

Welding Procedure Specifications (WPS)

Fermilab		Fermi National Accelerator Laboratory	
		<i>Technical Division-Machine Shop</i>	
Welding Procedure Specification No.	Fermi WPS Ti-3	Date	12/10/2008
Revision # 2-add Tungsten requirements	Date	1/22/2009	Supporting PQR No.(s) Fermi PQR Ti-3
Welding Processes	(1) <i>GTAW-Orbital</i>	Type 1	(Manual, Auto, Semi) <i>Automatic</i>
Welding Processes	(2)	Type 2	(Manual, Auto, Semi)

Joints (QW-402)			
Joint Design	<i>Square Butt Groove</i>		Backing
Backing Material (Type) Root	<i>Gas</i>		Remainder
Retainer	Yes	No X	Type
			Non-Metallic
			Metallic(non-fusing)

Details:
3" ASTM B 861 Grade 2
0.078 Wall

0.078

*No root opening-1pass-no filler
Autogenous*

Base Metals (QW -403)			
P No. 51	Group No.	TO	P No. 51
Specification Type & Grade	<i>ASTM B 861, Grade 2</i>	TO	Specification Type & Grade
			<i>ASTM B 861, Grade 2</i>
OR/Chemical Analysis & Mechanical Properties			
TO: Chemical Analysis & Mechanical Properties			
Thickness Range	Process 1		Process 2
Base Metal	Groove <i>0.078</i>	Fillet	Groove _____ Fillet
Deposited Weld Metal	Groove <i>0.078 to 0.156</i>	Fillet	Groove _____ Fillet
Pipe Diameter Range	Groove <i>2.875 Min.</i>	Fillet	Groove _____ Fillet
Other:			

Filler Metals (QW-404)	Process 1	Process 2
Specification No. (SFA)	<i>None-Autogenous</i>	
AWS No.		
F No.		
A No.		
Size of Filler Metals		
Deposited Weld Metal		
Thickness Range		
Electrode-Flux (Class)		
Consumable Insert		
Other		



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Positions (QW-405)		Postweld Heat Treatment (QW-407)	
Positions of Groove	All	Temperature Range	None
Welding Progression	Upward & Downward	Time Range	N/A
Positions of Fillet	All	Other	

Preheat (QW-408)		Gas (QW-408)			
Preheat Temp-Minimum	32°F	Closed Chamber Welding Head			
Interpass Temp Maximum	350°F	Gas'(s)	Mixture	Flow Rate	
Preheat Maintenance	N/A	Shielding	Argon	99.995>	30 CFH
		Trailing	None		
		Backing	Argon	99.995>	7 CHF

Electrical Characteristic (QW-409)				
Current AC or DC	Direct	Polarity	Straight	Characteristics:
AMPS (Range)	See Chart	Volts (Range)	10-15	Orbital with Pulse Current
Tungsten Electrode Size & Type:	1/16 EWCe-2		Mfg. Part # TC06-1085-03	
Mode of Metal Transfer for GMAW:	N/A			
Electrode Wire Feed Speed Range:	N/A			

Technique (QW-410)	
String or Weave Bead	Stringer
Orifice or Gas Cup Size	AMI Orbital Head Model 8-4000-Closed Chamber
Initial/Interpass Cleaning (Brushing, Grinding, ect.)	Initial cleaning with Acetone/Alcohol solvent
Method of Back Gouging	None
Oscillation	None
Contact Tube to Work Distance	N/A
Multiple or Single Pass (per side)	Single
Multiple or Single Electrodes	Single
Travel Speed (Range)	As Required
Peening	None
Other	AMI Orbital Welding Machine Model 227 with Model 8-4000 Welding Head Mfg. pre-ground/pre-shaped tungsten (TC06-1085-03)Required

Sequence Chart										
Weld Levels	Pulse	Rotation	RPM		Time Sec.	AMPS		PULSE		Other
			Primary IPM	Back IPM		Primary	Back	Primary Per sec	Back Per sec	
1	ON	Continuous	0.42	---	5	91	50	0.30	0.30	Voltage preset by Manufacturer
2	ON	Continuous	0.42	---	50	91	50	0.30	0.30	
3	ON	Continuous	0.42	---	46	91	50	0.30	0.30	
4	ON	Continuous	0.42	---	21	90	50	0.30	0.30	Manufacturer pre-ground/pre-shaped/pre-sized Tungsten(TC06-1085-03) set arc gap at .050"
5	ON	Continuous	0.42	---	25	90	50	0.30	0.30	
6	ON	Continuous	0.42	---	30	91	50	0.30	0.30	