CBI

WELDING PROCEDURE SPECIFICATION

LIGO-E950041-01-B

IDENTIFICATION WPS: E308L/STRUCT

CONTRACT: 930212

PRODUCT: LIGO BEAM TUBE MODULES
CUSTOMER: CALTECH

REV. NO. 1
BY RWP DATE 03/11/94

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)
9168	3G	3/16" to 1"	All	3/16" to 1"

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)

A240 Tp. 304L (ASME P-8, Gp. 1)
A240 Tp. 304 (ASME P-8, Gp. 1)

Any ASME P-8, Gp. 1 material may be welded together or to each other in any combination.

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

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 5.4
ASME CLASSIFICATION: E308L (1)
ASME ANALYSIS NO: A-8
ASME GROUP NO: F-5
CONSUMABLE INSERT: N/A
SUPP. POWDER FILLER: N/A

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

FLUX (QW-404) N/A

MANUAL [X] MACHINE [ ]
SEMI-AUTOMATIC [ ] AUTOMATIC [ ]

CUSTOMER APPROVAL

REVIEWED	OB ENGR	DIST ENGR	WELDING SERVICES HOUSTON	CORP QA	REG CONST QA	REG MFG QA				BY	DATE
									PREPARED	RWP	02/10/94
									CHECKED	BGG	02/17/94
									AUTHORIZED		/ /

ACCEPTED
M. Fallahian CBI 11/10/95
J. Doms LIGO 11/10/95

Printed in USA

WL100 REV JUL 87

CBI WELDING PROCEDURE SPECIFICATION	IDENTIFICATION WPS	CONTRACT
	E308L/STRUCT	930212

PRODUCT *LIGO BEAM TUBE MODULES*	PAGE NO. *2* OF *3*
CUSTOMER *CALTECH*	REV. NO. *1*
	BY *RWP* DATE *03/11/94*

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 Boundary Components).*
2. *Vertical welds shall be deposited uphill except:*
   a. *The root pass may be welded downhill.*
   b. *Wash passes may be downhill.*
   c. *Material 3/8" thick and less may have all downhill passes.*
   d. *Material up to 5/8" thick may have the second side welded with all downhill passes.*
3. *No single pass shall exceed 1/2" in thickness.*
4. *No flame burning is allowed on stainless steel materials.*
5. *Only stainless steel brushes may be used on stainless steel.*

INTERPASS TEMPERATURE:

The interpass temperature shall not exceed 350øF.

PREHEAT REQUIREMENTS: ASME P-8, Gp. 1 Material

No preheat is required except as an aid to remove moisture unless the ambient temperature falls below 0øF. When the ambient temperature falls below 0øF, a preheat of warm to the hand is required within 3" of where the welding is started and maintained 3" ahead of the arc.

	IDENTIFICATION WPS	CONTRACT
WELDING PROCEDURE SPECIFICATION	*E308L/STRUCT*	*930212*

PRODUCT *LIGO BEAM TUBE MODULES*

CUSTOMER *CALTECH*

PAGE NO. *3* OF *3*

REV. NO. *1*

BY *RWP* DATE *03/11/94*

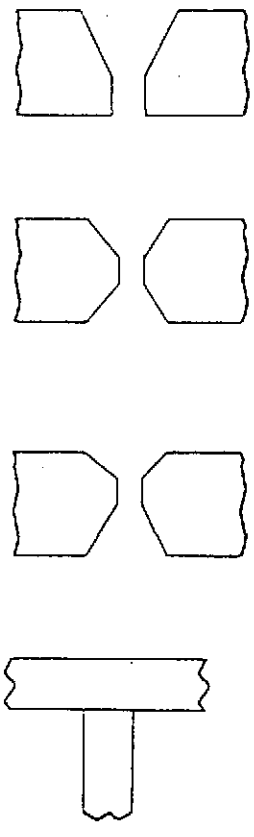
GENERAL WELDING TECHNIQUE

Operation Description	Beads Layer	Weld Proc.	Electrode Size	Electrode Type	Current (amps)	Voltage (Volts)	Travel (IPM)	B.O.R. Sec/12*
*Stringer Beads**	*As Reqd*	*SMA*	*3/32*	*E308L-15*	*60-100*	*23-26*		*54-30*
			1/8		*60-125*	*23-27*		*100-44*
			5/32		*100-180*	*23-27*		*86-45*
			3/16		*130-240*	*24-28*		*90-46*
			1/4		*150-320*	*24-30*		*130-59*
			3/32	*E308L-16*	*60-100*	*19-22*		*65-40*
			1/8		*70-152*	*23-27*		*112-42*
			5/32		*110-196*	*24-31*		*105-49*
			3/16		*160-307*	*24-32*		*91-42*
			1/4		*180-390*	*24-34*		*127-52*

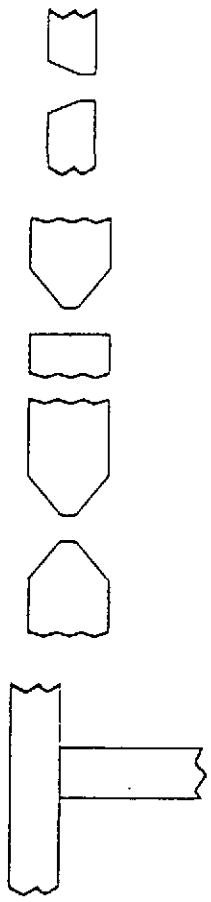
* *Vertical Uphill welds may be deposited using a weave technique.*

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

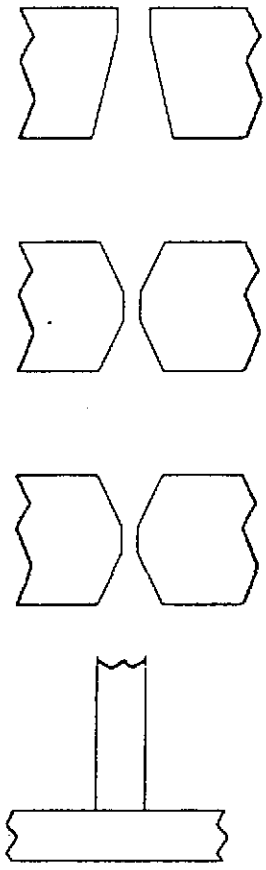
VERTICAL



HORIZONTAL



OVERHEAD & DOWNFLAT



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Contract

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

PQR No. 9168

Process SMAW — Manual [X] Machine [ ] Automatic [ ] Semiautomatic [ ]

Material specification SA240 Type 304

ASME p. no. P8, Gp. 1 To ASME p. no. P8, Gp. 1

Thickness (if pipe, dia and wall thick) 1/2" (12.7mm)

Filler metal group no. F. F5

Weld metal analysis no. A. A8

ASME specification no. SFA 5.4

AWS specification no. A 5.4

FLUX OR ATMOSPHERE

Flux trade name N/A

Inert gas composition N/A

Flow rate N/A

Preheat temperature range 70°F-350°F(IPT)(21°C-176°C)

Postweld heat treatment None

WELDING PROCEDURE

Single or multiple pass Multiple Single or multiple arc Single Position 3G

Mode of transfer for GMAW: Spray [ ] Globular [ ] Pulsating [ ] Short Circuit [ ]

Filler Metal for GTAW or PAW N/A Filler metal diameter N/A

Electrode E308 Electrode diameter 1/8" (3.2mm)

Type of backing None Welding current Direct Current, Electrode Positive (Reverse Polarity)

Consult WELDING VARIABLES for joint dimensions and welding current settings.

TEST RESULTS

Reduced Section Tensile Results

Specimen No.	Dimensions in		Area in 2	Ultimate Total Load	Ultimate Unit Stress		Character of Failure and Location
	Width	Thickness		Kips	ksi	MPa	
H8914-1	0.758	0.472	0.358	30.6	85.5	589.5	Ductile in SA240 Tp.304 Plate
H8914-2	0.758	0.472	0.358	30.5	85.2	587.4	Ductile in SA240 Tp.304 Plate

Guided Bend Test

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

Welder's name Glenn A. Adams Social Security no. 336-48-0346 Welder's Symbol GAA

Who by virtue of these tests meets welder performance requirements.

Work Order (Orig. WPS) No. H8914 Rev. 1

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 Peter Gissel Date 10/9/91

Peter Gissel

Remarks: Arcaloy 308 Lime (E308) by Alloy Rods

Metric Values are calculated from English System

Contract Material Used - Avesta - Sweden

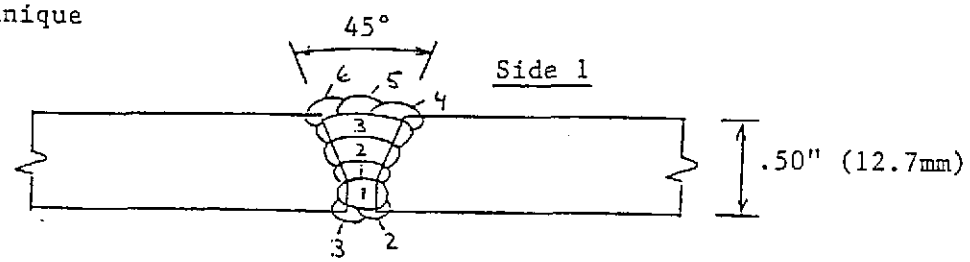
Ht. No. S10530-04073

PROCEDURE QUALIFICATION RECORD

To A.S.M.E. Section IX

WELDING VARIABLES

NOTE: Uphill Passes - Weave Bead Technique
Downhill Passes - Stringer Bead Technique



3G POSITION

GAP = 1/8" (3.2mm)
LAND = 5/32" (4.0mm)

Side	Pass	Electrode Type	Electrode Size IN	Electrode Size mm	Amps	Volts	Travel Speed in./min.	Travel Speed cm/min	Heat Input KJ/in	Heat Input KJ/cm	Remarks Pass Direction
1	1	E308	1/8	3.2	116	27	5.9	15.0	31.9	12.6	DNHILL
1	2	E308	1/8	3.2	84	25	2.2	5.6	57.3	22.6	UPHILL
1	3	E308	1/8	3.2	88	24	2.7	6.9	46.9	18.5	UPHILL
1	4	E308	1/8	3.2	101	29	10.0	25.4	17.6	6.9	DNHILL
1	5	E308	1/8	3.2	101	28	9.1	23.1	18.6	7.3	DNHILL
1	6	E308	1/8	3.2	101	26	9.1	23.1	17.3	6.8	DNHILL
2	1	E308	1/8	3.2	88	27	13.1	7.9	46.0	18.1	UPHILL
2	2	E308	1/8	3.2	101	27	11.1	28.2	14.7	5.8	DNHILL
2	3	E308	1/8	3.2	101	26	10.0	25.4	15.8	6.2	DNHILL

Qualification No. 9168
Date: 10/9/91

BY Peter Gissel
Peter Gissel