



WELDING PROCEDURE SPECIFICATION

LIGO-8950044-00-B  
IDENTIFICATION  
WPS  
E6010/STRUCT

CONTRACT  
930212

PRODUCT LIGO BEAM TUBE MODULES  
CUSTOMER CALTECH

PAGE NO. 1 OF 3  
REV. NO. 0  
BY RWP DATE 05/11/94

WORK THIS DOCUMENT WITH GENERAL WELD PROCEDURE SPEC. GWPS-

SMAW

REFERENCE PROCEDURE QUALIFICATION RECORD

SPECIFIC CONTRACT

NO.	POSITION QUALIFIED (QW-405)	THICKNESS QUALIFIED (QW-403)	POSITION (QW-405)	THICKNESS RANGE (QW-403)
7543	3G	1/16" to 3/4"	ALL	1/16" to 3/4"

SPECIFIC CONTRACT WPS REQUIREMENTS

CODE EDITION AND ADDENDA ASME Section VIII & IX, 1992 Edition, 92 Add.

JOINTS (QW-402) SEE GENERAL WELDING TECHNIQUE PAGE 3

PREHEAT/INTERPASS TEMPERATURE (QW-406) SEE ATTACHED PAGE 2

BACKING MATERIAL (QW-402)  
None Required

POST WELD HEAT TREATMENT (QW-407)  
PWHT REQUIRED No  
IF PWHT IS REQUIRED, SEE APPROVED CONTRACT PWHT PROCEDURE FOR DETAILS AND EXTENT OF PWHT.

BASE MATERIAL (QW-403)

A36 (ASME P-1, Gp. 1)  
A283 Gr. C (ASME P-1, Gp. 1)  
A516 Gr. 60 (ASME P-1, Gp. 1)

GAS (QW-408) SHIELDING BACK UP  
COMPOSITION: N/A N/A  
FLOW RATE: N/A N/A

Any ASME P-1, Gp. 1 material may be welded together or to each other in any combination.

ELECTRICAL CHARACTERISTICS (QW-409)  
CURRENT: Direct Current  
POLARITY: Electrode Positive  
OTHER: Reverse Polarity  
AMPERAGE AND VOLTAGE RANGE. SEE PAGE 3  
VOLUME OF WELD METAL REQUIRED No  
SEE ATTACHED PAGE N/A  
MODE OF TRANSFER N/A

FILLER METAL (QW-404)

ASME SPECIFICATION NO: SFA 5.1  
ASME CLASSIFICATION: E6010  
ASME ANALYSIS NO: A-1  
ASME GROUP NO: F-3  
CONSUMABLE INSERT: N/A  
SUPP. POWDER FILLER: N/A

TECHNIQUE (QW-410)/ SPECIAL LIMITATIONS  
SEE ATTACHED PAGE(S) 2, 3  
STRINGER OR WEAVE TECHNIQUE SEE PAGE 2, 3  
TYPE OF WELDING

FLUX (QW-404) N/A

MANUAL  MACHINE   
SEMI-AUTOMATIC  AUTOMATIC

CUSTOMER APPROVAL

OB ENGR	DIST ENGR	WELDING SERVICES HOUSTON	CORP QA	REG CONST QA	REG MFG QA	BY	DATE
						RWP BGG	05/11/94 05/11/94 / /

APPROVED  
M. Jellison  
CBI 11/10/95

PREPARED  
CHECKED  
AUTHORIZED



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LIMITATIONS:

1. This WPS is limited to the welding of structural components. It shall not be used for welding to the vessel shell or nozzle assemblies (ASME Sec. VIII Code Pressure Boundary Components).
2. Vertical welds shall be deposited using a downhill stringer bead technique.
3. No single pass shall exceed 1/2" in thickness.

INTERPASS TEMPERATURE:

The interpass temperature shall not exceed 500°F.

PREHEAT REQUIREMENTS:

No preheat is required except as an aid to remove moisture unless the ambient temperature falls below 32°F. When the ambient temperature falls below 32°F, a preheat of warm to the hand (approx. 100°F) is required within 3" of where the welding is started and maintained 3" ahead of the arc.



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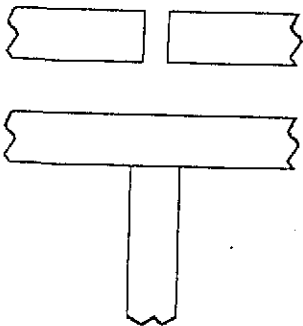
BY RWP DATE 05/11/94

GENERAL WELDING TECHNIQUE

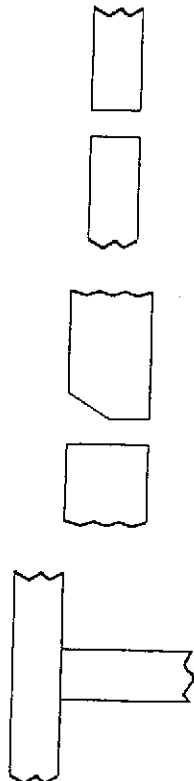
Operation Description	Beads Layer	Weld Proc.	Electrode		Current (amps)	Voltage (Volts)	Travel (IPM)	B.O.R. Sec/12"
			Size	Type				
Stringer Beads	As Req'd	SMA	1/8	E6010	75-125	22-28		74-48
			5/32		110-170	23-29		85-54
			3/16		140-215	25-30		92-64
			7/32		170-250	25-30		91-71
			1/4		210-320	25-30		94-68

JOINT DETAIL - See contract drawings for applicable joint details and dimensions.

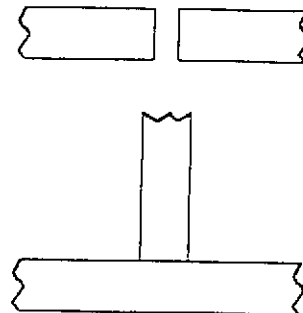
VERTICAL



HORIZONTAL



OVERHEAD & DOWNFLAT





PROCEDURE QUALIFICATION RECORD  
TO A.S.M.E. SECTION IX

Page \_\_\_\_\_  
Contract \_\_\_\_\_

PART II ESSENTIAL VARIABLES

PQR No. 7543  
 Process SMAW Manual  Machine  Automatic  Semiautomatic   
 Material specification SA285-C Date 7/18/86  
 ASME p. no. P-1, Gp. 1 To ASME p. no. P-1, Gp. 1 Flux OR ATMOSPHERE  
 Thickness (if pipe, dia and wall thick) 9.525mm (3/8") Flux trade name None Required  
 Filler metal group no. F. F-3 Inert gas composition None Required  
 Weld metal analysis no. A. A-1 Flow rate None Required  
 ASME specification no. SFA-5.1 Is backing strip used? No  
 AWS specification no. A-5.1 Preheat temperature range 20°C-300°C (IPT)  
 Postweld heat treatment None Required

WELDING PROCEDURE

Single or multiple pass Multiple Single or multiple arc Single Position 3G  
 Electrode E6010\* Filler wire diameter 4.8mm (3/16"), 4.0mm (5/32")  
 Type of backing None Required Welding current Direct Current, Electrode  
 Consult PART III WELDING VARIABLES for joint dimensions and welding current settings. Positive (Reverse Polarity)

TEST RESULTS

Reduced Section Tensile Results

Specimen No.	Dimensions in		Area in <sup>2</sup>	Ultimate Total Load Kips	Ultimate Unit Stress		Character of Failure and Location
	Width	Thickness			ksi	MPa	
H4962 - 1	0.765	0.322	0.246	15.4	62.6	431.6	Ductile in PL
H4962 - 2	0.745	0.298	0.222	13.8	62.2	428.9	Ductile in PL

Guided Bend Test

Type	Result	Type	Result
4 Transverse Side Bends	OK	----	---

Welder's name D. Davis Social Security no. 206-38-3276 Welder's Symbol DMD  
 Who by virtue of these tests meets welder performance requirements.  
 Work Order (Orig. WPS) No. H4962 Rev. 0 Date 6/26/86

We certify that the statements in this record are correct and that the test weld was prepared, welded and tested in accordance with the requirements of Section IX of the ASME code.

Signed CBI

By David R. Weinstein Date 7/18/86  
 David R. Weinstein

Remarks: \*Lincoln Fleetweld 5P

Plate edges were coated with 30-50 microns (wet) of deoxaluminite weld through primer.

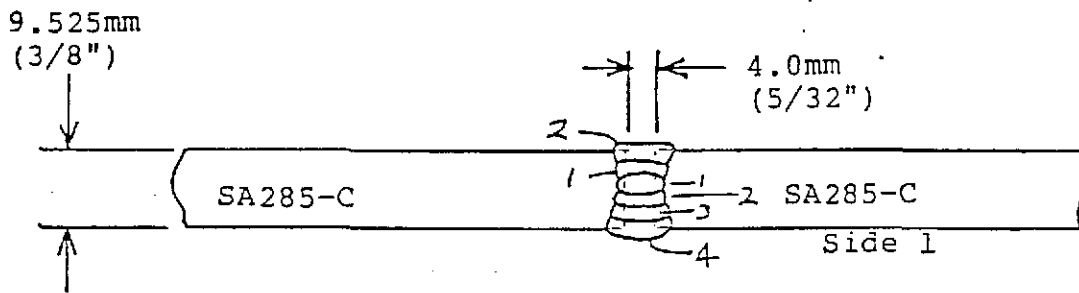
*WITNESSED, OBSERVED, AND MECHANICAL TESTING RESULTS VERIFIED BY B. J. [Signature]*  
 712286 [Signature] REV NOV 85



### PROCEDURE QUALIFICATION RECORD

To A.S.M.E. Section IX

### PART III WELDING VARIABLES

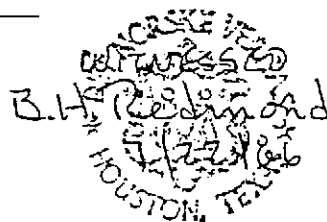


Side 2 back gouged to sound weld metal before welding.

#### 3G Position

Side	Pass	Electrode		Amps	Volts	Travel Speed		Heat Input		Remarks	BOR Sec. 12"	
		Type	Size			in./min.	cm/min	KJ/in	KJ/cm			
			IN									mm
1	1	E6010	5/32	4.0	150	27.8	7.1	18.0	35.2	13.9	Downhill	64
1	2	E6010	3/16	4.8	175	26.8	10.6	26.9	26.5	10.5	Downhill	79
1	3	E6010	3/16	4.8	175	25.6	17.0	43.2	15.8	6.2	Downhill	79
1	4	E6010	3/16	4.8	175	26.7	15.5	39.4	18.1	7.1	Downhill	79
2	1	E6010	3/16	4.8	175	24.2	10.6	26.9	24.0	9.4	Downhill	79
2	2	E6010	3/16	4.8	175	29.0	15.5	39.4	19.6	7.7	Downhill	79

Qualification No. 7543  
Date: 7/18/86



BY David R. Weinstein  
David R. Weinstein