LIGO-E950040-00-B

CBI WELDING PROCEDURE SPECIFICATION

IDENTIFICATION WPS E7018/STRUCT

CONTRACT 930212

PRODUCT LIGO BEAM TUBE MODULES
CUSTOMER CALTECH

REV. NO. 0
BY RWP DATE 02/10/94

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)
8903	3G	3/16" to 8"	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)

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

Any ASME P-1, Gp. 1 or Gp. 2 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 5.1
ASME CLASSIFICATION: E7018
ASME ANALYSIS NO: A-1
ASME GROUP NO: F-4
CONSUMABLE INSERT: N/A
SUPP. POWDER FILLER: N/A

FLUX (QW-404) N/A

TECHNIQUE (QW-410)/ SPECIAL LIMITATIONS
SEE ATTACHED PAGE(S) 2
STRINGER OR WEAVE TECHNIQUE SEE PAGE 2 3
TYPE OF WELDING
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
				M. [signature] CBI 11/10/95		[signature] LIGO		11/10/95	PREPARED	RWP	02/10/94
									CHECKED	BGG	02/17/94
									AUTHORIZED		/ /

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CBI	IDENTIFICATION WPS	CONTRACT
WELDING PROCEDURE SPECIFICATION	E7018/STRUCT	930212

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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 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 9/16" thick may have the second side welded with all downhill passes.*
3. *No single pass shall exceed 1/2" in thickness.*

INTERPASS TEMPERATURE:

The interpass temperature shall not exceed 500øF.

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

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

PREHEAT REQUIREMENTS: ASME P-1, Gp. 2 Material

No preheat is required except as an aid to remove moisture unless the ambient temperature falls below 50øF. When the ambient temperature falls below 50øF, 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
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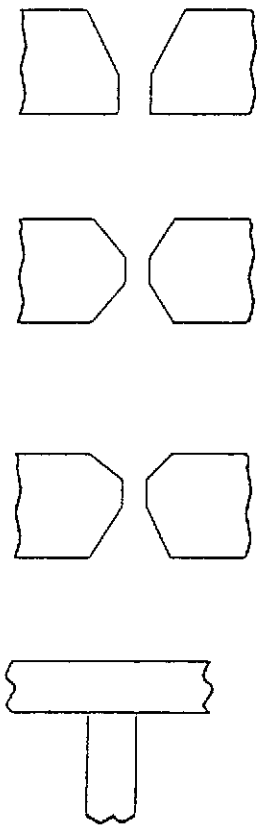
GENERAL WELDING TECHNIQUE

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	E7018	70-100	20-24		73-53
			1/8		100-175	16-28		90-48
			5/32		125-225	15-29		96-57
			3/16		180-290	16-28		89-57
			7/32		240-370	20-32		95-64
			1/4		275-410	20-32		96-67

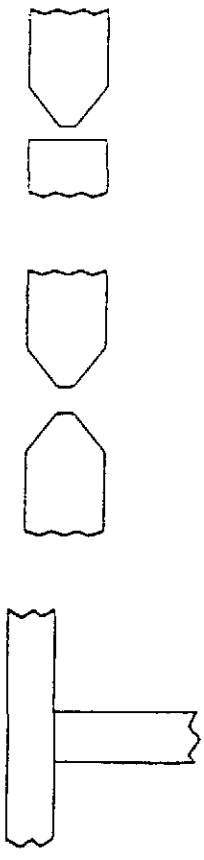
* Vertical Uphill Welds and Overhead Welds may be deposited using a weave technique.

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

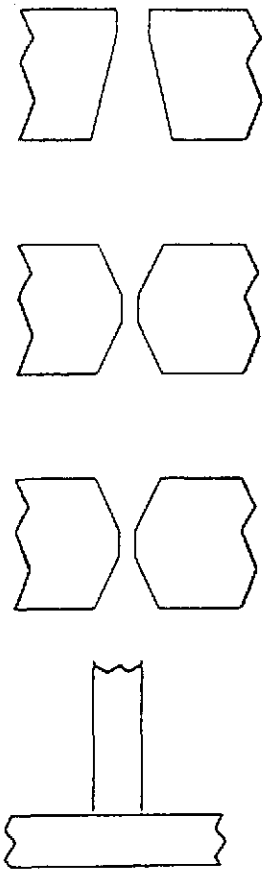
VERTICAL



HORIZONTAL



OVERHEAD & DOWNFLAT



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Contract

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

PQR No. 8903

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

Material specification SA516 Gr. 60 to SA537 Cl. 1

ASME p. no. 1, Gp. 1 To ASME p. no. 1, Gp. 2

Thickness (if pipe, dia and wall thick) 1½"

Filler metal group no. F. 4

Weld metal analysis no. A. 1

ASME specification no. SFA 5.1

AWS specification no. A 5.1

FLUX OR ATMOSPHERE

Flux trade name N/A

Inert gas composition N/A

Flow rate N/A

Preheat temperature range 70°F to 500°F (IPT)

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 E7018 Electrode diameter 1/8"

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	
H8266-1	.756	1.425	1.077	75.9	70.5	486.1	Ductile in SA 516-60 Plate
H8266-2	.756	1.426	1.078	76.0	70.5	486.1	Ductile in SA 516-60 Plate

Guided Bend Test

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

Welder's name Otho Richardson Social Security no. 464-22-4511 Welder's Symbol OMR

Who by virtue of these tests meets welder performance requirements.

Work Order (Orig. WPS) No. H8266 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 C. Dwayne Baker Date 10-22-90

Remarks:

E7018 (AA7018) by Alloy Rods

Plate edges coated with deoxaluminite.

Material Heat Treatment: A516-60 and A537-Cl. 1 Normalized

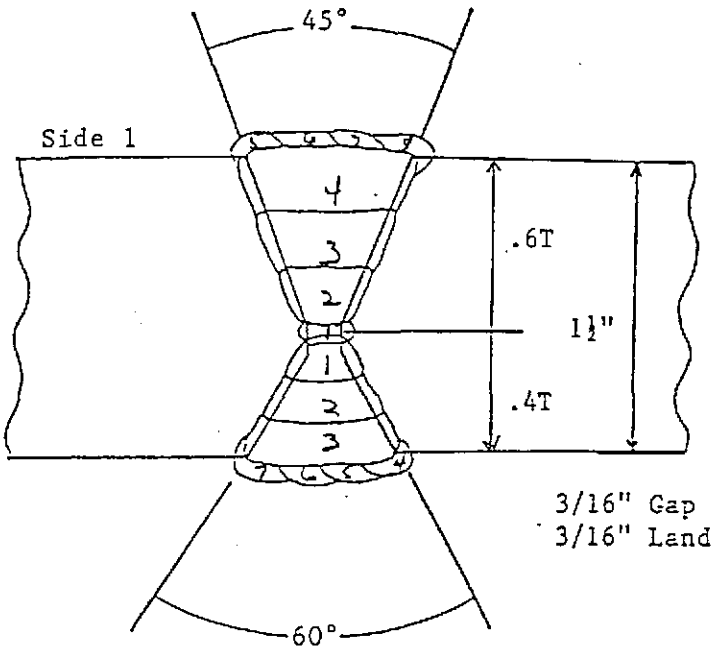
PROCEDURE QUALIFICATION RECORD

To A.S.M.E. Section IX

WELDING VARIABLES

Downhill passes use stringer bead

Uphill passes use weave technique



3G Position

Side	Pass	Electrode			Amps	Volts	Travel Speed		Heat Input		Remarks
		Type	Size								
			IN	mm			in./min.	cm/min	KJ/in	KJ/cm	Pass Dir.
1	1	E7018	1/8	3.2	135	24.0	3.0	7.6	64.8	25.5	DN
1	2	E7018	1/8	3.2	127	22.4	1.5	3.8	113.8	44.8	UP
1	3	E7018	1/8	3.2	127	22.5	1.3	3.3	131.9	51.9	UP
1	4	E7018	1/8	3.2	131	22.5	1.0	2.5	176.9	69.6	UP
1	5	E7018	1/8	3.2	133	25.5	12.0	30.5	17.0	6.7	DN
1	6	E7018	1/8	3.2	135	24.0	12.9	32.8	15.1	5.9	DN

Qualification No. 8903
Date: 10-22-90

BY C. Dwayne Baker

Editorial clarification, TMJ, 5/6/93

CBI

PROCEDURE QUALIFICATION RECORD

To A.S.M.E. Section IX

WELDING VARIABLES

Side	Pass	Electrode			Amps	Volts	Travel Speed		Heat Input		Remarks
		Type	Size								
			IN	mm			in./min.	cm/min	KJ/in	KJ/cm	
1	7	E7018	1/8"	3.2	135	25.0	13.8	35.1	14.7	5.8	DN
1	8	E7018	1/8"	3.2	135	24.3	12.9	32.8	15.3	6.0	DN
2	1	E7018	1/8	3.2	130	22.0	1.7	4.3	100.9	39.7	UP
2	2	E7018	1/8"	3.2	130	22.5	1.7	4.3	103.2	40.6	UP
2	3	E7018	1/8"	3.2	130	22.5	1.5	3.8	117.0	46.1	UP
2	4	E7018	1/8"	3.2	135	23.2	12.0	30.5	15.7	6.2	DN
2	5	E7018	1/8"	3.2	135	23.9	11.3	28.7	17.1	6.7	DN
2	6	E7018	1/8"	3.2	135	26.0	13.8	35.1	15.3	6.0	DN
2	7	E7018	1/8"	3.2	135	23.9	13.8	35.1	14.0	5.5	DN

Qualification No. 8903
Date: 10-22-90

BY C. Dwayne Baker