Shielding :</td><td>Argon</td><td>6-10 LPM</td></tr><tr><td>Trailing :</td><td>No</td><td>--</td></tr><tr><td>Backing :</td><td>No</td><td>--</td></tr></table>					Gas(es)	Flow Rate	Shielding :	Argon	6-10 LPM	Trailing :	No	--	Backing :	No	--
	Gas(es)	Flow Rate																	
Shielding :	Argon	6-10 LPM																	
Trailing :	No	--																	
Backing :	No	--																	
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>Straight (ELECTRODE NEGATIVE)</u> Amps [Range] : <u>70 to 130 A</u> Volts Range : <u>12-18 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm 2% Thoriated</u> Pulsing : <u>No</u>																			
TECHNIQUE (QW-410) String or Weave Bead : <u>string</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>not allowed</u> Closed Chamber : <u>No</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																			
Weld Layer (s)	Process	Filler Metal		Current		Voltage Range	Other												
		Class	Dia mm	Type Polar	Amp Range														
	GTAW	ER 80S-B2	1.6	DC -	70-100	12-16	String												
	GTAW	ER 80S-B2	2.4	DC-	100-130	12-18	do												



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED Ramachandrapuram, Hyderabad – 502 032.	
QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)	
Welding Procedure Specification No.: <u>WE 313</u> Date: <u>17-11-77</u> Supporting PQR No.: <u>79 & 79 IGC</u>	
Revision No.: <u>03</u> Date: <u>27.01.2006</u>	
Welding Process (es) : <u>GTAW</u> Type (s) : <u>MANUAL</u>	
JOINTS (QW 402) Joint Design : <u>As per manufacturing drawing (groove / fillet)</u> Backing (Yes) : <u>for double side and backing strip joints</u> (No) : <u>for single side joints</u> Backing Material (Type) : <u>Weld metal / base metal</u> Metal : <u>Yes</u> Non-Fusing Metal : <u>No</u> Retainer : <u>No</u>	
BASE METALS (QW – 403) P. No. : 8 Group No. : 1 TO P. No.: 8 Group No.: 1 OR Specification type & grade : ----- to Specification type & grade : ----- OR Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ---- <u>Thickness Range :</u> Base Metal : Groove: <u>1.6 to 7.50 mm</u> Fillet : <u>all sizes</u> Pipe Dia. Range : Groove: <u>all dia</u> Fillet : : <u>all sizes</u> Other : <u>Root spacing : 2 ± 1 mm</u> <u>403.13 : not applicable</u>	
Filler Metals (QW – 404)	
Spec. No. (SFA)	5.9
AWS NO (CLASS)	ER 347
F. No.	6
A. No.	8
Size of Filler Metals	Dia 1.6 to 2.4 mm
Deposited Weld Metal	
Thickness Range: Groove:	7.50 mm Max.
Fillet :	ALL
Electrode Flux (Class)	NA
Consumable Insert	No
Max. Bead Thickness	3 mm

Rev. 3 : PDO DEP SP1173 requirements (PQR Added)

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : Nil Time Range : ---																							
PREHEAT (QW-406) Preheat Temp Min : 18° C Interpass Temp Max : 200 ° C Preheat Maintenance : Nil				GAS (QW-408) Percent Composition : Single Gas <table><tr><td></td><td>Gas(es)</td><td>Mixture</td><td>Flow Rate</td></tr><tr><td>Shielding :</td><td>Argon</td><td>--</td><td>6-10 LPM</td></tr><tr><td>Trailing :</td><td>No</td><td>--</td><td></td></tr><tr><td>Backing :</td><td>Argon</td><td>--</td><td>4-6 LPM</td></tr><tr><td colspan="4">Closed Chamber : No</td></tr></table>					Gas(es)	Mixture	Flow Rate	Shielding :	Argon	--	6-10 LPM	Trailing :	No	--		Backing :	Argon	--	4-6 LPM	Closed Chamber : No			
	Gas(es)	Mixture	Flow Rate																								
Shielding :	Argon	--	6-10 LPM																								
Trailing :	No	--																									
Backing :	Argon	--	4-6 LPM																								
Closed Chamber : No																											
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>ELECTRODE NEGATIVE</u> Amps [Range] : <u>70 to 110 A</u> Volts Range : <u>11 – 20 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm, 2% Thoriated</u> Pulsing : <u>No</u>																											
TECHNIQUE (QW-410) String or Weave Bead : <u>string</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> (Use SS tools only) Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																											
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other																				
		Class	Dia mm	Type Polar	Amp Range																						
1	GTAW	ER 347	1.6	DC -	70-90	11-15	String																				
2	GTAW	ER 347	2.4	DC -	80-110	14-20	„																				



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE 314 Date: 21-03-83 Supporting PQR No.: 79A

Revision No.: 02

Date: 14-08-04

Welding Process (es) : GTAW

Type (s) : MANUAL

JOINTS (QW 402)

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : for double side and backing strip joints

(No) : for single side joints

Backing Material (Type) : Weld metal / base metal

Metal : Yes

Non-Fusing Metal : No

Retainer : No

BASE METALS (QW – 403)

P. No. : 8 Group No. : 1 TO P. No.: 8 Group No.: 1

OR

Specification type & grade : ----- to Specification type & grade : -----

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : Groove: 1.6 to 9.6 mm

Fillet : all sizes

Pipe Dia. Range : Groove: all dia

Fillet : : all sizes

Other : Root spacing for backing strip joints : 8 - 10 mm

For others : 2 ± 1 mm

403.13 : not applicable

Filler Metals (QW – 404)

Spec. No. (SFA)	5.9
AWS NO (CLASS)	ER 308L
F. No.	6
A. No.	8
Size of Filler Metals	Dia 1.6 to 2.4 mm
Deposited Weld Metal	
Thickness Range: Groove:	9.6 mm Max.
Fillet :	ALL
Electrode Flux (Class)	NA
Consumable Insert	No
Max. Bead Thickness	3 mm

Rev 02 : Changes in non essential variables

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL	POSTWELD HEAT TREATMENT (QW-407) Temperature Range : Nil Time Range : ---																																
PREHEAT (QW-406) Preheat Temp Min : 10° C Interpass Temp Max : 200 ° C Preheat Maintenance : Nil	GAS (QW-408) Percent Composition : Single Gas <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;"></th> <th style="width: 25%;">Gas(es)</th> <th style="width: 25%;">Mixture</th> <th style="width: 35%;">Flow Rate</th> </tr> </thead> <tbody> <tr> <td>Shielding :</td> <td>Argon</td> <td>--</td> <td>6-10 LPM</td> </tr> <tr> <td>Trailing :</td> <td>No</td> <td>--</td> <td></td> </tr> <tr> <td>Backing :</td> <td>Argon</td> <td>--</td> <td>4-6 LPM</td> </tr> <tr> <td>Closed Chamber :</td> <td>No</td> <td></td> <td></td> </tr> </tbody> </table>		Gas(es)	Mixture	Flow Rate	Shielding :	Argon	--	6-10 LPM	Trailing :	No	--		Backing :	Argon	--	4-6 LPM	Closed Chamber :	No														
	Gas(es)	Mixture	Flow Rate																														
Shielding :	Argon	--	6-10 LPM																														
Trailing :	No	--																															
Backing :	Argon	--	4-6 LPM																														
Closed Chamber :	No																																
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>ELECTRODE NEGATIVE</u> Amps [Range] : <u>70 to 100 A</u> Volts Range : <u>10 – 20 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm, 2% Thoriated</u> Pulsing : <u>No</u>																																	
TECHNIQUE (QW-410) String or Weave Bead : <u>string</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> (USE STAINLESS STEEL TOOLS) Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass /single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																																	
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 10%;">Weld Layer (s)</th> <th rowspan="2" style="width: 10%;">Process</th> <th colspan="2" style="width: 20%;">Filler Metal</th> <th colspan="2" style="width: 20%;">Current</th> <th rowspan="2" style="width: 10%;">Volt Range</th> <th rowspan="2" style="width: 20%;">Other</th> </tr> <tr> <th style="width: 10%;">Class</th> <th style="width: 10%;">Dia mm</th> <th style="width: 10%;">Type Polar</th> <th style="width: 10%;">Amp Range</th> </tr> </thead> <tbody> <tr> <td rowspan="2" style="text-align: center;">Root/sub sequent</td> <td style="text-align: center;">GTAW</td> <td style="text-align: center;">ER308L</td> <td style="text-align: center;">1.6</td> <td style="text-align: center;">DC -</td> <td style="text-align: center;">70-90</td> <td style="text-align: center;">10-18</td> <td rowspan="2" style="text-align: center;">String ,,</td> </tr> <tr> <td style="text-align: center;">GTAW</td> <td style="text-align: center;">ER308L</td> <td style="text-align: center;">2.4</td> <td style="text-align: center;">DC -</td> <td style="text-align: center;">80-100</td> <td style="text-align: center;">12-20</td> </tr> </tbody> </table>								Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other	Class	Dia mm	Type Polar	Amp Range	Root/sub sequent	GTAW	ER308L	1.6	DC -	70-90	10-18	String ,,	GTAW	ER308L	2.4	DC -	80-100	12-20
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other																										
		Class	Dia mm	Type Polar	Amp Range																												
Root/sub sequent	GTAW	ER308L	1.6	DC -	70-90	10-18	String ,,																										
	GTAW	ER308L	2.4	DC -	80-100	12-20																											



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED Ramachandrapuram, Hyderabad – 502 032.	
QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)	
Welding Procedure Specification No.: <u>WE 315</u> Date: <u>10-04-90</u> Supporting PQR No.: <u>82</u> Revision No.: <u>0</u> Date: <u>--</u> Welding Process (es) : <u>GTAW</u> Type (s) : <u>MANUAL</u>	
JOINTS (QW 402) Joint Design : <u>As per manufacturing drawing (groove / fillet)</u> Backing (Yes) : <u>for double side and backing strip joints</u> (No) : <u>for single side joints</u> Backing Material (Type) : <u>Weld metal / base metal</u> Metal : <u>Yes</u> Non-Fusing Metal : <u>No</u> Retainer : <u>No</u>	
BASE METALS (QW – 403) P. No. : <u>8</u> Group No. : <u>1</u> TO P. No.: <u>1</u> Group No.: <u>1&2</u> OR Specification type & grade : <u>-----</u> to Specification type & grade : <u>-----</u> OR Chemical Analysis & Mechanical Properties : <u>---</u> to Chemical Analysis & Mechanical Properties : <u>----</u> <u>Thickness Range :</u> Base Metal : Groove: <u>1.6 to 15 mm</u> Fillet : <u>all sizes</u> Pipe Dia. Range : Groove: <u>all dia</u> Fillet : : <u>all sizes</u> Other : <u>Root spacing for backing strip joints : 8 - 10 mm</u> <u>For others : 2 ± 1 mm</u> <u>403.13 : not applicable</u>	
Filler Metals (QW – 404)	
Spec. No. (SFA)	5.9
AWS NO (CLASS)	ER 309L
F. No.	6
A. No.	8
Size of Filler Metals	Dia 1.6 to 2.4 mm
Deposited Weld Metal	
Thickness Range: Groove:	15 mm Max.
Fillet :	15 mm
Electrode Flux (Class)	NA
Consumable Insert	No
Max. Bead Thickness	3 mm

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : Nil Time Range : ---																							
PREHEAT (QW-406) Preheat Temp Min : 10° C Interpass Temp Max : 200 ° C Preheat Maintenance : Nil				GAS (QW-408) Percent Composition : Single Gas <table><tr><td></td><td>Gas(es)</td><td>Mixture</td><td>Flow Rate</td></tr><tr><td>Shielding :</td><td>Argon</td><td>--</td><td>6-10 LPM</td></tr><tr><td>Trailing :</td><td>No</td><td>--</td><td></td></tr><tr><td>Backing :</td><td>Argon</td><td>--</td><td>4-6 LPM</td></tr><tr><td>Closed Chamber :</td><td>No</td><td></td><td></td></tr></table>					Gas(es)	Mixture	Flow Rate	Shielding :	Argon	--	6-10 LPM	Trailing :	No	--		Backing :	Argon	--	4-6 LPM	Closed Chamber :	No		
	Gas(es)	Mixture	Flow Rate																								
Shielding :	Argon	--	6-10 LPM																								
Trailing :	No	--																									
Backing :	Argon	--	4-6 LPM																								
Closed Chamber :	No																										
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : <u>ELECTRODE NEGATIVE</u> Amps [Range] : <u>70 to 120 A</u> Volts Range : <u>12 – 20 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm, 2% Thoriated</u> Pulsing : <u>No</u>																											
TECHNIQUE (QW-410) String or Weave Bead : <u>string</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>by grinding</u> Multiple or Single Pass : <u>multiple pass /single pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>no</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																											
Weld Layer (s)	Process	Filler Metal		Current		Volt Range	Other																				
		Class	Dia mm	Type Polar	Amp Range																						
Root/sub sequent	GTAW	ER309L	1.6	DC -	70-90	12-18	String ,,																				
	GTAW	ER309L	2.4	DC -	80-100	12-20																					



HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED

Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)Welding Procedure Specification No.: WE 343 Date: 18.02.1985 Supporting PQR No.: 228 +105Revision No.: 03Date: 10.03.1995Welding Process (es) : GTAW + SMAWType (s) : MANUAL**JOINTS (QW 402)**Joint Design : As per manufacturing drawing (groove / fillet)Backing (Yes) : for double side welds and backing strip joints(No) : for single side weldsBacking Material (Type) : Base metal / Weld metalMetal : YesNon-Fusing Metal : NoRetainer : No**BASE METALS (QW – 403)**

P. No. : 4 Group No. : 1&2 TO P. No.: 4 Group No.: 1&2

OR

Specification type & grade : --- to Specification type & grade : ---

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :Base Metal : Groove: 1.6 mm to 50 mm Fillet : all sizesPipe Dia. Range : Groove: all dia Fillet : : all sizesOther : Root spacing for backing strip joints : 8 - 10 mmFor others : 2 ± 1 mm403.13 : not applicable**Filler Metals (QW – 404)**

	GTAW	SMAW
Spec. No. (SFA)	5.28	5.5
AWS NO (CLASS)	ER 80S-B2	E 8018-B2
F. No.	6	4
A. No.	3	3
Size of Filler Metals	<i>Dia 2.4 mm</i>	<i>Dia 3.15, 4.0, 5.0</i>
Deposited Weld Metal		
Thickness Range: Groove: Fillet :	8 mm Max. <i>All sizes</i>	42 mm Max. <i>All sizes</i>
Electrode Flux (Class)	<i>NA</i>	<i>Basic</i>
Consumable Insert	<i>No</i>	<i>No</i>
Max. Bead Thickness	4 mm	5 mm

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : <u>660-680° C</u> Time Range : <i>As per UCS 56 of ASME Sec VIII Div 1</i>															
PREHEAT (QW-406) Preheat Temp Min : 150 ° C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				GAS (QW-408) Percent Composition : <i>Single Gas</i> <table><tr><td></td><td>Gas(es)</td><td>Flow Rate</td></tr><tr><td>Shielding :</td><td><i>Argon</i></td><td><i>6-10 LPM</i></td></tr><tr><td>Trailing :</td><td><i>No</i></td><td>--</td></tr><tr><td>Backing :</td><td><i>No</i></td><td>--</td></tr></table>					Gas(es)	Flow Rate	Shielding :	<i>Argon</i>	<i>6-10 LPM</i>	Trailing :	<i>No</i>	--	Backing :	<i>No</i>	--
	Gas(es)	Flow Rate																	
Shielding :	<i>Argon</i>	<i>6-10 LPM</i>																	
Trailing :	<i>No</i>	--																	
Backing :	<i>No</i>	--																	
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u><i>DIRECT CURRENT</i></u> Polarity : GTAW : <u><i>Straight (ELECTRODE NEGATIVE)</i></u> SMAW : <u><i>Reverse (ELECTRODE POSITIVE)</i></u> Amps [Range] : <u>100 to 240 A</u> Volts Range : GTAW : <u>12-16 V</u> SMAW: <u>22-26 V</u> Tungsten Electrode Size and Type : <u><i>Dia 2.4 mm 2% Thoriated</i></u> Pulsing : <u><i>No</i></u>																			
TECHNIQUE (QW-410) String or Weave Bead : <u>string and weave</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>not allowed</u> Closed Chamber : <u>No</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																			
Weld Layer (s)	Process	Filler Metal		Current		Voltage Range	Other												
		Class	Dia mm	Type Polar	Amp Range														
1	GTAW	ER 80S-B2	2.4	DC -	100-130	12-16	String Weave (Max 3 x Electrode Dia)												
2	SMAW	E 8018-B2	3.15	DC +	90-140	22-26													
3	SMAW	E 8018-B2	4.0	DC +	140-180	22-26													
4	SMAW	E 8018-B2	5.0	DC +	180-240	22-26													

HEAD / WELDING ENGG

BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad – 502 032.

QW – 482 WELDING PROCEDURE SPECIFICATION (WPS)

Welding Procedure Specification No.: WE 345 Date: 18.02.1985 Supporting PQR No.: 228 +105

Revision No.: 02 Date: 10.03.1995

Welding Process (es) : GTAW + SMAW Type (s) : MANUAL

JOINTS (QW 402)

Joint Design : As per manufacturing drawing (groove / fillet)

Backing (Yes) : for double side welds and backing strip joints
(No) : for single side welds

Backing Material (Type) : Base metal / Weld metal

Metal : Yes

Non-Fusing Metal : No

Retainer : No

BASE METALS (QW – 403)

P. No. : 4 Group No. : 1&2 TO P. No.: 1 Group No.: 1&2

OR

Specification type & grade : --- to Specification type & grade : ---

OR

Chemical Analysis & Mechanical Properties : --- to Chemical Analysis & Mechanical Properties : ----

Thickness Range :

Base Metal : Groove: 1.6 mm to 50 mm Fillet : all sizes

Pipe Dia. Range : Groove: all dia Fillet : : all sizes

Other : Root spacing for backing strip joints : 8 - 10 mm
For others : 2 ± 1 mm

403.13 : not applicable

Filler Metals (QW – 404)

	GTAW	SMAW
Spec. No. (SFA)	5.28	5.5
AWS NO (CLASS)	ER 80S-B2	E 8018-B2
F. No.	6	4
A. No.	3	3
Size of Filler Metals	Dia 2.4 mm	Dia 3.15, 4.0, 5.0
Deposited Weld Metal		
Thickness Range:Groove: Fillet :	8 mm Max. All sizes	42 mm Max. All sizes
Electrode Flux (Class)	NA	Basic
Consumable Insert	No	No
Max. Bead Thickness	4 mm	5 mm

POSITIONS (QW-405) Position(s) : ALL POSITIONS Welding Progression : UP for Vertical Down --- Position (s) Fillet : ALL				POSTWELD HEAT TREATMENT (QW-407) Temperature Range : <u>660-680° C</u> Time Range : As per UCS 56 of ASME Sec VIII Div 1															
PREHEAT (QW-406) Preheat Temp Min : 150 ° C Interpass Temp Max : 350 ° C Preheat Maintenance : Nil				GAS (QW-408) Percent Composition : Single Gas <table><tr><td></td><td>Gas(es)</td><td>Flow Rate</td></tr><tr><td>Shielding :</td><td>Argon</td><td>6-10 LPM</td></tr><tr><td>Trailing :</td><td>No</td><td>--</td></tr><tr><td>Backing :</td><td>No</td><td>--</td></tr></table>					Gas(es)	Flow Rate	Shielding :	Argon	6-10 LPM	Trailing :	No	--	Backing :	No	--
	Gas(es)	Flow Rate																	
Shielding :	Argon	6-10 LPM																	
Trailing :	No	--																	
Backing :	No	--																	
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC : <u>DIRECT CURRENT</u> Polarity : GTAW : <u>Straight (ELECTRODE NEGATIVE)</u> SMAW : <u>Reverse (ELECTRODE POSITIVE)</u> Amps [Range] : <u>100 to 240 A</u> Volts Range : GTAW : <u>12-16 V</u> SMAW: <u>22-26 V</u> Tungsten Electrode Size and Type : <u>Dia 2.4 mm 2% Thoriated</u> Pulsing : <u>No</u>																			
TECHNIQUE (QW-410) String or Weave Bead : <u>string and weave</u> Orifice or Gas Cup Size : <u>9-11 mm ID</u> Initial and Interpass Cleaning : <u>chipping ; brushing ; grinding</u> Method of Back Gouging: <u>grinding</u> Multiple or Single Pass : <u>multiple pass</u> Multiple or Single Electrodes : <u>single electrode</u> Peening : <u>not allowed</u> Closed Chamber : <u>No</u> Clean weld area to remove oil, rust, grease, etc. prior to welding.																			
Weld Layer (s)	Process	Filler Metal		Current		Voltage Range	Other												
		Class	Dia mm	Type Polar	Amp Range														
1	GTAW	ER 80S-B2	2.4	DC -	100-130	12-16	String Weave (Max 3 x Electrode Dia)												
2	SMAW	E 8018-B2	3.15	DC +	90-140	22-26													
3	SMAW	E 8018-B2	4.0	DC +	140-180	22-26													
4	SMAW	E 8018-B2	5.0	DC +	180-240	22-26													

HEAD / WELDING ENGG