LIGO VACUUM EQUIPMENT
FINAL DESIGN REPORT
VOLUME III
FABRICATION

LIGO-E960966-01-V

CONTRACT NO:	**PC 175730**
PSI DOCUMENT NO:	**V049-1-099**
PROGRAM I.D.	**LIGO VACUUM EQUIPMENT**
CDRL NO:	**03**
APPROVAL STATUS:	**A**

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581

CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LIGO PROJECT

SPOOL V1049-4-B4-02

SPECIFICATION V049-2-173 **REV.** 0

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366- 9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPool B-4 46.25" ID with 56" O.D Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. V59049
DWG NO. V049-4-B4
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-134-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp							

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SPOOL V049-4-34-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B5A-01

ϕ	ARB 11/22/96	——	RELEASED ON DED # 0364
REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE ARBrookhod 11/22/96	APPROVED DATE RES 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-B5A-01

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL B-5A 30.5"ID with 60.5"ID Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-B5A
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BSA-01 **SPECIFICATION** V049-2-173 **REV.** 8

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up And Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BSA--01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B5A-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBundbak 11/22/96	APPROVED DATE RBG 11/25/96	Number A V049-2-173	Rev. Φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. 0

PS-997

SPOOL V049-4-B5A-02

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL B-5A 30.5"ID with 60.5"ID Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. V59049
DWG NO. V049-4-B5A
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BSA-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-B5A-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B6-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. Φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

PS-007

SPOOL V049-4-B6-01 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-6 48.25" ID with 56" O.D Flange DWG NO. V049-4-B6
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-136-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect Following				X			
Fit-up And Welding							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform Final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-B6-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	V			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B7-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBurdick 11/22/96	APPROVED DATE RJS 11/25/96	Number A V049-Z-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-B7-01 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366- 9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-7 48.25"ID with 56"OD flange DWG NO. V049-4-B7
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-B7-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect Following				X			
Fit-up And Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform Final	V-D			X			
Dimensional Insp.							

SPOOL V049-4-137-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B8-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL U049-4-B8-01 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366- 9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-8 72.25" ID with 80" OD Flange DWG NO. U049-4-B8
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			
V-D			X			
V-D			X			

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SPOOL V049-4-B8-01 **SPECIFICATION** V049-2-173 **REV.** 0

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-B8-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B8-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBundbrook 11/22/96	APPROVED DATE RES 11/25/96		Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-B8-02 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-8 72.25" ID with 80" OD Flange DWG NO. V049-4-138
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE) PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

SPOOL V049-4-B8-02 **SPECIFICATION** V049-2-173 **REV.** 0

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY							
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-B8-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B9-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RSB 11/25/96	Number A V049-2-173	Rev. ϕ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. 0

PS-997

SPOOL V049-4-B9-01

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL B-9 72.25"ID with 80" OD Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-B9
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D.			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-B9-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp							

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SPOOL V049-4-139-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B9-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE VSG 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

SPOOL V049-4-B9-02 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-9 72.25"ID with 80" OD Flange DWG NO. V049-4-B9
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-B9-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-139-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B9-03

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96		RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE	APPROVED	DATE	Number	Rev.
	ARBradbrook 11/22/96	RCG	11/25/96	A V049-2-173	Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

SPOOL V049-4-B9-03 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366- 9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-9 72.25"ID with 80" OD Flange DWG NO. V049-4-B9
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D.			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-B9-03

SPECIFICATION V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And Welding of Flanges to Shell	V-D						
Inspect following Fit-UP and Welding:				X			
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform Final Dimensional Insp.	V-D			X			

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SPOOL U049-4-139-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019	-	X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - B9-04

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RES 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-B9-04 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL B-9 72.25"ID with 80" OD Flange DWG NO. V049-4-B9
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-B9-04 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And Welding OF Flanges to Shell	V-D						
Inspect following Fit-UP And Welding:				X			
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp.	V-D			X			

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SPOOL V049-4-139-04 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	V			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE1-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RSG 11/25/96	Number A V049-2-173	Rev. ϕ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

PS-007

SPOOL V049-4-BE1-01

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL BE-1 72.25" ID with 80" OD Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-BE1
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-BE1-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** **D** = DIMENSIONAL **V** = VISIUAL **RT** = RADIOGRAPHY **PT** = LIQUID PENETRANT **MT** = MAGNETIC PARTICLE **ET** = EDDY CURRENT **LT** = LEAK TEST **UT** = ULTRASONIC **W** = WITNESS **X** = HOLD POINT **√** = APPROVED **R** = REVIEW **VR** = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect Following Fit-up And Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform Final Dimensional Insp.	V-D			X			

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SPOOL V049-4-BE1-01 **SPECIFICATION** V049-2-173 **REV.** 0

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE1-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBundbrook 11/22/96	APPROVED DATE RGB 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE1-02 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-1 72.25" ID with 80" OD Flange DWG NO. V049-4-BE1
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BE1-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** **D** = DIMENSIONAL **V** = VISIUAL **RT** = RADIOGRAPHY	**PT** = LIQUID PENETRANT **MT** = MAGNETIC PARTICLE **ET** = EDDY CURRENT	**LT** = LEAK TEST **UT** = ULTRASONIC **W** = WITNESS	**X** = HOLD POINT √ = APPROVED **R** = REVIEW	**VR** = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nazzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding							
Nazzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BE1-02 **SPECIFICATION** V049-2-173 **REV.** 6

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE2-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE	APPROVED DATE	Number	Rev.
	ARBrudbrook 11/22/96	RES 11/25/96	A V049-2-173	ϕ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

SPOOL V049-4-BE2-01

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM Spool BE-2 60.5" ID with 68.25" OD Flg
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-BE2
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE2-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And Welding of Flanges to Shell	V-D						
Inspect following Fit-UP And Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL U049-4-BE2-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE2-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96		RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED	DATE 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE2-02

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM Spool BE-2 60.5" ID with 68.25" OD flng DWG NO. V049-4-BE2
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BE2-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp.	V-D			X			

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SPOOL V049-4-BE2-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE2-03

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
φ	aRB 11/22/96	——	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED aRBuddhook	DATE 11/22/96	APPROVED RGB	DATE 11/25/96	Number A V049-2-173	Rev. φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. ϕ

SPOOL V049-4-BE2-03 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-2 60.5"ID with 68.25"OD flg DWG NO. V049-4-BE2
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-BE2-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL U049-4-BE2-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE2-04

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE KRG 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE2-04 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366- 9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-2 60.5"ID with 68.25"OD Flg DWG NO. V049-4-BE2
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE2-04 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following							
Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And	V-D						
Welding OF Flanges							
to Shell							
Inspect Following				X			
Fit-UP And Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Grass	R			X			
Leak Check							
Perform Final	V-D			X			
Dimensional Insp.							

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SPOOL U049-4-BE2-04 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE3-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE: ARBuddhook 11/22/96	APPROVED DATE: ARB 11/25/96	Number: A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE3-01 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM OFFSET SPOOL BE-3 66.5" ID 66.5" Universal Flg. DWG NO. V049-4-BE 3
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

QUALITY PLAN REVIEWED	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-BE3-01 **SPECIFICATION** V049-2-173 **REV.** ____

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-UP And Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BE3-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE3-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE3-02 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM OFFSET SPOOL BE-3 60.5" ID 160.5" Unions Flange DWG NO. V049-4-BE3
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-BE3-02 **SPECIFICATION** V049-2-173 **REV.** ____

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BE3-02 **SPECIFICATION** V049-2-173 **REV.** 0

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE3-03

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

SPOOL V049-4-BE3-03 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM OFFSET SPOOL BE-3 60.5"ID 60.5" Union + Flg. DWG NO. V049-4-BE3
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-BE3-03 **SPECIFICATION** V049-2-173 **REV.** ____

ASME CODE QUALITY PLAN	**LEGEND:** **D** = DIMENSIONAL **V** = VISIUAL **RT** = RADIOGRAPHY	**PT** = LIQUID PENETRANT **MT** = MAGNETIC PARTICLE **ET** = EDDY CURRENT	**LT** = LEAK TEST **UT** = ULTRASONIC **W** = WITNESS	**X** = HOLD POINT **√** = APPROVED **R** = REVIEW **VR** = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following							
Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And	V-D						
Welding of Flanges							
to Shell							
Inspect Following				X			
Fit-UP And Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform Final	V-D			X			
Dimensional Insp.							

SPOOL V049-4-BE3-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE3A-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARB initials 11/22/96	APPROVED DATE [illegible] 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE3A-01

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM (Offset Spool BE-3A 60.5"ID to 60.5"ID 56.56 TO Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-BE3A
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			
V-D			X			
V-D			X			

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SPOOL V049-4-BE3A-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Grass Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-BE3A-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE3A-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE3A-02

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM Offset Spool BE-3A 60.5"ID to 60.5"ID 56.56 TO Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. Y59049
DWG NO. V049-4-BE3A
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE3A-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp							

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SPOOL V049-4-BE3A-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE3A-03

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE MSG 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE3A-03

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM Offset Spool BE-3A 60.5" ID to 60.5" ID & 56.56 TO Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. V59049
DWG NO. V049-4-BE3A
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BE3A-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up And Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BE3A-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE4 - 01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBundbrook 11/22/96	APPROVED DATE BES 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE4-01 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM Spool BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE) PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-up & Welding of Long Seam(s)	V-D			X			
Verify Fit-up and Welding of Girth Seams							

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SPOOL V049-4-BE4-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-BE4-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE4-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RGB 11/25/96	Number A V049-2-173	Rev. Φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. 0

PS-997

11/88

SPOOL V049-4-BE4-02

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL BE-4 44.62"ID with 52"OD Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-BE4
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BE4-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** **D** = DIMENSIONAL **V** = VISIUAL **RT** = RADIOGRAPHY **PT** = LIQUID PENETRANT **MT** = MAGNETIC PARTICLE **ET** = EDDY CURRENT **LT** = LEAK TEST **UT** = ULTRASONIC **W** = WITNESS **X** = HOLD POINT **√** = APPROVED **R** = REVIEW **VR** = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Performinal	V-D			X			
Dimensional Insp							

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SPOOL V049-4-BEH-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE4-03

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBurdick 11/22/96	APPROVED DATE RES 11/25/96	Number A V049-2-173	Rev. Φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. 0

PS-997

SPOOL V049-4-BE4-03 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE) PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BE4-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up And Welding:				X			
Nazzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp.	V-D			X			

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE4 - 04

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE	APPROVED	DATE	Number	Rev.
	ARBurkhook 11/22/96	RES	11/25/96	A V049-2-173	ϕ

SPOOL V049-4-BE4-03 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

FILED:F:\TEMPLATE\ENGFORMS\ASMEQPL

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING GTAW P8-P8 100%Ar
V049-2-146	WELDING PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE
V049-2-014	LEAK CHECK PLAN
V049-2-015	CLEANING PROCEDURE
V049-2-019	BAKEOUT PROCEDURE
V049-2-040	STAINLESS STEEL FLANGE FORGINGS
V049-2-047	COMPONENT SHOP CONDITIONING PLAN
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB
V049-2-120	RAW MATERIAL HANDLING PROCEDURE
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING
V049-2-084	WELD DATA SHEET SPECIFICATIONS

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

PS-997

SPOOL V049-4-BE4-04

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM Spool BE-4 44.62"ID with 52"OD Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)

JOB NO. V59049
DWG NO. V049-4-BE4
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE4-04 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-REH-04 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE4-05

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.		SPECIFICATION	
INITIAL APPROVALS	PREPARED ARBudbrook DATE 11/22/96	APPROVED REB DATE 11/25/96	Number A V049-2-173	Rev. φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

SPOOL V049-4-BE4-05 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-up & Welding of Long Seam(s)	V-D			X			
Verify Fit-up and Welding of Girth Seams							

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SPOOL V049-4-BE4-05 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre rab Nazzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding:							
Nazzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BE4-05 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	V			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE4 - 06

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBradbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. Φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. ϕ

PS-997

SPOOL V049-4-BE4-06 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM Spool BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE4-06 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And Welding OF Flanges to Shell	V-D						
Inspect Following Fit-UP And Welding:				X			
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform Final Dimensional Insp.	V-D			X			

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SPOOL V049-4-BE4-06 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY							

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE4-07

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE4-07 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE4-07 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Grass	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BE4-07 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE4-08

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	——	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE 1 E/3 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE4-08 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM Spool BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-BE4-08 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up And Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Grass Leak Check	R			X			
Perform final Dimensional Insp.	V-D			X			

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SPOOL V049-4-BE4-08 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE4-09

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBundbrook 11/22/96	APPROVED DATE REG 11/25/96	Number A V049-2-173	Rev. Φ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

SPOOL V049-4-BE4-09 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM Spool BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-BE4-09 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Grass Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-RE4-09 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE4-10

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RES 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE4-10 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL BE-4 44.62"ID with 52"OD Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. V59049
DWG NO. V049-4-BE4
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BE4-10 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up and Welding:				X			
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-REH-10 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE4-11

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudhead 11/22/96	APPROVED DATE 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE4-11 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-4 44.62"ID with 52"OD Flange DWG NO. V049-4-BE4
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI *Inspection* SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BE4-11 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-UP And Welding of Flanges to Shell	V-D						
Inspect Following Fit-UP And Welding: Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform Final Dimensional Insp.	V-D			X			

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SPOOL V049-4-BE4-11 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	V			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049-4-BE4-12

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RSO 11/25/96	Number A V049-2-173	Rev. ϕ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

SPOOL V049-4-BE4-12 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366- 9111 Fax (508) 870-5930

PROJECT LIGO
ITEM Spool BE-4 44.62"ID with 52"OD Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. V59049
DWG NO. V049-4-BE4
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-BE4-12 SPECIFICATION V049-2-173 REV. Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And Welding of Flanges to Shell	V-D						
Inspect following Fit-up And Welding Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross Leak Check	R			X			
Perform final Dimensional Insp	V-D			X			

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SPOOL V049-4-BE4-12 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BES-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RGS 11/25/96	Number A V049-2-173	Rev. ϕ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE5-01 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-5 72.25" ID with 80" O.D. Flange DWG NO. V049-4-BE5
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE) PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BES-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following							
Pre Fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect Following				X			
Fit-up And Welding							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform Final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BES-01 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE5-02

φ	ARB 11/22/96	—	RELEASED ON DED # 0364
REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED: ARBindlock	DATE: 11/22/96	APPROVED: RSB	DATE: 11/25/96	Number: A V049-2-173	Rev. φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL J049-4-BE5-02 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO JOB NO. V59049
ITEM SPOOL BE-5 72.25" ID with 86" O.D. Flange DWG NO. J049-4-BE5
APPLICABLE CODE ASME VIII DIV.1 PG 3 OF 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A

TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
V-D			X			Verify Roundness of Rolled Shells
V-D			X			Verify Location of Nozzle Cutouts in Shell.
V-D			X			Verify Fit-UP & Welding of Long Seam(s)
						Verify Fit-UP and Welding of Girth Seams

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SPOOL V049-4-BES-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect Following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect Following				X			
Fit-up and Welding:							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp.							

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SPOOL V049-4-BES-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE6-01

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RBS 11/25/96	Number A V049-2-173	Rev. ϕ

Title

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

Number

Rev.

SPECIFICATION

Number A V049-2-173 Rev. Ø

SPOOL V049-4-BE6-01

SPECIFICATION V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO
ITEM SPOOL BE-6 72.25" ID to 72.25" ID Flange
APPLICABLE CODE ASME VIII DIV.1 (WHERE APPLICABLE)
JOB NO. Y59049
DWG NO. V049-4-BE6
PG 3 OF 5

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED
QA GS
AI N/A

	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

SPOOL V049-4-BEB-01 **SPECIFICATION** V049-2473 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre tab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp							

SPOOL V049-4-BEG-01 **SPECIFICATION** V049-2-173 **REV.** E

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY						
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final Detergent Clean	Y			X			
Bakeout	R	V049-2-019		X			
Perform Final Leak Check	R	V049-2-047		X			
Ship to LIGO							

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Title: QUALITY PLAN FOR LIGO- SPOOLS

QUALITY PLAN

FOR

LIGO

SPOOLS

SERIAL No. V049 - 4 - BE6-02

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Φ	ARB 11/22/96	—	RELEASED ON DED # 0364

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE ARBrudbrook 11/22/96	APPROVED DATE RES 11/25/96	Number A V049-2-173	Rev. Φ

APPLICABLE DRAWINGS

REFER TO FABRICATION PLAN

APPLICABLE PROCEDURES

V049-2-070	WELDING	PAW P8-P8 75%Ar, 25%He
V049-2-071	WELDING	PAW P8-P8 75%Ar, 25%He PWHT
V049-2-072	WELDING	GTAW P8-P8 100%Ar PWHT
V049-2-073	WELDING	GTAW P8-P8 100%Ar
V049-2-146	WELDING	PAW P8-P8 75%He, 25%Ar
V049-2-074	GENERAL REPAIR PROCEDURE	
V049-2-014	LEAK CHECK PLAN	
V049-2-015	CLEANING PROCEDURE	
V049-2-019	BAKEOUT PROCEDURE	
V049-2-040	STAINLESS STEEL FLANGE FORGINGS	
V049-2-047	COMPONENT SHOP CONDITIONING PLAN	
V049-2-097	SPOOLS/MODE CLEANERS/BEAM TUBE MANIFOLDS FAB	
V049-2-120	RAW MATERIAL HANDLING PROCEDURE	
V049-2-121	PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY	
V049-2-123	COMPONENT PACKAGING, HANDLING AND SHIPPING	
V049-2-084	WELD DATA SHEET SPECIFICATIONS	

SPOOL V049-4-BE6-02 **SPECIFICATION** V049-2-173 **REV.** Ø

Process Systems International, Inc.
20 Walkup Drive
Westborough, MA 01581-5003
(508) 366-9111 Fax (508) 870-5930

PROJECT LIGO **JOB NO.** V59049
ITEM SPOOL BE-6 72.25"ID-to 72.25"ID Flange **DWG NO.** V049-4-BE6
APPLICABLE CODE ASME VIII DIV.1 **PG** 3 **OF** 5
(WHERE APPLICABLE)

ASME CODE QUALITY PLAN

LEGEND: D = DIMENSIONAL; V = VISIUAL; RT = RADIOGRAPHY; PT = LIQUID PENETRANT; MT = MAGNETIC PARTICLE; ET = EDDY CURRENT; LT = LEAK TEST; UT = ULTRASONIC; W = WITNESS; X = HOLD POINT; √ = APPROVED; R = REVIEW; VR = VERIFY

QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Verify Roundness of Rolled Shells	V-D			X			
Verify Location of Nozzle Cutouts in Shell.	V-D			X			
Verify Fit-UP & Welding of Long Seam(s)	V-D			X			
Verify Fit-UP and Welding of Girth Seams							

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SPOOL V049-4-BEB-02 SPECIFICATION V049-2-173 REV. Ø

ASME CODE QUALITY PLAN	LEGEND: D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Inspect following							
Pre fab Nozzles:	V-D			X			
Leg Assembly:	V-D			X			
Verify Fit-up And	V-D						
Welding of Flanges							
to Shell							
Inspect following				X			
Fit-up and Welding							
Nozzles	V-D			X			
Angle Stiffners	V-D			X			
Perform Gross	R			X			
Leak Check							
Perform final	V-D			X			
Dimensional Insp							

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SPOOL V049-4-BEG-02 **SPECIFICATION** V049-2-173 **REV.** Ø

ASME CODE QUALITY PLAN	**LEGEND:** D = DIMENSIONAL, V = VISIUAL, RT = RADIOGRAPHY, PT = LIQUID PENETRANT, MT = MAGNETIC PARTICLE, ET = EDDY CURRENT, LT = LEAK TEST, UT = ULTRASONIC, W = WITNESS, X = HOLD POINT, √ = APPROVED, R = REVIEW, VR = VERIFY					
QUALITY PLAN REVIEWED QA GS AI N/A	TYPE INSP.	PROCEDURE OR DRAWING	WELDING PROCEDURE	PSI Inspection SIGN/DATE	AUTHORIZED INSPECTOR SIGN/DATE	CUSTOMER QA SIGN/DATE	REMARKS
Perform Final	Y			X			
Detergent Clean							
Bakeout	R	V049-2-019		X			
Perform Final	R	V049-2-047					
Leak Check				X			
Ship to LIGO							

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5.4 Spools/Mode Cleaner/Beam Manifold Testing/Inspections

Each Spool/Mode Cleaner and Beam Manifold will be inspected after Mechanical Assembly is complete prior to being released for conditioning/testing (See "Dimensional Fabrication Procedure" V049-2-121 for additional details).

After release, the components will be leak checked, cleaned, baked out and prepared for shipment. (See "Component Shop Conditioning/Test Procedure" V049-2-047 and "Component Packaging, Handling and Preparation for Shipment" V049-2-123 for additional details).

6.0 MISCELLANEOUS COMPONENTS

6.1 General

Miscellaneous components will be evaluated during the fabrication program on a make/buy basis. These components include clean air piping, Class 100 clean rooms, vacuum header piping and miscellaneous pipe/valve supports.

Once a decision has been made to make an item rather than to buy it, the appropriate fabrication documentation will be prepared and submitted to LIGO.

6.2 Manufacturing Documentation/Q.A.

Once PSI determines a component will be made in-house, detailed fabrication drawings will be made. The same project procedures included as attachments to this volume will be applied to these miscellaneous components as well.

6.3 Testing

Miscellaneous components will be tested at the site as part of the system acceptance tests.

7.0 SPECIAL EQUIPMENT REQUIREMENTS

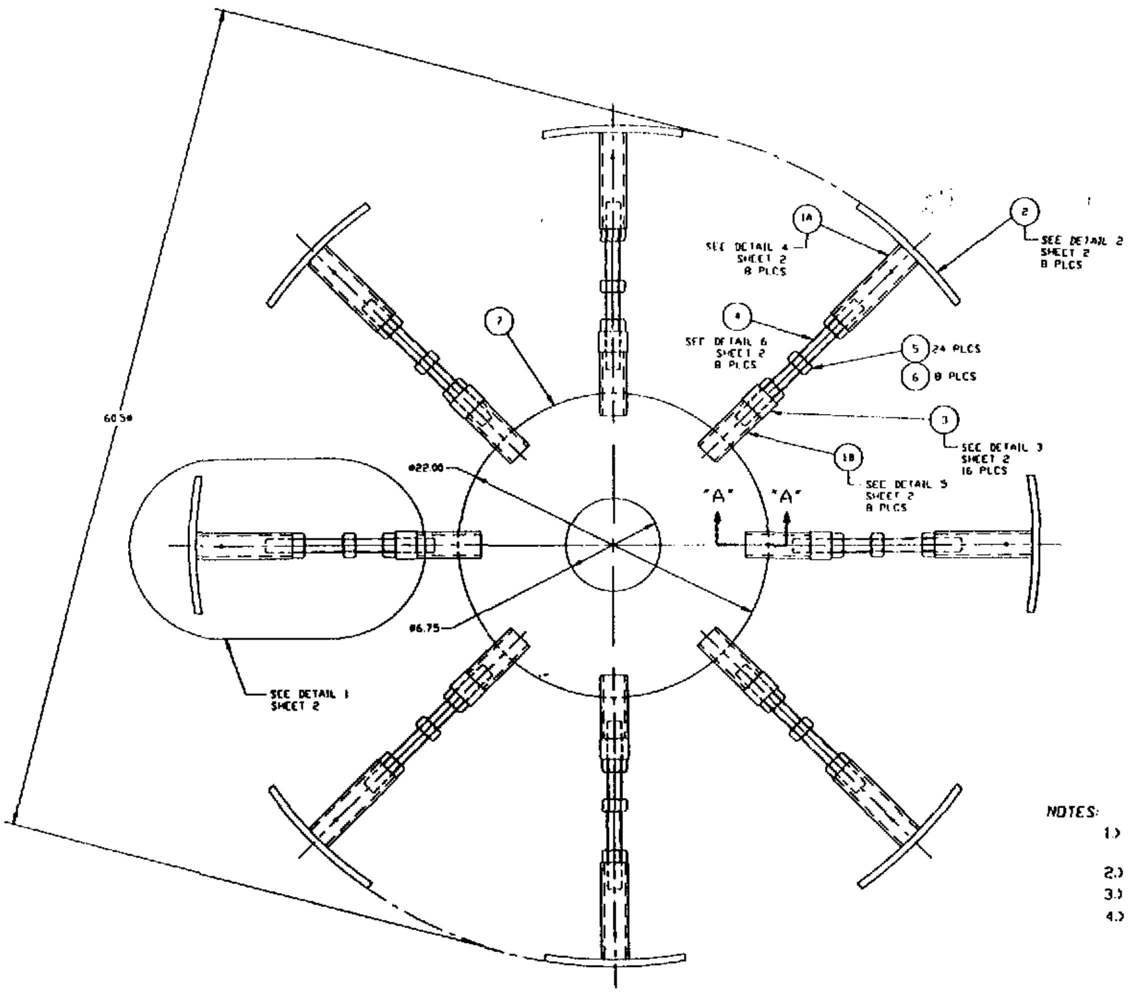
7.1 General

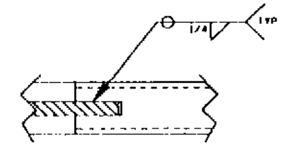
Various special devices/facilities will be used to fabricate the LIGO Vacuum Equipment. These devices/facilities are required to attain and maintain the required level of component dimensional accuracy and cleanliness.

7.2 Vessel Fixtures

Special rounding fixtures (internal spiders and external clam shell clamps) will be used to maintain vessel shell and nozzle roundness. These devices will remain in the vessel during machining, heat treating and welding operations. (See attached drawing.)

ITEM	PART NUMBER	SUFFIX	QTY	UM	DESCRIPTION
1	C011003-10		10	FT	PIPE, SCH 80 304 A312 1-1/2"
2	C307900-06		10	FT	BAR 1/2" x 6" 304 A479
3	C467032		1	FT	ROUND BAR 2" OD 304 A479
4	V049M076		8	EA	ROD THREADED 1"-8 UNC A193 GRB8 NICKLE PLATED
5	C106300		8	EA	NUT, HEAVY HEX 1"-8 UNC A193 GRB8
6	C429600		8	EA	WASHER FLAT 1" SST
7	BY VENDOR		1	EA	PLATE, 304 SST 22" DIA x .75 THK





SECTION "A"-"A"
SCALE HALF

NOTES:

1.) CLEANING: ASSEMBLY TO BE SCRUBBED WITH NYLON BRUSH AND DETERGENT, THEN RINSED WITH STEM AND DRYED.
2.) ITEM 2 TO BE CLEANED AND INSPECTED BEFORE EACH INSTALLATION IN A SHELL.
3.) NO LUBRICANTS ARE ALLOWED ON ANY PARTS. KEEP CLEAN OF ALL HYDROCARBONS.
4.) SPECIAL CARE IS REQUIRED TO PREVENT CONTAMINATION OF FIXTURE BY COVERING WITH TARPS AND STORING INSIDE WHEN NOT IN USE.

4-REQ'D

PROPRIETARY AND CONFIDENTIAL

REFERENCE DRAWINGS

DO NOT SCALE THIS DRAWING

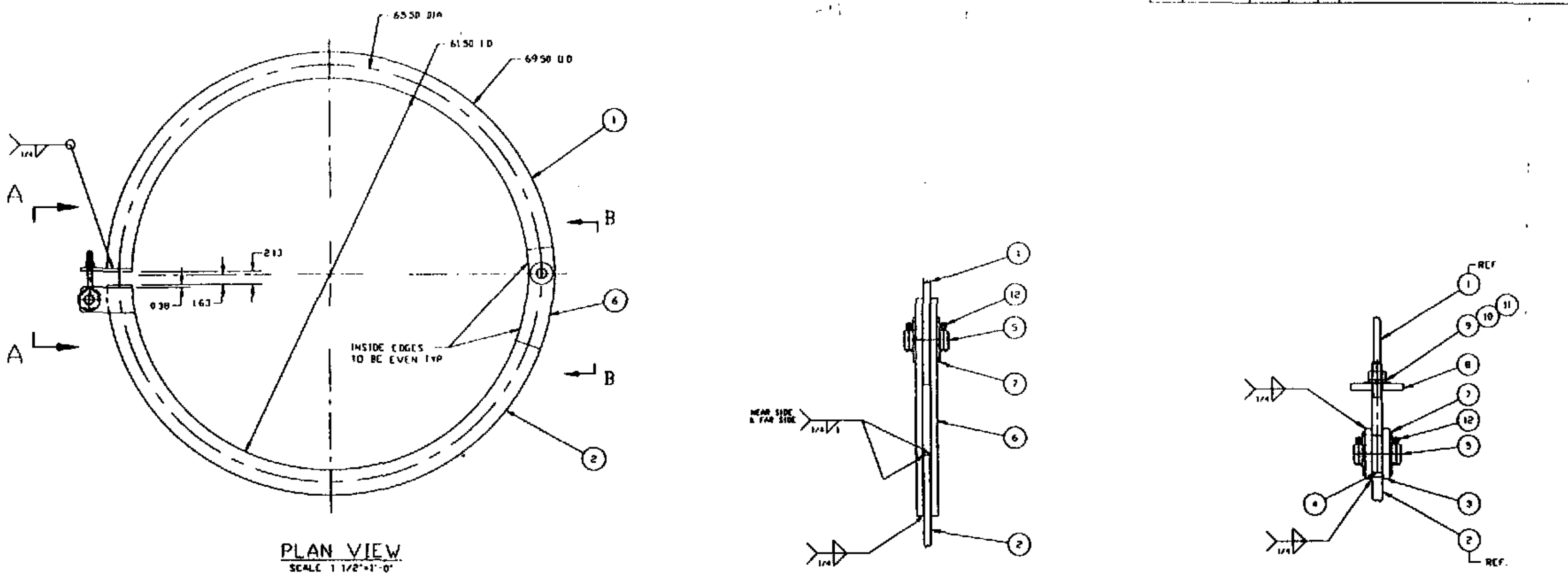
REV	DESCRIPTION
P2	RELEASED FOR FABRICATION
P1	PRELIMINARY DESIGN UPDATE

PROCESS SYSTEMS INTERNATIONAL, INC.

FIXTURE
60S OD INTERNAL
LIGO VACUUM EQUIPMENT

SIZE D | DWG NO V049-4-049 | REV P2 | SHEET 1 OF 2

ITEM	PART NUMBER	SUFFIX	QTY	UM	DESCRIPTION
1	V049H075		2	EA	FLAT BAR 1/2X 4X ?FT. 304 A479 ROLLED HARD WAY TO 61 1/2" ID
2					MADE FROM OF ITEM (1)
3					MADE FROM DROP OF ITEM (1)
4			1	EA	EYE BOLT X 7" LG MCMASTER CARR 6251K25
5	C461924		1	FT	ROUND BAR 1 1/2" X 3" LG 304 A479
6					MADE FROM DROP OF ITEM (1)
7			4	EA	1 1/4" WASHER MCMASTER CARR 90108A041
8					MADE FROM DROP OF ITEM (2)
9	429906		1	EA	FLAT WASHER 3/4 A436
10	439906		1	EA	LOCK WASHER 3/4 A436
11	109706		1	EA	HEX NUT 3/4 A563
12			2	EA	COTTER PIN 1/4 X 3" CS



PLAN VIEW
SCALE 1 1/2"=1'-0"

VIEW "B-B"
SCALE: 3"=1'-0"

VIEW "A-A"
SCALE: 3"=1'-0"

2-REQ'D

		V049-4-001	BEAM SPLITTER CHAMBER ASSY
DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION
REFERENCE DRAWINGS			

DO NOT SCALE THIS DRAWING

USED ON

NEXT ASS'Y

REV	DESCRIPTION	CHKD	DRWN	DATE	RECH
P2	RELEASED FOR FABRICATION		AH	03/26/96	
P1	RELEASED FOR PROTOTYPE FABRICATION		PV	03/18/96	

ISSUE DESCRIPTION

PROCESS SYSTEMS INTERNATIONAL INC.

EXTERNAL FIXTURE 61.5 I.D

LIGO VACUUM EQUIPMENT

DWG. NO. V049-4-050 REV P2

SCALE AS NOTED SHEET 1 OF 2

7.3 Washing System

7.3.1 Hardware Description

All chambers, spools, tubes, adapters and covers will be given a final washing before final assembly or packaging for shipment to the sites. This will be done in a washing system in the PSI shop. The washing system consists of a component support dolly and sled, a washing booth and the systems to control the delivery of washing and rinsing fluids.

7.3.1.1 Support Dolly and Sled

Components will be moved around the shop for washing and final assembly on wheeled dollies. The actual component will be supported on a wheeled sled which sits on top of the dolly. The purpose of the sled is to provide an easily movable support having minimum elevation to move the component into and out of the washing booth. The sled has wheels with bearings which are appropriate for the conditions inside of the washing booth (the dolly's casters need to provide a greater degree of movement and are not suitable to be washed). The dolly also serves to keep the sled at the proper elevation for entry into the washing booth.

The sled has another important feature. It supports each chamber with an appropriate slope to assure free draining, and provides the means to turn the chamber inside the washing booth, thereby exposing all of the surfaces to the spray nozzles. This requires the mounting of an additional support ring to certain vessels to allow free rotation. Inside the washing booth, power is applied to the sled's drive wheels to turn the vessel.

7.3.1.2 Washing Booth

The washing booth is an enclosed cabinet approximately 16' x 16' x 14' H. It is enclosed by stainless steel sheet to contain the fluids, and has a sloped floor to direct the drains to a sump. The sump is equipped with a pump for recirculation of the fluids. The booth has a door on one side for entry from the shop of the component to be washed, and a door on the other side for removal of the component directly into a cleanroom.

The booth is equipped with two fixed spray headers having multiple nozzles. One header is for the washing detergent and primary rinse water, and the other is dedicated to the final DI water rinse. The second header not only provides greater separation of the fluids, thereby protecting the quality of the DI water, but it also allows optimizing the spray nozzles for the lower flowrate of DI water that is used (wash and primary rinse are at approximately 50 gpm at 80 psig, while the DI water rinse is at 20 gpm at 20 psig). The spray headers are constructed of threaded plastic pipe and are capable of being configured to provide the best spray coverage of the component being washed, and of being located as closely as possible to the component. This will be done manually prior to the start of a wash cycle.

A vent is also provided in the washing booth to discharge steam laden vapor to the outside. Clean air is also blown into the booth during the drying part of the cycle. Drying is accomplished by the evaporation of water from the heated metal surfaces into the clean air purge stream.

7.3.1.3 Fluid System

The washing detergent solution and rinse waters are managed with a system of tanks, pumps, filters, piping and valves. The washing cycle is automatically controlled by a PLC to assure repeatability. Refer to P&ID V049-0-031, Washing System.

The detergent solution and primary rinse water are continuously recirculated at a rate of 50 gpm between their storage tanks and the washing booth. Each tank (as well as the DI water tank) has a capacity of 100 gallons and is equipped with an electric heater to maintain the temperature at approximately 150 F. There are also the appropriate level indicators, interlocks, controls, relief valves and drain and fill valves.
Through the action of automatic valves controlled by the system PLC, either the detergent solution or the primary rinse water valves are opened, allowing flow to a recirculation pump. A filter at the pump discharge keeps any particulate from the spray nozzles. Indicators are provided for temperature, pressure and flowrate. Periodically, water can be pumped to a waste water hold-up tank for analysis and treatment, if required, before discharge.

After being sprayed onto the component being washed, water is directed into a sump at the bottom of the washing booth, where a pump pressurizes it to be recirculated to its tank. An in-line heater is provided to bring the temperature back to 150 F, since the tank heater will not have the capability to respond fast enough for the recirculating flow.

The final DI water rinse is accomplished similarly, but the water is not recirculated. A larger supply tank (200 gallons) is used, and the water is used on a once-through basis, being pumped by a dedicated pump through the separate DI water spray header.. It is returned to a separate 200 gallon storage tank. After the wash cycle is completed, and before the next cycle, this water is pumped at a reduced rate (approximately 5 gpm) through a deionizing system (city water can be used instead, if desired) to replenish the DI storage tank.

7.3.2 Washing System Qualification

The key issues in the washing process are the adequacy of:

The Detergent
The Washing and Primary Rinsing Conditions
    Flowrate, Temperature, Duration
The Sprays
    Pressure and Type of Spray Nozzle
    Coverage
The Final Rinse
    DI Water Quality
    Conditions
        Flowrate, Temperature, Duration

The ultimate proofs of the adequacy of the values or definitions chosen for the above listed variables are the final vacuum and RGA tests on the components being washed. In order to minimize risks, PSI has undertaken a 10" diameter bench scale prototype program and first article test programs for the chambers.

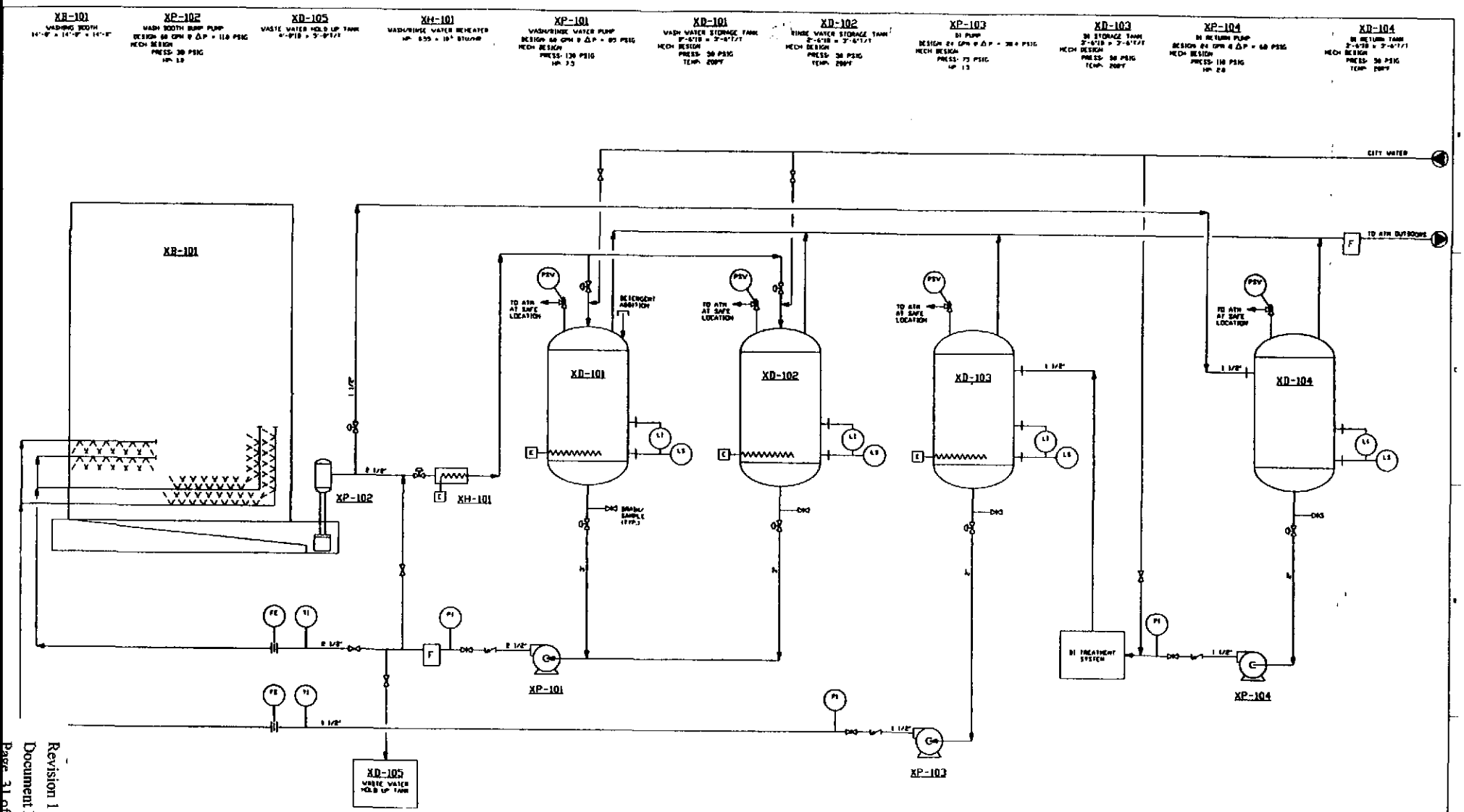
A manual washing station was constructed to allow the washing of relatively small pieces (including the 10" prototype chamber). Test coupons were washed using a manual pressure washer and DI water rinse using six different detergent candidates. The coupons were analyzed by XPS to allow ranking. The first 10" chamber test, however, was washed using the detergent that was the least corrosive and which was familiar to the Town of Westboro. Use of this detergent would facilitate obtaining the necessary waste discharge permit. Initial vacuum and RGA tests after bakeout indicate that this detergent and the washing cycle used would meet the cleanliness requirements. Testing of the first full scale chamber (manual washing) will confirm the detergent and cycle choices, or indicate the necessary changes.

For the automatic washing system, a design basis was chosen that would result in reasonably sized equipment (pumps, piping, tanks, etc.). Of primary importance was

the spray header and nozzle design. The required number of nozzles and reasonable flows and pressures set the basis for the other equipment. The temperature of 150 F was chosen as being reasonably achievable. The final variable, duration, is truly variable and can be adjusted at any time. It will be set initially to assure multiple coverages of all surfaces of the component being washed by the sprays.

The spray coverage will be initially configured for each component. Immediately following washing and drying, a visual inspection will be made to determine if coverage was indeed complete. If necessary, the spray header configuration will be changed and the washing cycle repeated. Likewise, the conditions for the final DI water rinse will be initially checked by inspection. The adequacy of the DI water quality, as well as the adequacy of the entire washing process, will ultimately be proven only by vacuum and RGA testing.

The first component to be washed will be a 10" prototype vessel. This will allow a relatively quick washing, baking and testing compared to a full sized chamber. The results of the 10" test will indicate any immediate changes in the washing cycle that may be required.



PROCESS SYSTEMS INTERNATIONAL INC.

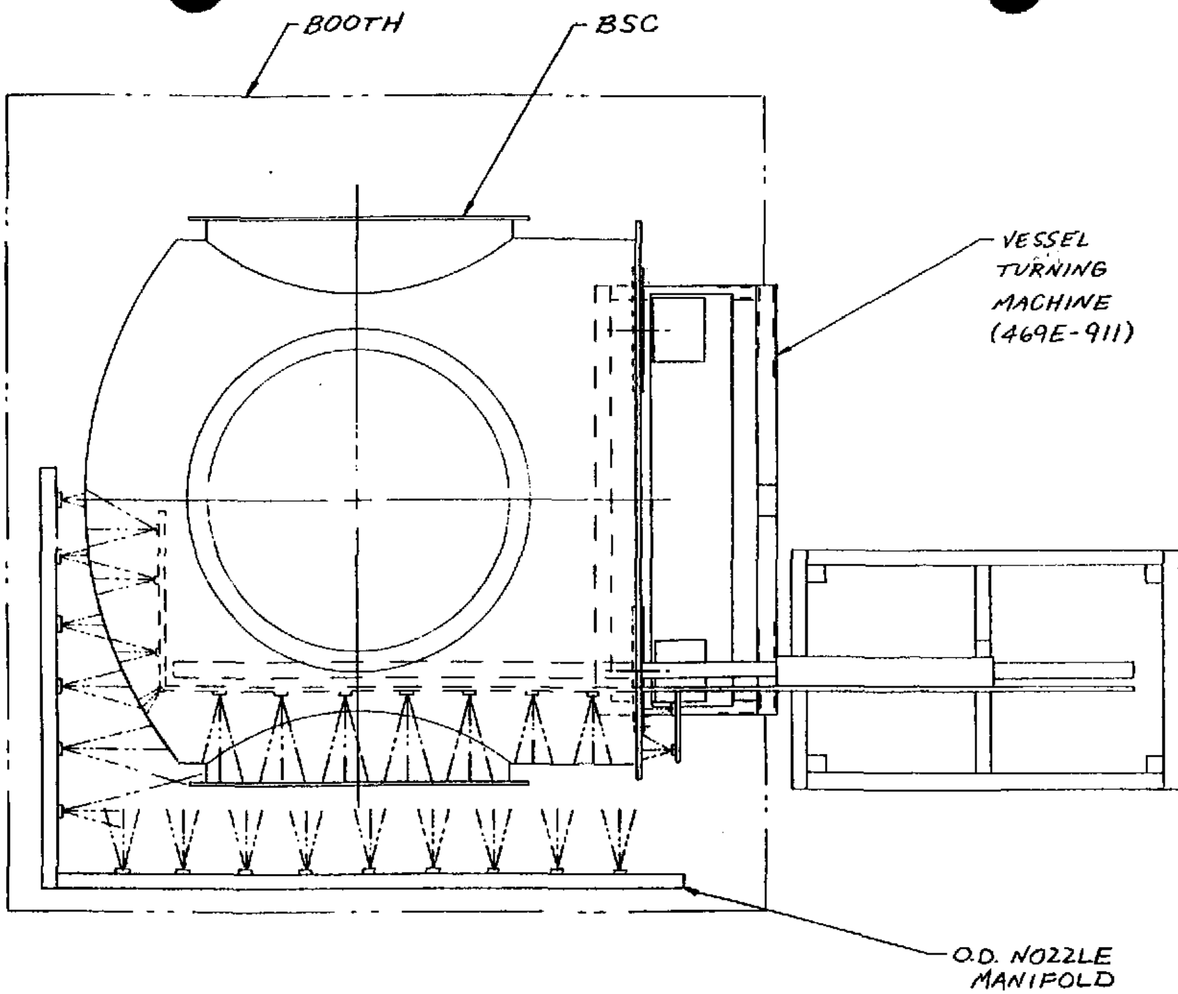
PIPING & INSTRUMENTATION DIAGRAM
LIGO VACUUM EQUIPMENT
WASHING SYSTEM

V049-0-031

Revision 1

Document No. V049-1-099

Page 31 of 36



PLAN VIEW

PROCESS SYSTEMS INTERNATIONAL
DOCUMENT REVIEW CHECKLIST

PROJECT NAME: LIGO

PSI DOC. NO. ______

CHK		BY / DATE
____	PROJECT ENG	____
____	MECHANICAL	____
____	STRESS	____
____	ELECTRICAL	____
____	PROCESS	____
____	MFG. ENG.	____
____	MANUF	____
____	Q.A.	____
____	DRAFTING	____

PROCESS SYSTEMS INTERNATIONAL
DOCUMENT APPROVAL CHECKLIST

PROJECT NAME: ______

PSI DOC. NO. ______

NOTE: THIS REVIEW DOES NOT RELIEVE THE SELLER OR CONTRACTOR OF ANY OBLIGATIONS UNDER THE P.O. OR CONTRACT.

- ____ FA = FINAL APPROVAL
- ____ AS = APP'D AS NOTED - REVISE & RESUBMIT
- ____ AF = APPROVED FOR FABRICATION
- ____ NA = NOT APPROVED
- ____ RP = RELEASED FOR PROCUREMENT OF MATERIALS ONLY
- ____ RR = REVISE & RESUBMIT

BY ______ DATE ______

PSI DWG # V049-2-264

APR 30 1996

VENDOR NAME: Dangel Robots

REVISION NO: ______

SUBMITTAL NO: 1st

STATUS: Review & Approval

DANGEL ROBOTS & MACHINERY INC.

SCALE: 1/25	APPROVED BY	DRAWN BY R. ANNIS
DATE: 4-29-96		

LIGO PROJECT

WASHING MACHINE CONCEPT — DRAWING NUMBER 469B-914

TE PRO-FORM 92097 PRINTED ON 920H CHARPRINT VELLUM

DOCUMENT REVIEW CHECKLIST

PROJECT NAME: _____

PSI DOC. NO. _____

CHK		BY / DATE
	PROJECT ENG.	
	MECHANICAL	
	STRESS	
	ELECTRICAL	
	PROCESS	
	MFG. ENG.	
	MANUF.	
	Q.A.	
	DRAFTING	

PROCESS SYSTEMS INTERNATIONAL

DOCUMENT APPROVAL CHECKLIST

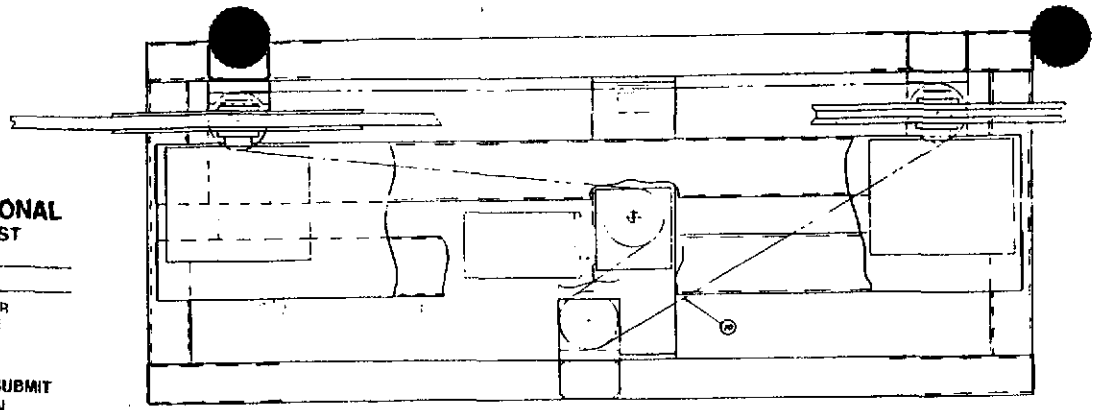
PROJECT NAME: 1182

PSI DOC. NO. _____

NOTE: THIS REVIEW DOES NOT RELIEVE THE SELLER OR CONTRACTOR OF ANY OBLIGATIONS UNDER THE P.O. OR CONTRACT.

_____ **FA = FINAL APPROVAL**
_____ **AS = APP'D AS NOTED - REVISE & RESUBMIT**
_____ **AF = APPROVED FOR FABRICATION**
_____ **NA = NOT APPROVED**
_____ **RP = RELEASED FOR PROCUREMENT OF MATERIALS ONLY**
_____ **RR = REVISE & RESUBMIT**

BY _____ DATE _____



VENDOR NAME: Daniel Robots

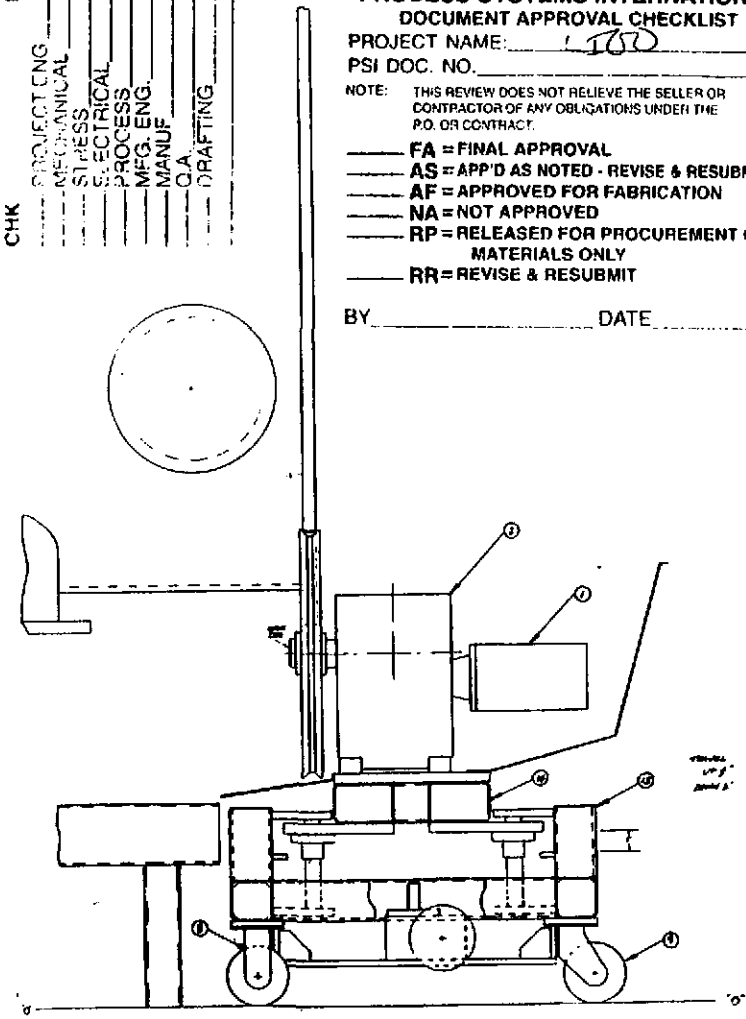
REV: _____

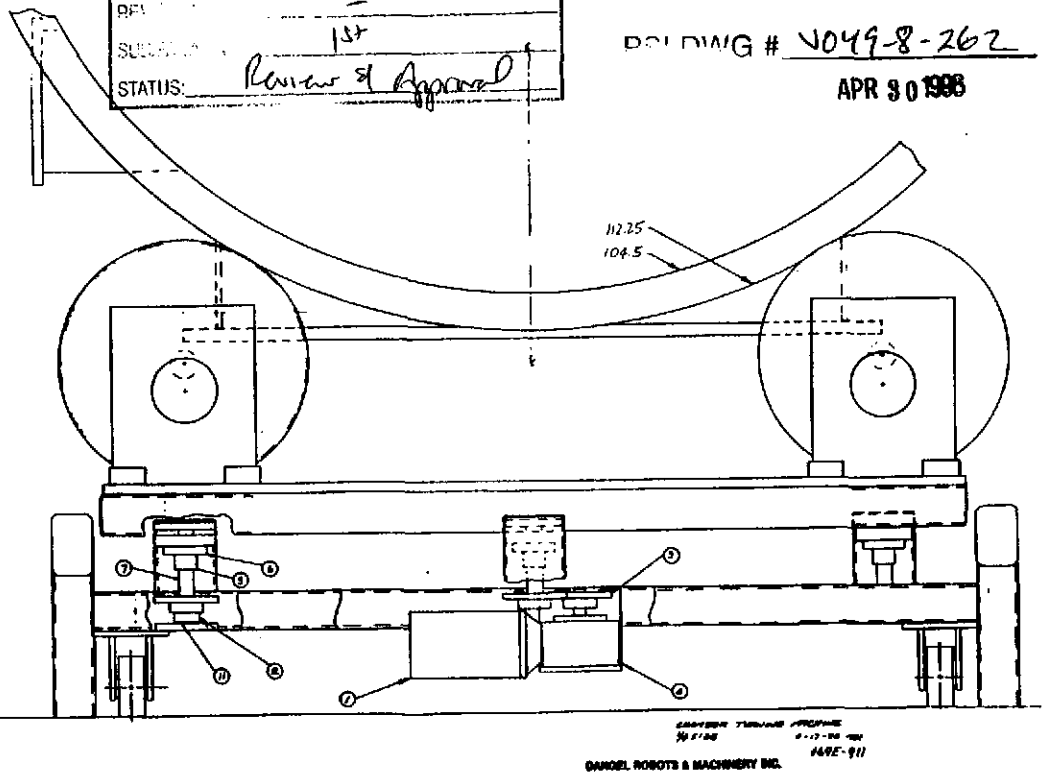
SUBMITTAL: 1st

STATUS: Review & Approval

PSI DWG # V049-8-262

APR 30 1998





DANIEL ROBOTS & MACHINERY INC.

7.4 Clean Manufacturing Space

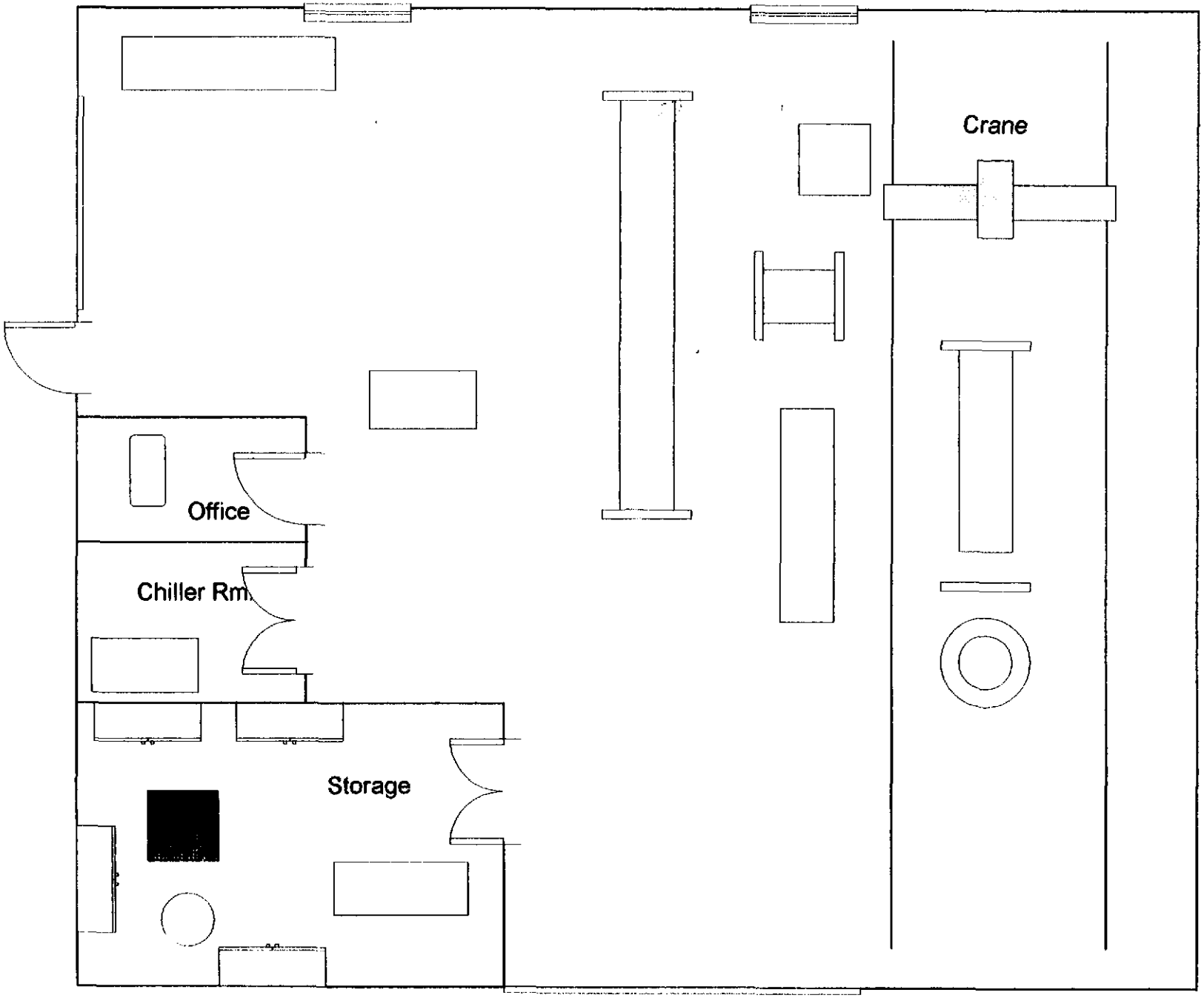
PSI is modifying part of its manufacturing space to create a clean manufacturing area. Filtered outside air will be used to pressurize this space and prevent contamination from the remainder of the fabrication shop. This area will also be dehumidified to eliminate contamination from condensation.

Welding stations in this area will be equipped with vent fans to discharge welding smoke outside of the clean space.

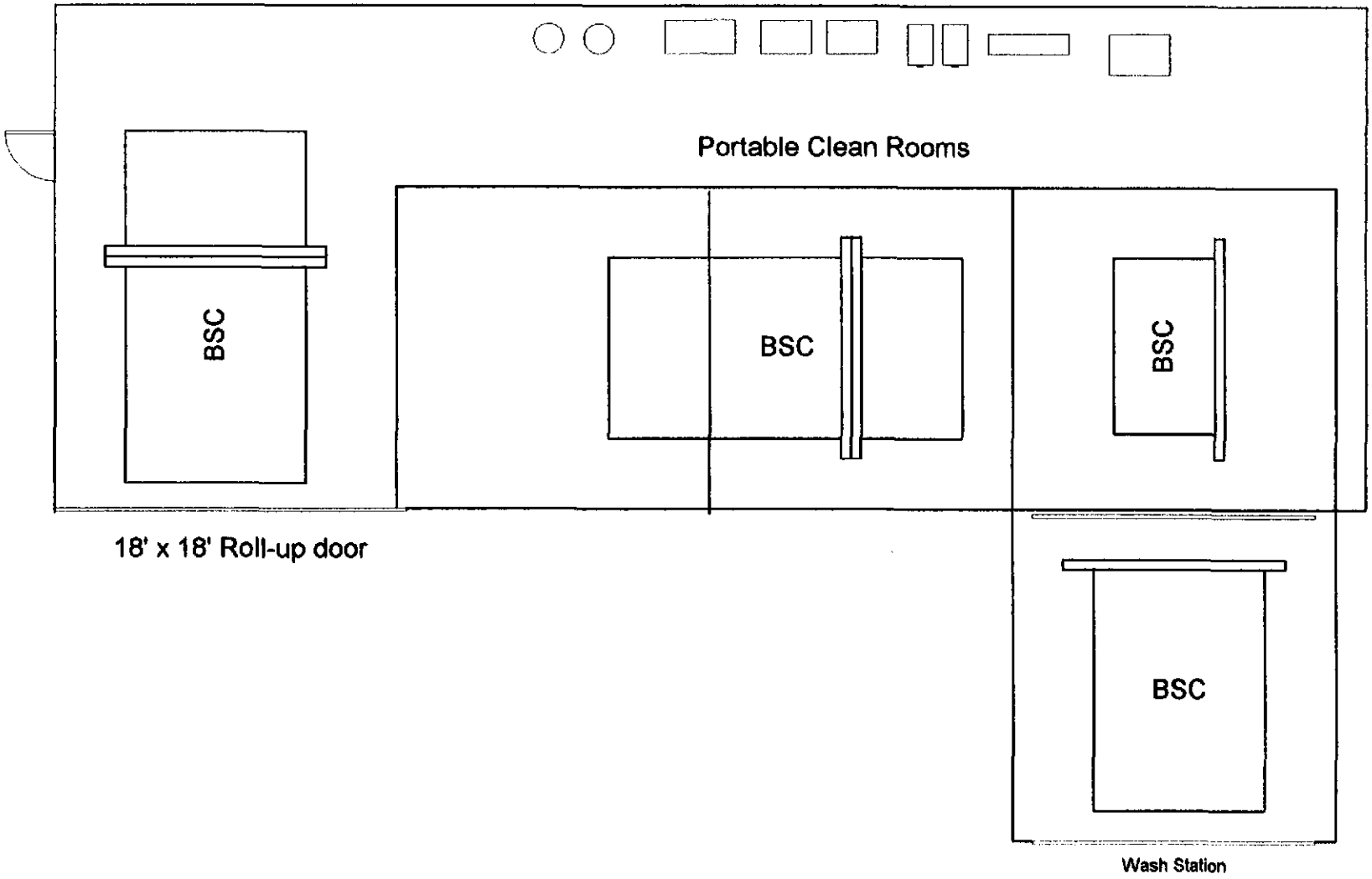
Class 100 clean rooms will be set up in this area to protect components after they have been cleaned. (See attached drawings). The Class 100 clean rooms are used whenever cleaned components are opened to the atmosphere.

LIGO Spooling and Assembly Area

75 ft x 75 ft x 18 ft H



LIGO
Custom Shop - Mezzanine
Clean Area
65 ft x 25 ft x 18 ft H



Title: SPECIFICATION FOR LEAK CHECK PLAN LIGO VACUUM EQUIPMENT

SPECIFICATION FOR LEAK CHECK PLAN FOR LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PROCESS ENGINEER [signature]

PROJECT ENGINEER S Motar

QUALITY ASSURANCE Alan L Bradbrook

TECHNICAL DIRECTOR D. A. McWilliams

PROJECT MANAGER [signature]

1	Sm 12/4/96	RGB 12/4/96	REVISED PER DEO 0378
Ø	GS 10/10/96	——	Release for fab Per DEO #0302
Ø	Sm 5/4/96	RGB 5/4/96	INITIAL RELEASE DEO 0162 FOR FDR
REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED Sm	DATE 5/4/96	Approved RGB DATE 5/4/96	Number: A V049-2-014	Rev. 1

1.0 PURPOSE

The purpose of this procedure is to define the necessary steps to ensure that equipment fabricated by Process Systems International (PSI) meets the leak rate specification for each component. The procedure includes proposed methods for leak checking welded joints and the double O-ring /pumped annulus flange joints. Where required ,additional data will be gathered and tests will be performed to confirm the methods.

2.0 GENERAL

This specification will be periodically updated to reflect the latest leak check test data that becomes available from prototype and production component testing.
The leak testing methods will make use of a Residual Gas Analyzer and a dry (oil free) Helium Mass Spectrometer Leak Detector. All leak testing methods and calibration will be derived from A.S.T.M. E498 Standard Test Methods for Leaks Using the MSLD or RGA in Tracer Probe Method

3.0 RESPONSIBILITY

This procedure is applicable to PSI Testing Department and its personnel.

4.0 PROCEDURE

4.1 Joint Categories:

Category I
Welded joint located away from the double O-ring flange assembly .

Category II
Welded joint located near the double O-ring flange assembly .

Category III
CF flange joint.

Category IV
Atmospheric O-ring. (O-ring between atmosphere and annulus channel.)

Category V
UHV O-ring. (O-ring between annulus channel and UHV chamber.)

4.2 Leak Checking Welded Joints

Category I
Welded joint located away from the double O-ring flange assembly .

These leaks can be detected using standard MSLD leak detection procedures with He as the tracer gas. The leak detector is sensing the vacuum chamber and He is sprayed external to the vessel. If there are multiple or large leaks the potential problem of building a high He background level in the vessel exists.

Category II
Weld joint located near a double O-ring flange assembly .

Helium leak detection procedures are still preferred. The proposed method is to bag the O-ring flanged joint and introduce a pure nitrogen purge into the bag. This will keep the concentration of helium in the bag low in order to minimize permeation or leakage of He through the atmospheric O-ring seal.Maintaining a vacuum in the O-ring annulus will also help by removing helium before it can permeate the UHV O-ring and enter the vacuum chamber.

4.3 Leak Checking Conflats

Category III
Conflats.

The conflats can be leak checked using standard Helium MSLD procedures.As in Category II leak detection,nearby O-ring flange assemblies may need bagging and nitrogen purging.

4.4 Leak Checking O-rings

Category IV
Atmospheric O-ring. (O-ring between atmosphere and annulus channel.)

Leak checking method
An Ion vacuum gauge will be sensing the vacuum pressure in the pumped annulus volume between the atmospheric O-ring seal (Cat.IV) and the UHV O-ring (Cat.V). Air that leaks across or diffuses through the O-ring seals will be pumped by the annulus pumping system . The vacuum pressure, as measured by the Ion guage, in the annulus will be compared to previously successfully tested systems.If the vacuum pressure is comparable,the o-ring seals are considered to be good.

Category V
UHV O-ring. (O-ring between UHV space and annulus channel.)

Leak checking method
Same as Category IV O-ring leak checking method described above.

Outgassing of O-Rings (reference)

Air contains approximately 1% Argon , 5 ppm Helium, 18ppm Neon.Outgassing of these gasses from the O-ring will contribute to the background levels during leak checking.
The solubility for these individual gasses in Viton is unknown, therefore actual outgassng levels for these gasses will have to be determined experimentally.
As an estimate , the outgassing load from the O-ring is 10^{-11} Torr-L/sec for Helium and Neon, and 10^{-8} Torr-L/sec for Argon.

LEAK TEST DATA SHEET

	1	2	3
Component Name			
Model Number			
Serial Number			
Drawing Number			
Detector Name			
Model Number			
Serial Number			
Detector Calibration			
Expiration Date			
Standard Leak Rate			
Background			
Standard Response			
Leak Test Data			
Location /Date			
Tracer Gas			
Pressure			
Duration			
Response			
Leak Rate			
Measured			
Calculated			
Allowable			
Performed By :	Date :		
Witnessed By :	Date :		
Signature :	Date :		
Title :			

Remarks :

BSC LEAK TEST SUMMARY SHEET

Name							
Model No.							
Serial No.							
Drwg.No.							
Location	Category	Leak Rate	Allowable	Pass	Fail	Signature	Date
		Torr	Torr				
Annulus-1	IV		$1x10^{-5}$				
Annulus-2	IV		$1x10^{-5}$				
Annulus-3	IV		$1x10^{-5}$				
Annulus-4	IV		$1x10^{-5}$				
Annulus-5	IV		$1x10^{-5}$				
Annulus-1	V		$1x10^{-5}$				
Annulus-2	V		$1x10^{-5}$				
Annulus-3	V		$1x10^{-5}$				
Annulus-4	V		$1x10^{-5}$				
Annulus-5	V		$1x10^{-5}$				
		Torr-L/s	Torr-L/s				
Weld Joint	I		$1x10^{-9}$				
Weld Joint	II		$1x10^{-9}$				
Conflat	III		$1x10^{-9}$				
Comments							
Witnessed Signature Title Date							

HAM LEAK TEST SUMMARY SHEET

Name							
Model No.							
Serial No.							
Drwg.No.							
Location	Category	Leak Rate	Allowable	Pass	Fail	Signature	Date
		Torr	Torr				
Annulus-1	IV		$1x10^{-5}$				
Annulus-2	IV		$1x10^{-5}$				
Annulus-3	IV		$1x10^{-5}$				
Annulus-4	IV		$1x10^{-5}$				
Annulus-1	V		$1x10^{-5}$				
Annulus-2	V		$1x10^{-5}$				
Annulus-3	V		$1x10^{-5}$				
Annulus-4	V		$1x10^{-5}$				
		Torr-L/s	Torr-L/s				
Weld Joint	I		$1x10^{-9}$				
Weld Joint	II		$1x10^{-9}$				
Conflat	III		$1x10^{-9}$				
Comments							

Witnessed
Signature
Title
Date

SPOOL SECTION LEAK TEST SUMMARY SHEET

Name							
Model No.							
Serial No.							
Drwg.No.							
Location	Category	Leak Rate	Allowable	Pass	Fail	Signature	Date
		Torr	Torr				
Annulus-1	IV		$1x10^{-5}$				
Annulus-2	IV		$1x10^{-5}$				
Annulus-1	V		$1x10^{-5}$				
Annulus-2	V		$1x10^{-5}$				
		Torr-L/s	Torr-L/s				
Weld Joint	I		$1x10^{-9}$				
Weld Joint	II		$1x10^{-9}$				
Conflat	III		$1x10^{-9}$				
Comments							
Witnessed Signature Title Date							

SPECIFICATION FOR

CLEANING PROCEDURE

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY: Thomas M. Stan

QUALITY ASSURANCE: Allan L Baldwin

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
1	GS 10-10-96		Release for Fab Per DEO #0302
1	TMS 8-6-96	DMW 8-L	Added Acetone Precleaning And Updated Procedure Per DEO 0240
0	TMS 4-30-96		General Revision Per DEO # 0151

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED T. Stan	DATE 4-30-96	APPROVED RGS	DATE 5/1/96	Number A V049-2-015	Rev. 1

TABLE OF CONTENTS

1.0 Purpose

2.0 General

3.0 Responsibility

4.0 Equipment and Systems

5.0 Procedure

6.0 Required Documentation

Attachment Component Cleaning Data Sheet

1.0 PURPOSE

The purpose of this procedure is to define the necessary steps for the cleaning of the LIGO vacuum equipment components such that all vacuum exposed surfaces are compatible with ultra high vacuum service.

2.0 GENERAL

This procedure is applicable to any fabricated stainless or aluminum component that is exposed to UHV service. It applies to the cleaning of these components subsequent to completion of all machining and welding operations.

3.0 RESPONSIBILITY

3.1 PSI Engineering is responsible for identifying all components and portions of components that are subject to this procedure. All cleaning will be as specified on the drawings.

3.2 PSI manufacturing is responsible for the execution of this procedure in the PSI shop.

3.3 The installation contractor is responsible for maintaining this procedure at the sites.

3.4 Quality Assurance is responsible for monitoring compliance with this procedure in the PSI shop. Engineering will be responsible for compliance at the sites.

3.5 This procedure shall be maintained and modified as required by the cognizant engineer.

4.0 EQUIPMENT AND SYSTEMS

4.1 The cleaning equipment consists of the following:

4.1.1 Washing Cabinet
- Enclosure
- Spray header system
- Drain collection system and pump
- Vent system
- Controls

4.1.2 Cleaning Solution and Rinse System

Wash water storage tank
Rinse water storage tank
DI Water system and storrage tank
Waste water hold-up tank
Wash/Rinse water heater
DI Water heater
Pumps, filters, piping, valves

4.2 Clean Manufacturing Area

An isolated section of the PSI shop will be provided with an outside air purge to form a clean manufacturing space. Class 100 cleanrooms will be operated in this area. Because the air is recirculated through the cleanroom filters, it will also be cleaner than the shop atmosphere. It is expected that it may reach a level as low as Class 50,000 to 100,000. The components cleaned in the washing cabinet will be moved into the Class 100 cleanrooms for packaging (or closure of the vessel ports) without going back into the shop atmosphere.

4.3 Class 100 Cleanroom

4.3.1 Two Class 100 soft-wall portable cleanrooms are joined together to make a large working area. The cleanrooms circulate air through HEPA filters at the tops of the rooms downward. The air exits under the soft-walls (plastic curtains) at the bottom and recirculates through the room to the blower inlets at the top.

4.3.2 Cleanroom activities shall be performed in accordance with Cleanroom Procedure V049-2-118. Specific cleanroom training is required for anyone entering the cleanroom. This training, given by Manufacturing Engineering, covers principles, gowning and necessary behavior.

5.0 PROCEDURE

5.1 Starting Condition

a.. All welding completed to the degree possible.

b. Remove gross contamination from all interior and exterior surfaces (including flange faces) by steam cleaning with a portable steam system. Remove ink markings, such as material designations, with acetone.

5.2 Equipment Set-Up

a. Establish the proper level of DI water in the storage tank by running city water through the DI water system and into the tank

b. If any water remains in the waste water hold-up tank, drain it to the waste storage tank. (Note: If the waste water is to be drained to the town sanitary sewer, testing and treatment may be needed before discharge.)

c. Establish the proper water level in the rinse water tank, adding DI water as required.

d. Establish the proper level in the wash water tank, adding detergent and DI water as required. (The entire contents of this tank should be drained every 2 months or longer if the system is not used continuously.)

e. Activate the wash/rinse water heater and circulate the wash water in a closed loop to heat the contents of the tank to approximately 150 F as read on the thermometer at the pump inlet. Repeat for the rinse water. Repeat for the DI water using its dedicated pump and heater.

f. Confirm proper piping connections and valve lineup for the system.

g. Confirm proper operation of the vent fan.

h. Confirm proper operation of the cleanroom.

5.3 Cleaning Precautions

5.3.1 There shall be a minimum of two operators present (in the area) for all cleaning operations.

5.3.2 The operator doing the washing shall wear a lab coat, shoe covers and clean room gloves. (This applies to anyone handling the cleaned pieces.)

5.3.3 The operators should be familiar with the washing system and its components before operating the equipment.

5.3.4 Do not let any surface dry between start of washing and end of final rinse.

5.3.5 Handle each piece or component with appropriate care and clean gloves.

5.4 Cleaning

5.4.1 *General*

a. The heater controls should be set to provide approximately 150 F water.

b. When making DI water, periodically monitor the quality light at the DI system.

5.4.2 *Component Loading*

a. Mount the component to be cleaned on a cart, and position in the washing cabinet.

b. Assemble and position the spray headers as appropriate for the piece being washed.

c. Install the turning machine. Run the turning machine and visually confirm proper rotation of the component and positioning of the spray headers.

d. Close and secure the cabinet doors.

5.4.3 *Wash*

a. Start the cleaning cycle (the vent fan will automatically start during drying). Note: The cycle should not be interrupted between steps.

b. As the controller steps through the washing and rinsing steps of the cycle, periodically monitor the status of the pumps, valves, filters and tanks.

5.4.4 *Drying*

a. Drying will be accomplished by blowing clean air over the component before allowing it to cool.

b. Inspect and bag the component (or close up the vessel) as soon after drying as possible. Avoid contamination from unfiltered shop air through open doorways.

5.5 Inspection

a. Inspection shall be done (before removing the piece from the washing cabinet) using a black light on all interior surfaces or flange faces. No visible contaminant of any form shall be detected when viewed with the naked eye under both natural and ultraviolet light.

b. The presence of any hydrocarbon or fingerprints on any interior surface or flange face shall be cause for rejection. This will require CO_2 cleaning to rectify.

c. A visual inspection shall be made of exterior surfaces. Visible particulates or actual contamination shall be removed.

5.6 Bagging/Wrapping

a. Immediately after drying and inspection, double bag the component using clean, oil-free polyethylene bags or wrap and seal using the same material.

b. Remove the component to the clean area.

6.0 REQUIRED DOCUMENTATION

A component cleaning data sheet containing the following data shall be filled out on completion of cleaning. The data sheet will become part of the component QA package.

- Cleaning log describing parts cleaned and procedure used
- Comments and observations
- Record of flow rates, temperatures and durations used
- Record of inspection results

Attachment

LIGO COMPONENT CLEANING DATA SHEET

Project V59049

Component	Serial Number

Wash Cycle: _____

Flowrates: _____ Max. Temp.: _____ Duration: _____

Operator: _____ Date: _____

Comments: _____

Component(s) Inspected By: _____ Date: _____

Quality Assurance: _____ Date: _____

Comments: _____

Number

Rev.

Title: SPECIFICATION FOR BAKE OUT PROCEDURE VACUUM ENVELOPE COMPONENT

SPECIFICATION FOR COMPONENT BAKE OUT PROCEDURE

FOR LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY: Roberto Thon

QUALITY ASSURANCE: Allan L Bradbook

TECHNICAL DIRECTOR: D.A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	GS 10/10/96		Release for Fab Per DEO #0302
0		RES 5/3/96	INITIAL RELEASE PER DEO 166 FOR FDR

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE	Approved DATE RES 5/3/96	Number: V049-2-019 A	Rev. 0

1.0 PURPOSE

The purpose of this is to define the necessary steps to perform a factory bakeout of a vacuum vessel component at 150 °C. This includes the steps necessary to prepare for the bake out sequence.

2.0 GENERAL

The procedure will general apply to any vessel component and vacuum monitoring equipment that goes with the component.

Required References

A. Blanket System mechanical layout configuration and electric configuration drawings for vacuum envelope.
B. Bakeout System Control Cart Operating Manual & Procedure.
C. RGA Operating Manual
E. STPH2000C Turbomolecular Pump Operating Manuals
F. QDP80 Dry Backing Pump Operating Manuals
G. Vacuum Gauges: Cold Cathode & Pirani Gauges Operating Manuals
H. 500 L/s Ion Pumps Operating Manual

3.0 RESPONSIBILITY

The procedure is applicable to PSI Personnel.

4.0 PROCEDURE

Summary of bakeout sequence

-Install blankets
-Equipment checkout
-Pumpdown vessel
-RGA reading
-Rampup temperature (warmup)
-Soak for 48 hours
-Rampdown temperature (cooldown)
- RGA reading

4.1 Bakeout System

4.1.1 Bake out carts check out

Follow procedures for electric and data acquisition and control parameters checkout of the bake out control/electric system carts.
Refer to: Bakeout System Control Carts, Operating *Manual & Setup* Procedure.

4.1.2 Blanket installation

Each heating blanket is identified and will fit onto certain sections of the vacuum envelope. Install the assigned blankets according to the assigned locations per blanket system drawing layout and installation procedures.

In addition the following components will also be baked:
- Cold cathode/ Pirani Gauge pairs on isolatable section.
- RGA head with electronics removed.
- Main Turbo Pump inlet

Refer to: Blanket System mechanical layout configuration and electric configuration.
Refer to: Bakeout System Control Cart Operating Manual & Procedure.

4.1.3 Electrical and thermocouples connection and checkout

Connect each blanket power cable and thermocouple cable to the controlled cart according to procedures and drawing for connecting blankets electricals and instrumentation to control carts
Refer to: Blanket System mechanical layout configuration and electric configuration.

4.2 Vacuum System

4.2.1 Vacuum Pump(s)

The Main turbo system will be used to pumpdown the component.

A cryotrap upstream of the turbo inlet will be used to trap hydrocarbons and water and to keep the turbo pump clean during initial bake of the vessel.
Do functional check of turbomolecular pump system.
Refer to: STPH2000C Turbomolecular Pump Operating Manuals
QDP80 Dry Backing Pump Operating Manuals

4.3 Vacuum Instrumentation

4.3.1 RGA

The RGA will be used before and after bakeout. The RGA itself needs to be baked. The RGA assembly will be mounted off a 2½ all metal UHV valve mounted on the vacuum envelope. The assembly will have a 2½" Tee or Cross Conflat fitting with an 1½" roughing valve on one end and the RGA on the other. A cross fitting is recommended so that a high vacuum gauge can be mounted on the fitting to serve as the pressure protection device for the RGA.
Isolate the 2½ UHV valve from the vacuum envelope and connect the aux. cart to the RGA to pumpdown the RGA assembly for RGA checkout.
Refer to: RGA Operating Manual

4.3.2 Pressure gauges: Pirani and High vacuum gauge

In order to monitor pressure during the bake, a high operating temperature vacuum gauge is required. The gauge pair can be mounted on the RGA assembly.
Do not start warmup of pressure gauges until a pressure of less than $1X10^{-4}$ Torr has been reached.
Refer to: Vacuum Gauges Operating Manuals

4.4 Bakeout Sequence

4.4.1 Pumpdown

Connect the cryotrap to the component.
Connect the main turbo to the cryotrap.
Start the QDP80 roughing back.
Pumpdown until a pressure of less 0.1 Torr is reached.
Close bypass valve and start the turbo pump.

4.4.2 RGA data

A residual gas analysis will be carried out as a reference point prior to start of bakeout.
Power up RGA only after pressure has dropped to less 5X 10^{-5} Torr.
Take RGA scans for 10 minutes and turn off the RGA and remove the electronics from the head.

4.4.3 Ramp-up

Ramp rate:
Warm-up will occur over a period of 72 hours at a ramp rate of approximately 1.8°C/hr.
Set ramp rate for blanket system on control carts to 1.8°C/hr.
Set target setpoint to 150°C.

Do not start warmup until the pressure has dropped to less 5X 10^{-5} Torr otherwise hydrocarbons will be baked onto the gauge.

Pressure gauge pairs: Ramprate of the pressure gauge pairs will be at least 5 °C/hr to ensure that the gauges remain hotter than the vacuum envelope at all times.
The pressure gauge will be use to monitor pressure during the bake.
Set ramp rate for blanket system on control carts to 5°C/hr.
Set target setpoint to 150°C.

RGA: The RGA needs to be baked also.
Bake the RGA independently i.e. isolated from the vacuum envelope bake.
This will be done using a 25L/s Ion pump.
Bake out of the RGA will be done with the electronics removed.
Bakeout temperature of the RGA will set at below manufacturers recommended maximum (200°C)

4.4.4 Soak for 48 hours

The component will be heated to 150°C and soaked for 48 hours at 150°C±20°. The pressure gauge pairs will be operating at 150°C to monitor pressure during the bake. The RGA will soak at a temperature below 200°C. Set this temperature to 175°C.

4.4.5 Cooldown

Cooldown will be controlled by ramping the setpoints of the system to ambient temperature at a ramprate of -1.8°/hr. The heating jackets for the pressure gauge pair will remain on and turned off when the system has cooled down.

4.4.6 RGA data

With the system baked and cooled down, a residual gas analysis will be carried out to determine the presence of any air leaks and cleanliness of the system.

Follow procedures in document: V049-2-127 "RGA TEST" for data acquisition and analysis.

Title: PROJECT SAFETY PLAN

PROJECT SAFETY PLAN

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

QUALITY ASSURANCE: Alan L Bradbrook

LIGO SAFETY OFFICER: David McEwen

PROJECT MANAGER: Richard Bayley

1	D. McW	RCB 11/15/96	RELEASED PER DEO 351
Ø	4/24/96		RELEASED PER DEO 137
REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE

PROCESS SYSTEMS INTERNATIONAL, INC.		SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE NMS 25APR96	APPROVED DATE REB 4/24/96	Number A V049-2-023	Rev. 1

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1.0 Purpose
2.0 Scope
3.0 Applicable Documents
4.0 Plan Maintenance
5.0 Safety Philosophy
6.0 Safety Objections
7.0 Maintenance of Safety Controls
8.0 Site Safety Plan

ATTACHMENTS

1. PSI Safety Manual

1.0 PURPOSE

This plan defines and establishes the safety requirements for the LIGO Project vacuum equipment supply and installation. The program requirements include safety management systems as well as safety engineering controls necessary to ensure the identification and resolution of all safety issues relative to this project.

This program provides for the review and approval of all operations, facilities equipment, and manpower application for safety and environmental controls necessary to provide maximum protection and to minimize risk of personnel, facilities, and hardware/equipment, etc.

2.0 SCOPE

The requirements as stated herein, will apply to all PSI facilities and construction sites.

All facility and site managers report to the PSI president located in the Westobrough, MA facility.
Each PSI facility and site manager is responsible for safety at their location.

3.0 APPLICABLE DOCUMENTS

The current revisions of the following documents dictate the requirements relative to the implementation of this plan.

a. 29 CFR Occupational Safety and Health Administration (OSHA) General Industry Standards

b. 40 CFR Environment Protection Agency (EPA) Protection of Environment

c. 49 CFR Department of Transportation (DOT) Transportation

d. National Fire Protection Association (NFPA) Fire Codes, Handbook Of Fire Protection, Life Safety Code Handbook, National Electrical Code.

e. American National Standards Institute (ANSI) Safety Standards.

f. National Safety Council (NSC) Accident Prevention Manual for Industrial Operations.

g. Toxic Substances Control Act (TSCA).

PSI has in place safety policies to meet general OSHA, Government and State requirements (regulations) which have been qualified by implementations/audits and by on-site visitation of these agencies.

4.0 PLAN MAINTENANCE

During the execution of this program, PSI's safety philosophy will be dictated by its Safety Policy Statement.

PSI is committed to providing a safe workplace for all employees. Program objectives are the prevention of injury, an the prevention of injury, and the prevention of employee and visitor exposure to hazardous conditions or materials. In order to achieve these objectives, environmental health and safety issues will be addressed as integral components of our business strategy. Our goal is to provide quality products and services while actively conserving our human and natural resources. It is our belief that accidents and undesirable environmental incidents are preventable by active participation from each employee.

All managers and leaders are responsible for ensuring that each employee receives the training and instruction necessary to perform his job safely. Each employee has the responsibility to comply with the company work rules following safe work practices and procedures established to protect the environment, and for reporting to leaders and managers all unsafe acts and hazardous conditions which may impact the environment. PSI's scope of operations range from manufacturing facilities to administrative offices. Therefore, safety programs will be tailored to each situation.

All PSI employees are required to read and follow the PSI Safety Manual as a condition of employment. (See Attachment I.)

6.0 SAFETY OBJECTIVES

6.1 To carry out the PSI safety policy, the following objectives have been identified relative to the Safety Program.

a. All work will be performed in the safest possible manner to reduce accidents involving personal injury, environmental impact, and equipment, facility or product damage.

b. A formal safety program has been established to define safety responsibilities, safety management controls, procedures, industrial safety requirements, industrial hygiene requirements, environmental functions, and other provisions to meet regulatory agency requirements. (See PSI Safety Manual.)

c. The PSI Safety program has the active support of all PSI employees. All levels of management will support the program and the concept of individual responsibility for safe operations will be established and reinforced.

d. The primary responsibility for safe operations will rest with the supervisor, who supported by the Safety Committee, is charged with conducting assigned tasks in the safest possible manner. Each supervisor will assure that organizational procedures provide safe working conditions and that team members comply with all Safety Committee requirements associated with the task.

e. The value of personnel training and certification as an accident preventive measure will be emphasized. Employees will be trained to be familiar with the systems, equipment and facilities which are required for the safe performance of their assigned tasks.

f. The Safety Program will be responsible for all safety related contractual directions.

g. To ensure site safety programs comply with PSI Safety Standards.

6.2 Organization

To accomplish the safety objectives relative to this program, a Safety Committee has been established at PSI. The Safety Committee has been designated and charged with the responsibility of coordinating the safety program to meet company and contractual safety requirements. The committee reports to the President of PSI. There are 12 to 14 people on the safety committee representing each PSI department including Humor Resources. The committee normally meets every two weeks. Special meetings may be called by the chairman if required.

6.3 Responsibilities

Throughout the performance of this project, responsibilities have been established to carry out the requirements of this plan. Each Safety Committee chairman (or individual members) are responsible for informing the President of PSI if an unsafety condition is allowed to exist at PSI after it has been identified. Each PSI facility maintains its own safety committee.

a. Each PSI facility and department has the responsibility for identifying potential hazardous operations, facilities and equipment; for providing required documentation and information incorporating safety requirements for continuing the safe conduct of activities; and for developing procedures and controls necessary for the safe processing of fabricated articles/items throughout all phases of manufacturing and delivery of products.

b. Supervisors/Team Leaders are responsible for assuring safe workmanship practices, including training, certification and qualification of personnel to approved training requirements. Supervisor/operators are trained in equipment operation (i.e. crane, forklift, welding) as well as general fabrication safety.

c. All involved personnel are responsible for reporting to any potential unsafe condition throughout the performance of their duties/responsibilities - to the Safety Committee Chairman or to the LIGO safety officer for resolution.

7.0 MAINTENANCE OF SAFETY CONTROLS

7.1 The Safety Manual, which is available to all personnel, will be revised/updated when new information is obtained, or when new development of processes/equipment dictate changes, and for training/qualification of personnel as determined by growth/expansion/development, etc.

7.2 Safety meetings will be held based on a "as needed" basis and as a minimum monthly. Meeting minutes (with assigned action items) are issued to all supervisors and the PSI president.

8.0 SITE SAFETY PLAN

Weekly safety meetings are mandatory on all PSI jobsites, and are administered by the PSI site manager. PSI subcontractors will be required to maintain a formal safety program. Site specific safety plans will be developed inconjunction with the selected PSI installation contractor. This will result in a cohesive document that has been proved to be successful in application. It also results in more familiarity by the people performing and supervising the work.

Subcontractor safety plans are evaluated based on OSHA requirements and the requirements of PSI's safety program.

SPECIFICATION FOR

THERMAL STRESS RELIEVING

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY: D. McWilliams

STRUCTUAL ENGINEER: R. D. Gatto

QUALITY ASSURANCE: Allan A Bradbrook

TECHNICAL DIRECTOR: D. O. McWilliams

PROJECT MANAGER: Rachel Bay Jr

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
0	D. McW	RBJ	ISSUED PER DEO 0193 FOR FDR

PROCESS SYSTEMS INTERNATIONAL, INC. | **SPECIFICATION**

INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number A V049-2-046	Rev.
	D. McW	4-26-96	RBJ	4/26/96		0

TABLE OF CONTENTS

1.0 Purpose

2.0 General

3.0 Responsibility

4.0 Procedure

Number

Rev.

SPECIFICATION

Number A 049-2-046 Rev. ϕ

11/88

PS-00

Title

SPECIFICATION FOR THERMAL STRESS RELIEVING

1.0 PURPOSE

The purpose of this procedure is to minimize distortion and provide dimensional stability on LIGO stainless steel vacuum vessels with critical tolerances.

2.0 GENERAL

This procedure is applicable to BSC lower vessel and the HAM main assembly only. Stress relieving operations shall be performed at the points in fabrication cycle as described in the vessel fabrication procedure.

3.0 RESPONSIBILITY

This procedure is applicable to the fabricator and its personnel.

4.0 PROCEDURE

4.1 Steam clean vessel to remove any hydrocarbons. Use straight steam without any detergent.

4.2 The temperature of the vessel shall be measured and recorded throughout the stress relieving process .using a type K thermocouple mounted to the external surface of the vessel.

4.3 Furnace shal be natural fired and is to be adjusted so the that atmosphere shall run lean with an excess O_2 content in the flue gas of at least 5%. Documentation of the furnace atmosphere shall be provided.

4.4 The vessel shall be protected from direct impingement of the furnace flames.

4.5 Heat the vessel at the rate of 100 F/ hour above 350F up to 1000F+/- 50F. Hold for four hours. Cool at a rate of 100F/hour to 300F before removing from furnace.

Number

Rev.

SPECIFICATION

Number A 049-2-046 Rev. Ø

Title: SPECIFICATION FOR COMPONENT SHOP CONDITIONING/TEST PLAN

SPECIFICATION FOR COMPONENT SHOP CONDITIONING / TEST PLAN
FOR LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PROCESS ENGINEER	R. Thew
PROJECT ENGINEER	S. Matson
QUALITY ASSURANCE	Alan L Bradbrook
TECHNICAL DIRECTOR	D A McWilliams
PROJECT MANAGER	Richard Bagley

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	GS 10/10/96		Release for Fab Per DEO #0302
Φ	SM 5/3/96	RES 5/3/96	INITIAL RELEASE DEO 0166 FOR FDR

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED SM	DATE 5/3/96	Approved RES DATE 5/3/96	Number: A V049-2-047 Rev. 0

1.0 PURPOSE

This specification outlines the basic sequence of vacuum equipment conditioning processes and test procedures that will be used during the manufacturing cycle for all vacuum vessels and components.These vessels and components include BSC's ,HAM's,80KCryopumps, Adapters,Spools,and Bellows.

2.0 GENERAL

Reference will be made to specifications covering cleaning,bakeout,leak checking,RGA ,dimensional inspection and shipping.A flow diagram is included as part of this specification.

3.0 RESPONSIBILITY

The procedures referenced in this plan will be performed at PSI upon completion of the fabrication of the component.Fabrication will be done either by PSI or subcontractor.

4.0 PROCEDURE

Reference Attachment "A", Conditioning / Test Plan Flow Diagram.
The following is a description of each step shown on the Flow Diagram;

100-110

Fabrication of the vessel or component is complete.Final dimensions and tolerences have been checked and certified in accordance with PSI specification V049-2-121,latest revision.
The vessel or component is completely assembled and has been steam cleaned during the fabrication cycle.The component is now ready for evacuation and initial leak checking.The purpose of the initial leak check is to find and repair leaks in the welded joints and CF (metal gasket) flanged joints before final cleaning and baking.

110-120-130
Refer to PSI specification V049-2-014,latest revision. for leak checking catagories I,II,III joints.The joint catagories are defined as follows:

Category I
Welded joint located away from the double O-ring flange assembly .

Category II
Welded joint located near the double O-ring flange assembly .

Category III
CF flange joint.

Category IV
Atmospheric O-ring. (O-ring between atmosphere and annulus channel.)

Category V
UHV O-ring. (O-ring between annulus channel and UHV chamber.)

After successful completion of the initial leak check of catagory I,II,III joints,the component is ready for full cleaning.

130-200
Refer to PSI specification V049-2-015,latest revision,for the cleaning procedure.
After full cleaning,the component is reassembled and prepared for final leak checking.

200-220
Refer to PSI specification V049-2-014,latest revision. for final leak checking procedures.Final leak checking includes joint catagories I,II,III,IV,V. After successful completion of the final leak check of catagory I,II,III,IV,V joints,the component is ready for a pre-baked RGA scan.

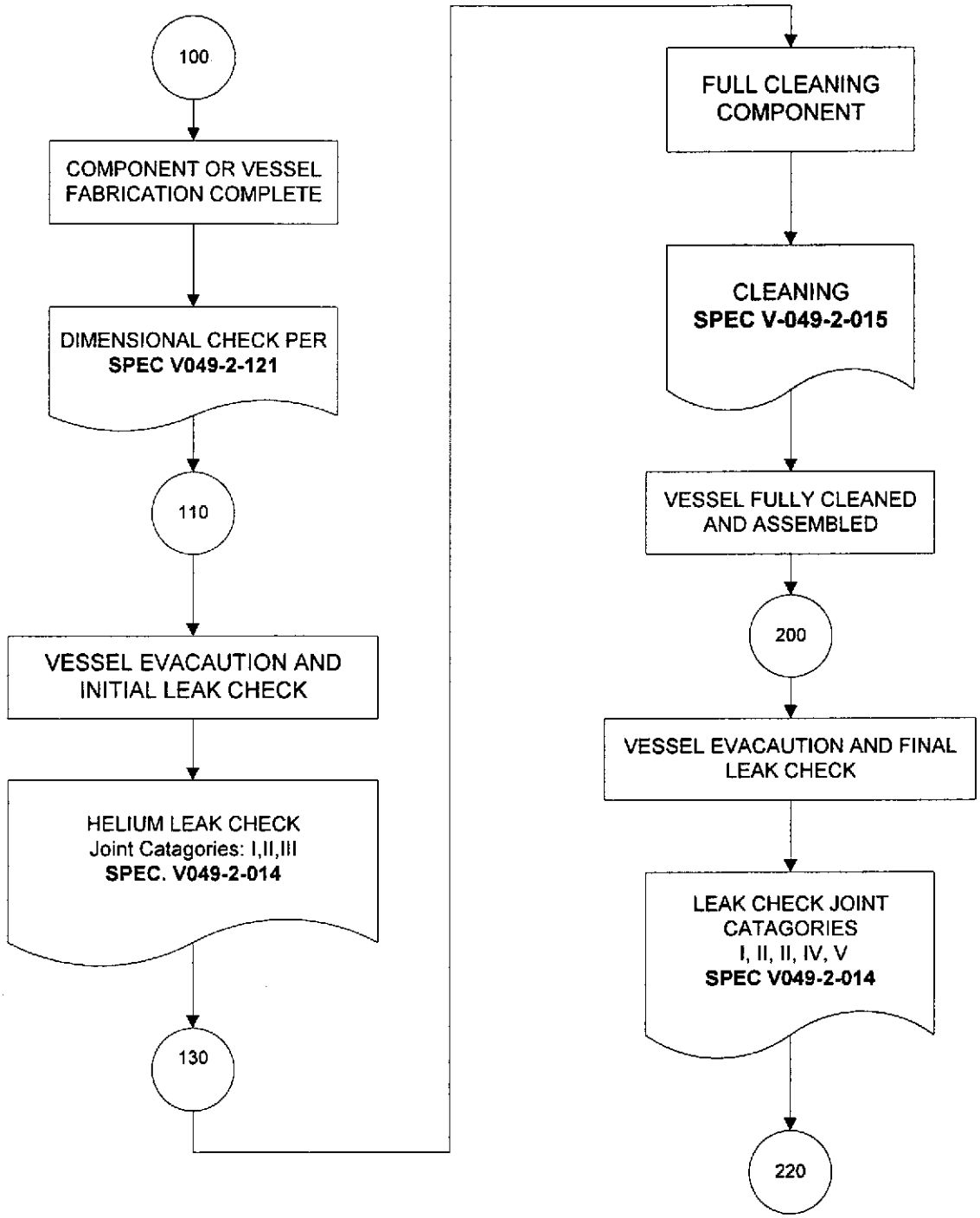
220-240
Refer to PSI specification V049-2-127,latest revision,for component RGA test procedure.
The purpose of the pre-baked RGA scan is to verify that the component is ready for bakeout and final testing.Any problems identified at this time will be corrected before bakeout is allowed.After the RGA scan is completed, the component is prepared for bakeout.

240-250
Refer to PSI specification V049-2-019,latest revision, for bakeout procedure.After bakeout,the component is prepared for final RGA testing.

250-260
Refer to PSI specification V049-2-127,latest revision,for component RGA test procedure.The final RGA test will certify that the component's vacuum performance is acceptable for installation.

260-280
A final test report is prepared and the component documentation package is assembled. The component is prepared for transport to the installation site.Refer to PSI specification V049-2-123,latest revision, for packaging,handling and shipping procedures.

ATTACHMENT A: CONDITIONING / TEST FLOW DIAGRAM, PAGE -1

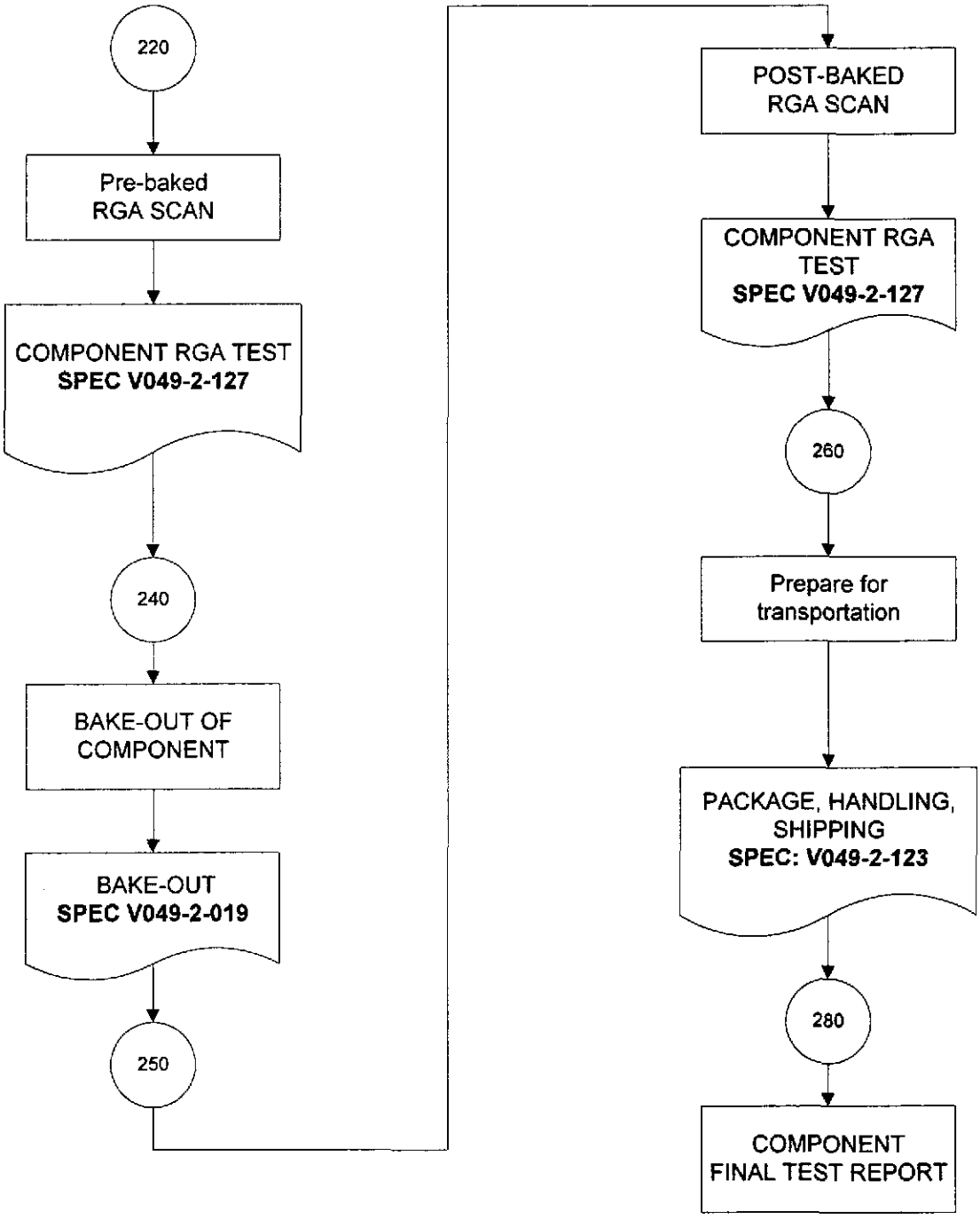


SPECIFICATION		
Number: V049-2-047 A		Rev.0

FDR VOLUME III

ATTACHMENTS	*DOCUMENT NO.*	*REVISION*
Leak Testing Procedure	V049-2-014	1
Cleaning Procedures	V049-2-015	1
Component Bakeout Procedure	V049-2-019	0
Project Safety Plan	V049-2-023	1
Project Q.A. Plan	V049-2-029	1
Stress Relief Procedure (304 S.S.)	V049-2-046	0
Component Shop Conditioning/Test Plan	V049-2-047	0
Weld Procedures	V049-2-070	0
	V049-2-071	2
	V049-2-072	2
	V049-2-073	0
Weld Data Specifications	V049-2-084	2
Cleanliness Testing Procedure	V049-2-118	0
Contamination Control Plan	V049-2-119	1
Raw Material Handling Procedure	V049-2-120	0
Dimensional Verification Procedure	V049-2-121	0
Viton O-Ring Bakeout Procedure	V049-2-122	0
Component Packaging, Handling and Shipping Procedure	V049-2-123	0
Control of Non-Conformance	V049-2-124	0
Material Control Procedure	V049-2-125	0
Component RGA Test Procedure	V049-2-127	0
Visual Inspection Procedure	V049-2-128	1
Black Light Inspection Procedure	V049-2-130	0
Conflat Flange Assembly Procedure	V049-2-168	0
O-Ring Installation and Flange Assembly Procedure	V049-2-169	0

ATTACHMENT A: CONDITIONING / TEST FLOW DIAGRAM PAGE-2



LIGO- V049-2-070 Rev B

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
WELDING PROCEDURE SPECIFICATION (WPS)

WPS No.: 150 Date: 02/08/96 Date: 04/23/96
Supporting PQRs: 150 H48

BASE METAL (QW-403, QW-405)	JOINT (QW-402)
P No. 8 to P No.:8	Joint design Groove/Fillet(see pg 2)
Thickness range. 0.1875" to 1.0000"	Backing..... With or without backing
Position(s).All positions	Backing Matl Optional
Progression.Vertical Up	Fillet Weld Size All (QW-451.4)
notes	notes

PREHEAT (QW-406)	POSTWELD HEAT TREATMENT (QW-407)
Minimum Temperature. 60 Degrees F.	Temperature range None
Interpass Temp. Max. 350 Degrees F.	Time range None
Preheat Maintenance. None	notes

	All pass(es)	None
Process / type	PAW / manual	
Process thickness limit.	0.1875" to 1.0000"	None
GAS (QW-408)		
Shielding Gas / CFH.....	75% Argon, 25% He./ 20-30	None / -
Trailing Gas / CFH.....	None / -	None / -
Backing Gas / CFH.....	100% Argon / 9-24	None / -
Plasma Gas / CFH.....	100% Argon / 1-3	None / -
FILLER METAL (QW-404)		
AWS classification.....	ER308L	None
SFA Spec. No. & F No....	SFA#: 5.9 F#: 6	SFA#: None F#: -
A No. or Chem. Comp.....	8	None
Filler metal trade name.	SOLID FILLER METAL	None
SAW flux trade name/type	N/A / -	None / -
Elec./Wire size (in) ...	1/16 | 3/32 | 1/8	- | - | -
ELECTRICAL (QW-409)		
Welding amperage range..	30-100 | 75-160 | 100-200	- | - | -
Welding voltage range...	12-18 | 14-21 | 16-26	- | - | -
Travel speed (ipm).....	Var. | Var. | Var	- | - | -
Max. Heat Input (J/in)..	None	None
Tungsten Type/Size.....	EWTh-2 / 1/16" - 3/16"	N/A / -
Current & Polarity.....	DCEN (straight)	N/A
TECHNIQUE (QW-410)		
String / weave bead.....	String & Weave Bead	N/A
Orifice / gas cup.....	3/8" to 5/8"	None
Contact tube to work....	N/A	None
Oscillation.....	Transverse	None
Mult./Single electrode..	Single Electrode	N/A
Other Technique Notes...	Keyhole & Melt-in used	None

Multiple or Single Pass (per side).... Multiple Passes
(n1)No Pass > 1/2" t
(n2)No supplementary filler metal will be used with this procedure.
(n3)
(n4) WELD WIRE SHALL BE CLEANED SPECIAL AND HANDLED WITH POLY GLOVES.
(n5) GRINDING WITH ABRASIVE WHEELS IS "NOT ALLOWED.
(n6) WIRE BRUSHING IS "NOT ALLOWED".
(n7) DEFECT REMOVAL MUST BE ACCOMPLISHED WITH A CARBIDE BURR CUTTER.

WPS No.: 150 Date: 02/08/96 Revision No.: 1 Date: 04/23/96

JOINT (QW-402)

Single-V groove Backing : no backing Root Opening: .125-.1875 max. Groove Angle: 50 degree min. Root Face : .030-.060 max.	**Single-Bevel groove** Backing : no backing Root Opening: .125-.1875 max. Groove Angle: 45 degree min. Root Face : .030-060 max.
Single-V groove Backing : gouged & back welded Root Opening: .125-.1875 max. Groove Angle: 50 degree min. Root Face : .030-.060 max.	**Double-Bevel groove** Backing : gouged & back welded Root Opening: .125-.1875 max. Groove Angle: 45 degree min. Root Face : .030-.060 max.
Double-V groove Backing : gouged & back welded Root Opening: .125-.1875 max. Groove Angle: 45 degree min. Root Face : .030-.060 max.	**Single/Double Fillet** Backing : Root Opening: 1/32" max. Weld Size : Required fillet plus root opening
Square groove Backing : T-joint Root Opening: 1/32" max.	**Square groove** Backing : no backing Root Opening: 3/32" max.

WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL OF THOSE FOUND ON THE JOB. WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR DESIGN DRAWING SHALL TAKE PREFERENCE OVER WELD JOINTS SHOWN IN THIS WPS.

Initial cleaning shall be in strict compliance with special job procedures. Method of back gouging must be accomplished with a carbide burr cutter.

(a) NON-FUSABLE RETAINERS MAY BE USED.

(b) WELD WIRE SHALL BE CLEANED SPECIAL IN ACCORDANCE WITH SPECIFIC JOB PROCEDURES. SEALED IN BAGS AND HANDLED WITH POLY GLOVES AT ALL TIMES.

(c) GRINDING AND WIRE BRUSHING ARE "NOT ALLOWED" ON THE LIGO JOB. DEFECT REMOVAL MUST BE ACCOMPLISHED WITH A CARBIDE BURR CUTTER.

(d) WELDING STARTS & STOPS MUST RAMP GRADUALLY UP & DOWN TO AVOID CRACKING. THE WELDER SHALL PROVIDE A POST (AFTER FLOW) GAS FLOW OF 10 SECONDS.

(e)

We certify that the statements in this record are correct and in accordance with the requirements of Sections IX and VIII of the ASME Code.

Prepared By: A Rollins (04/23/96) Weld Specialist

Accepted By: Alan Bunbook (04/23/96) QA Manager:

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
Procedure Qualification Record (PQR)

PQR No.: 150 H48 Date: 2/ 8/96 WPS No.: 150 Rev 2

JOINT DESIGN (QW-402)
WELD JOINT CONFIGURATION
Single-V groove
Gas backing was used
Groove Angle : 75 Degrees
Root Opening : 0-125" Inches
Root Face : 030-062" Inches

note:

BASE METAL (QW-403)
Material form. Plate
Material Spec. SA-240, Type 304L
To ..... SA-240, Type 304L
P No. 8 Gr. 1 to P No. 8 Gr. 1
Thickness (in) 0.5000

HEAT TREATMENT (QW-406, QW-407)
Preheat Temperature: 60 Degrees F.
Preheat Maintenance: None
Interpass Temperature: 350 Degrees F.
PWHT temperature ... : None Degrees F.
PWHT Holding time(hr): None
note:

POSITION (QW-405)
Position of Joint : 1G - Flat
Progression: N/A
note:

	All pass(es)			None				
Weld Process / type	PAW / manual							
GAS (QW-408)								
Shielding Gas / CFH.....	75% Argon, 25% He./ 20-30			None / -				
Trailing Gas / CFH.....	None / -			None / -				
Backing Gas / CFH.....	100% Argon / 10-20			None / -				
Plasma Gas / CFH.....	100% Argon / 1-3			None / -				
FILLER METAL (QW-404)								
AWS Classification.....	ER308L			None				
SFA Spec. No. & F No....	SFA#: 5.9		F#: 6	SFA#: None		F#: -		
A No. or Chem. Comp.....	8			None				
Filler Metal Trade Name.	SOLID FILLER METAL							
SAW Flux Trade Name/Type	N/A / -			None / -				
Weld Deposit 't' (in)...	0.5000			None				
Elec./Wire Size (in)....	1/16	3/32	1/8	-	-	-		
ELECTRICAL (QW-409)								
Amperage USED	30-100	75-160	100-200	-	-	-		
Voltage USED	12-18	14-20	16-26	-	-	-		
Travel Speed (ipm).....	Var.	Var	Var	-	-	-		
Max. Heat Input (J/in)..	None			None				
Tungsten Type & Size....	EWTh-2 / 3/32" - 3/16"			N/A / -				
Current Type/Polarity...	DCEN (straight)			N/A				
TECHNIQUE (QW-410)								
String or Weave Bead....	String & Weave Bead			N/A				
Orifice/Gas Cup Size....	1/2" - 5/8"			None				
Contact Tube to Work....	N/A			None				
Oscillation.....	Transverse			None				
Mult./Single Electrodes.	Single Electrode			N/A				
Other Technique Notes...	Keyhole & Melt-in used			None				

Multiple or Single Pass (per side).... Multiple Passes

(n1) No supplementary filler metal will be used with this procedure.
(n2)
(n3)
(n4)
(n5)

Procedure Qualification Record (PQR)

PQR No.: 150 H48

TENSILE TEST (QW-150)

Specimen No.	Width (in.)	Thick. (in.)	Area (sq.in.)	Ultimate total load (lb)	Ultimate stress (psi)	Type of failure and location
1	0.748	0.497	0.372	33550	90200	Weld metal
2	0.750	0.505	0.379	34350	90600	Weld metal

GUIDED BEND TEST (QW-160)

Figure No. and Type	Result	Figure No. and Type	Result
QW-462.2 Side bend	No defects	QW-462.2 Side bend	No defects
QW-462.2 Side bend	No defects	QW-462.2 Side bend	No defects

TOUGHNESS TEST (QW-170)

Spec. No.	Notch Location	Notch Type	Test Temp. (F)	Impact Values (ft-lbs)	Lateral exp.		Drop weight break
					Shear %	Mils	
None							

HARDNESS TEST - No hardness test

Base metal	-1-	-2-	-3-	HAZ	-1-	-2-	-3-	WM	-1	-2-	-3-

(Heat Affected Zone=HAZ, Weld Metal=WM)

Notes:

Stamp: H48 Welder's Name: Kennedy, Dan ID:
Tests conducted by: CONAM INSPECTION INC. Laboratory Test No: 14082
PQR was done & welding of coupon was witnessed by : Process Systems

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

Prepared By: A Rollar (2/ 8/96) Weld Specialist

Certified By: Alan R Bardsley (2/ 8/96) QA Manager:

LIGO V049-2-07/Rev 2

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
WELDING PROCEDURE SPECIFICATION (WPS)

WPS No.: 151-1 Date: 05/06/96 REVISED NO.: 0
Supporting PQRs: 151-1-H48

BASE METAL (QW-403, QW-405)	JOINT (QW-402)
P No. 8 to P No.:8	Joint design Groove/Fillet(see pg 2)
Thickness range. 0.1875" to 1.0000"	Backing..... With or without backing
Position(s).All positions	Backing Matl Optional
Progression.Vertical Up	Fillet Weld Size All (QW-451.4)
notes	notes

PREHEAT (QW-406)	POSTWELD HEAT TREATMENT (QW-407)
Minimum Temperature. 60 Degrees F.	Temperature range 1000 DEG.F.
Interpass Temp. Max. 350 Degrees F.	Time range 4.00
Preheat Maintenance. None	notes

	All pass(es)	None
Process / type	PAW / manual	
Process thickness limit.	0.1875" to 1.0000"	None
GAS (QW-408)		
Shielding Gas / CFH.....	75% Argon, 25% He./ 20-30	None / -
Trailing Gas / CFH.....	None / -	None / -
Backing Gas / CFH.....	100% Argon / 9-24	None / -
Plasma Gas / CFH.....	100% Argon / 1-3	None / -
FILLER METAL (QW-404)		
AWS classification.....	ER308L	None
SFA Spec. No. & F No....	SFA#: 5.9 F#: 6	SFA#: None F#: -
A No. or Chem. Comp.....	8	None
Filler metal trade name.	SOLID FILLER METAL	None
SAW flux trade name/type	N/A / -	None / -
Elec./Wire size (in) ...	1/16 | 3/32 | 1/8	- | - | -
ELECTRICAL (QW-409)		
Welding amperage range..	30-100 | 75-160 | 100-200	- | - | -
Welding voltage range...	12-18 | 14-21 | 16-26	- | - | -
Travel speed (ipm).....	Var. | Var. | Var	- | - | -
Max. Heat Input (J/in)..	None	None
Tungsten Type/Size.....	EWTh-2 / 1/16"-3/16"	N/A / -
Current & Polarity.....	DCEN (straight)	N/A
TECHNIQUE (QW-410)		
String / weave bead.....	String & Weave Bead	N/A
Orifice / gas cup.....	3/8" to 5/8"	None
Contact tube to work....	N/A	None
Oscillation.....	Transverse	None
Mult./Single electrode..	Single Electrode	N/A
Other Technique Notes...	Keyhole & Melt-in used	None

Multiple or Single Pass (per side).... Multiple Passes

(n1)No pass > 1/2 " t.
(n2)No supplementary filler will be used with this procedure.
(n3)WELD WIRE SHALL BE CLEANED SPECIAL AND HANDLED WITH POLY GLOVES.
(n4)GRINDING WITH ABRASIVE WHEELS IS "NOT ALLOWED".
(n5)WIRE BRUSHING IS "NOT ALLOWED".
(n6)PWHT RAMP UP TO 300 DEG.F.THEN 100 DEG.F./HR.UP TO 1000 DEG.F.
(n7)PWHT RAMP DOWN AT 100 DEG.F./HR.TO 300 DEG.F.AND COOL IN STILL AIR.

WPS No.: 151-1 Date: 05/06/96 Revision No.: 0

JOINT (QW-402)

Single-V groove
Backing : no backing
Root Opening: 3/16" max.
Groove Angle: 50 degree min.
Root Face : 1/8" max.

Single-Bevel groove
Backing : no backing
Root Opening: 3/16" max.
Groove Angle: 45 degree min.
Root Face : 1/8" max.

Single-V groove
Backing : gouged & back welded
Root Opening: 1/4" max.
Groove Angle: 50 degree min.
Root Face : 3/16" max.

Double-Bevel groove
Backing : gouged & back welded
Root Opening: 1/4" max.
Groove Angle: 45 degree min.
Root Face : 3/16" max.

Double-V groove
Backing : gouged & back welded
Root Opening: 1/4" max.
Groove Angle: 45 degree min.
Root Face : 3/16" max.

Single/Double Fillet
Backing :
Root Opening: 3/16" max.
Weld Size : Required fillet plus root opening

Square groove
Backing : T-joint
Root Opening: 1/32" max.

Square groove
Backing : no backing
Root Opening: 3/32" max.

WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL OF THOSE FOUND ON A JOB. WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR DESIGN DRAWING SHALL TAKE PRECEDENCE OVER WELD JOINTS SHOWN IN THIS WPS.

Initial cleaning shall be in strict compliance with special job procedures. Method of back gouging must be accomplished with a carbide burr cutter.

(a) NON-FUSABLE RETAINERS MAY BE USED.

(b) WELD WIRE SHALL BE CLEANED SPECIAL IN ACCORDANCE WITH SPECIFIC JOB PROCEDURES. SEALED IN BAGS AND HANDLED WITH POLY GLOVES AT ALL TIMES.

(c) GRINDING AND WIRE BRUSHING ARE "NOT ALLOWED" ON THE LIGO JOB. DEFECT REMOVAL MUST BE ACCOMPLISHED WITH A CARBIDE BURR CUTTER.

(d) WELDING STARTS & STOPS MUST RAMP GRADUALLY UP & DOWN TO AVOID CRACKING. THE WELDER SHALL PROVIDE A POST (AFTER FLOW) GAS FLOW OF 10 SECONDS.

(e)

We certify that the statements in this record are correct and in accordance with the requirements of Sections IX and VIII of the ASME Code.

Prepared By: C Rollins (05/06/96) Weld Specialist

Accepted By: Allen L Bradford (05/06/96) Q.A.Manager:

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
Procedure Qualification Record (PQR)

PQR No.: 151-1-H48 Date: 05/06/96 WPS No.: 151-1

JOINT DESIGN (QW-402) WELD JOINT CONFIGURATION Single-V groove Gas backing was used Groove Angle : 75 Degrees Root Opening : 062-125 Inches Root Face : 030-062 Inches note:	BASE METAL (QW-403) Material form. Plate Material Spec. SA-240, Type 304L To ..... SA-240, Type 304L P No. 8 Gr. 1 to P No. 8 Gr. 1 Thickness (in) 0.5000 HEAT TREATMENT (QW-406, QW-407) Preheat Temperature: 60 Degrees F. Preheat Maintenance: None Interpass Temperature: 350 Degrees F. PWHT temperature ... : 1000 Degrees F. PWHT Holding time(hr): 4.00 note: +/- 50 DEG. F.
POSITION (QW-405) Position of Joint : 1G - Flat Progression: N/A note:	

	All pass(es)			None				
Weld Process / type	PAW / manual							
GAS (QW-408)								
Shielding Gas / CFH.....	75% Argon, 25% He./ 20-30			None / -				
Trailing Gas / CFH.....	None / -			None / -				
Backing Gas / CFH.....	100% Argon / 10-20			None / -				
Plasma Gas / CFH.....	100% Argon / 1-3			None / -				
FILLER METAL (QW-404)								
AWS Classification.....	ER308L			None				
SFA Spec. No. & F No....	SFA#: 5.9 F#: 6			SFA#: None F#: -				
A No. or Chem. Comp.....	8			None				
Filler Metal Trade Name.	SOLID FILLER METAL			None				
SAW Flux Trade Name/Type	N/A / -			None / -				
Weld Deposit 't' (in)...	0.5000			None				
Elec./Wire Size (in)....	1/16	3/32	1/8	-	-	-		
ELECTRICAL (QW-409)								
Amperage USED	30-100	75-160	100-200	-	-	-		
Voltage USED	12-18	14-20	16-26	-	-	-		
Travel Speed (ipm).....	Var.	Var	Var	-	-	-		
Max. Heat Input (J/in)..	None			None				
Tungsten Type & Size....	EWTh-2 / 3/32"-3/16"			N/A / -				
Current Type/Polarity...	DCEN (straight)			N/A				
TECHNIQUE (QW-410)								
String or Weave Bead....	String & Weave Bead			N/A				
Orifice/Gas Cup Size....	1/2"-5/8"			None				
Contact Tube to Work....	N/A			None				
Oscillation.....	Transverse			None				
Mult./Single Electrodes.	Single Electrode			N/A				
Other Technique Notes...	Keyhole & Melt-in used			None				

Multiple or Single Pass (per side).... Multiple Passes

(n1) Peening was not used with this weld test.
(n2) No supplementary filler will be used with this procedure.
(n3)
(n4) PWHT Ramp up to 300 Deg.F. then 100 Deg.F./Hr.up to 1000 Deg.F.
(n5) PWHT Ramp down at 100 Deg.F./Hr. to 300 Deg.F.and cool in still air.

PQR No.: 151-1-H48

Procedure Qualification Record (PQR)

TENSILE TEST (QW-150)

Specimen No.	Width (in.)	Thick. (in.)	Area (sq.in.)	Ultimate total load (lb)	Ultimate stress (psi)	Type of failure and location
1	0.745	0.513	0.382	34850	91200	Weld metal
2	0.745	0.505	0.376	34200	91000	Base metal

GUIDED BEND TEST (QW-160)

Figure No. and Type	Result	Figure No. and Type	Result
QW-462.2 Side bend	No defects	QW-462.2 Side bend	No defects
QW-462.2 Side bend	No defects	QW-462.2 Side bend	No defects

TOUGHNESS TEST (QW-170)

Spec. No.	Notch Location	Notch Type	Test Temp. (F)	Impact Values (ft-lbs)	Lateral exp. Shear %	Lateral exp. Mils	Drop weight break
None							

HARDNESS TEST - No hardness test

Base metal	-1-	-2-	-3-	HAZ	-1-	-2-	-3-	WM	-1	-2-	-3-

(Heat Affected Zone=HAZ, Weld Metal=WM)

Notes:

Stamp: H48 Welder's Name: Kennedy, Dan ID:
Tests conducted by: CONAM INSPECTION INC. Laboratory Test No: 14215
PQR was done & welding of coupon was witnessed by : Process Systems

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

Prepared By: _____ (05/06/96) Weld Specialist

Certified By: _____ (05/06/96) Q.A.Manager:

LIGO- V049-2-072
Rev. 2

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
WELDING PROCEDURE SPECIFICATION (WPS)

WPS No.: 153-1 Date: 10/28/96
Supporting PQRs: 153-1-H48

BASE METAL (QW-403, QW-405)	JOINT (QW-402)
P No. 8 to P No.:8	Joint design Groove/Fillet(see pg 2)
Thickness range. 0.1875" to 1.0000"	Backing..... With or without backing
Position(s).All positions	Backing Matl Optional
Progression.Vertical Up	Fillet Weld Size All (QW-451.4)
notes	notes

PREHEAT (QW-406)	POSTWELD HEAT TREATMENT (QW-407)
Minimum Temperature. 60 Degrees F.	Temperature range 1000
Interpass Temp. Max. 350 Degrees F.	Time range 4.0
Preheat Maintenance. None	notes Stress Relief 1000F.+/-50 F.

	All pass(es)	None
Process / type	GTAW / manual	
Process thickness limit.	0.1875" to 1.0000"	None
GAS (QW-408)		
Shielding Gas / CFH.....	100% Argon / 18-36	None / -
Trailing Gas / CFH.....	None / -	None / -
Backing Gas / CFH.....	100% Argon / 9-24	None / -
FILLER METAL (QW-404)		
AWS classification.....	ER308L	None
SFA Spec. No. & F No....	SFA#: 5.9 F#: 6	SFA#: None F#: -
A No. or Chem. Comp.....	8	None
Filler metal trade name.	SOLID FILLER METAL	None
SAW flux trade name/type	N/A / -	None / -
Elec./Wire size (in) ...	1/16 | 3/32 | 1/8	- | - | -
ELECTRICAL (QW-409)		
Welding amperage range..	70-150 | 80-180 | 130-275	- | - | -
Welding voltage range...	n/r | n/r | n/r	- | - | -
Travel speed (ipm).....	Var. | Var. | Var.	- | - | -
Max. Heat Input (J/in)..	None	None
Tungsten Type/Size.....	EWTh-2 / 1/16" - 3/16"	N/A / -
Current & Polarity.....	DCEN (straight)	N/A
TECHNIQUE (QW-410)		
String / weave bead.....	String & Weave Bead	N/A
Orifice / gas cup.....	# 5 to # 10	None
Contact tube to work....	N/A	None
Oscillation.....	N/A	None
Mult./Single electrode..	Single Electrode	N/A
Other Technique Notes...		None

Multiple or Single Pass (per side).... Multiple Passes
(n1) No peening done with this procedure.
(n2)No pass > 1/2 " t.
(n3)WELD WIRE SHALL BE CLEANED SPECIAL AND HANDLED WITH POLY GLOVES.
(n4)GRINDING WITH ABRASIVE WHEELS IS "NOT ALLOWED".
(n5)WIRE BRUSHING IS "NOT ALLOWED".
(n6)PWHT RAMP UP TO 300 DEG.F.THEN 100 DEG.F/HR TO 1000 DEG.F,HOLD FOR 4 HR.
(n7)PWHT RAMP DOWN FROM 1000F.TO 300F. @100F/HR. THEN COOL TO ROOM TEMP.

WPS No.: 153-1 Date: 10/28/96 Revis.

JOINT (QW-402)

Single-V groove
Backing : no backing
Root Opening: 3/16" max.
Groove Angle: 50 degree min.
Root Face : 1/8" max.

Single-Bevel groove
Backing : no backing
Root Opening: 3/16" max.
Groove Angle: 45 degree min.
Root Face : 1/8" max.

Single-V groove
Backing : gouged & back welded
Root Opening: 1/4" max.
Groove Angle: 50 degree min.
Root Face : 3/16" max.

Double-Bevel groove
Backing : gouged & back welded
Root Opening: 1/4" max.
Groove Angle: 45 degree min.
Root Face : 3/16" max.

Double-V groove
Backing : gouged & back welded
Root Opening: 1/4" max.
Groove Angle: 45 degree min.
Root Face : 3/16" max.

Single/Double Fillet
Backing :
Root Opening: 3/16" max.
Weld Size : Required fillet plus root opening

Square groove
Backing : T-joint
Root Opening: 1/32" max.

Square groove
Backing : no backing
Root Opening: 3/32" max.

WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL OF THOSE FOUND ON A JOB. WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR DESIGN DRAWING SHALL TAKE PRECEDENCE OVER WELD JOINTS SHOWN IN THIS WPS.

Initial cleaning shall be in strict compliance with special job procedures. Method of back gouging must be accomplished with a carbide burr cutter.

(a) NON-FUSABLE RETAINERS MAY BE USED.

(b) WELD WIRE SHALL BE CLEANED SPECIAL IN ACCORDANCE WITH SPECIFIC JOB PROCEDURES. SEALED IN BAGS AND HANDLED WITH POLY GLOVES AT ALL TIMES.

(c) GRINDING AND WIRE BRUSHING ARE "NOT ALLOWED" ON THE LIGO JOB. DEFECT REMOVAL MUST BE ACCOMPLISHED WITH A CARBIDE BURR CUTTER.

(d) WELDING STARTS & STOPS MUST RAMP GRADUALLY UP & DOWN TO AVOID CRACKING. THE WELDER SHALL PROVIDE A POST (AFTER FLOW) GAS FLOW OF 10 SECONDS.

(e)

We certify that the statements in this record are correct and in accordance with the requirements of Sections IX and VIII of the ASME Code.

Prepared By: Howard Klee (10/28/96) Weld Specialist

Accepted By: Alan R Bradbrook (10/28/96) Q.A.Manager:

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
Procedure Qualification Record (PQR)

PQR No.: 153-1-H48 Date: 10/28/96 WPS No.: 153-1 Rev 0

JOINT DESIGN (QW-402) WELD JOINT CONFIGURATION Single-V groove Gas backing was used Groove Angle : 75 Degrees Root Opening : 062-125 Inches Root Face : 030-062 Inches note:	BASE METAL (QW-403) Material form. Plate Material Spec. SA-240, Type 304L To ..... SA-240, Type 304L P No. 8 Gr. 1 to P No. 8 Gr. 1 Thickness (in) 0.5000
POSITION (QW-405) Position of Joint : 1G - Flat Progression: N/A note:	HEAT TREATMENT (QW-406, QW-407) Preheat Temperature: 60 Degrees F. Preheat Maintenance: None Interpass Temperature: 350 Degrees F. PWHT temperature ... : 1000 Degrees F. PWHT Holding time(hr): 4.00 note: Stress Relief 1000 Deg.F.+/-50 F.

	All pass(es)	None
Weld Process / type	GTAW / manual	
GAS (QW-408)		
Shielding Gas / CFH.....	100% Argon / 20-30	None / -
Trailing Gas / CFH.....	None / -	None / -
Backing Gas / CFH.....	100% Argon / 10-20	None / -
FILLER METAL (QW-404)		
AWS Classification.....	ER308L	None
SFA Spec. No. & F No....	SFA#: 5.9 F#: 6	SFA#: None F#: -
A No. or Chem. Comp.....	8	None
Filler Metal Trade Name.	SOLID FILLER METAL	None
SAW Flux Trade Name/Type	N/A / -	None / -
Weld Deposit 't' (in)...	0.5000	None
Elec./Wire Size (in)....	1/16" | 3/32" | 1/8"	- | - | -
ELECTRICAL (QW-409)		
Amperage USED	70-150 | 80-180 | 130-275	- | - | -
Voltage USED	n/r | n/r | n/r	- | - | -
Travel Speed (ipm).....	Var. | Var | Var	- | - | -
Max. Heat Input (J/in)..	None	None
Tungsten Type & Size....	EWTh-2 / 3/32"-1/8"	N/A / -
Current Type/Polarity...	DCEN (straight)	N/A
TECHNIQUE (QW-410)		
String or Weave Bead....	String & Weave Bead	N/A
Orifice/Gas Cup Size....	# 8	None
Contact Tube to Work....	N/A	None
Oscillation.....	N/A	None
Mult./Single Electrodes.	Single Electrode	N/A
Other Technique Notes...		None

Multiple or Single Pass (per side).... Multiple Passes

(n1) Peening was not used with this weld test.
(n2) No pass > 1/2 " t.
(n3) PWHT Ramp up to 300 Deg.F then 100 Deg.F/Hr to 1000 Deg.F,Hold for 4 Hr.
(n4) PWHT Ramp down from 1000F.to 300F. @100F/Hr. then cool to room temp.
(n5)

Procedure Qualification Record (PQR)

PQR No.: 153-1-H48

TENSILE TEST (QW-150)

Specimen No.	Width (in.)	Thick. (in.)	Area (sq.in.)	Ultimate total load (lb)	Ultimate stress (psi)	Type of failure and location
1	0.750	0.515	0.386	35850	92900	Base metal
2	0.750	0.515	0.386	36000	93300	Base metal

GUIDED BEND TEST (QW-160)

Figure No. and Type	Result	Figure No. and Type	Result
QW-462.2 Side bend	No defects	QW-462.2 Side bend	No defects
QW-462.2 Side bend	No defects	QW-462.2 Side bend	No defects

TOUGHNESS TEST (QW-170)

Spec. No.	Notch Location	Notch Type	Test Temp. (F)	Impact Values (ft-lbs)	Lateral exp. Shear %	Lateral exp. Mils	Drop weight break
None							

HARDNESS TEST - No hardness test

Base metal	-1-	-2-	-3-	HAZ	-1-	-2-	-3-	WM	-1	-2-	-3-

(Heat Affected Zone=HAZ, Weld Metal=WM)

Notes:

Stamp: H48 Welder's Name: Kennedy, Dan ID:
Tests conducted by: CONAM INSPECTION INC. Laboratory Test No: S06100-861
PQR was done & welding of coupon was witnessed by : Process Systems

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

Prepared By: Herbert Klee (10/28/96) Weld Specialist

Certified By: Alan R Bullock (10/28/96) Q.A.Manager:

LIGO - V049-2-073 Rev Ø

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
WELDING PROCEDURE SPECIFICATION (WPS)

WPS No.: 073-3 Date: 05/29/74 Revision No.: Date: 04/23/96
Supporting PQRs: 073-H9

BASE METAL (QW-403, QW-405)	JOINT (QW-402)
P No. 8 to P No.:8	Joint design Groove/Fillet(see pg 2)
Thickness range. 0.0625" to 0.7500"	Backing..... With or without backing
Position(s).All positions	Backing Matl Optional
Progression.Vertical Up	Fillet Weld Size All (QW-451.4)
notes	notes

PREHEAT (QW-406)	POSTWELD HEAT TREATMENT (QW-407)
Minimum Temperature. 50 Degrees F.	Temperature range None
Interpass Temp. Max. 350 Degrees F.	Time range None
Preheat Maintenance. None	notes

	All pass(es)	None
Process / type	GTAW / manual	
Process thickness limit.	0.0625" to 0.7500"	None
GAS (QW-408)		
Shielding Gas / CFH.....	100% Argon / 15-25	None / -
Trailing Gas / CFH.....	None / -	None / -
Backing Gas / CFH.....	100% Argon / 9-30	None / -
FILLER METAL (QW-404)		
AWS classification.....	ER308L	None
SFA Spec. No. & F No....	SFA#: 5.9 F#: 6	SFA#: None F#: -
A No. or Chem. Comp.....	8	None
Filler metal trade name.	SOLID FILLER METAL	None
SAW flux trade name/type	N/A / -	None / -
Elec./Wire size (in) ...	1/16 | 3/32 | 1/8	- | - | -
ELECTRICAL (QW-409)		
Welding amperage range..	70-150 | 80-180 | 130-275	- | - | -
Welding voltage range...	n/r | n/r | n/r	- | - | -
Travel speed (ipm).....	Var. | Var. | Var.	- | - | -
Max. Heat Input (J/in)..	None	None
Tungsten Type/Size.....	EWTh-2 / 1/16" - 3/16"	N/A / -
Current & Polarity.....	DCEN (straight)	N/A
TECHNIQUE (QW-410)		
String / weave bead.....	String & Weave Bead	N/A
Orifice / gas cup.....	# 5 to # 10	None
Contact tube to work....	N/A	None
Oscillation.....	N/A	None
Mult./Single electrode..	Single Electrode	N/A
Other Technique Notes...		None

Multiple or Single Pass (per side).... Multiple Passes
(n1)No Pass > 1/2" t
(n2)
(n3)WELD WIRE SHALL BE CLEANED SPECIAL AND HANDLED WITH POLY GLOVES.
(n4)GRINDING WITH ABRASIVE WHEELS IS "NOT ALLOWED".
(n5)WIRE BRUSHING IS "NOT ALLOWED".
(n6)
(n7)

WPS No.: 073-3 Date: 05/29/74 Revision No.: Date: 04/23/96

JOINT (QW-402)

Single-V groove
Backing : no backing
Root Opening: .125-.1875 max.
Groove Angle: 50 degree min.
Root Face : .030-.060 max.

Single-Bevel groove
Backing : no backing
Root Opening: .125-.1875 max.
Groove Angle: 45 degree min.
Root Face : .030-.060 max.

Single-V groove
Backing : gouged & back welded
Root Opening: .125-.1875 max.
Groove Angle: 50 degree min.
Root Face : .030-.060 max.

Double-Bevel groove
Backing : gouged & back welded
Root Opening: .125-.1875 max.
Groove Angle: 45 degree min.
Root Face : .030-.060 max.

Double-V groove
Backing : gouged & back welded
Root Opening: .125-.1875 max.
Groove Angle: 45 degree min.
Root Face : .030-.060 max.

Single/Double Fillet
Backing :
Root Opening: 1/32" max.
Weld Size : Required fillet plus root opening

Square groove
Backing : T-joint
Root Opening: 1/32" max.

Square groove
Backing : no backing
Root Opening: 3/32" max.

WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL OF THOSE FOUND ON THE JOB. WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR DESIGN DRAWING SHALL TAKE PREFERENCE OVER WELD JOINTS SHOWN IN THIS WPS.

Initial cleaning shall be in strict compliance with special job procedures. Method of back gouging must be accomplished with a carbide burr cutter.

(a) NON-FUSABLE RETAINERS MAY BE USED.

(b) WELD WIRE SHALL BE CLEANED SPECIAL IN ACCORDANCE WITH SPECIFIC JOB PROCEDURES. SEALED IN BAGS AND HANDLED WITH POLY GLOVES AT ALL TIMES.

(c) GRINDING AND WIRE BRUSHING ARE "NOT ALLOWED" ON THE LIGO JOB. DEFECT REMOVAL MUST BE ACCOMPLISHED WITH A CARBIDE BURR CUTTER.

(d) WELDING STARTS & STOPS MUST RAMP GRADUALLY UP & DOWN TO AVOID CRACKING. THE WELDER SHALL PROVIDE A POST (AFTER FLOW) GAS FLOW OF 10 SECONDS.

(e)

We certify that the statements in this record are correct and in accordance with the requirements of Sections IX and VIII of the ASME Code.

Prepared By: _____ (05/29/74) Weld Specialist

Accepted By: _____ (05/29/74) QA Manager:

Process Systems International, Inc.
20 Walkup Drive Westborough, MA 01581
Procedure Qualification Record (PQR)

PQR No.: 073-H9 Date: 05/29/74 WPS No.: 073-3

JOINT DESIGN (QW-402)
WELD JOINT CONFIGURATION
Single-V groove
Gas backing was used
Groove Angle : 75 Degrees
Root Opening : 062-125 Inches
Root Face : 030-062 Inches

note:

POSITION (QW-405)
Position of Joint : 6G - 45 Deg.
Progression:Vertical Up
note:

BASE METAL (QW-403)
Material form. Pipe / Tube
Material Spec. SA-312, Grade TP304L
To ..... SA-312, Grade TP304L
P No. 8 Gr. 1 to P No. 8 Gr. 1
Thickness (in) 0.3750 Dia.(in) 5.5630

HEAT TREATMENT (QW-406, QW-407)
Preheat Temperature: 50 Degrees F.
Preheat Maintenance: None
Interpass Temperature: 350 Degrees F.
PWHT temperature ... : None Degrees F.
PWHT Holding time(hr): None
note:

	All pass(es)			None				
Weld Process / type	GTAW / manual							
GAS (QW-408)								
Shielding Gas / CFH.....	100% Argon	/	17-20	None	/	-		
Trailing Gas / CFH.....	None	/	-	None	/	-		
Backing Gas / CFH.....	100% Argon	/	18	None	/	-		
FILLER METAL (QW-404)								
AWS Classification.....	ER308L			None				
SFA Spec. No. & F No....	SFA#: 5.9		F#: 6	SFA#: None		F#: -		
A No. or Chem. Comp.....	8			None				
Filler Metal Trade Name.	SOLID FILLER METAL			None				
SAW Flux Trade Name/Type	N/A	/	-	None	/	-		
Weld Deposit 't' (in)...	0.3750			None				
Elec./Wire Size (in)....	1/16"	-	-	-	-	-		
ELECTRICAL (QW-409)								
Amperage USED	110	-	-	-	-	-		
Voltage USED	14	-	-	-	-	-		
Travel Speed (ipm).....	5	-	-	-	-	-		
Max. Heat Input (J/in)..	None			None				
Tungsten Type & Size....	EWTh-2 /	3/32"		N/A /		-		
Current Type/Polarity...	DCEN (straight)			N/A				
TECHNIQUE (QW-410)								
String or Weave Bead....	String & Weave Bead			N/A				
Orifice/Gas Cup Size....	# 8			None				
Contact Tube to Work....	N/A			None				
Oscillation.....	N/A			None				
Mult./Single Electrodes.	Single Electrode			N/A				
Other Technique Notes...				None				

Multiple or Single Pass (per side).... Multiple Passes

(n1) Peening was not used with this weld test.
(n2) No pass > 3/16" t.
(n3)
(n4)
(n5)

Procedure Qualification Record (PQR)

PQR No.: 073-H9

TENSILE TEST (QW-150)

Specimen No.	Width (in.)	Thick. (in.)	Area (sq.in.)	Ultimate total load (lb)	Ultimate stress (psi)	Type of failure and location
1	0.750	0.300	0.225	19400	86200	Weld metal
2	0.753	0.302	0.227	20100	88500	Weld metal

GUIDED BEND TEST (QW-160)

Figure No. and Type	Result	Figure No. and Type	Result
QW-462.2 Side bend	Satisfactory	QW-462.2 Side bend	Satisfactory
QW-462.2 Side bend	Satisfactory	QW-462.2 Side bend	Satisfactory

TOUGHNESS TEST (QW-170)

Spec. No.	Notch Location	Notch Type	Test Temp. (F)	Impact Values (ft-lbs)	Lateral exp. Shear %	Lateral exp. Mils	Drop weight break
None							

HARDNESS TEST - No hardness test

Base metal	-1-	-2-	-3-	HAZ	-1-	-2-	-3-	WM	-1	-2-	-3-

(Heat Affected Zone=HAZ, Weld Metal=WM)

Notes:

Stamp: H9 Welder's Name: Anthony J. Rollas ID:
Tests conducted by: J.G.Sylvester Assoc.Inc. Laboratory Test No: 5944
PQR was done & welding of coupon was witnessed by : Process Systems

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

Prepared By: A Rollas (05/29/74) Weld Specialist

Certified By: Alan R Budbath (05/29/74) QA Manager:

Title: WELD DATA SHEET SPECIFICATIONS

WELD DATA SHEET SPECIFICATIONS

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY:	
QUALITY ASSURANCE:	
MANUFACTURING ENGINEER:	
TECHNICAL DIRECTOR:	
PROJECT MANAGER:	

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
3	PEF 12/3/96	RER 12/3/96	RELEASE FOR FAB, MODIFIED WDS #s 8, 12, 16, 35, + 37
2	PEF 11/5/96		RELEASE FOR FAB + ADDED #s 37-50 DEO #0342
1	PEF 8/28/96	AH/PEB 8/28/96	RELEASE FOR FAB. + ADDED #s 22-36 DEO #0203
Ø	PEF 5/2/96	RER 5/3/96	RELEASE FOR FDR PER DEO 0169

PROCESS SYSTEMS INTERNATIONAL, INC.					SPECIFICATION	
INITIAL APPROVALS	PREPARED PEF	DATE 5/2/96	APPROVED RER	DATE 5/3/96	Number A V049-2-084	Rev. 3

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1.0 Purpose

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3.0 Responsibilities

4.0 Procedure

ATTACHMENTS:

1. List of Weld Procedures

2. Weld Data Sheets

Number

Rev.

SPECIFICATION

Number A V049-2-084 REV. 3

1.0 PURPOSE

The purpose of this specification is to provide definitive guidelines for the welding of all components to assure a consistent and repeatable result per LIGO requirements.

2.0 GENERAL

The Weld Data Sheets shall be used to identify which welding procedures are to be used for specific weld joint configurations. Additionally, pertinent welding machine settings shall be provided. Notes concerning tack weld size and spacing and sequence of welding shall also be provided.

3.0 RESPONSIBILITIES

The Manufacturing Department is responsible for the execution of this procedure, with input and monitoring by the Project Engineer, the Quality Assurance Department, and the Project Manager.

4.0 PROCEDURE

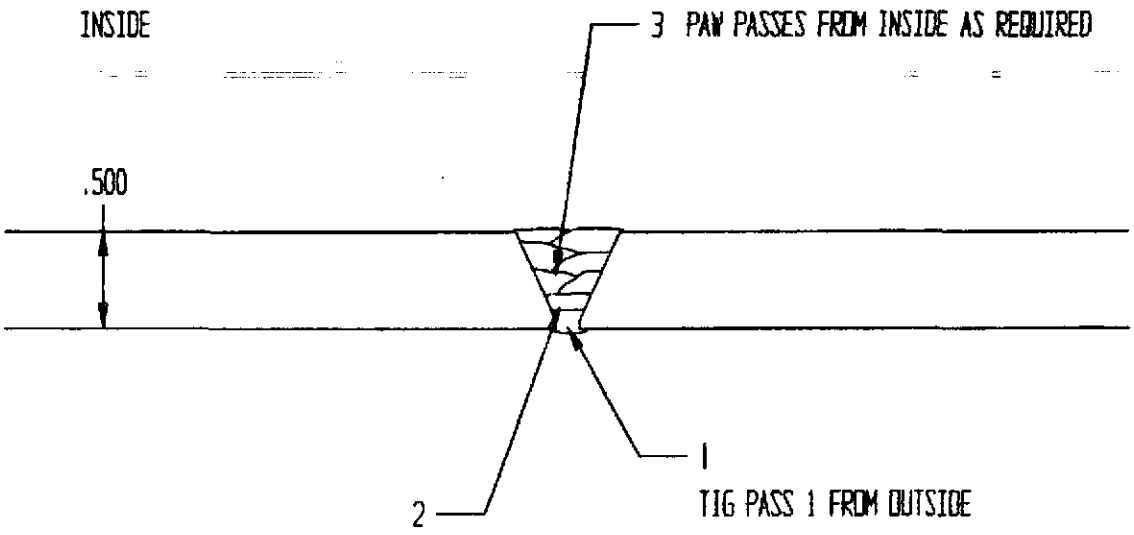
Weld Data Sheets shall be numbered by type and shall be logically tied to the appropriate weld by a corresponding number in the weld symbol on the drawing.

ATTACHMENT 1

WELD PROCEDURES

Weld Procedure	V049-2-070
Weld Procedure	V049-2-071
Weld Procedure	V049-2-072
Weld Procedure	V049-2-073
Weld Repair Procedure	V049-2-074

WDS 1



WDS 1

FIT UP WITH 1/8-3/16 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK FROM OUTSIDE (TIG)
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (PAW)

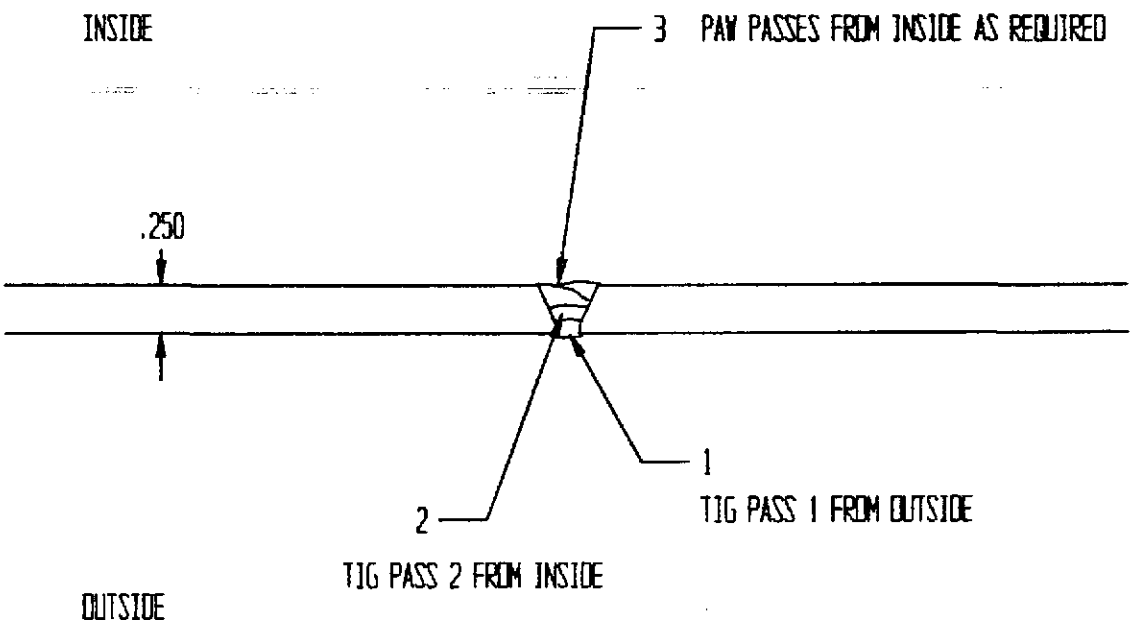
WELD # 2

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size	1/4		1/4	
Bevel in Total Degress	50		50	
Land	.045		.045	
Root Opening			1/8	
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				

WDS 2



WDS 2

FIT UP WITH 1/8-3/16 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK FROM OUTSIDE (TIG)
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (PAW)

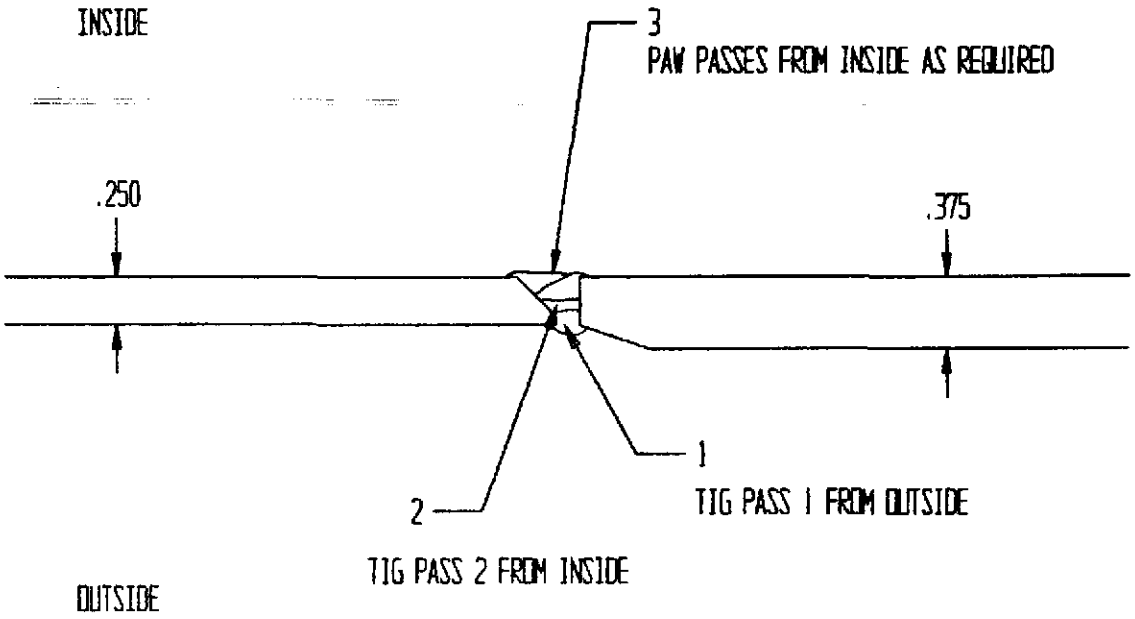
WELD # 3

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS# 073-3	Remarks
Plate Thks. or Pipe Size	1/4 - 3/8		1/4 - 3/8	
Bevel in Total Degress	45		45	
Land	.045		.045	
Root Opening			1/8	
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8 - 4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 - 5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	Also 3/32
Cleaning Technique	CO_2	Wire and Weld Zone	CO_2	Wire and Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				

WDS 3



WDS 3

FIT UP WITH 1/8-3/16 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK FROM OUTSIDE (TIG)
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (PAW)

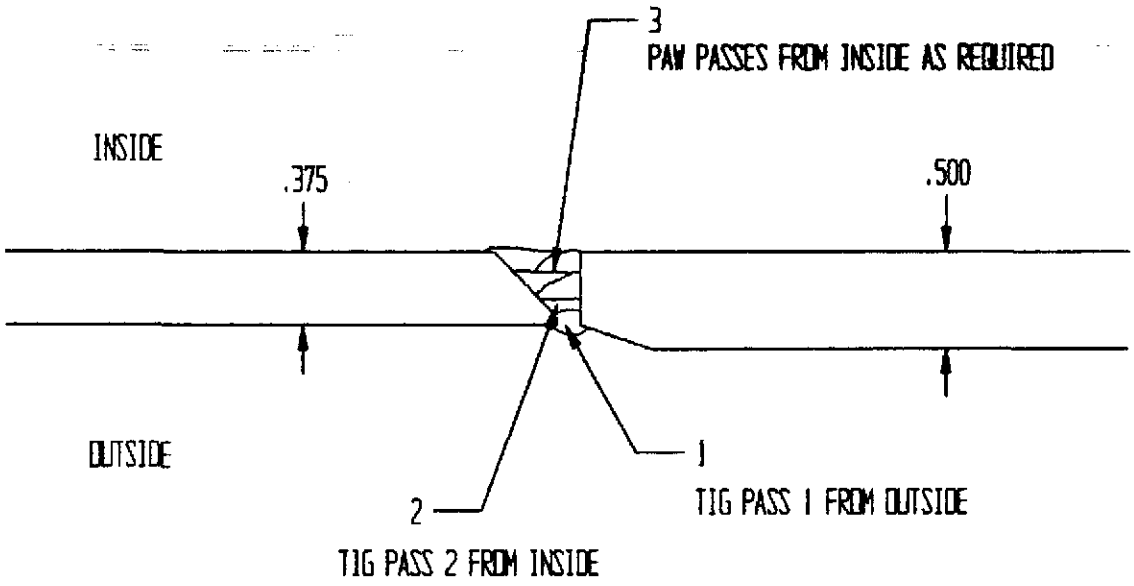
WELD # 4

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 151	Remarks	WPS# 153	
Plate Thks. or Pipe Size	3/8 - 1/2		3/8 - 1/2	
Bevel in Total Degress	45		45	
Land	.045		.045	
Root Opening				
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	Also 3/32
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				

WDS 4



WDS 4

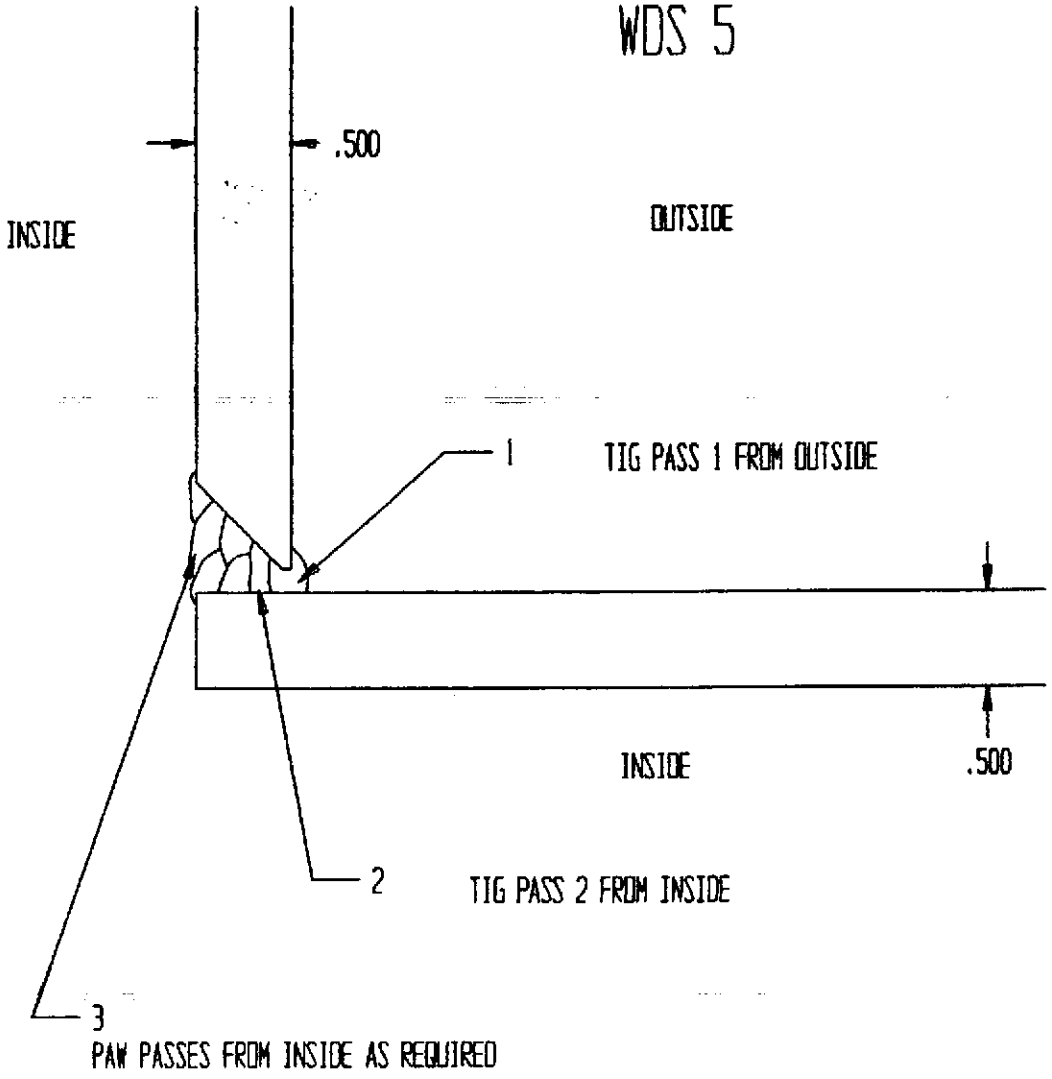
FIT UP WITH 1/8-3/16 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK FROM OUTSIDE (TIG)
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (PAW)

WELD # 5

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 151	Remarks	WPS# 153	
Plate Thks. or Pipe Size	1/2		1/2	
Bevel in Total Degress	45		45	
Land	.045		.045	
Root Opening			1/8 - 3/16	
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	V8 308L		1/8 308L	
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				



WDS 5

FIT UP WITH 1/8-3/16 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
DIVIDE NOZZLE INTO FOUR QUADRANTS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK
  FROM OUTSIDE (TIG); WORK FROM QUADRANT
  TO QUADRANT IN BOLT TORQUING PATTERN
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (PAW)

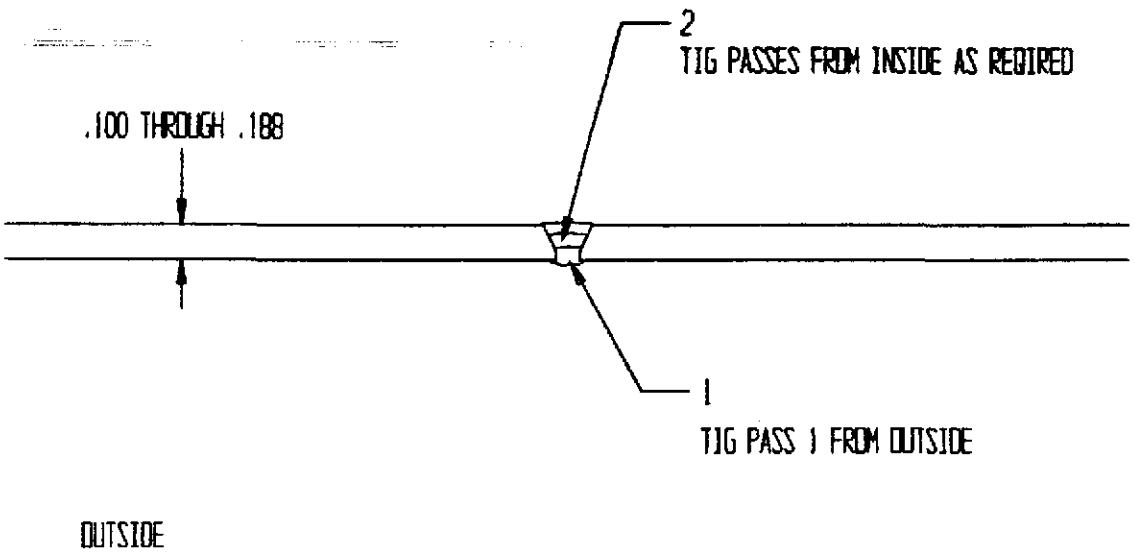
WELD # 6

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 153	
Plate Thks. or Pipe Size			11ga	
Bevel in Total Degress			50	
Land			.045	
Root Opening			1/16 - 3/32	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			30	
Wire Size/Type			3/32 - 1/8	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd					2nd	190	22	1/8	
3rd					3rd				
4th					4th				
5th					5th				

WDS 6



WDS 6

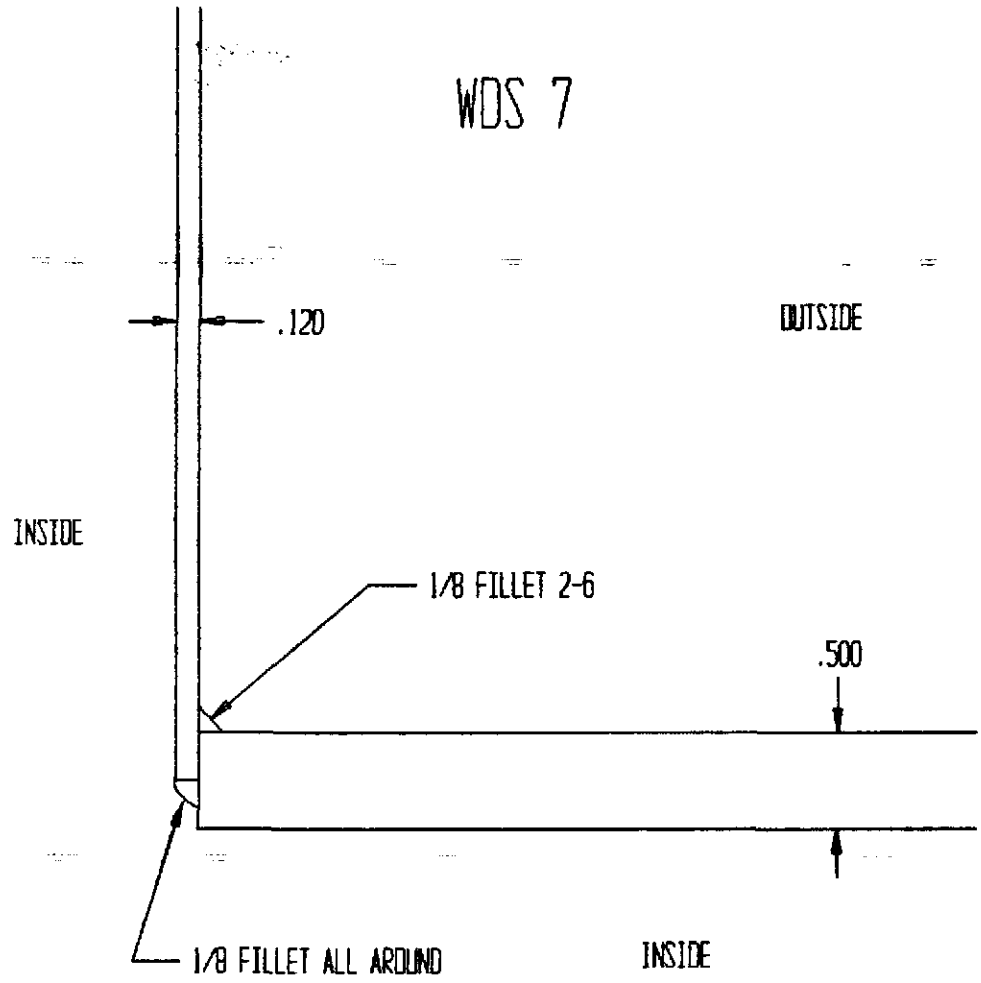
FIT UP WITH 1/8 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK FROM OUTSIDE (TIG)
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (TIG)

WELD # 7

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 153**	
Plate Thks. or Pipe Size			1/8 - 1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size			250	
Tungsten Size			3/32	
Tungsten Set Back			N/A	
Cup Size			7	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			150	
Volts			17	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	150	17		
2nd					2nd	150	17		
3rd					3rd				
4th					4th				
5th					5th				



WDS 7

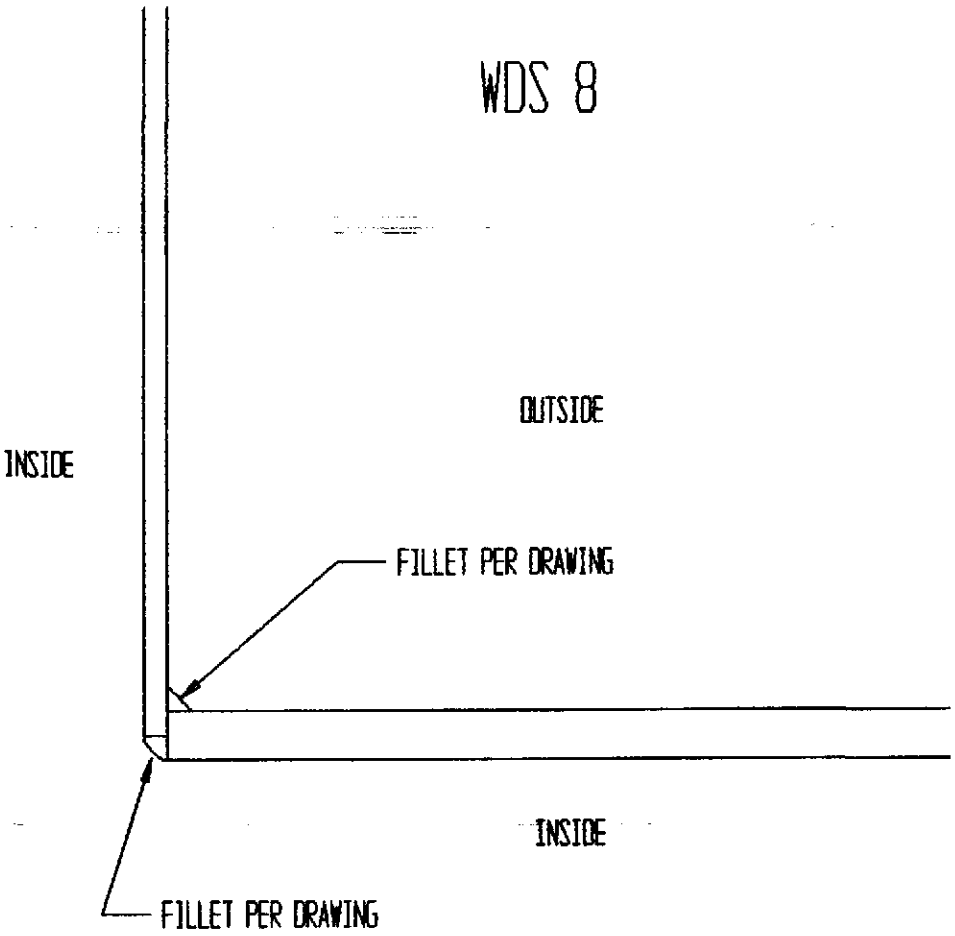
TACK NOZZLE TO SHELL FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

WELD # 8

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			1/8 - 1/4	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size			250	
Tungsten Size			3/32	
Tungsten Set Back			N/A	
Cup Size			7	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			150	
Volts			17	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	150	17		
2nd					2nd	150	17		
3rd					3rd				
4th					4th				
5th					5th				



WDS 8

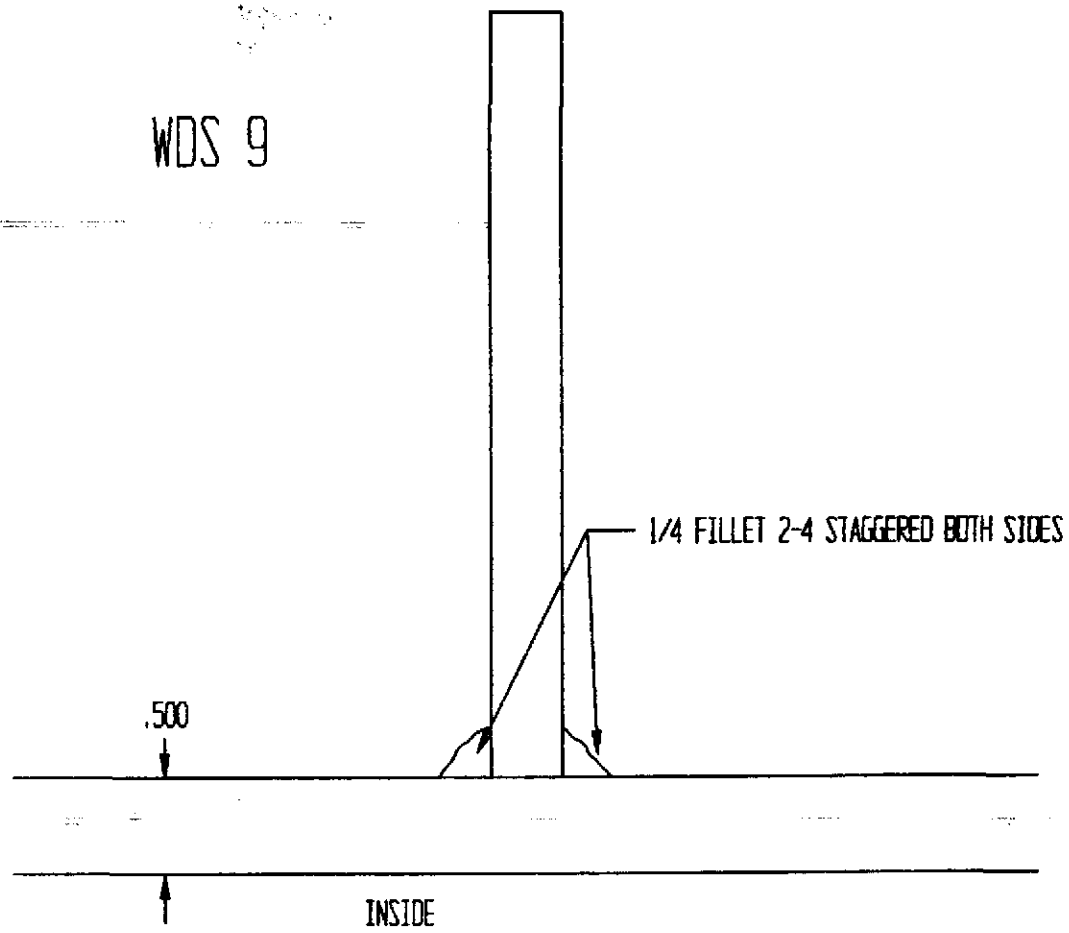
TACK NOZZLE TO SHELL FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

WELD # 9

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 151	**Remarks**	**WPS#**	
Plate Thks. or Pipe Size	3/8 - 1/2/3/4-1/2			
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd	180	20	1/8		2nd				
3rd					3rd				
4th					4th				
5th					5th				



WDS 9

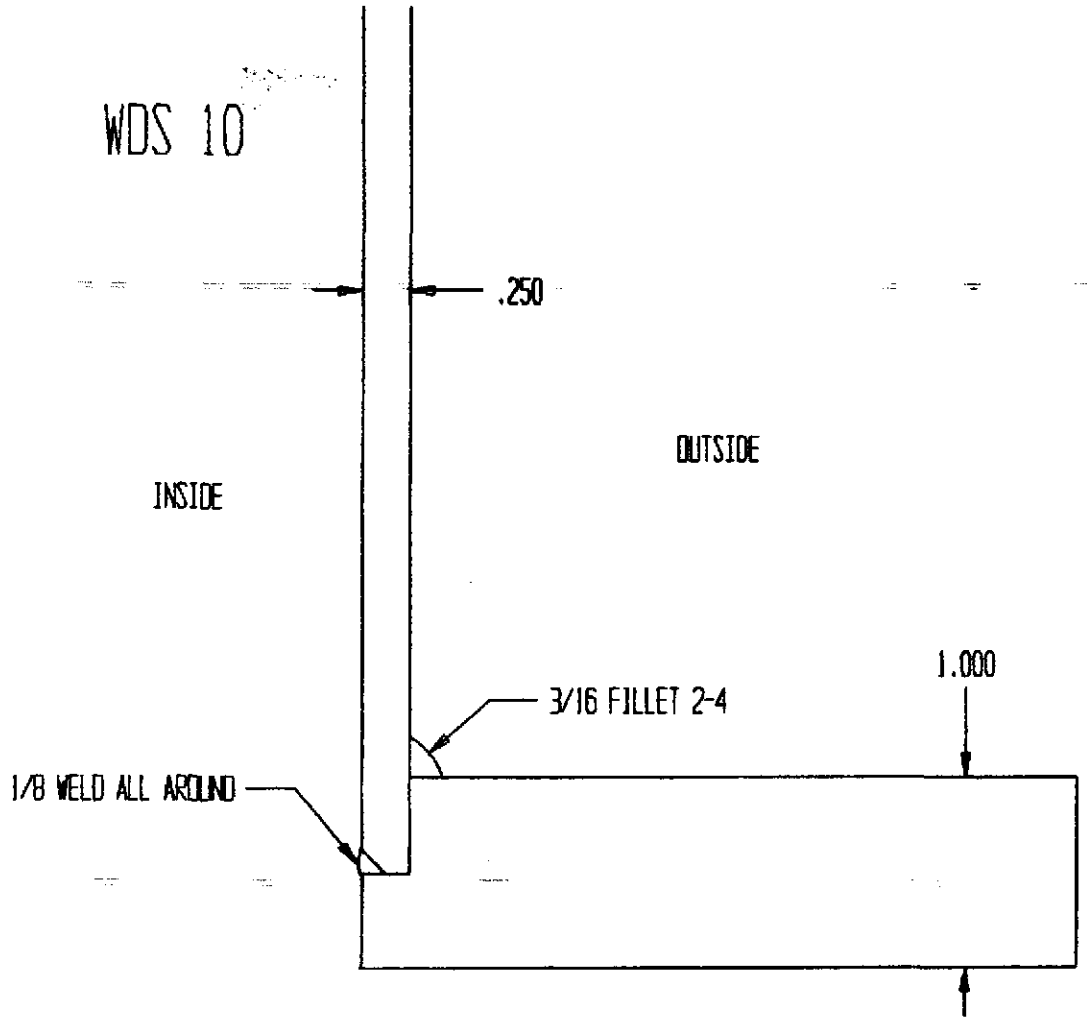
TACK BOTH SIDES (PAW)
WELD BOTH SIDES ALTERNATING; END WELDS ON TACKS (PAW)

WELD # 10

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS#	
Plate Thks. or Pipe Size	1/4 - 1			
Bevel in Total Degress	45			
Land	N/A			
Root Opening	N/A			
Root Pass TIG	N/A			
Root Pass Plasma	N/A			
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				



WDS 10

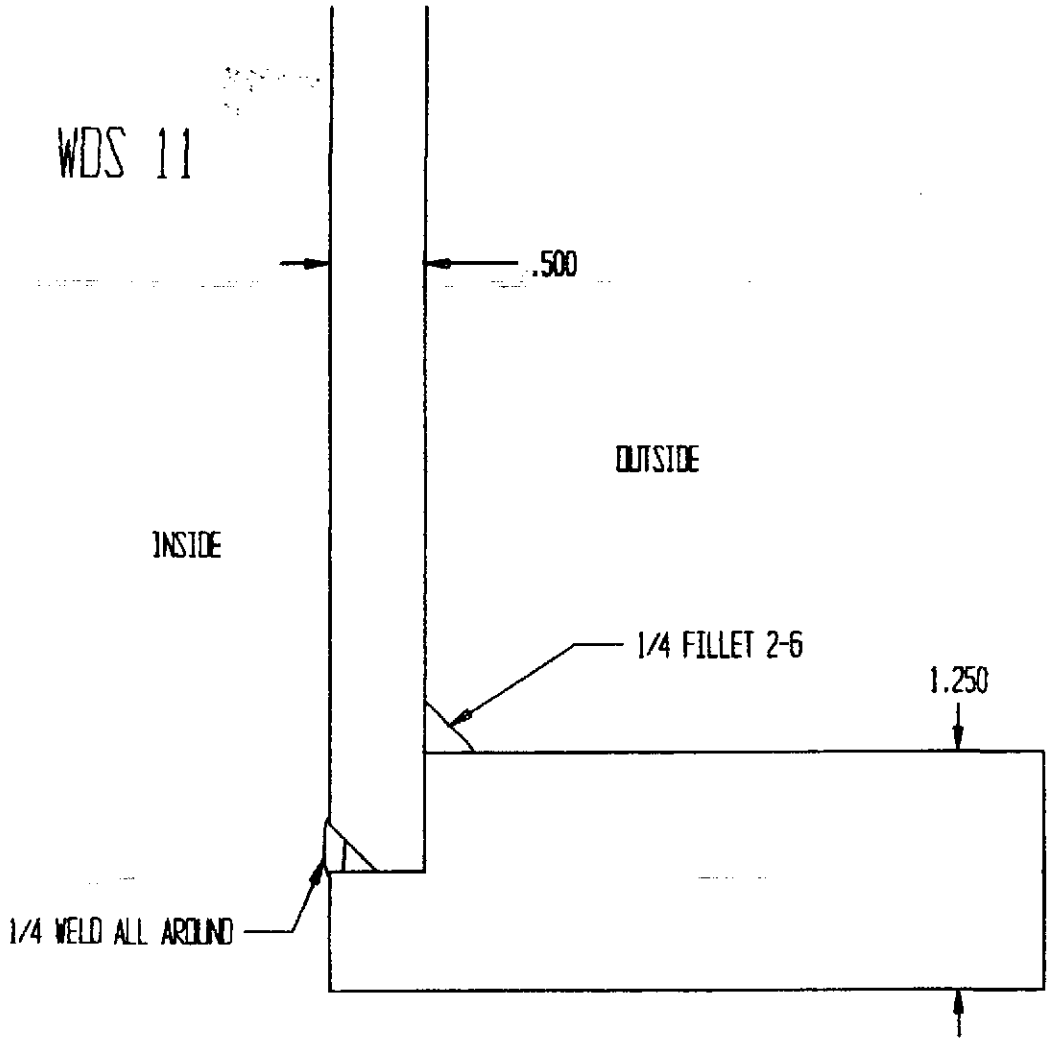
TACK NOZZLE FROM OUTSIDE (PAW)
WELD NOZZLE FROM INSIDE (PAW)
WELD FILLETS TO TACKS ON OUTSIDE (PAW)

WELD # 11

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS#**	
Plate Thks. or Pipe Size	1/2 - 1.250			
Bevel in Total Degress	45			
Land	N/A			
Root Opening	N/A			
Root Pass TIG	N/A			
Root Pass Plasma	N/A			
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				



WDS 11

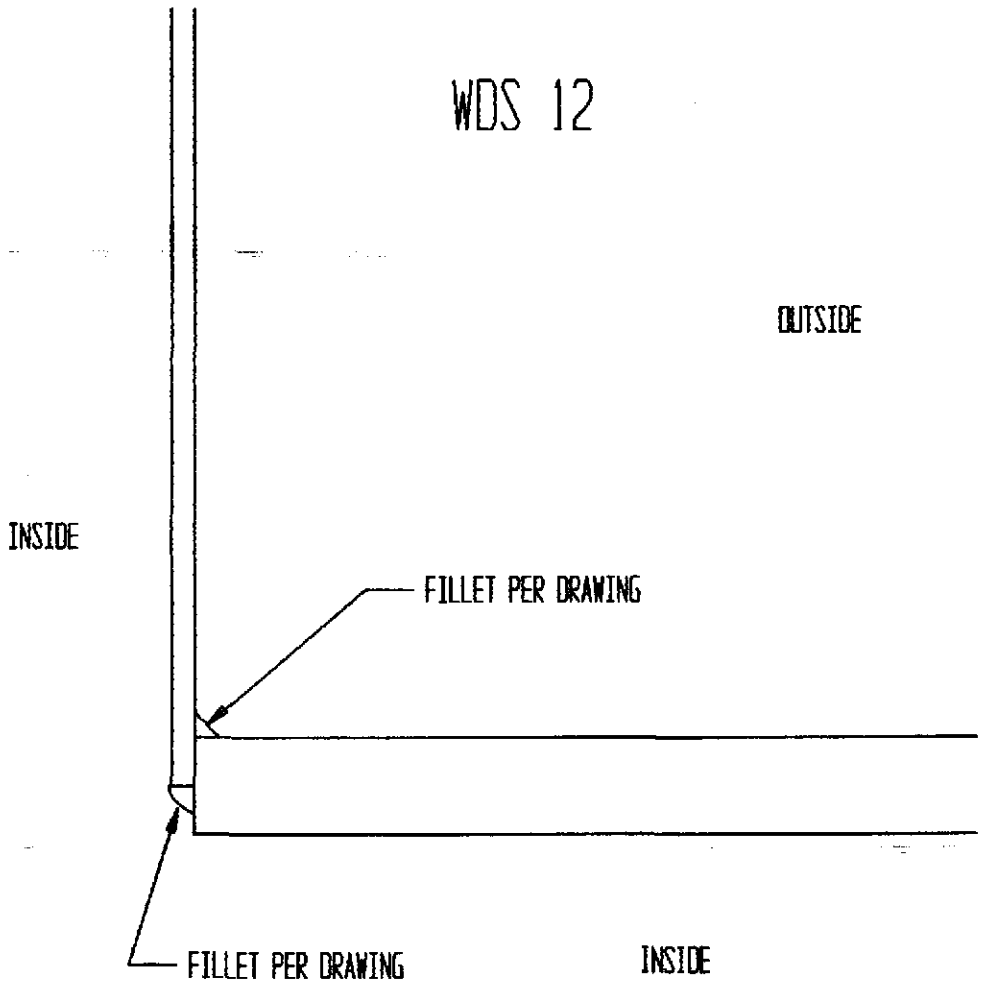
TACK NOZZLE FROM OUTSIDE (PAW)
WELD NOZZLE FROM INSIDE (PAW)
WELD FILLETS TO TACKS ON OUTSIDE (PAW)

WELD # 12

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			1/8 to 1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			N/A	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				



WDS 12

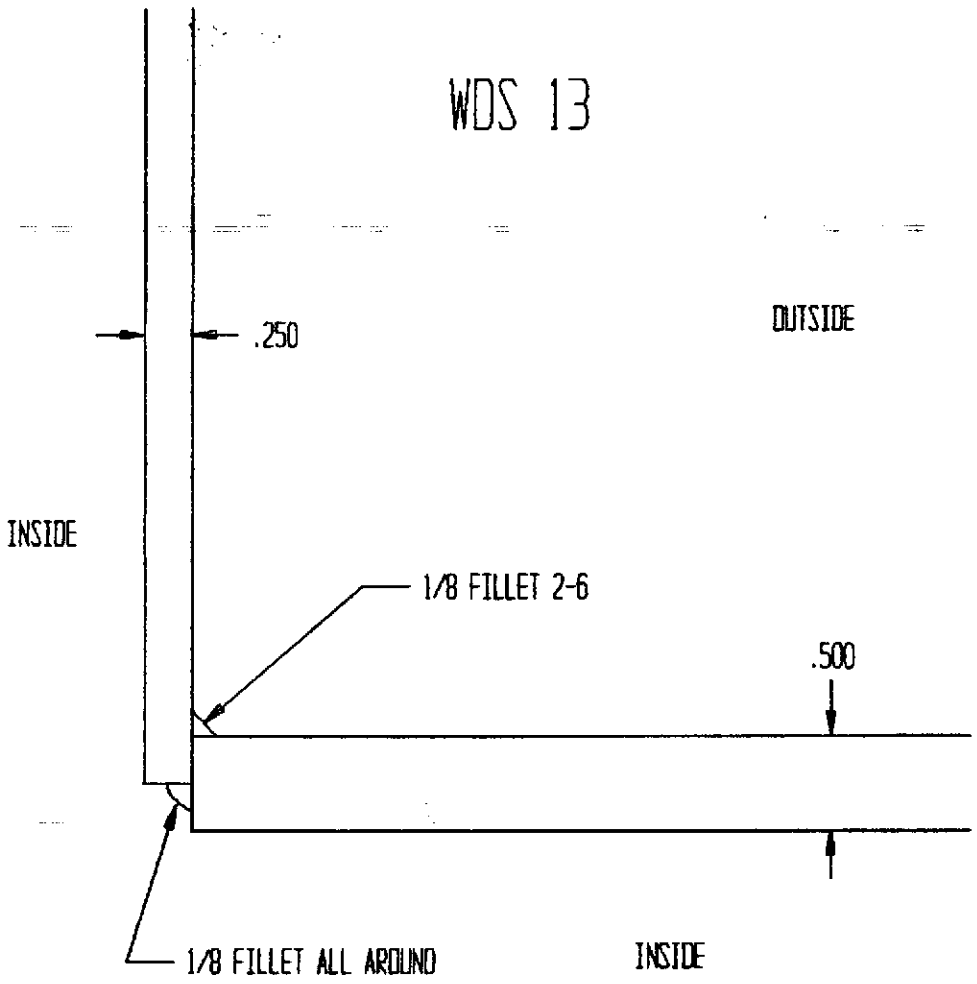
TACK NOZZLE TO SHELL FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

WELD # 13

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 153	
Plate Thks. or Pipe Size			1/4 to 1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			N/A	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				



WDS 13

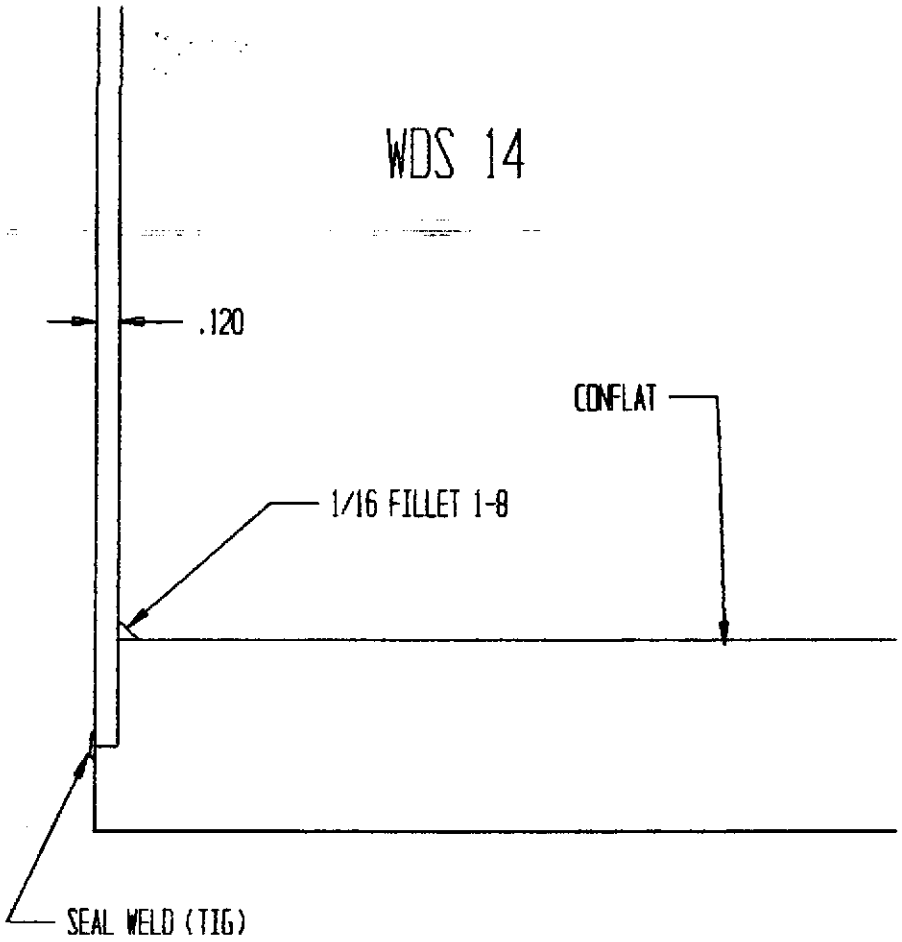
TACK NOZZLE TO SHELL FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

WELD # 14

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	Remarks
Plate Thks. or Pipe Size			1/8 - 1	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size			250	
Tungsten Size			3/32	
Tungsten Set Back			N/A	
Cup Size			7	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			150	
Volts			17	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire/Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	150	17		
2nd					2nd	150	17		
3rd					3rd				
4th					4th				
5th					5th				



WDS 14

TACK CONFLAT TO NOZZLE FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

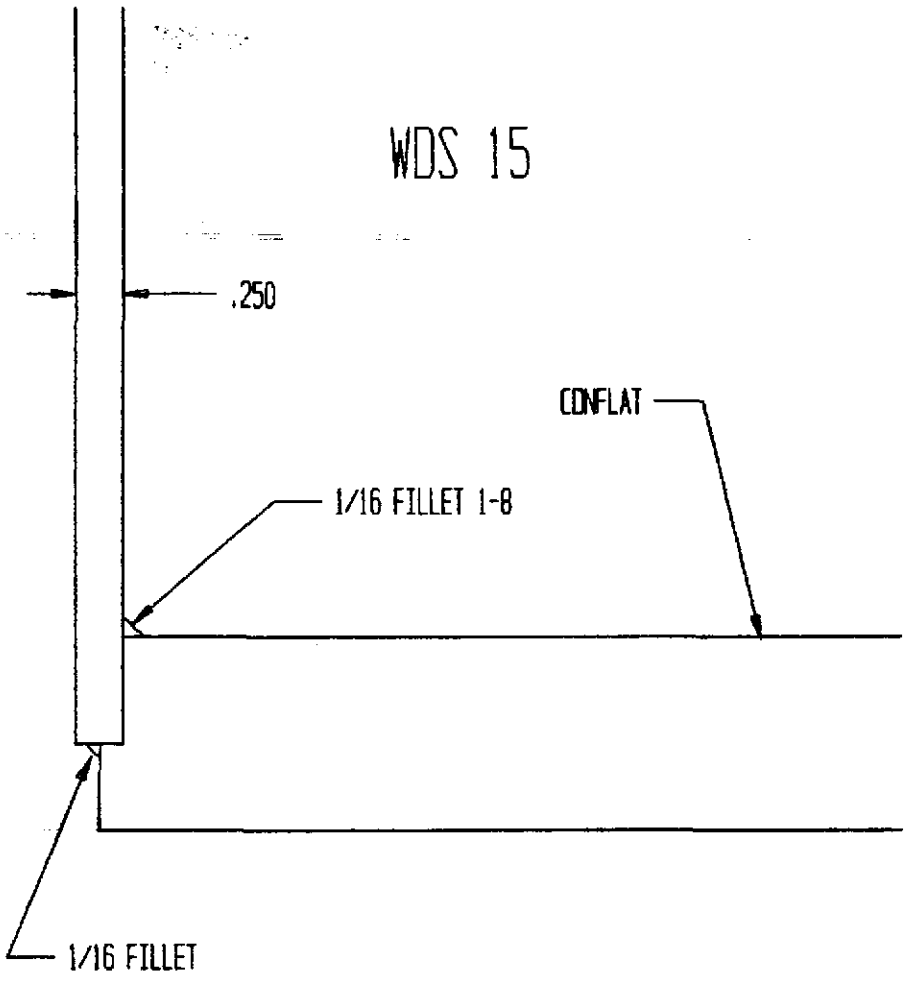
WELD # 15

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			1/4 to 1	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size			250	
Tungsten Size			3/32	
Tungsten Set Back			N/A	
Cup Size			7	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			150	
Volts			17	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	150	17		
2nd					2nd	150	17		
3rd					3rd				
4th					4th				
5th					5th				

WDS 15



WDS 15

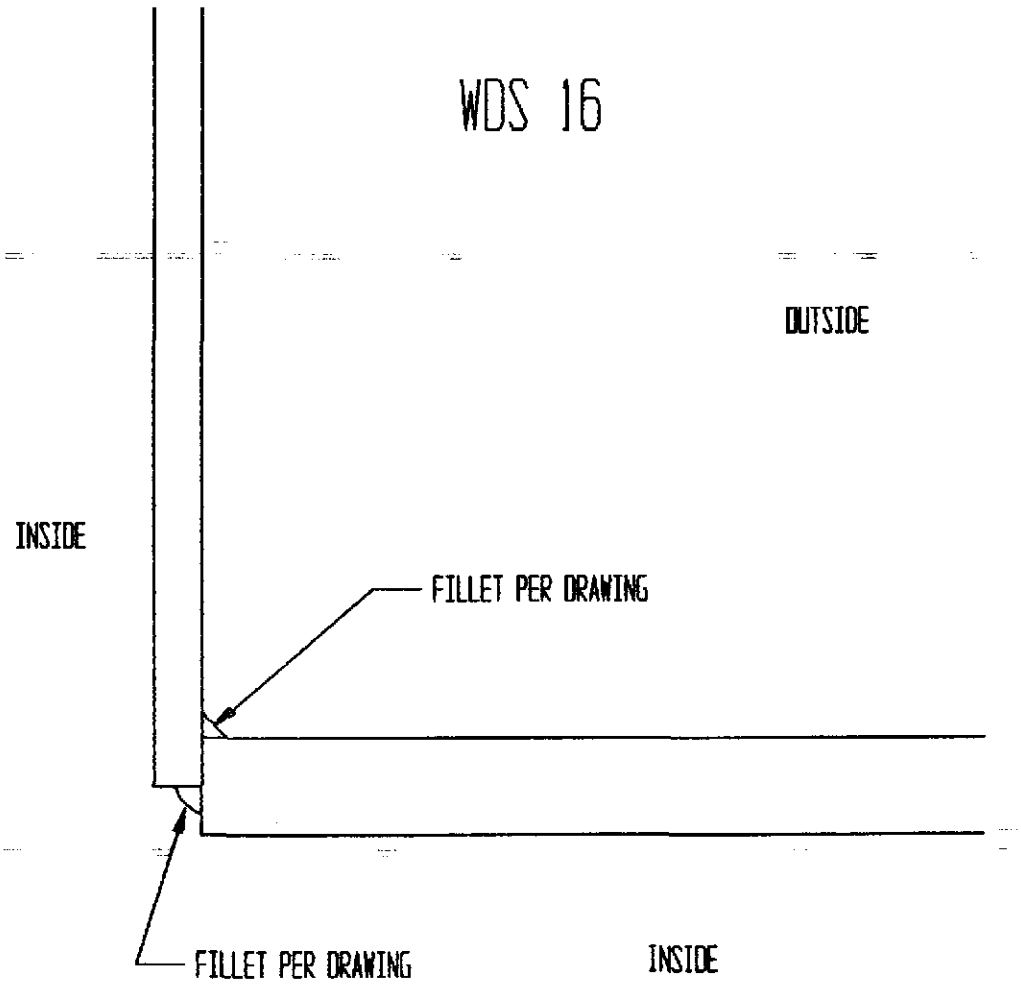
TACK CONFLAT TO NOZZLE FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

WELD # 16

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			1/4 to 1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			N/A	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			3/32 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				



WDS 16

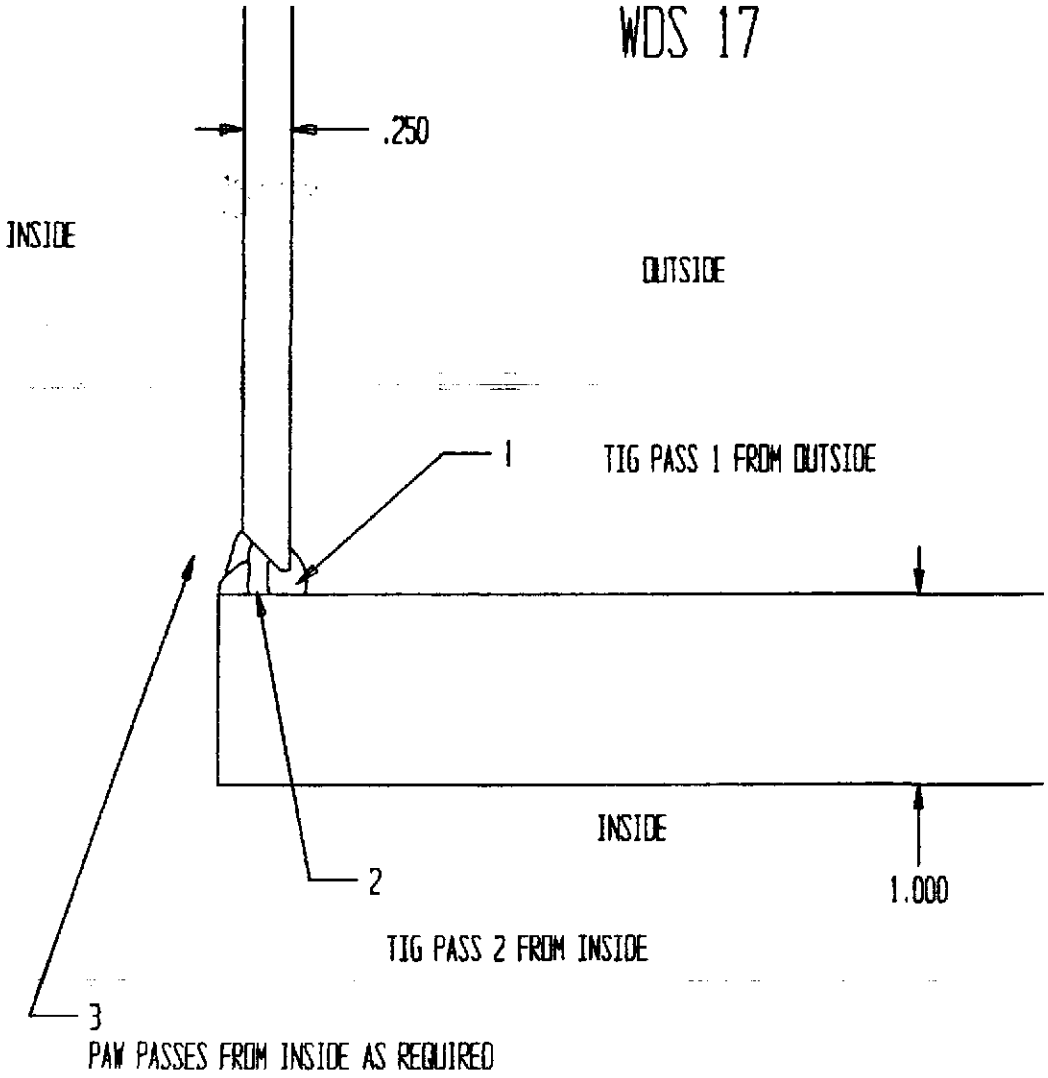
TACK NOZZLE TO SHELL FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)
WELD TO TACKS FROM OUTSIDE (TIG)

WELD # 17

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size	1/4 to 1		1/4 to 1	
Bevel in Total Degress	50		50	
Land	.045		.045	
Root Opening			1/8	
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 - 5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	Also 3/32
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				



WDS 17

FIT UP WITH 1/8-3/16 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
DIVIDE NOZZLE INTO FOUR QUADRANTS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK
FROM OUTSIDE (TIG); WORK FROM QUADRANT
TO QUADRANT IN BOLT TORQUING PATTERN
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (PAW)

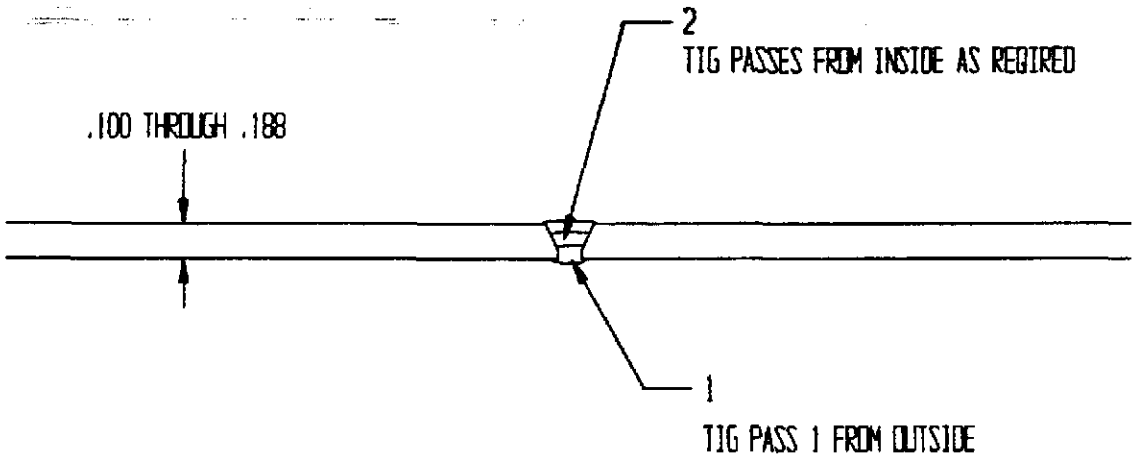
WELD # 18

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			11ga	
Bevel in Total Degress			50	
Land			.045	
Root Opening			1/16 - 3/32	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			30	
Wire Size/Type			3/32 1/8	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd					2nd	190	22	1/8	
3rd					3rd				
4th					4th				
5th					5th				

WDS 18



WDS 18

FIT UP WITH 1/8 GAP
TACK FROM OUTSIDE WITH PURGE INSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK FROM OUTSIDE (TIG)
TIG PASS FROM INSIDE (TIG)
FILL FROM INSIDE AS REQUIRED (TIG)

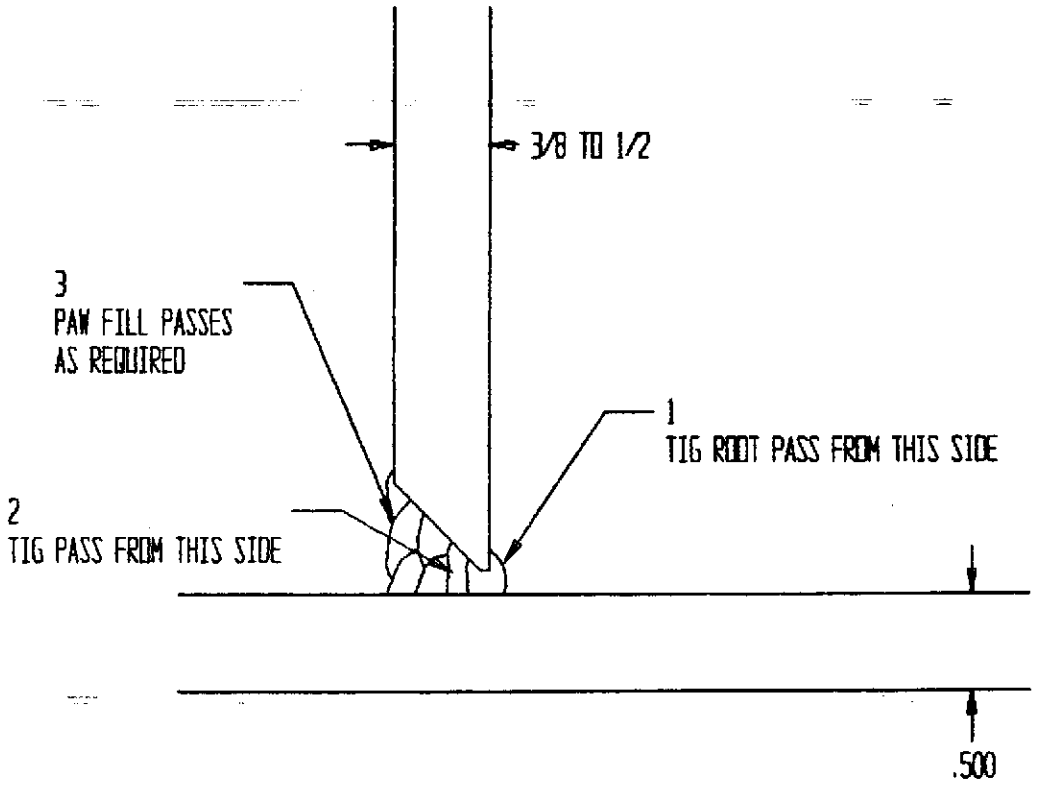
WELD # 19

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 151	**Remarks**	**WPS# 153**	
Plate Thks. or Pipe Size	1/2 to 3/8		1/2 to 3/8	
Bevel in Total Degress	45		45	
Land	.045		.045	
Root Opening			1/8 - 3/16	
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 - 5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	V8 308L		1/8 308L	
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				

WDS 19



WDS 19

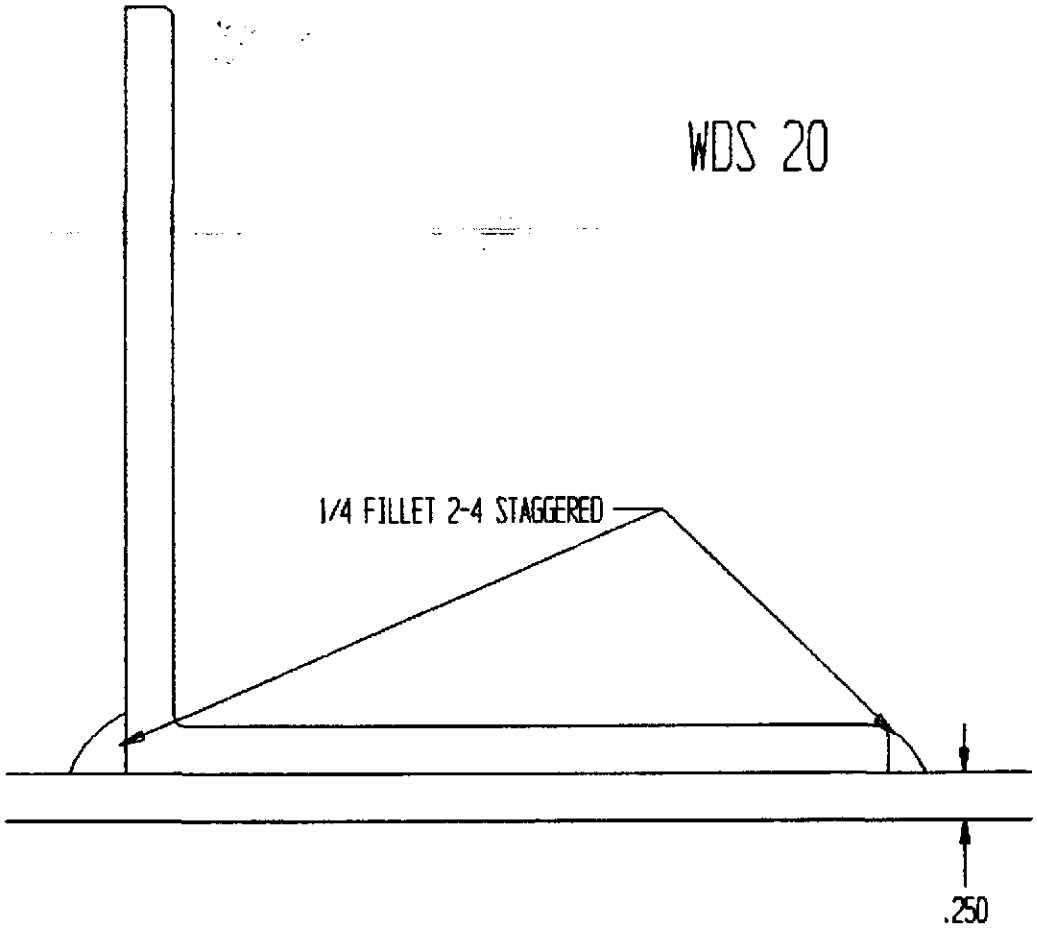
TIG TACK FROM RIGHT SIDE (VIEW)
PURGE FROM LEFT (VIEW) (TIG)
TIG PASS FROM LEFT (VIEW) (TIG)
PAW FILL FROM LEFT (VIEW) (PAW)

WELD # 20

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS#**	
Plate Thks. or Pipe Size	1/4			
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 - 5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				



WDS 20

TACK BOTH SIDES (PAW)
WELD BOTH SIDES ALTERNATING; END WELDS ON TACKS (PAW)

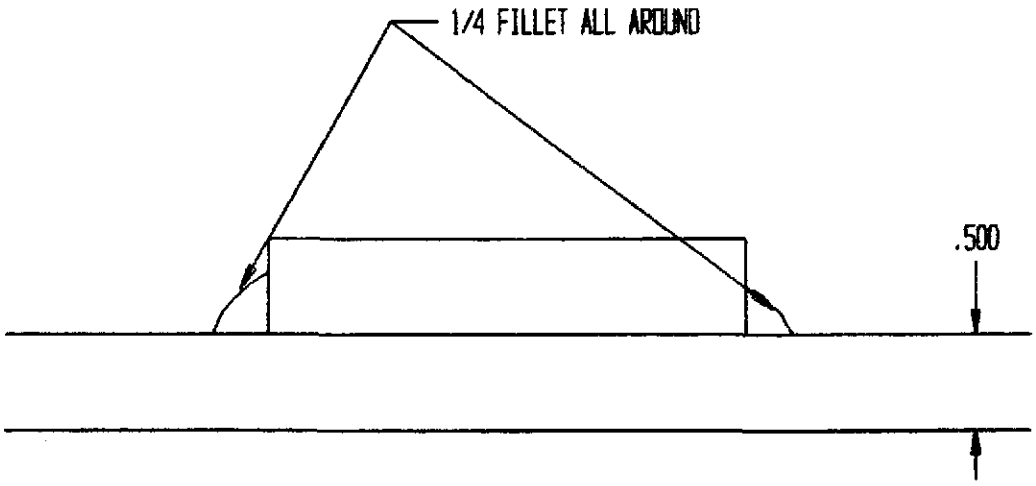
WELD # 21

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS#	
Plate Thks. or Pipe Size	1/4 - 1/2			
Bevel in Total Degress	45			
Land	N/A			
Root Opening	N/A			
Root Pass TIG	N/A			
Root Pass Plasma	N/A			
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 - 5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 21



WDS 21

TACK BOTH SIDES (PAW)
WELD BOTH SIDES (PAW)

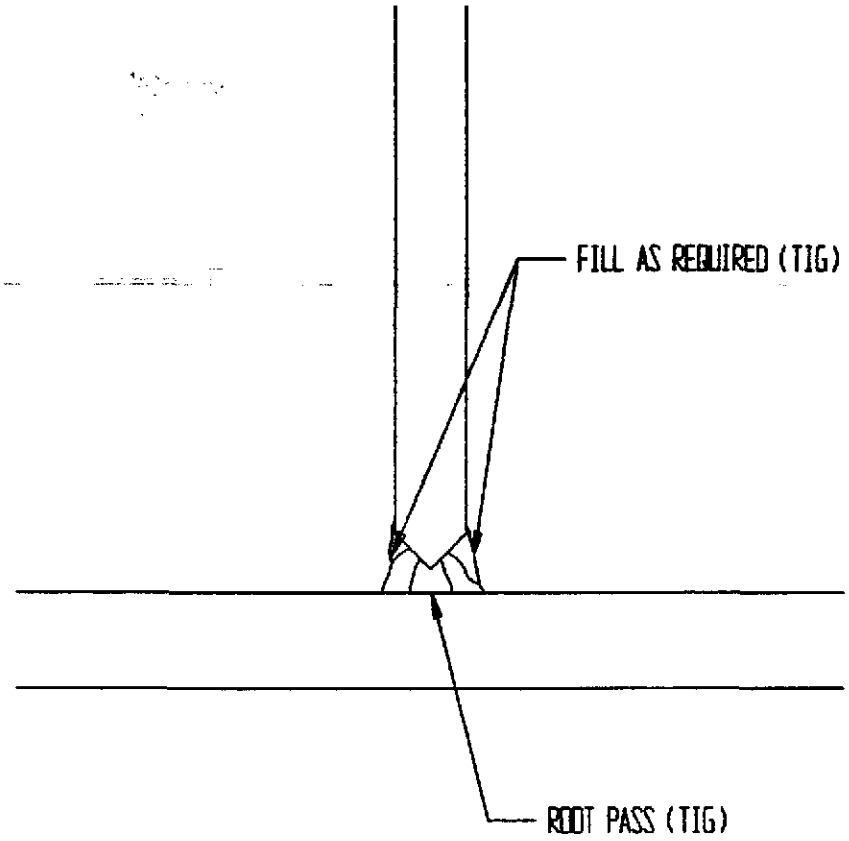
WELD # 22

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			3/8 to 1/2	
Bevel in Total Degress			45 x 2	
Land			0	
Root Opening			1/8	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			30	
Wire Size/Type			1/8 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	1/8	
2nd					2nd	190	22	1/8	
3rd					3rd				
4th					4th				
5th					5th				

WDS 22



WDS 22

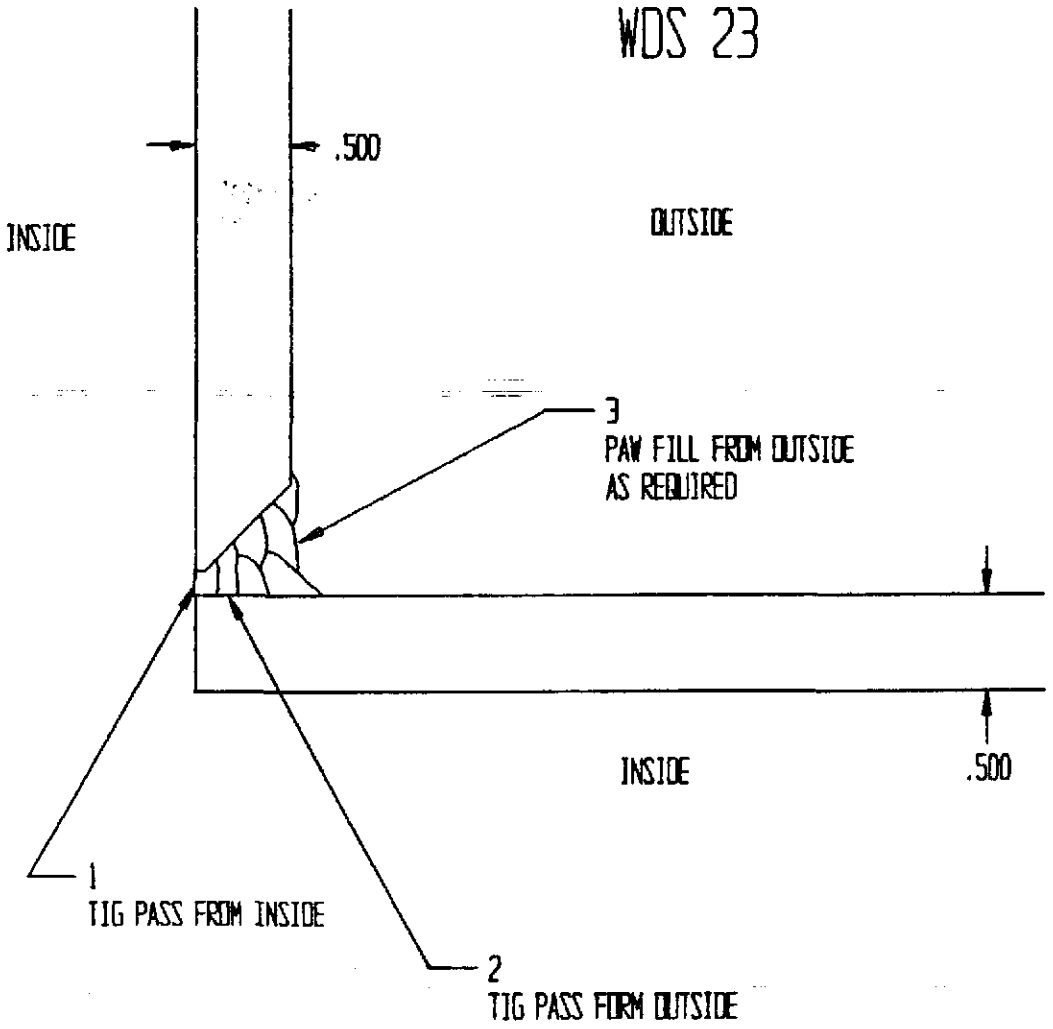
FIT UP WITH 1/8 GAP
TACK FROM ONE SIDE WITH PURGE ON OTHER SIDE (TIG)
WELD 2ND PASS WITH PURGE (TIG)
FILL AS REQUIRED (TIG)

WELD #23

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 151	Remarks	WPS# 153	
Plate Thks. or Pipe Size	1/2		1/2	
Bevel in Total Degress	45		45	
Land	.045		.045	
Root Opening			1/8 - 3/16	
Root Pass TIG			Yes	
Root Pass Plasma	No			
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	V8 308L		1/8 308L	
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st	190	22	3/32	
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				



WDS 23

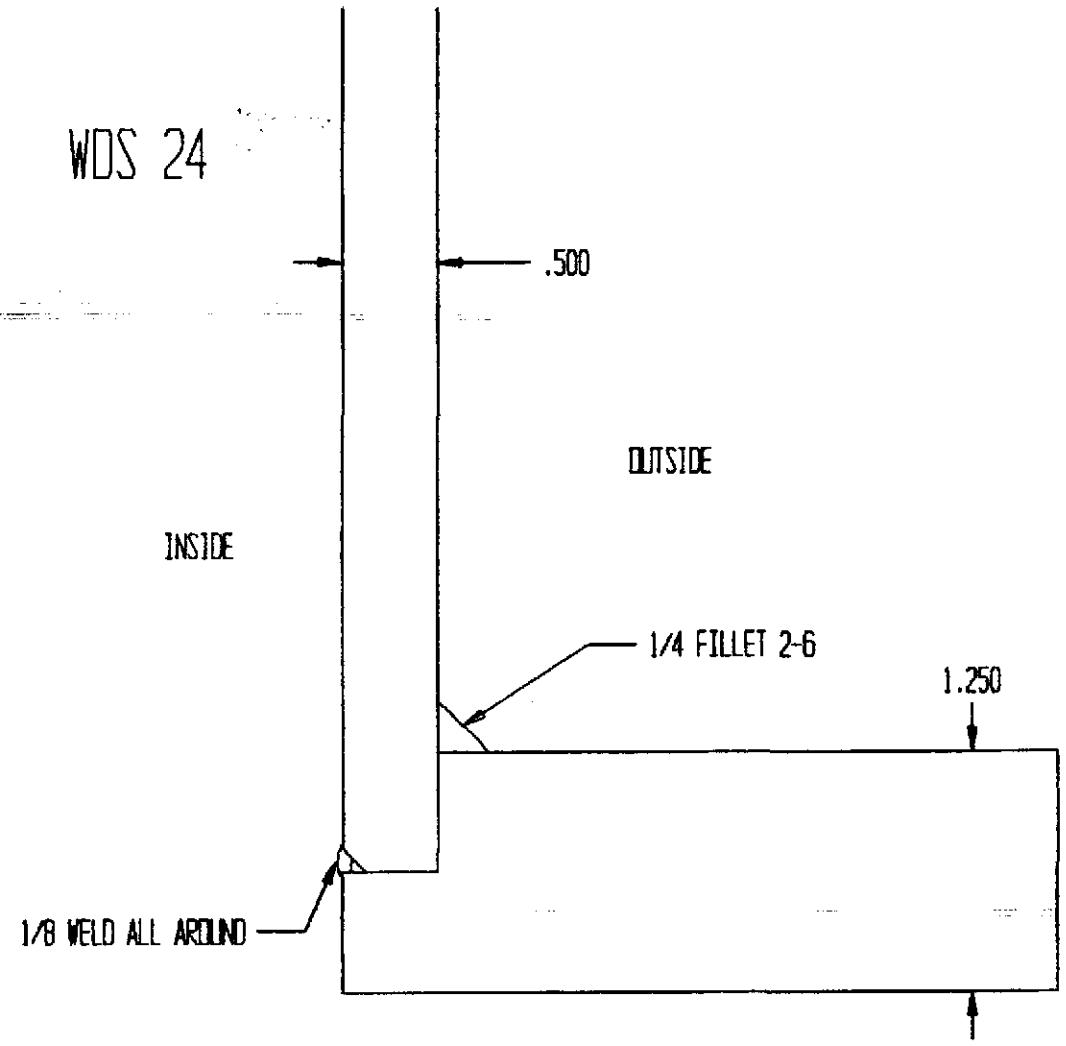
FIT UP WITH 1/8-3/16 GAP
TACK FROM INSIDE WITH PURGE OUTSIDE (TIG)
ONE INCH TACKS ON TEN INCH CENTERS
DIVIDE NOZZLE INTO FOUR QUADRANTS
BACKSTEP WELD ROOT PASS FROM TACK TO TACK
FROM INSIDE (TIG); WORK FROM QUADRANT
TO QUADRANT IN BOLT TORQUING PATTERN
TIG PASS FROM OUTSIDE (TIG)
FILL FROM OUTSIDE AS REQUIRED (PAW)

WELD #24

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size	1/2		1/2	
Bevel in Total Degress	45		45	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	Also 3/32
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				



WDS 24

TACK FROM OUTSIDE (TIG)
WELD FROM INSIDE (TIG)

WELD FILLETS TO TACKS ON OUTSIDE (PAW)

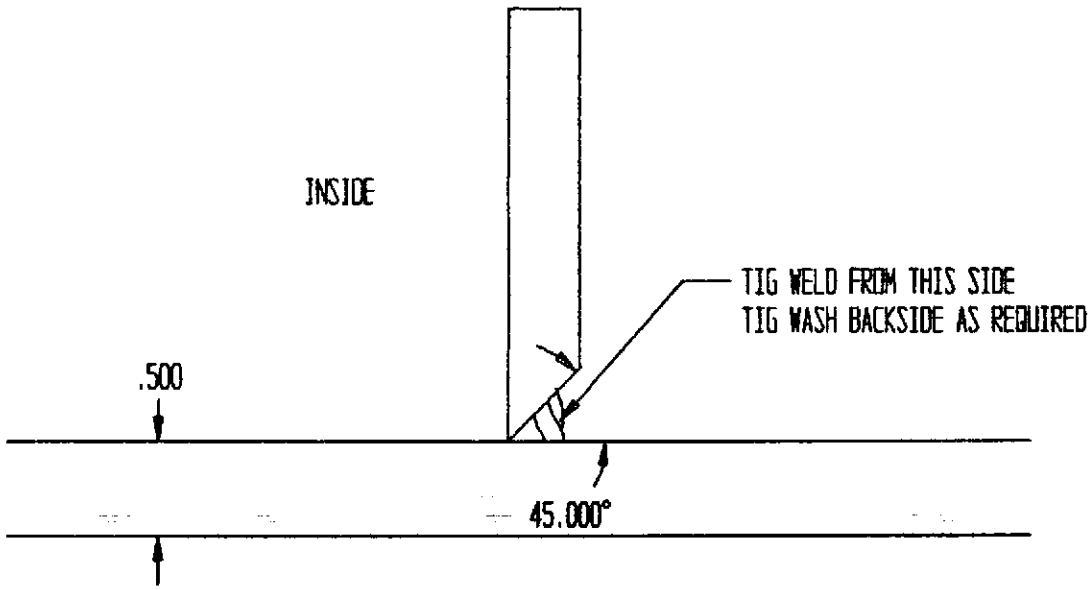
WELD #25

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 073-3	
Plate Thks. or Pipe Size			3/8 - 1/2	
Bevel in Total Degress			45	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			N/A	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			30	
Wire Size/Type			3/32 - 1/8	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	190	22	3/32	
2nd					2nd	190	22	1/8	
3rd					3rd				
4th					4th				
5th					5th				

WDS 25



WDS 25

TACK, FILL AS REQUIRED BY DRAWING (TIG)

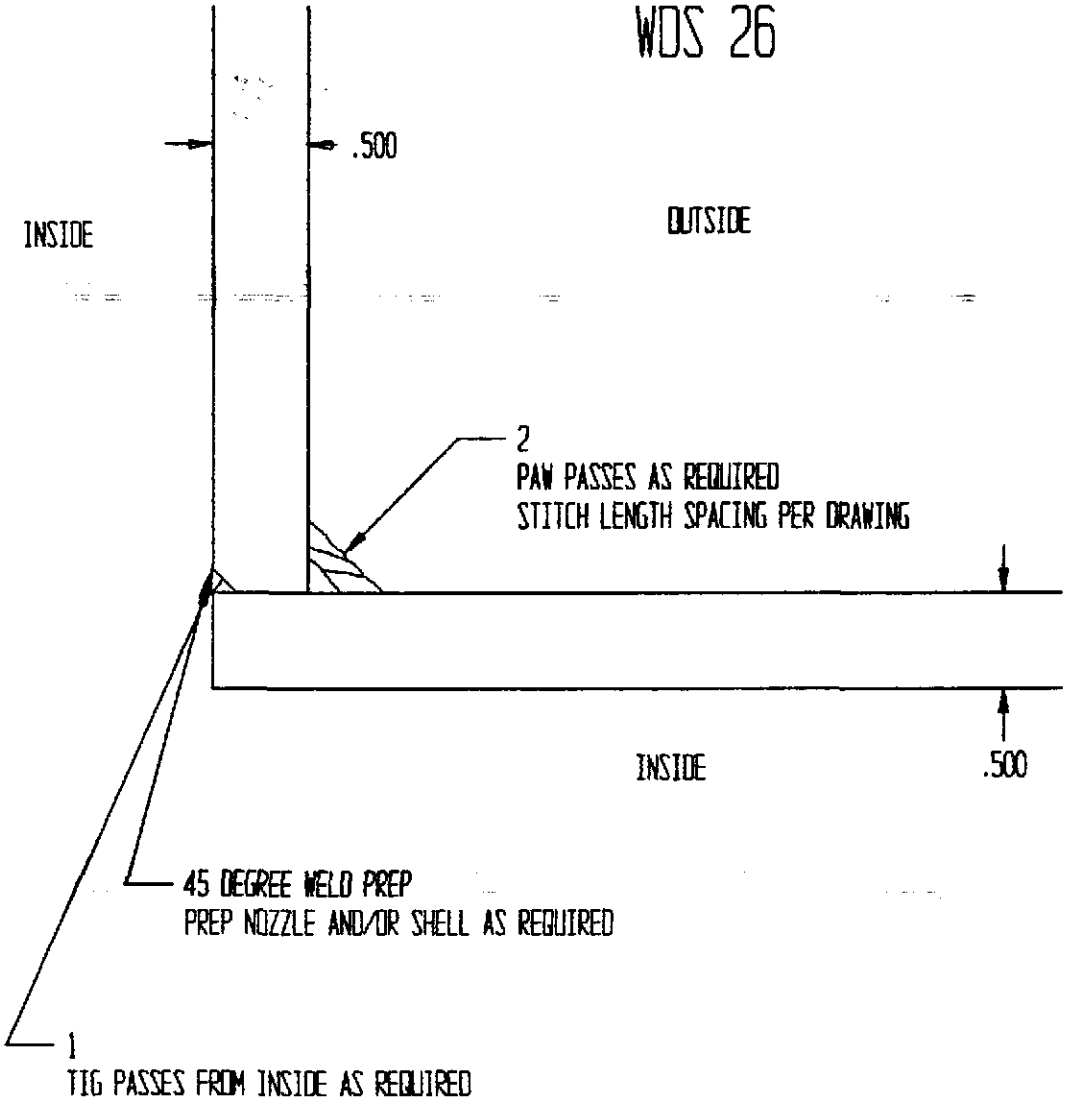
WELD #26

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size	1/2		1/2	
Bevel in Total Degress	45		45	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	Also 3/32
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				

WDS 26



WDS 26
TIG TACK OUTSIDE
TIG WELD INSIDE
PAW STITCH WELD OUTSIDE
AS REQUIRED

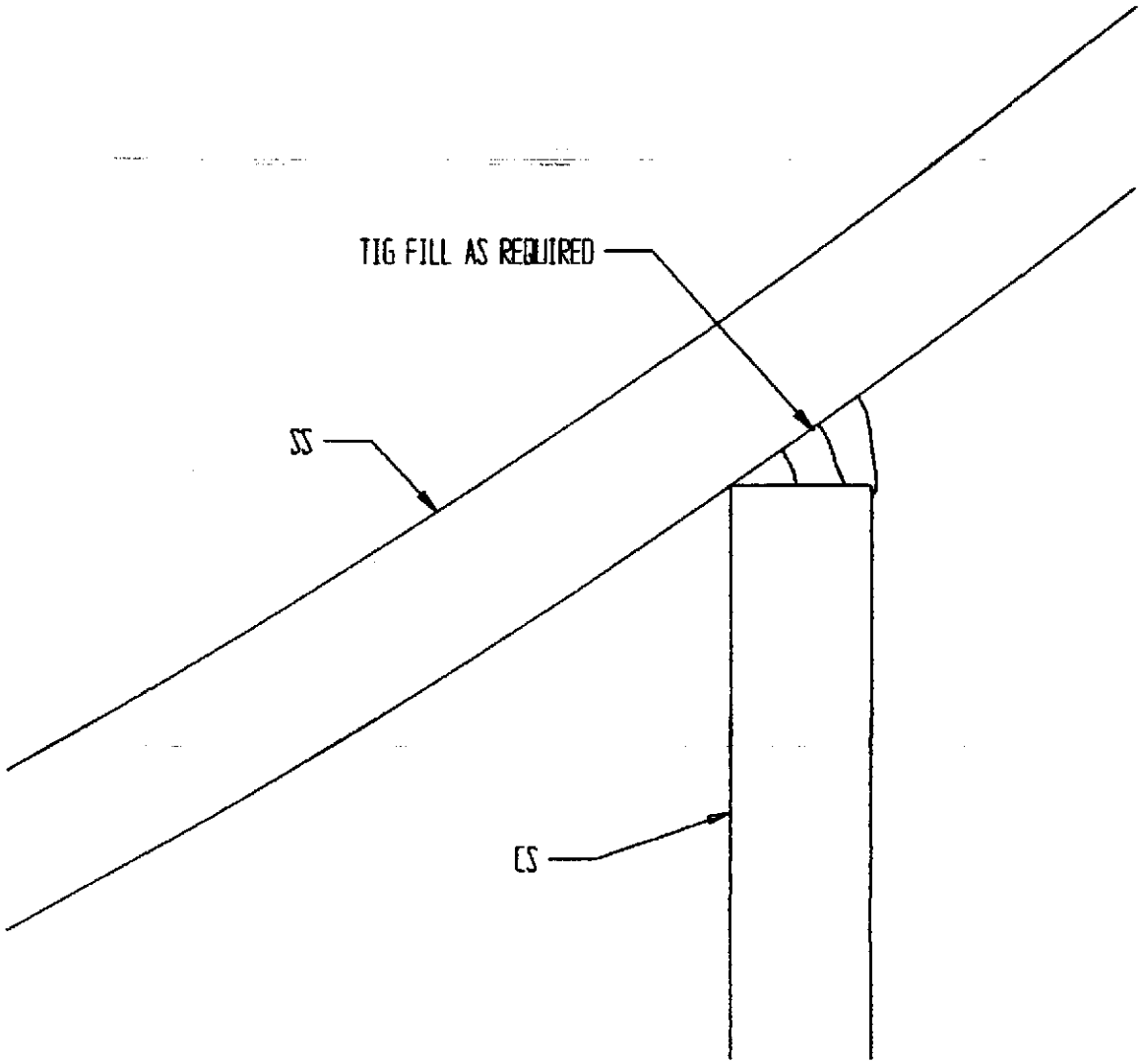
WELD #27

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS#**	
Plate Thks. or Pipe Size				
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size				
Tungsten Size				
Tungsten Set Back				
Cup Size				
Tip Size/Number				
Pass or Pass Number				
Amps Setting				
Volts				
Argon Gas				
Argon/He 75%/25%				
Gas Flow CFH				
Gas Plasma Flow CFH				
Purge Argon CFH				
Wire Size/Type				
Cleaning Technique				
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 27



WDS 27
TIG WELD AS REQUIRED

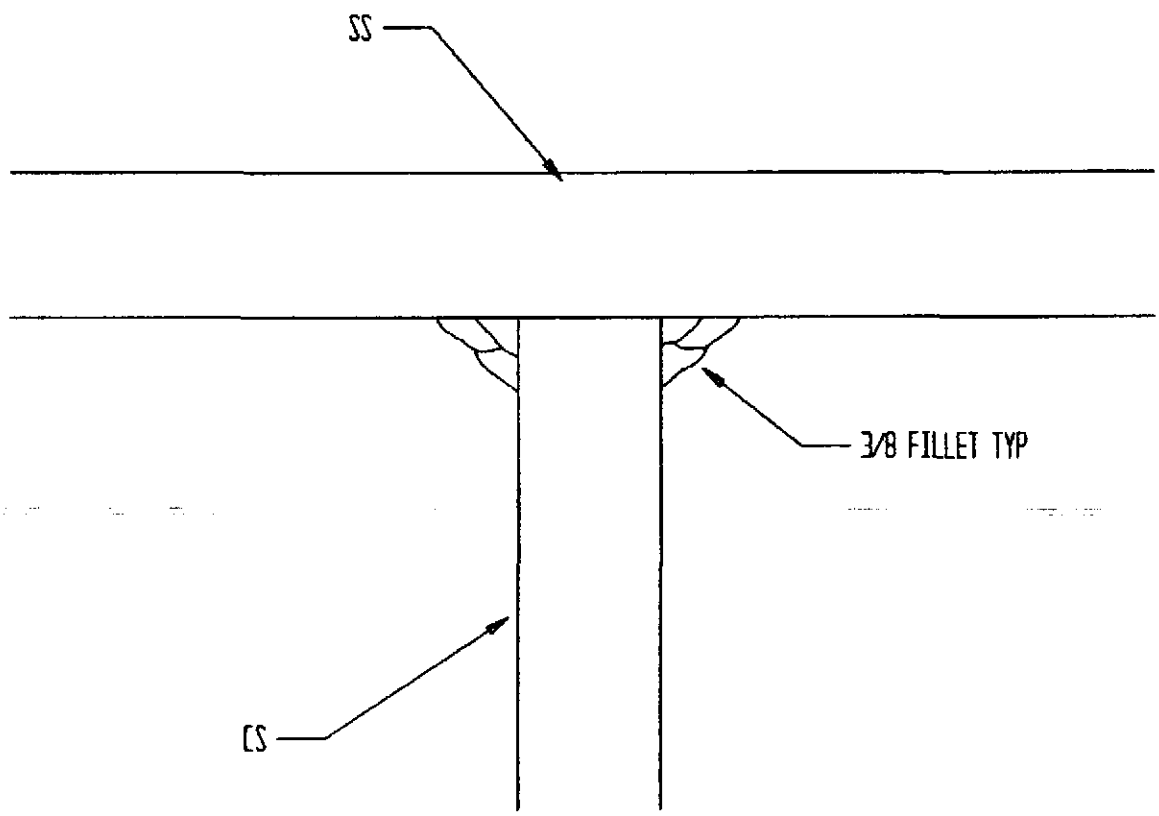
WELD #28

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS#	
Plate Thks. or Pipe Size				
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size				
Tungsten Size				
Tungsten Set Back				
Cup Size				
Tip Size/Number				
Pass or Pass Number				
Amps Setting				
Volts				
Argon Gas				
Argon/He 75%/25%				
Gas Flow CFH				
Gas Plasma Flow CFH				
Purge Argon CFH				
Wire Size/Type				
Cleaning Technique				
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 28



WDS 28

TIG WELD AS REQUIRED

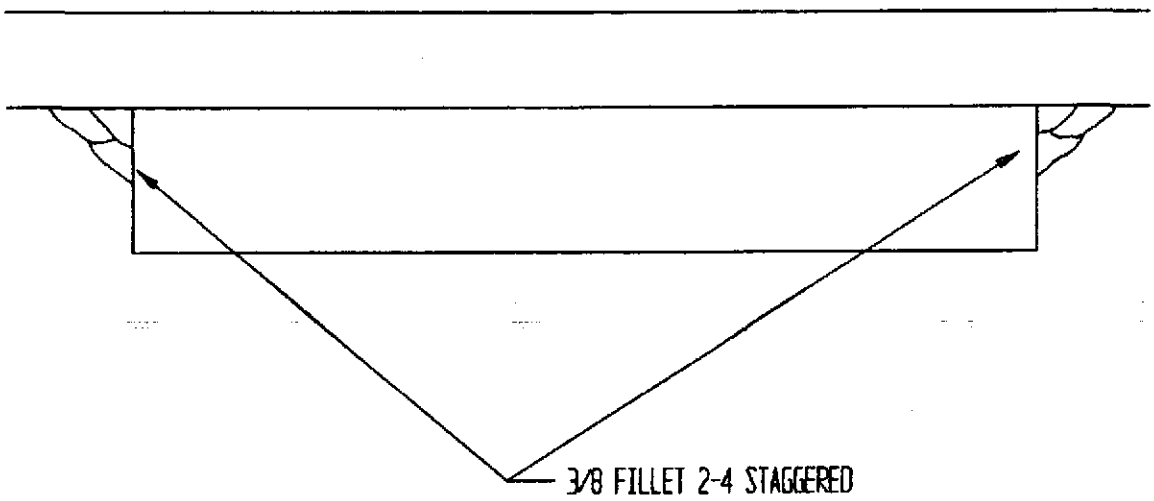
WELD # 29

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 151	Remarks	WPS#	
Plate Thks. or Pipe Size	1/2			
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 29



WDS 29

PAW WELD AS REQUIRED

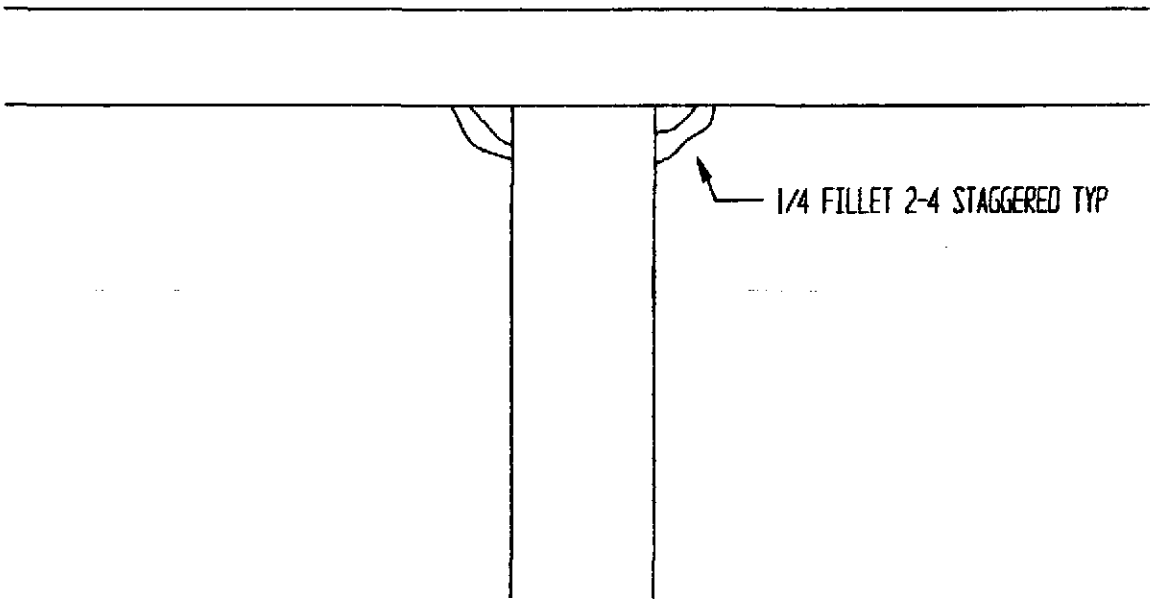
WELD # 30

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS#	
Plate Thks. or Pipe Size	1/4			
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 30



WDS 30

PAW WELD AS REQUIRED

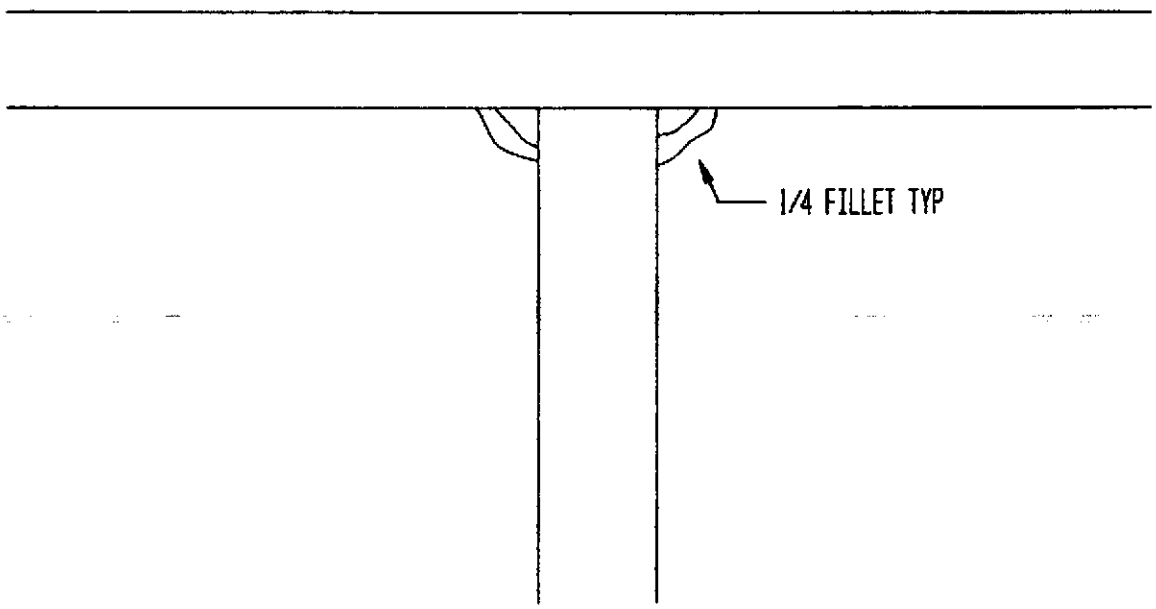
WELD # 31

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 153	
Plate Thks. or Pipe Size			5/8 - 1/2	
Bevel in Total Degress			50	
Land			.045	
Root Opening			1/16 - 3/32	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			30	
Wire Size/Type			3/32 - 1/8	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	190	22	3/32	
2nd					2nd	190	22	1/8	
3rd					3rd				
4th					4th				
5th					5th				

WDS 31



WDS 31

TIG WELD AS REQUIRED

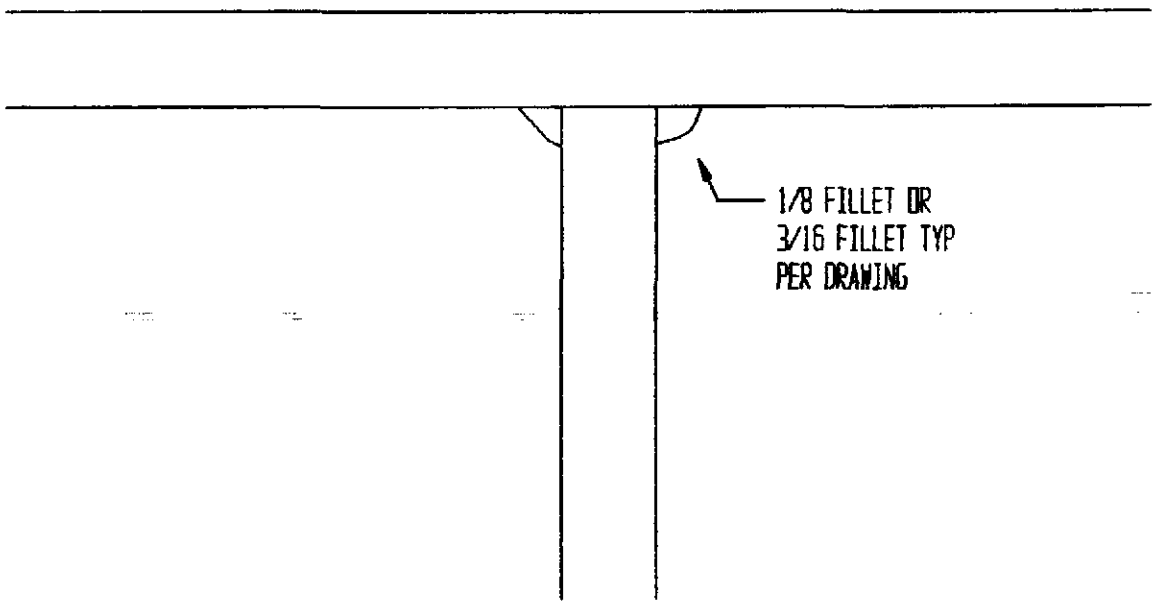
WELD # 32

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	Remarks	WPS# 153	
Plate Thks. or Pipe Size			1/2 - 1/2	
Bevel in Total Degress			50	
Land			.045	
Root Opening			1/16 - 3/32	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				Below
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He.75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			30	
Wire Size/Type			3/32 - 1/8	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	190	22	3/32	
2nd					2nd	190	22	1/8	
3rd					3rd				
4th					4th				
5th					5th				

WDS 32



WDS 32

TIG WELD AS REQUIRED

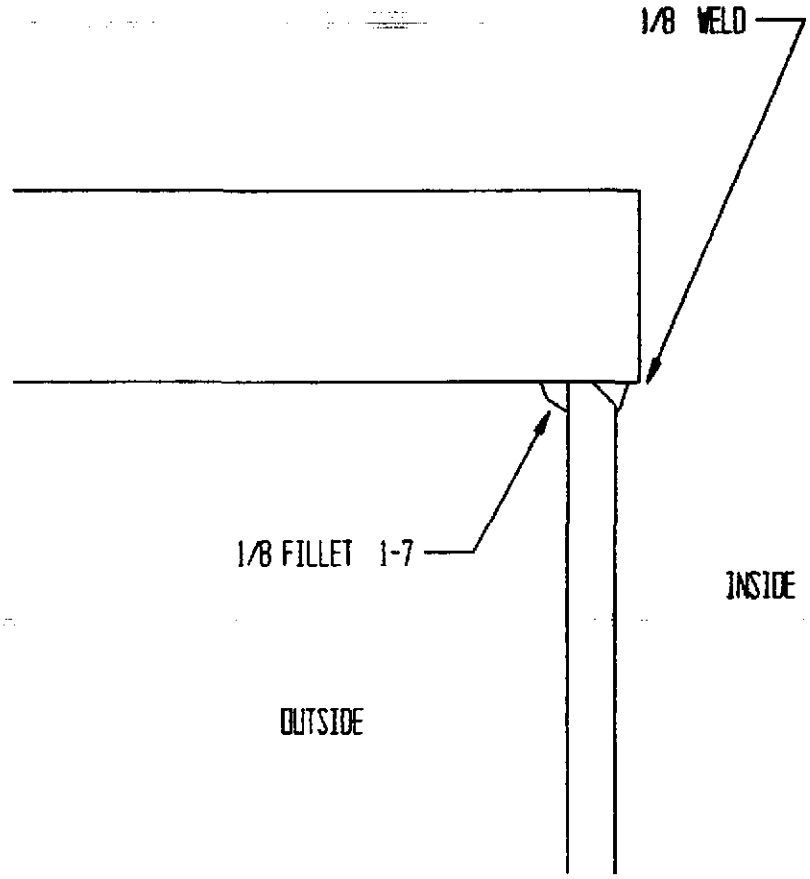
WELD #33

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS#**	
Plate Thks. or Pipe Size	1/4 - 1			
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 33



WDS 33

TACK OUTSIDE PER WELD SPACING
WELD INSIDE (PAW)
STITCH WELD OUTSIDE (PAW)

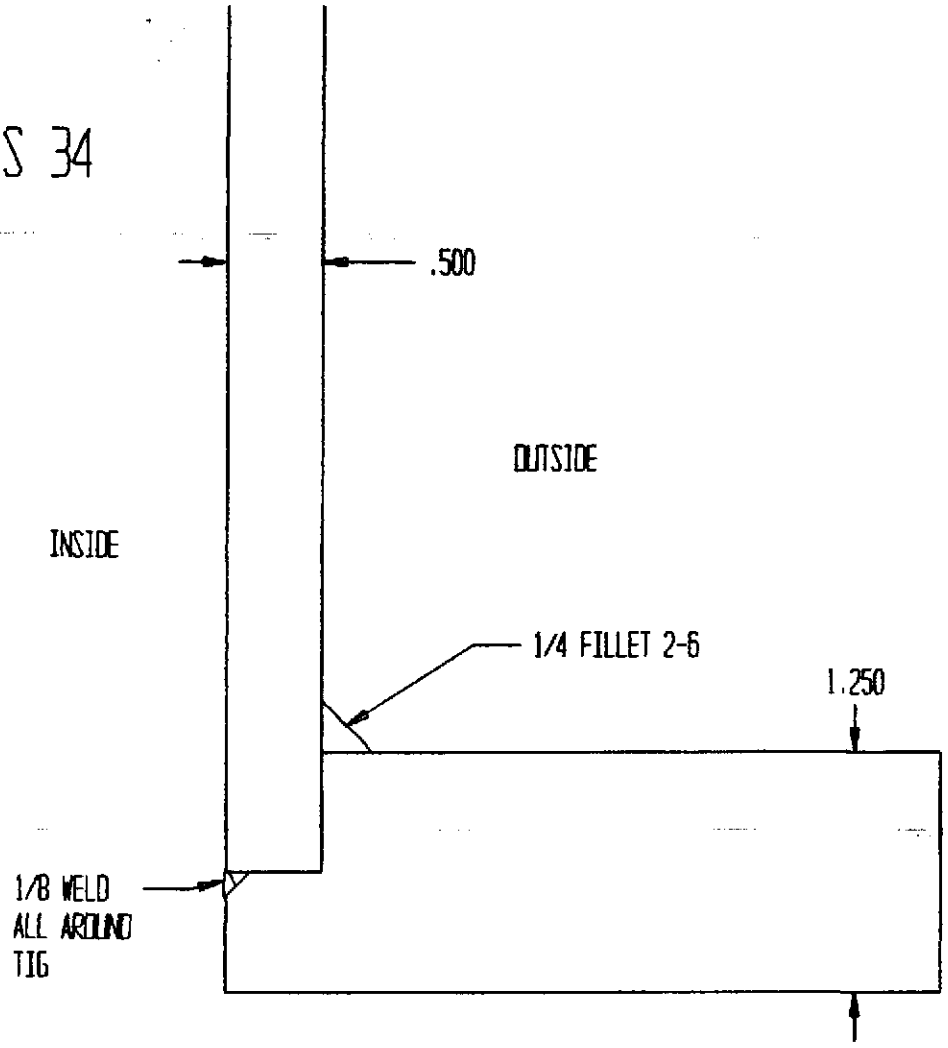
WELD # 34

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size	1/2 - 1 1/4		1/2 - 1 1/4	
Bevel in Total Degress	45		45	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				

WDS 34



WDS 34
TIG TACK OUTSIDE
TIG WELD INSIDE
PAW STITCH WELD OUTSIDE

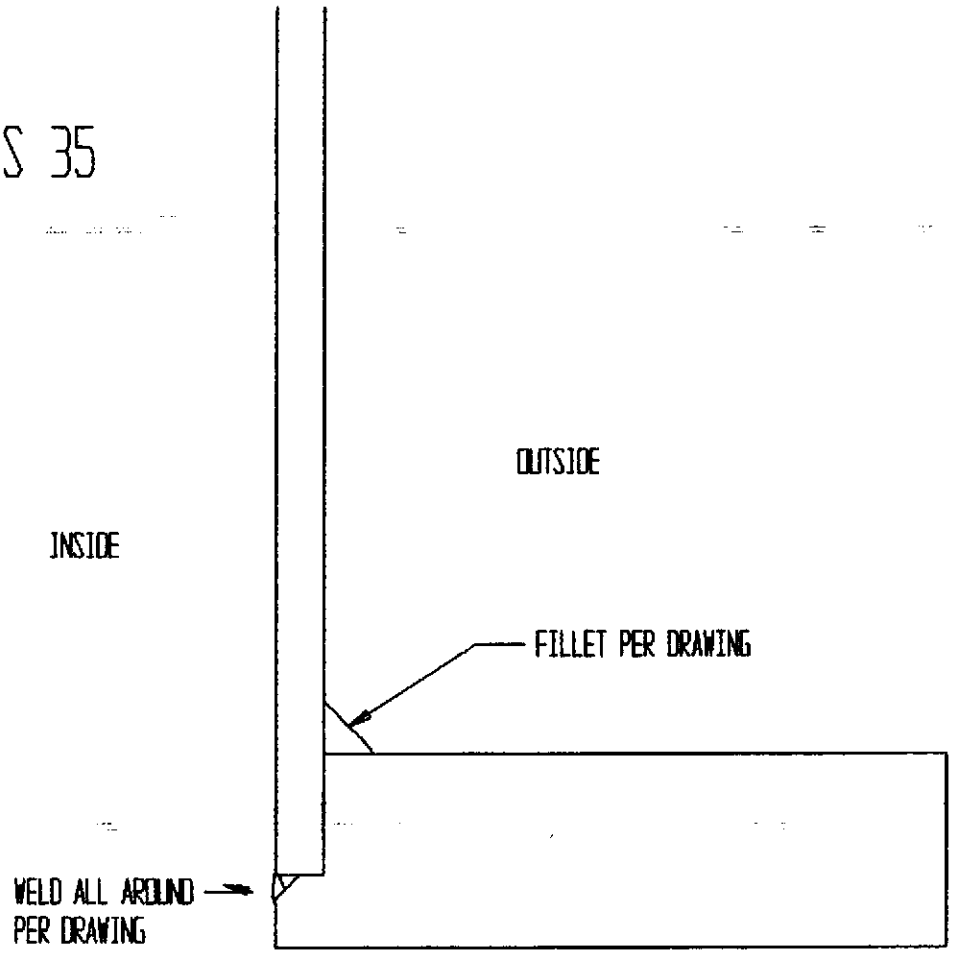
WELD # 35

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size	1/4 - 1		1/4 - 1	
Bevel in Total Degress	45		45	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A		350	
Tungsten Size	3/16		1/8	
Tungsten Set Back	Flush		N/A	
Cup Size	8-4088		8	
Tip Size/Number	.125/9-1892		N/A	
Pass or Pass Number		Below		Below
Amps Setting	180		190	
Volts	20		22	
Argon Gas	Plasma		Shield	
Argon/He 75%/25%	Shield		N/A	
Gas Flow CFH	20		30	
Gas Plasma Flow CFH	4 -5		N/A	
Purge Argon CFH	30		30	
Wire Size/Type	1/8 308L		1/8 308L	
Cleaning Technique	CO_2	Wire & Weld Zone	CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st	190	22	3/32	
2nd					2nd	190	22	3/32	
3rd					3rd				
4th					4th				
5th					5th				

WDS 35



WDS 35
TIG TACK OUTSIDE
TIG WELD INSIDE
PAW STITCH WELD OUTSIDE

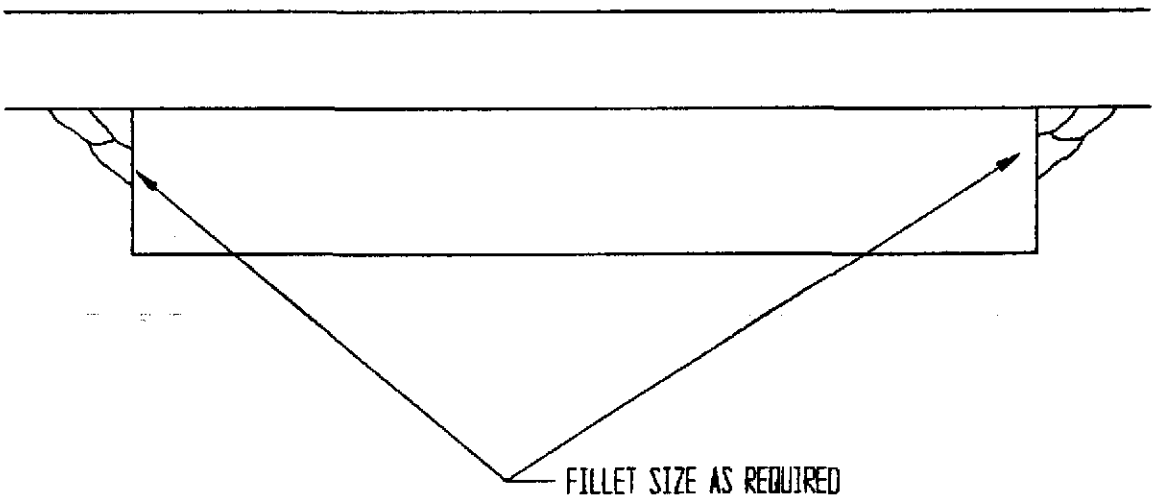
WELD # 36

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 150	Remarks	WPS#	
Plate Thks. or Pipe Size	1/2			
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size	4A			
Tungsten Size	3/16			
Tungsten Set Back	Flush			
Cup Size	8-4088			
Tip Size/Number	.125/9-1892			
Pass or Pass Number		Below		
Amps Setting	180			
Volts	20			
Argon Gas	Plasma			
Argon/He 75%/25%	Shielding			
Gas Flow CFH	20			
Gas Plasma Flow CFH	4 -5			
Purge Argon CFH	30			
Wire Size/Type	1/8 308L			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st	180	20	1/8		1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 36



WDS 36

PAW WELD AS REQUIRED

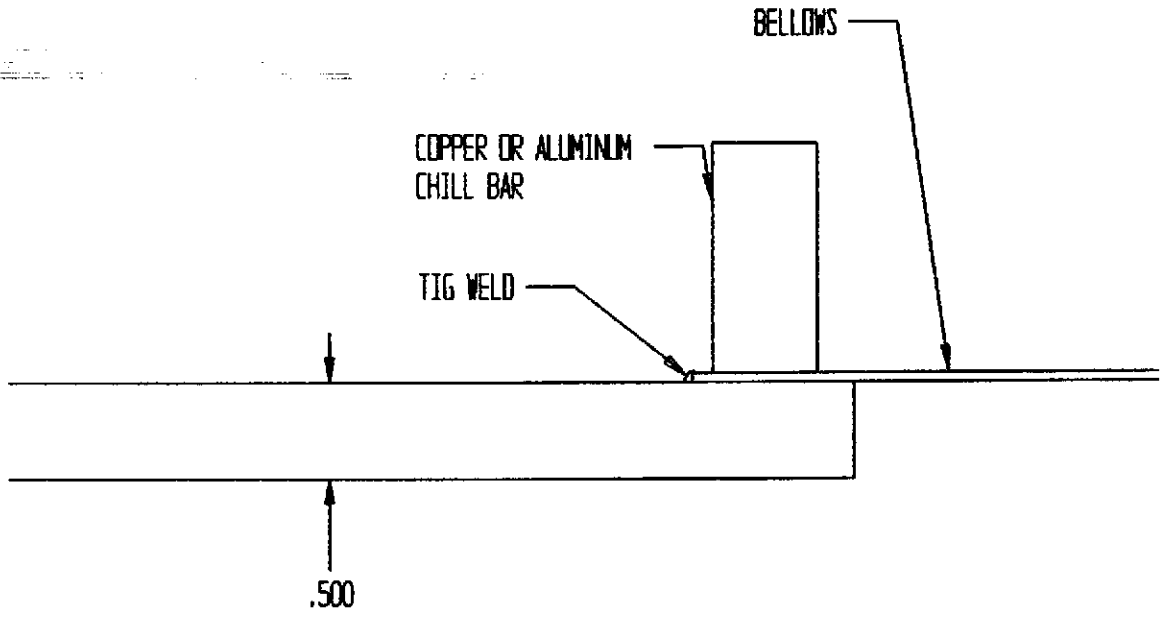
WELD # 37

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size				
Bevel in Total Degress				
Land				
Root Opening				
Root Pass TIG				
Root Pass Plasma				
Torch Size			250	
Tungsten Size			3/32	
Tungsten Set Back			N/A	
Cup Size			7	
Tip Size/Number				
Pass or Pass Number				
Amps Setting			100	
Volts			10	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH				
Wire Size/Type			1/16 308L	
Cleaning Technique			CO_2	Wire & Weld Area
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root				
1st					1st	100	10	1/16	
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 37



WDS 37
TIG WELD AS REQUIRED
USE CHILL BAR TO PREVENT

WELD # 38

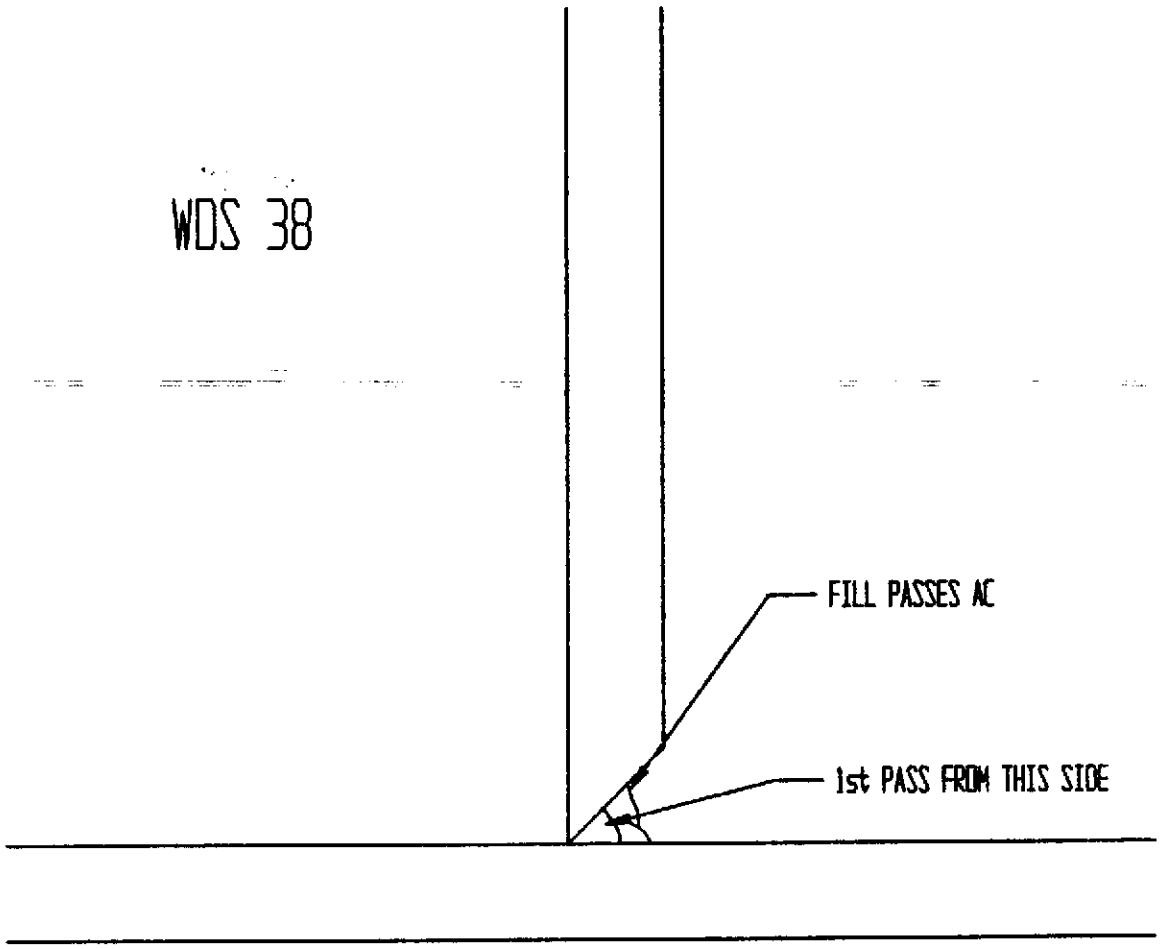
WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 1512**	
Plate Thks. or Pipe Size			3/8 - 1"	
Bevel in Total Degress			45	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			500	
Tungsten Size			1/8 - 5/32	
Tungsten Set Back				
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			250	
Volts			25	
Argon Gas			Shield Gas	75% He 25% AR
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			1/8 - 5/32	5/83
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#
Root				
1st				
2nd				
3rd				
4th				
5th				

GTAW	AMPS	VOLTS	FILLER	W#
Root	250	25	1/8-5/32	
1st	250	25	1/8-5/32	
2nd				
3rd				
4th				
5th				

WDS 38



WDS 38
TIG WELD 1st PASS AC PROCEDURE
FILL AS REQUIRED AC PROCEDURE

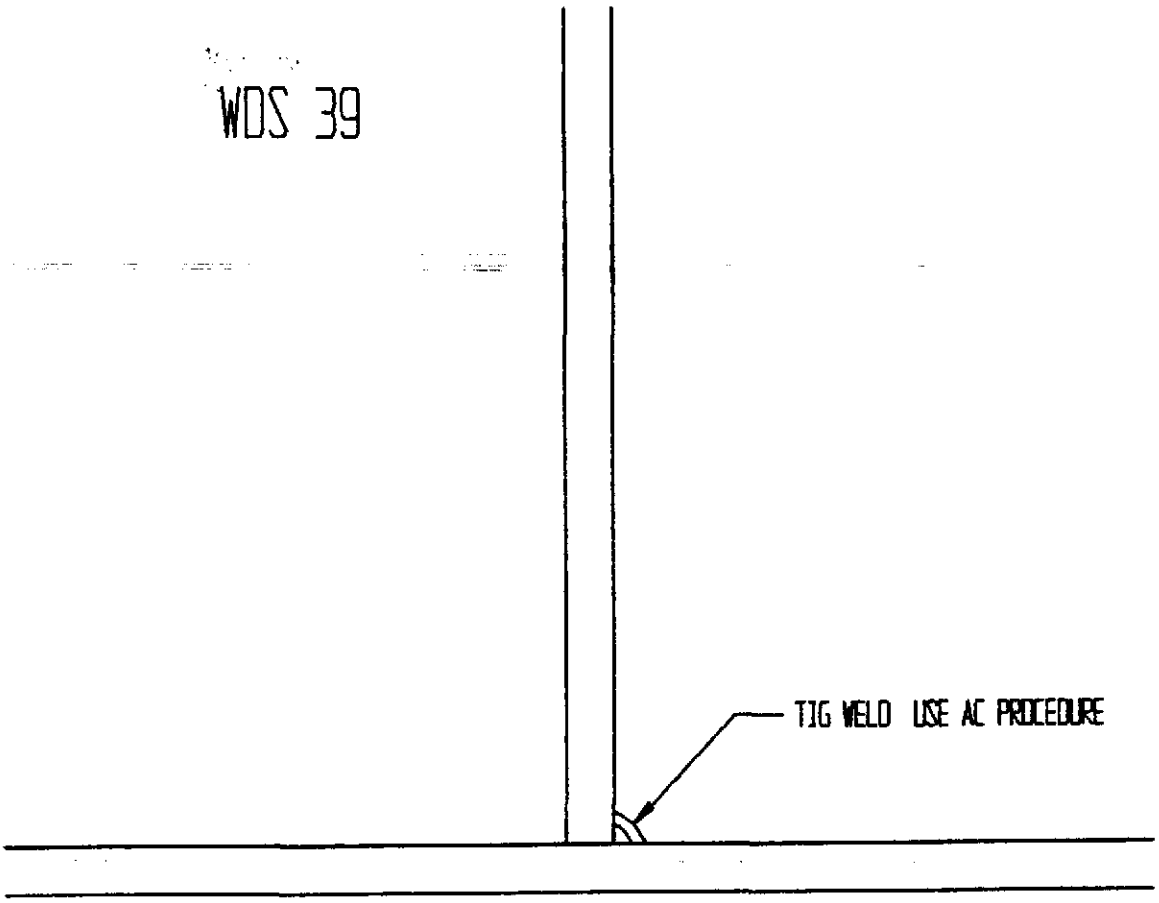
WELD # 39

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 1512**	
Plate Thks. or Pipe Size			1/8 - 1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			Yes	
Root Pass Plasma			N/A	
Torch Size			500	
Tungsten Size			1/8 - 5/32	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			190-250	
Volts			22-25	
Argon Gas			Shield Gas	75% He 25% AR
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			1/8	5/83
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	25	1/8	
1st					1st	250	25	1/8-5/32	
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 39



WDS 39
TIG WELD AC PROCEDURE
FILL AS REQUIRED

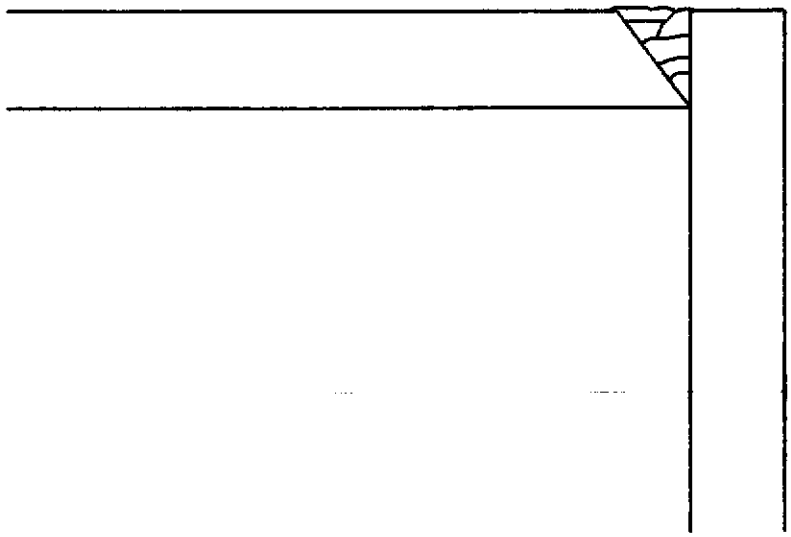
WELD # 40

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 1512**	
Plate Thks. or Pipe Size			1/2 - 5/8	
Bevel in Total Degress			45	
Land			0	
Root Opening			N/A	
Root Pass TIG			Yes	
Root Pass Plasma			N/A	
Torch Size			500	
Tungsten Size			1/8 - 5/32	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number			All	
Amps Setting			250	
Volts			25	
Argon Gas			Shield Gas	75% He 25% AR
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			1/8-5/32	5/83
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	250	25	1/8-5/32	
1st					1st	250	25	1/8-5/32	
2nd					2nd	250	25	1/8-5/32	
3rd					3rd				
4th					4th				
5th					5th				

WDS 40



WDS 40
TIG WELD AC PROCEDURE
FILL AS REQUIRED

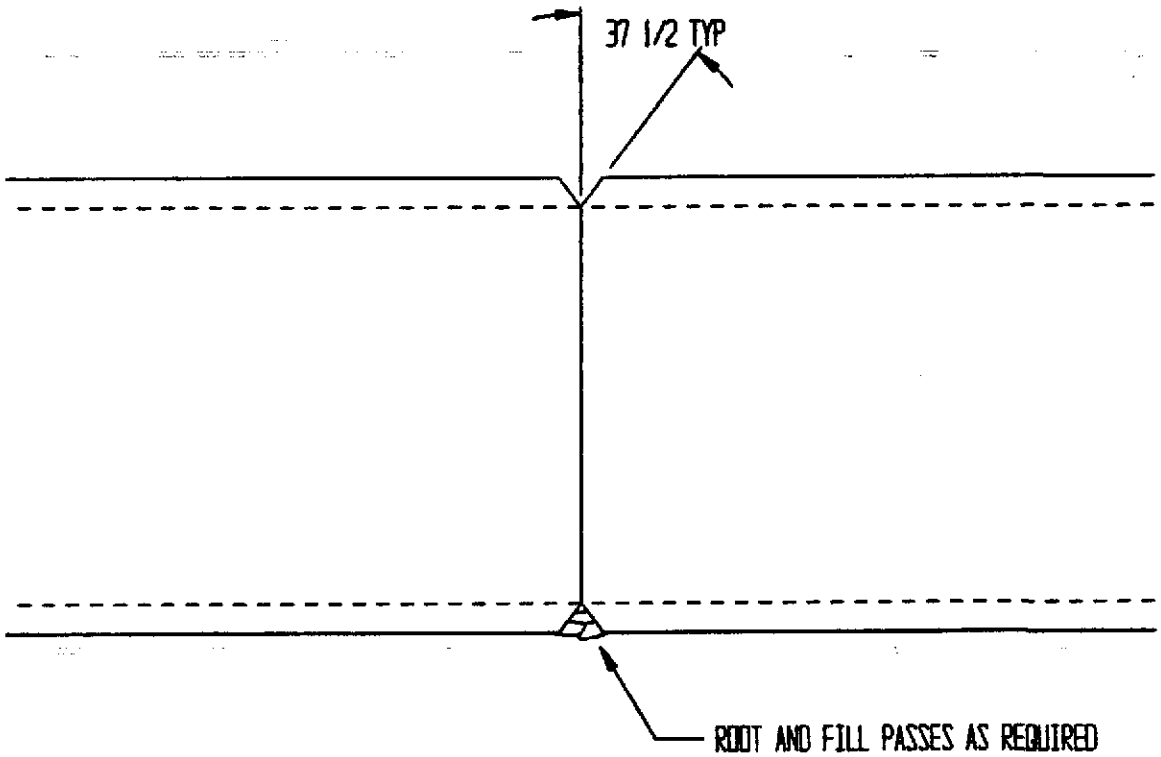
WELD # 41

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 1512**	
Plate Thks. or Pipe Size			1/8 - 3/8	
Bevel in Total Degress			75	
Land			0	
Root Opening			0	
Root Pass TIG			Yes	
Root Pass Plasma			N/A	
Torch Size			500	
Tungsten Size			1/8 - 5/32	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number			As Required	
Amps Setting			190-250	
Volts			22-25	
Argon Gas			Shield Gas	75% He 25% AR
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			1/8-5/32	5/83
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	170	22		
1st					1st	190	22		
2nd					2nd	190	22		
3rd					3rd				
4th					4th				
5th					5th				

WDS 41



WDS 41
TIG WELD AC PROCEDURE
FILL AS REQUIRED

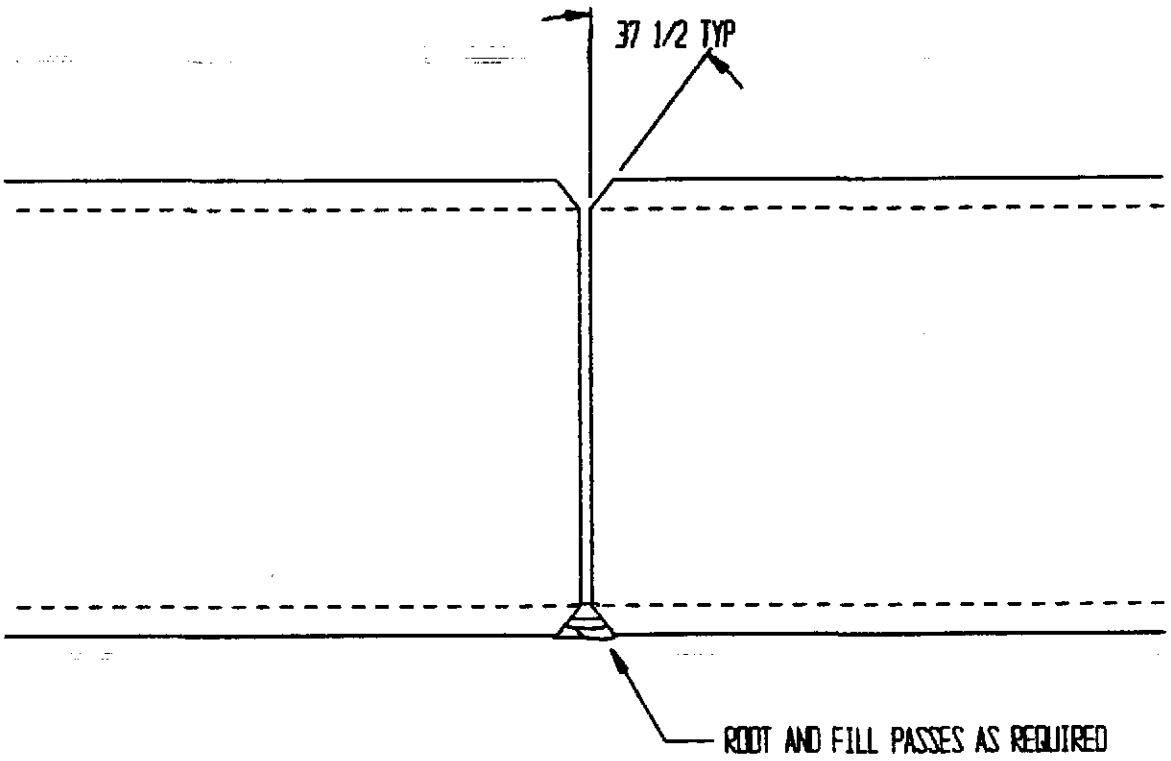
WELD # 42

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/8 - 3/8	
Bevel in Total Degress			75	
Land			1/16	
Root Opening			1/16-3/32	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			3/32-1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			150-190	
Volts			17-22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			15-30	
Wire Size/Type			1/16-3/32	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

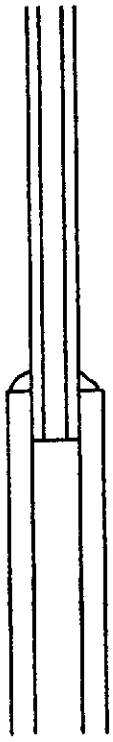
PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	150	17		
1st					1st	190	22		
2nd					2nd	190	22		
3rd					3rd				
4th					4th				
5th					5th				

WDS 42



WDS 42
TIG WELD DC PROCEDURE
FILL AS REQUIRED
WELD GAP 1/16-3/32
PURGE INSIDE WITH ARGON

WDS 43



WDS 43
TIG WELD DC PROCEDURE
FILL AS REQUIRED
2ND PASS WASH

WELD # 43

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/16 - 1/4	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			3/32-1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			150	
Volts			17	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH				
Purge Argon CFH			15-30	
Wire Size/Type			1/16	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	150	17		
1st					1st	150	17		
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

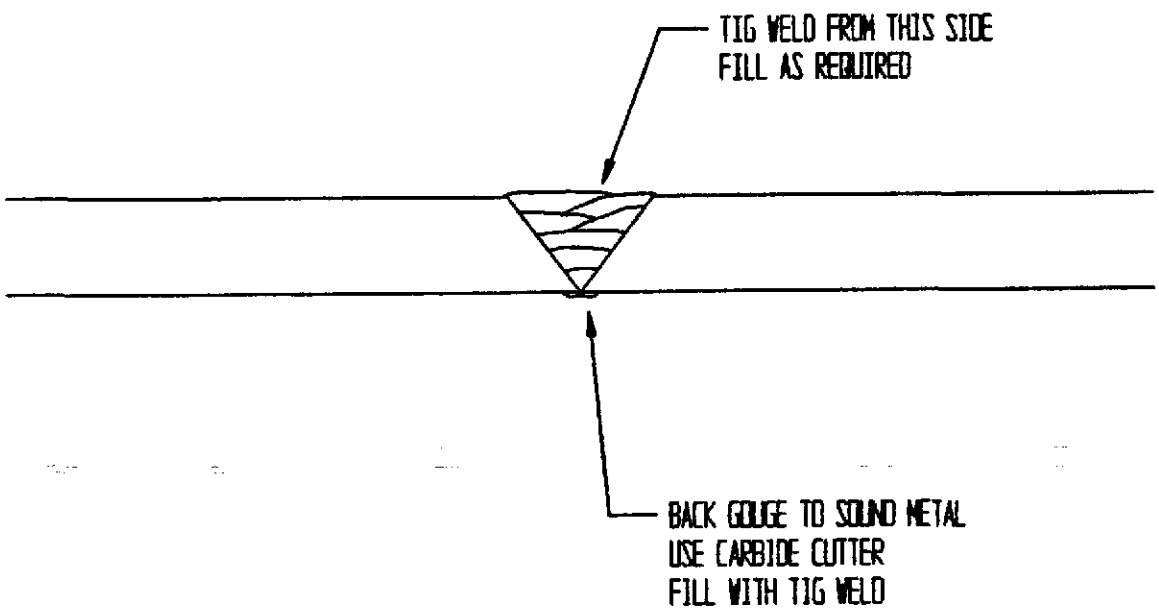
WELD # 44

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 1512**	
Plate Thks. or Pipe Size			1/2-5/8	
Bevel in Total Degress			75	
Land			0-1/16	
Root Opening			0	
Root Pass TIG			Yes	
Root Pass Plasma			N/A	
Torch Size			500	
Tungsten Size			1/8-5/32	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			230-250	
Volts			23-25	
Argon Gas			Shield Gas	75%He 25%AR
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH				
Wire Size/Type			1/8	5183
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	230	23	1/8	
1st					1st	250	25	1/8	
2nd					2nd	250	25	1/8	
3rd					3rd	250	25	1/8	
4th					4th	250	25	1/8	
5th					5th				

WDS 44



WDS 44
TIG WELD AC PROCEDURE
FILL AS REQUIRED
BACK GRIND AND FILL

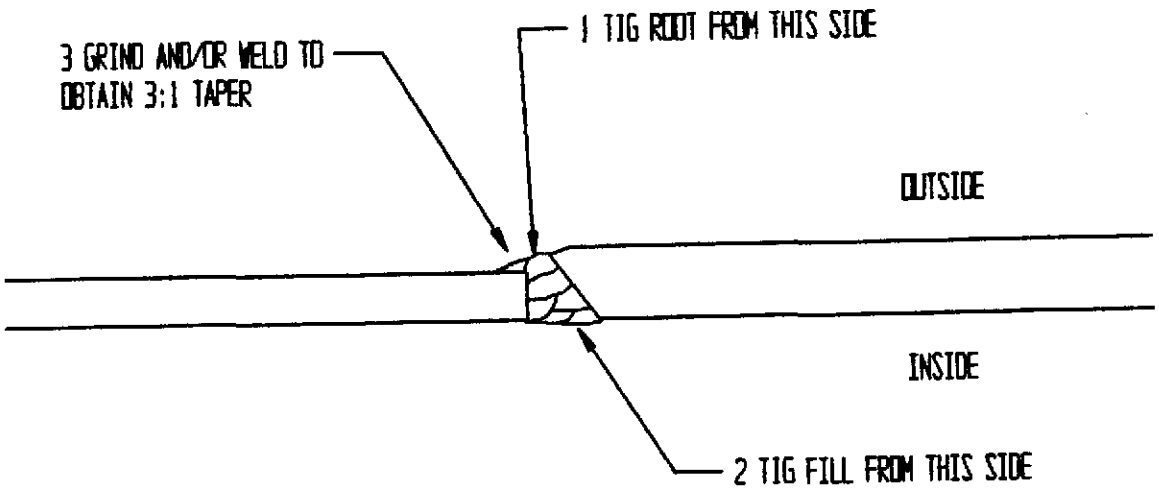
WELD # 45

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/4-3/8	
Bevel in Total Degress			45	
Land				
Root Opening			1/16-1/8	
Root Pass TIG			Yes	
Root Pass Plasma			N/A	
Torch Size			350	
Tungsten Size			3/32-1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			150-190	
Volts			17-22	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH				
Purge Argon CFH			20-30	Root Pass
Wire Size/Type			3/32-1/8	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	165	18	308L	
1st					1st	165	18	308L	
2nd					2nd	190	22	308L	
3rd					3rd	190	22	308L	
4th					4th				
5th					5th				

WDS 45



WDS 45
TIG ROOT FROM OUTSIDE
FILL AS REQUIRED FROM IN SIDE
GRIND AND/OR WELD TO OBTAIN
3:1 TAPER ON OUTSIDE

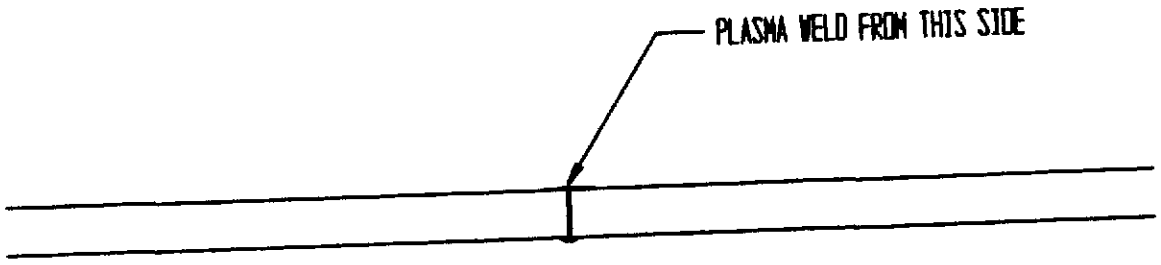
WELD # 46

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS# 155	**Remarks**	**WPS#**	
Plate Thks. or Pipe Size	1/4			
Bevel in Total Degress	None			
Land	N/A			
Root Opening	None			
Root Pass TIG				
Root Pass Plasma	Yes			
Torch Size	300			
Tungsten Size	3/16			
Tungsten Set Back	0.032-0.062			
Cup Size	8-4373			
Tip Size/Number	.125			
Pass or Pass Number	1			
Amps Setting	230			
Volts	23			
Argon Gas	Plasma			
Argon/He 75%/25%	Shield			
Gas Flow CFH	22			
Gas Plasma Flow CFH	5			
Purge Argon CFH	35			
Wire Size/Type	.045			
Cleaning Technique	CO_2	Wire & Weld Zone		
Cold Wire Feeder	WF-3	OK		
Wire Speed	0.32			
Continuous	Yes			
Retract	3.5			
Delay	No			
Pulse	No			

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root	230	23	308L		Root				
1st					1st				
2nd	180	20	1/8		2nd				
3rd	180	20	1/8		3rd				
4th					4th				
5th					5th				

WDS 46



WDS 46
PLASMA WELD SQUARE BUTT JOINT
TIG IRREGULARITES AS REQUIRED

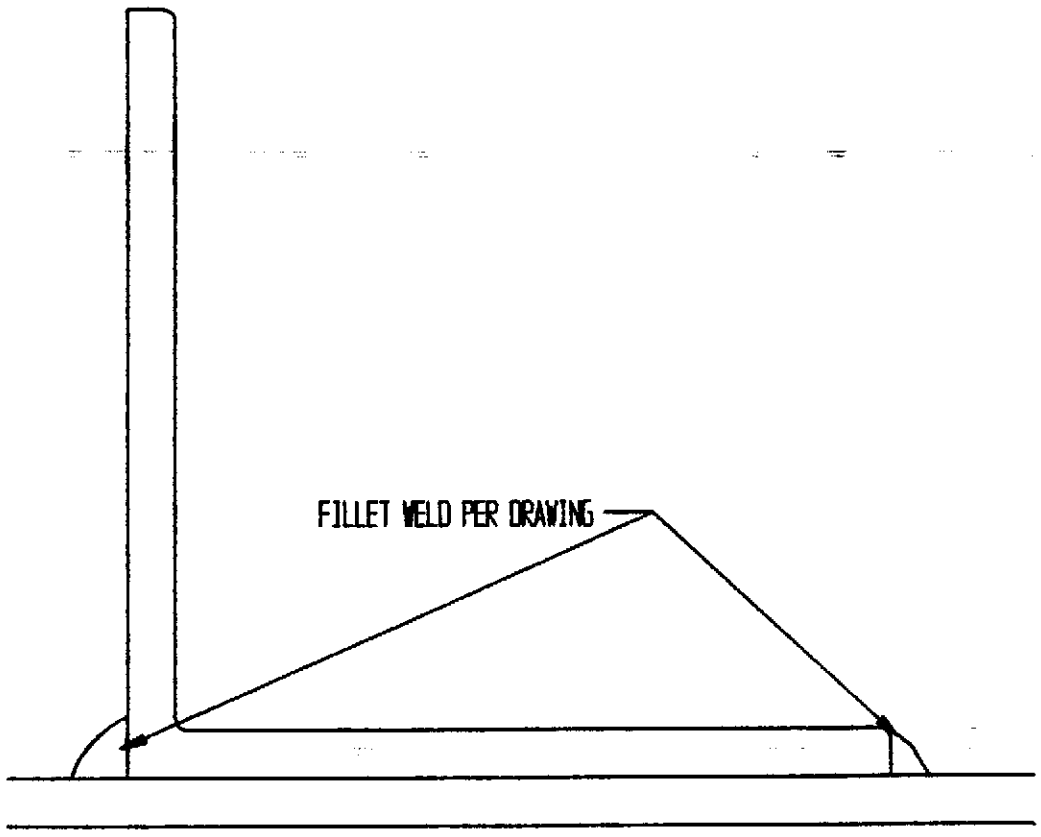
WELD # 47

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/4-1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening			N/A	
Root Pass TIG				
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH			N/A	
Purge Argon CFH			N/A	
Wire Size/Type			1/8 308L	
Cleaning Technique			N/A	
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	1/8	
1st					1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 47



WDS 47

TACK BOTH SIDES (TIG)
WELD BOTH SIDES ALTERNATING; END WELDS ON TACKS (TIG)

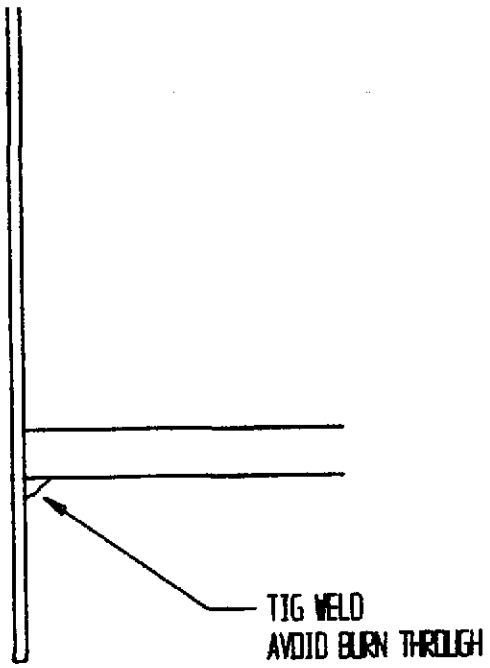
WELD # 48

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/16-1/4	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening				
Root Pass TIG			Yes	
Root Pass Plasma			N/A	
Torch Size			350	
Tungsten Size			3/32	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			150	
Volts			17	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH				
Purge Argon CFH			30	If Required
Wire Size/Type			1/16	308L
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	15	17	308L	
1st					1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 48



WDS 48
TIG WELD
AVOID BURNTHROUGH
IF REQUIRED PURGE THINNER MATERIAL WITH ARGON

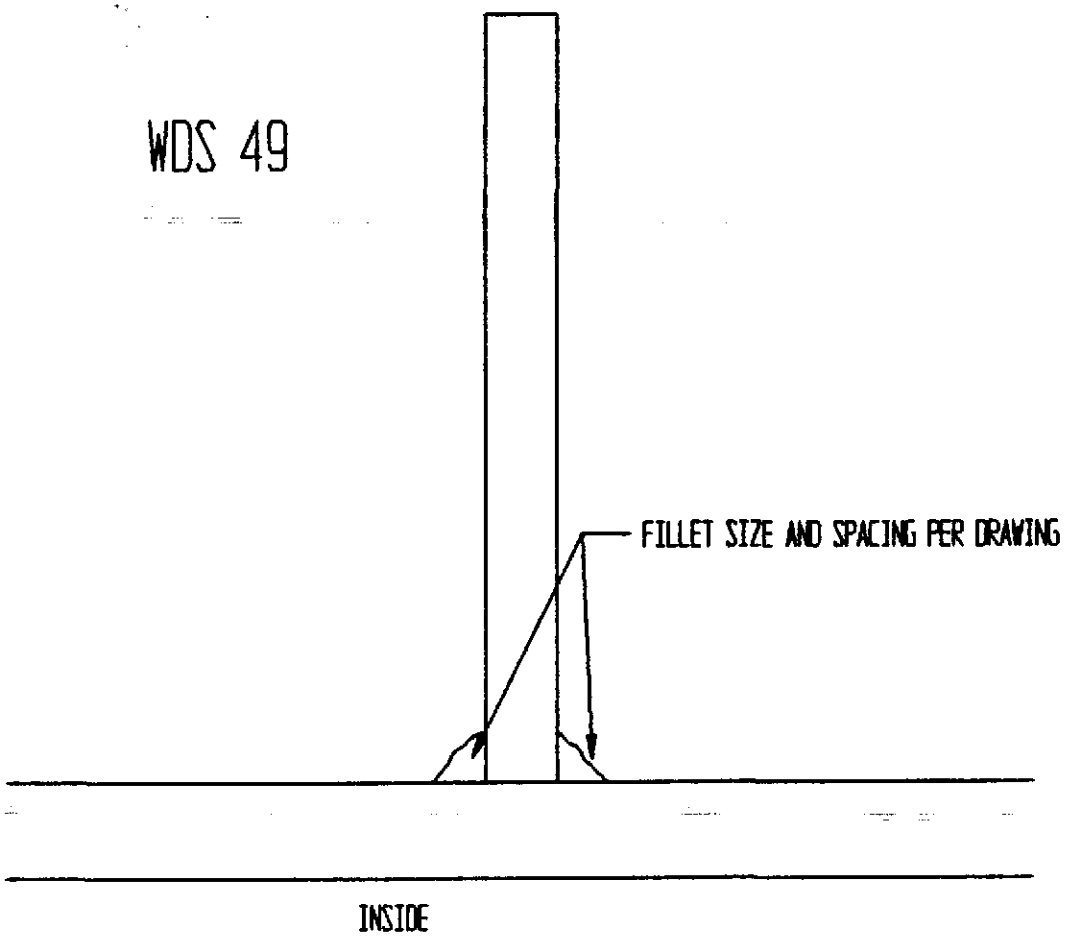
WELD # 49

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/4-1/2	
Bevel in Total Degress			N/A	
Land			N/A	
Root Opening				
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number				
Pass or Pass Number				
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%				
Gas Flow CFH			30	
Gas Plasma Flow CFH				
Purge Argon CFH			30	
Wire Size/Type				
Cleaning Technique			1/8 308L	
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	308L	
1st					1st				
2nd					2nd				
3rd					3rd				
4th					4th				
5th					5th				

WDS 49



WDS 49

TACK BOTH SIDES (TIG)
WELD BOTH SIDES ALTERNATING; END WELDS ON TACKS (TIG)

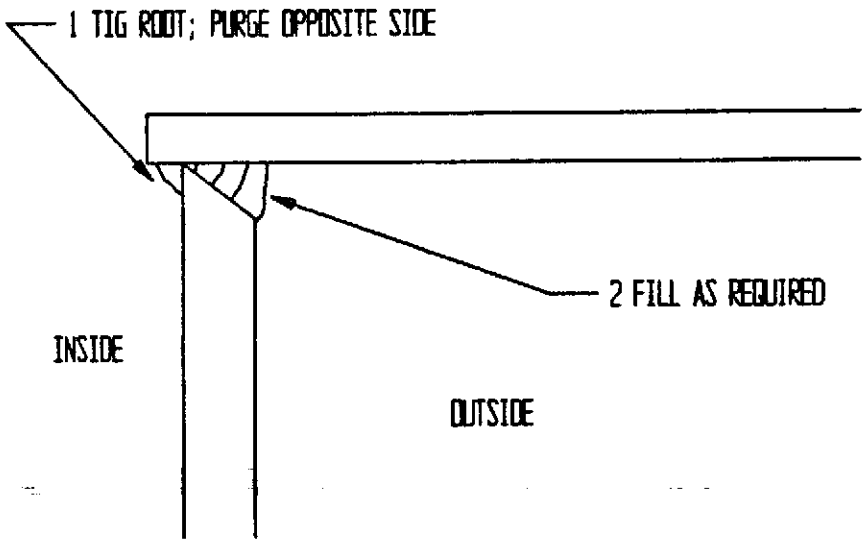
WELD # 50

WELD DATA SHEET

	PLASMA ARC WELDING P.A.W.		GAS TUNGSTEN ARC WELDING G.T.A.W.	
	WPS#	**Remarks**	**WPS# 073-3**	
Plate Thks. or Pipe Size			1/4 -1/2	
Bevel in Total Degress			37.5 - 45	
Land			0 - 1/16	
Root Opening				
Root Pass TIG			Yes	
Root Pass Plasma				
Torch Size			350	
Tungsten Size			1/8	
Tungsten Set Back			N/A	
Cup Size			8	
Tip Size/Number			N/A	
Pass or Pass Number				
Amps Setting			190	
Volts			22	
Argon Gas			Shield	
Argon/He 75%/25%			N/A	
Gas Flow CFH			30	
Gas Plasma Flow CFH				
Purge Argon CFH			30	
Wire Size/Type			3/32-1/8 308L	
Cleaning Technique			CO_2	Wire & Weld Zone
Cold Wire Feeder				
Wire Speed				
Continuous				
Retract				
Delay				
Pulse				

PAW	AMPS	VOLTS	FILLER	W#	GTAW	AMPS	VOLTS	FILLER	W#
Root					Root	190	22	308L	
1st					1st	190	22	308L	
2nd					2nd	190	22	308L	
3rd					3rd	190	22	308L	
4th					4th				
5th					5th				

WDS 50



WDS 50

TACK FROM INSIDE (TIG)
WELD FROM INSIDE; PURGE OUTSIDE (TIG)
FILL AS REQUIRED FROM OUTSIDE

PROCEDURE FOR

CLEAN ROOM ACTIVITIES

LIGO VACUUM EQUIPMENT

Hanford, Washington

and

Livingston, Lousiana

PREPARED BY: Thomas M. Stein

QUALITY ASSURANCE: Alan L Bradbook

MANUFACTURING ENGR:

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Brian Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	TMS 5-3-96	REB 5/3/96	RELEASED PER DEO 167

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number A V049-2-118	Rev.
	T. M. S.	5-3-96	REB	5/3/96		Ø

Title

PROCEDURE FOR CLEAN ROOM ACTIVITIES

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1.0 Purpose

2.0 General

3.0 Responsibilities

4.0 Procedure

Number

Rev.

SPECIFICATION

Number A V049-2-118 Rev. Ø

1.0 PURPOSE

The purpose of this procedure is to define the operational procedures to effectively perform manufacturing and testing in a Class 100 Clean Room environment.

2.0 GENERAL

The LIGO vacuum system performance is greatly influenced by the level of cleanliness of the vacuum surfaces. All components must be shipped to the site and installed without allowing contamination of the vacuum surfaces (flange faces and interior surface).

Once LIGO components are cleaned to UHV standards, they must be protected by a Class 100 clean room environment. This applies to assembly operations after UHV cleaning and to any subsequent inspections or other entry into the components.

All personnel must be trained in clean room procedures before entering the LIGO clean room areas. This includes viewing the Micron video tapes "Basic Contamination Control", "Robing for the Cleanroom", and "Behavior in the Cleanroom".

All clean room clothing (boots, gloves, gowns, hat covers, hoods, etc. shall meet Class 100 clean room standards.

Safety glasses shall be worn at all times.

3.0 RESPONSIBILITIES

The manufacturing department is responsible for training and execution of clean room protocol per this procedure. The Q.A. department shall monitor manufacturing and testing activities for compliance to this clean room procedure.

4.0 PROCEDURE

4.1 *Clean Room Access*

4.1.1 All personnel shall put on clean room clothing systems in an attached gowning room prior to entry into the Class 100 Clean Room. Personnel shall move from the first sticky mat (dirty) to the second sticky mat (clean) as they put on each shoe cover. All joints (glove to sleeve, pants to shoe cover). After gowning, personnel shall wait two minutes prior to entering the Class 100 area.

4.1.2 All soiled or damaged clothing shall be discarded.

4.1.3 Only clean tools and components shall be allowed inside the Class 100 Clean Room. All equipment used inside the Class 100 clean room shall be oil free and shall not generate particles above Class 100 levels.

4.1.4 Clean Room particle levels shall be monitored during clean room operations where a component is open or about to be opened.

4.1.5 Clean Room particle levels must reach Class 100 level before a cleaned component maybe opened for inspection or assembly.

4.1.6 New personnel shall not enter the Class 100 Clean Room while a component is open.

4.1.7 Proper cleanroom behavior shall be observed while personnel arein the cleanroom.

4.2 *Clean Room Exit*

4.2.1 All personnel shall exit the Class 100 area onto the clean sticky mat.

4.2.2 Shoe covers shall be removed one at a time while moving over to the "dirty" sticky mat.

4.2.3 Personnel shall remove the remaining Class 100 clothing and store in a "used clothing" storage area if not soiled or torn. Once the Class 100 clothing is removed, personnel shall leave the gowning room immediately.

CONTAMINATION CONTROL PLAN

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PROJECT ENGINEER: Thomas M. Stan

QUALITY ASSURANCE: ALAN BRADBROOK /RJB

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
1	DMW 11-15-96	RCG 11/15/96	RELEASE PER DEO 351
0	TMS 5-4-96	REB 5/4/96	INITIAL RELEASE PER DEO # 0170 FOR FDR

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE	APPROVED / DATE	Number A V049-2-119	Rev. 1
	T.M.S. 5-4-96	REB 5/4/96		

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1.0 Purpose
2.0 Responsibilities
3.0 Reference Documents
4.0 General
5.0 Hydrocarbon Control
6.0 Particulate Control

1.0 PURPOSE

This plan defines measures to be taken to limit contamination of the ultra high vacuum surfaces of the LIGO vacuum equipment during fabrication, assembly and installation by particulate and hydrocarbons.

2.0 RESPONSIBILITIES

2.1 Material vendors, PSI and its subcontractors shall handle materials in accordance with the various specifications relating to them. These specifications define measures to be taken to limit contamination, including by carbon steel.

2.2 Personnel performing cleaning operations shall be trained by the manufacturing engineering department in the proper procedures.

2.3 Personnel performing work inside cleanrooms shall be trained by the manufacturing engineering group in the required cleanroom procedures and behavior.

2.4 All personnel shall be trained by the manufacturing engineering department in the philosophy and specific provisions of this plan.

3.0 REFERENCE DOCUMENTS

The following documents shall be used in conjunction with this plan:

PSI Specification V049-2-015, Cleaning Procedure
PSI Specification V049-2-118, Cleanroom Activities
PSI Material Specifications

4.0 GENERAL

While it is critical that all vacuum surfaces (internal surfaces and flange faces) be kept free of contamination, exterior surfaces must also be kept clean. This will not only facilitate keeping the interior surfaces clean, but it is necessary in order to maintain the cleanrooms at Class 100. Care shall be taken to minimize exposure to corrosive environments, such as those containing chloride compounds.

5.0 HYDROCARBON CONTROL

5.1 Material vendors, PSI and its subcontractors shall handle materials in accordance with the various specifications relating to them. These specifications define measures to be taken to limit contamination, including by carbon steel.

5.2 Contact of stainless steel by uncontrolled materials shall be avoided. This includes materials such as work gloves, work boots and unprotected shop floors.

5.3 Liquids, gases or vapors containing hydrocarbons or other contaminants shall not be allowed to come into contact with the stainless steel at any time. This includes fluids such as machining lubricants.

5.4 Leak testing shall be done only with the use of oil-free vacuum pumps.

6.0 PARTICULATE CONTROL

6.1 Material Protection

Materials shall be handled in such a manner as to limit contamination, including by carbon steel. This includes the following precautions:

6.1.1 No carbon steel hooks, fork lift forks, grapples or chains shall be allowed to contact the stainless steel.

6.1.2 Raw materials shall not be stored in direct contact with materials of different composition, but shall be separated by suitable spacers or sheeting. Depending on the parts level of cleanliness (raw material vs. cleaned part).

6.1.3 Stored materials (raw materials or work in process) shall be protected from the shop atmosphere when not being handled (or worked on) by plastic sheets or similar protective covers.

6.1.4 During transportation, components shall be shrink wrapped in plastic and shipped in closed trucks or under tight fitting tarpaulins.

6.1.5 Finished components shall be shipped to the sites under vacuum.

5.2 Cleanrooms

From the time that a vessel or other component has received its final washing, it shall not be opened unless it is inside a Class 100 cleanroom.

5.2.1 During Assembly

Immediately after washing, components shall be moved directly into a cleanroom without being exposed to the shop atmosphere. In the cleanroom, the component shall be closed to protect it from particulate contamination. This closure may be by joining to a mating piece, installation of covers, or wrapping or double bagging in plastic. The closure shall not be breached unless the component is inside a cleanroom.

5.2.2 During Installation

Components shall be moved into position and prepared to the greatest extent possible before breaching the protective wrapping or bagging. The outer protection is then removed, and a portable soft-wall cleanroom is moved into position over the component before it is opened. Once the cleanroom is in position and a Class 100 environment is established, Class 100 air is used to break the vacuum inside the component. Once atmospheric pressure has been reached, covers may be removed for final installation of the component. The component and all of its access ports and openings shall be closed or connected to another component before the cleanroom can be moved or shut down.

RAW MATERIAL HANDLING PROCEDURE

LIGO VACUUM EQUIPMENT

Hanford, Washington

and

Livingston, Lousiana

PREPARED BY: Thomas M. Stern

QUALITY ASSURANCE: ALAN BRADBROOK/REB

MANUFACTURING ENGR: [signature]

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
0	TMS 5-4-96	D. McW	INITIAL RELEASE PER DEO # 0170 FOR FDR

PROCESS SYSTEMS INTERNATIONAL, INC.					SPECIFICATION	
INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number A V049-2-120	Rev. 0
	T.M.S.	5-4-96	REB	5/4/96		

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1.0 Purpose

2.0 General

3.0 Responsibilities

4.0 Procedure

Number

Rev.

SPECIFICATION

Number A V049-2-120 Rev. Ø

1.0 PURPOSE

The purpose of this procedure is to define the requirements for handling and storing LIGO raw material.

2.0 GENERAL

This procedure is applicable to all LIGO vacuum boundary and vacuum internal component raw materials.

Contamination of LIGO vacuum surface materials must be prevented during receiving, storage and fabrication in order for the vacuum system to achieve its design goals. Contamination is defined as any foreign material (carbon steel, oil, grease, etc.) which could come in contact with the 304/304L S.S. and aluminum.

3.0 RESPONSIBILITIES

The receiving department is responsible for preventing contamination during receiving and storage of the raw material.

The manufacturing department is responsible for preventing contamination during the fabrication process.

4.0 PROCEDURE

4.1 Receiving

4.1.1 All LIGO Vacuum Boundary Material (304/304L S.S.) shall be handled (i.e. lifted, rolled, etc.) without coming in contact with carbon steel or other contaminants.

4.2 Storage

4.2.1 Vacuum Boundary material shall be stored indoors and shall be protected from carbon steel, hydrocarbon and other types of contamination.

4.3 Fabrication

4.3.1 Raw materials shall be protected from contamination throughout the fabrication process. All welding and fitting shall be done in clean manufacturing space (Class 100,000 - 200,000) with outside air purge to minimize contamination. Welding gases shall be collected in exhaust systems and vented outside.

4.3.2 No solvent wiping, grinding or wire brushing shall be done to the vacuum surfaces.

4.3.3 All machining fluids shall be water soluble and low in chlorides.

4.3.4 Welding wire and joints shall be cleaned with a CO_2 spray prior to welding.

4.3.4 After Ultra High Vacuum (UHV) cleaning, vacuum surfaces shall not be touched by skin or other contaminants. All cleaned vacuum boundary components shall be sealed (vessels with covers on), double plastic bagged or protected by a Class 100 Cleanroom atmosphere at all times.

4.4 Smoking is not allowed in any LIGO storage or manufacturing area.

PROCEDURE FOR VERIFYING COMPONENT DIMENSIONAL ACCURACY

LIGO VACUUM EQUIPMENT

Hanford, Washington

and

Livingston, Lousiana

PREPARED BY: Raymond D. Cutler

QUALITY ASSURANCE: Allan L Bridwell

MANUFACTURING ENGR: David M Gr

TECHNICAL DIRECTOR: D. M. Williams

PROJECT MANAGER: Richard Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	GS		Release for Fab Per DEO #0302
Ø	ROC	REB 5/3/96	RELEASED PER DEO 167

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED / DATE	APPROVED / DATE	Number A V049-2-121	Rev.
	R Cutler 5/3/96	REB 5/3/96		Ø

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1.0 Purpose

2.0 General

3.0 Responsibilities

4.0 Procedure

Number

Rev.

SPECIFICATION

Number A V049-2-121 Rev. Ø

1.0 PURPOSE

The purpose of this procedure is to define the activities required to verify dimensional accuracy of LIGO fabricated components.

2.0 GENERAL

LIGO components shall be inspected during and after fabrication to verify dimensional accuracy. All components shall be inspected to dimensions and tolerances given on the fabrication drawings.

3.0 RESPONSIBILITY

The Quality Assurance Department is responsible for inspecting and verifying LIGO component dimensional accuracy.

LIGO vessels manufactured by outside machine shops shall be inspected at the vendor while on the N.C. machine.

PSI fabricated components will be inspected in the PSI shop to verify dimensional accuracy. An electronic surface gauge shall be used to verify and record all o-ring sealing surface finishes (32 finish).

4.0 PROCEDURE

4.1 Outside Vessel Fabrication

The fabricated vessel shall be inspected during manufacture and at the Final Acceptance as detailed in the vessel Q.A. plan. The final inspection of the vessels shall be done on the N.C. machine. The fabrication drawings shall be used as the acceptance criteria. A discrepancy report shall be prepared for all non-conformances.

A PSI Q.A. (or engineering) representative shall witness and signoff all final inspections.

LIGO shall be notified five days prior to final inspections.

4.2 PSI Shop Fabrication

PSI fabricated vessels shall be inspected during manufacturing and at final assembly as detailed in the component Q.A. plan.

A Q.A. (or engineering) representative shall witness and signoff all final assembly inspections. The fabrication drawings shall be used as the acceptance criteria. A discrepancy report shall be prepared for all non-conformances.

SPECIFICATION FOR VITON VACUUM BAKEOUT

LIGO VACUUM EQUIPMENT

Hanford, Washington and Livingston, Louisiana

JOB NO. V59049

PREPARED BY: S Motter

QUALITY ASSURANCE: ALAN BRADBROOK/RES

TECHNICAL DIRECTOR: D. a. mcW illiams

PROJECT MANAGER: Richard Bagley

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
ϕ	SM 5/4/96	RE3 5/4/96	INITIAL RELEASE DEO 0162

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED SM	DATE 5/4/96	Approved RE3 DATE 5/4/96	Number: A V049-2-122 / Rev. 0

1.0 PURPOSE

The purpose of this specification is to outline the procedure to be used to vacuum bake Viton O-rings for UHV service.

2.0 GENERAL

This specification will be periodically updated as bakeout parameter data becomes available. Testing will be performed by PSI to develop a bakeout procedure that yields the best properties for Viton O-rings in UHV service,namely,low outgassing and high reliability.

3.0 RESPONSIBILITY

It shall be the responsibility of the project engineer , PSI manufacturing , and QA personell assigned to the Viton bakeout program to ensure that all procedures required by this specification are performed.Data sheets and test results for each lot of Viton that is processed will be signed and archived for future reference.

4.0 VITON BAKEOUT PROCEDURE

1.Prepare the following Viton bakeout system equipment for operation:

Vacuum chamber
Vacuum pumps
Heating system
Cryotrap and LN2 system
Instrumentation and controls

2.Load the Viton O-rings into the vacuum chamber using clean room techniques to prevent contamination of the chamber or Viton.*Log lot no.,quanties and sizes.*

3.Close up chamber.

4.Start rough pumping chamber .*Log time and ambient temperature.*

5.Continue rough pumping until pressure reaches ≤ 0.1 torr.*Log time,chamber pressure.*

6.Start cryotrap LN2 supply.*Log time, chamber pressure.*

7.Start turbomolecular pump when pressure reaches 0.05 torr. *Log time,chamber pressure*

8.When chamber pressure appears to have leveled off,start heating the chamber.The initial temperature set point is 40.C. *Log time,temp.,heater power, chamber pressure.*

9.The chamber temperature must be slowly ramped up to help achieve uniform heat distribution and sample "soaking".Colder areas of the chamber (typically flanges and thicker sections) may condense vapors.The maximum temperature set point to be achieved is 150 C.The temperature set point should be ramped up at 20 C / hr. *Log time ,set point, temp.,heater power, chamber pressure* hourly and each time the temperature set point is changed.

Caution! Dangerous byproducts may be formed if Viton is heated to a temperature greater than 200C

10.Once the maximum temperature is achieved ,the goal is to maintain this temperature until the pressure decays to an asymptotic minimum. *Log time,set point,temperature,pressure every 2 hrs.*

11.Cooldown requires that the temperature is slowly ramped down at 20.C/hr. avoiding cold spots as before.Pressure may drop during cooldown .*Log time,set point,temperature,pressure every hour.*

12.Cooldown is complete when the chamber temperature is at ambient and the pressure has been stable for 1 hour.*Log* final readings when cooldown is complete.

13.Isolate chamber and shutdown vacuum pumps.

14.Cryotrap remains cold until serviced.

15.Vent chamber with dry air or GN2.

16.Vent vacuum pumps with dry air or GN2.

17.Remove Viton O-rings from the chamber using clean room procedures.Visually inspect , bag and label the O-rings. Prepare a sample for durometer testing.

18.Service cryotrap.

Caution! Contents frozen in cryotrap should be considered hazardous waste and must be handled and treated accordingly.

19.Clean the vacuum chamber in preparation for the next lot.

Caution! Deposits found in the chamber should be considered hazardous waste and must be handled and treated accordingly.

Title: SPECIFICATION FOR VITON VACUUM BAKEOUT

VITON BAKEOUT DATA SHEET

Lot no. _____ Size _____ Quan. _____ Size _____ Quan. _____ __
Date _____ Size _____ Quan. _____ Size _____ Quan. _____
By _____ Size _____ Quan. _____ Size _____ Quan. _____

	1	2	3	4	5	6	7
Date/Time							
Pressure							
Temperature							
Set Point							
Htr.Power							
LN2 level							
Turbo Pump							
Rough Pump							

Remarks _____

_____

_____

SPECIFICATION

Number: **A** V049-2-122 | Rev.0

COMPONENT PACKAGING, HANDLING AND SHIPPING

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington

and

Livingston, Lousiana

PREPARED BY: DAVID EVERS/REB

MANUFACTURING ENGR: N/A

QUALITY ASSURANCE: ALAN BRADBROOK/REB

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bayer

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	D.E. 5/6/96	REB 5/6/96	RELEASE PER DRO 176

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE D. E. 5/6/96	APPROVED DATE REB 5/6/96	Number A V049-2-123	Rev. Ø

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1.0 Purpose

2.0 Shipping

3.0 Handling

ATTACHMENTS

1. Typical Module Weight And Center Of Gravity

1.0 PURPOSE

The purpose of this procedure is to provide basic guidelines for the safe transfer of vacuum equipment and components to the customer sites.

2.0 GENERAL

The primary objective of this procedure is to:

1. Provide sufficient supports to prevent damage to vacuum equipment and system components.
2. Provide protective closers on spools and valves.
3. Assure that the crates are strong enough to stand shipping and handling hazards.
4. Assure that the crated equipment and components are properly packed and fastened, and that the contents of each container is properly identified on a packing list.
5. Make packages and crates water tight and gas tight to prevent damage from the elements.
6. Provide identification of the equipment and parts shipped including warning notes on crates and boxes.

Crates And Crating

Crates shall be designed and constructed to comply with the military specification MIL-C-104B, Crates, Wood; Lumber and Plywood Sheathed, Nailed and Bolted.

The above specification provides reference tables relating weight of the objects to be crated, size of the crate and size of the crate frame members. It should be noted that crates constructed to MIL-C-104 specification develop their full strength after the side panels and top are installed in place. The specification also provides ample amount of sketches of the crate construction details.

The following points should be observed in the construction of crates:

The crate fabricator should be provided with information on each crate specifying the weight of the object to be crated, the internal dimensions of the crate (the crate shall clear the object by 2" on all sides) and any special data that may useful such as the internal crossbracing of equipment.

The maximum allowable span dimension between skids and other frame members shall be avoided.

Rubbing strips of 4" thick lumber shall be installed on the underside of the crate bases to provide for sling and forklift truck handling.

Sufficient reinforcing joists of proper size shall be on the crate tops in the center of balance area to prevent crushing of the crate when it is lifted with a single set of slings.

Crate liners shall be applied between the sheathing and the frame member of sides, ends and top. The liner material shall be polyethylene film at least 6 mils thick or any other approved waterproof material.

Visqueen polyethylene film and bags are both available in various widths and sizes and are readily from a variety of sources. This is a good choice for use as an initial layer of protection.

No ventilation holes shall be provided in the crates.

Drain holes shall be provided in the crate bases.

Crating Of Piping, Spools, Valves And Miscellaneous Items

Pipes, spools and valves with ends protected by pipe caps or blind flanges shall be secured to crates to prevent any movement during handling and shipment. In regard to large valves and automatic valve operators, each one shall be wrapped with water tight polyethylene enclosures. Small valves, bolting, and other small items can be wrapped in polyethylene bags and packed in water tight boxes. All items shall be properly marked.

Items To Be Removed And Crated Separately

Delicate items such as small automatic valves, instrumentation and automatic valve operators should be removed and crated or covered with water tight wrapping, plywood or sheet metal.

Stretch Wrapping

Stretch wrap (6 mil plastic) is available in various widths from 2" to 36" with hand applicators for wrapping of various components.

3.0 SHIPPING

Truck Transport

All vessels and components shall be transported on tractor/trailer combinations equipped with air ride suspensions.

Shipping Considerations For Components

The primary objective in the preparation of components for shipping is to minimize the chance for damage shipping can induce. Thoughtful planning is required in considering the causes of potential damage and its prevention.

The following recommendations shall be considered in preparing components for shipping:

All pipes, nozzles, flanges and so forth, shall be sealed. Various methods and materials may be used, but all must be watertight. All components shipped under vacuum shall be marked with warning labels.

Suitable lifting lugs, correctly orientated to the shipping face, shall be provided and identified as the lift and or tie down points.

At times there may be special tie-down lugs required for securing a component on particular transport, or bigger holes may be required on the lifting lugs to accommodate the lifting equipment at particular site. Such requirements will be known after the PSI Project Manager has submitted the component shipping drawings to the shipping concern, and the transporter has been selected.

Two point loading with substantial shipping saddles evenly spaced about the center of gravity in areas of relative stiffness, such as external or internal stiffening rings, internal structural members, or near shell seams. Avoid supporting components at the mid-span of unsupported shells.

All shipments of components utilizing more than two point loading shall have the review and approval of the LIGO Project Manager.

Supports shall be as wide as required to distribute the load on the shell, but shall not be less than six (6) inches wide.

Supports shall only be the minimum height required to clear protrusions and stay within the shipping envelope.

Supports shall be attached to the vessel. If wooden saddles are used they should be banded to the vessel. If steel saddles are used, they should be bolted to rings.

Use nylon slings for lifting. The use of chains is prohibited.

The type of transporter used will affect the design of supports.

Protective Storage And Identification

Completed components shall be securely stored to prevent inadvertent movement (rolling). All nozzles shall be protected. Once protected, these components shall be stored indoors.

Any parts removed for shipping shall be clearly labeled. A loose parts list shall be generated and given to the person who will coordinate the delivery of these parts to the customer sites. The loose parts list shall accompany the shipping documents.

Marking and Special Instructions

Establishment of a good marking system and good records is critical.

Identification shall be durable. The use of hand embossed metal tags produced on a Dymo tape writer is recommended where space is the limiting factor. In all other cases, stencil painting or writing with unwashable ink is recommended. Use of photographs showing details of equipment before disassembly is strongly recommended. A picture of each crate should be taken prior to closing the lid and side walls where applicable.

4.0 HANDLING

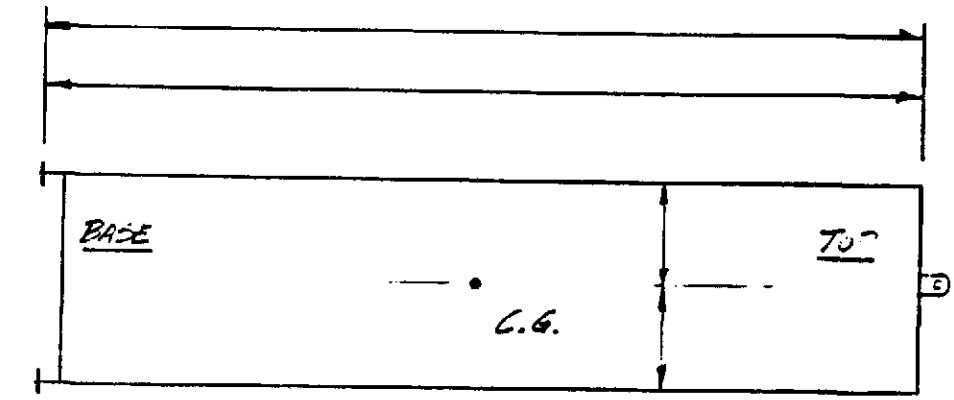
All LIGO components shall be handled (i.e. lifted, pulled, etc.) per the vessel handling data sheet. This sheet will detail weight, center of gravity, spreader beam requirements, offloading instructions, etc.

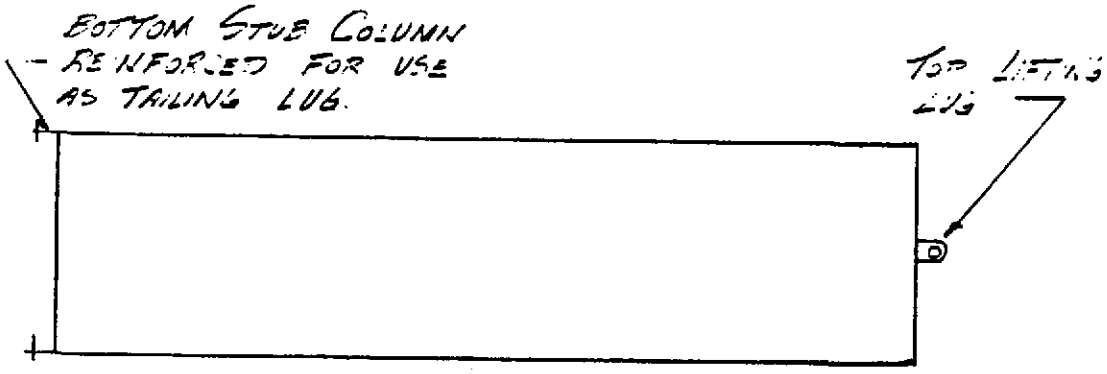
Special shipping instructions such as "USE SPREADER BAR WHEN LIFTING" or shipping weight should be painted in the proper places and detailed instructions attached to the vessel if applicable. (See Attachment 1).

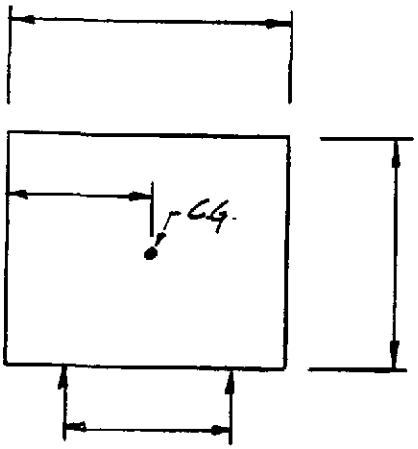
SAMPLE

PROCESS SYSTEMS INTERNATIONAL INC.
20 WALKUP DR. WESTBOROUGH, MASSACHUSETTS 01581 USA
(508) 366-9111 / TELEX 92-0331

ENGINEERING
MADE BY: _____ CHK'D _____
DATE: _____ APPV'D _____







SECTION A-A.

SHIPPING WEIGHT = _____ #

LIFTING & ERECTION WEIGHT = _____ #

REVISION:	A	B	C	D	E	F
CHK'D:						
DATE:						

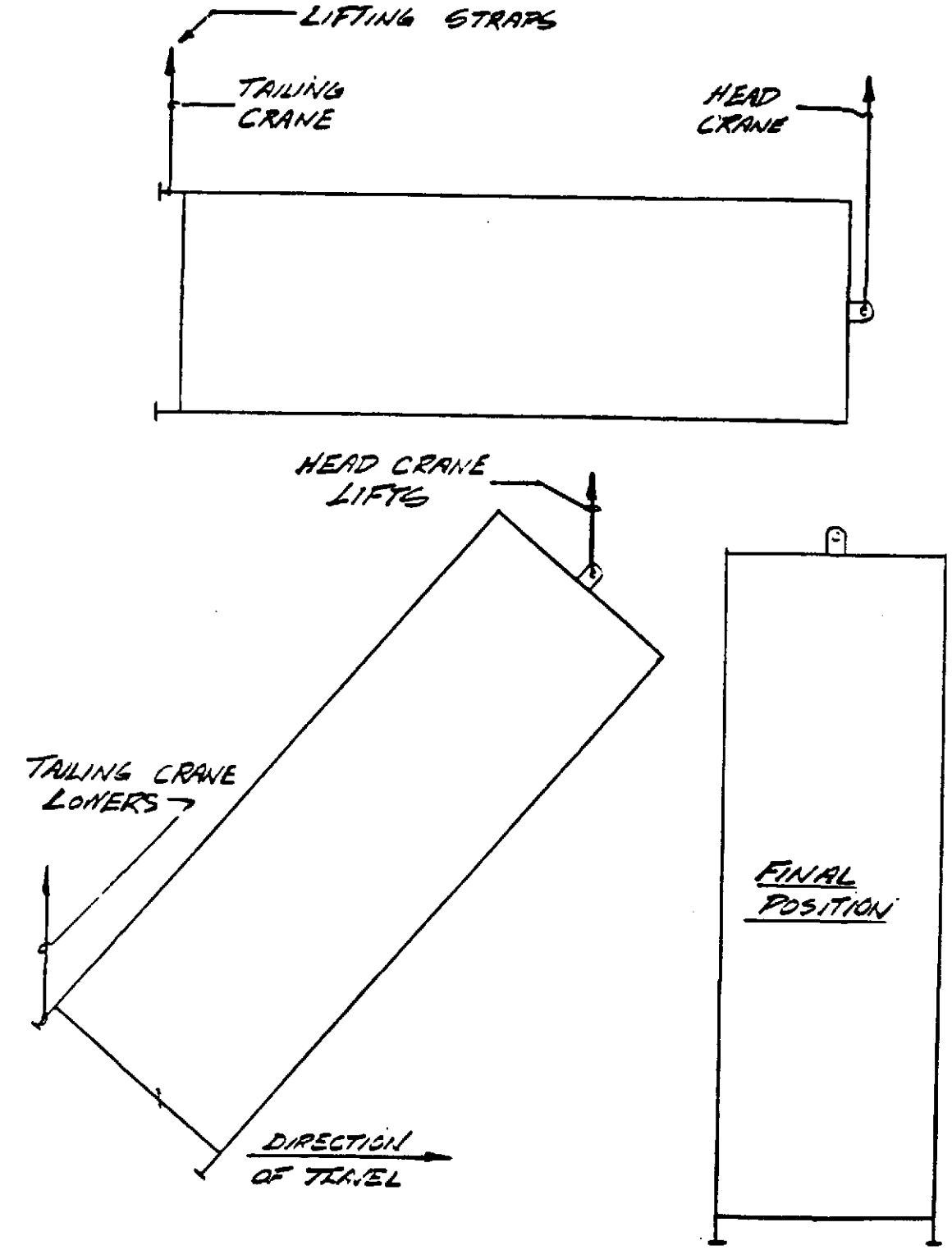
TITLE: MODULE WEIGHTS & CENTER OF GRAVITY

SHEET 1 OF 3
PAGE ____ OF ____

SAMPLE

PROCESS SYSTEMS INTERNATIONAL INC.
20 WALKUP DR WESTBOROUGH, MASSACHUSETTS 01581 USA
(508) 366-9111 / TELEX 92-0331

ENGINEERING
MADE BY: _____ CHK'D _____
DATE: _____ APPV'D _____



REVISION:	A	B	C	D	E	F
CHK'D:						
DATE:						

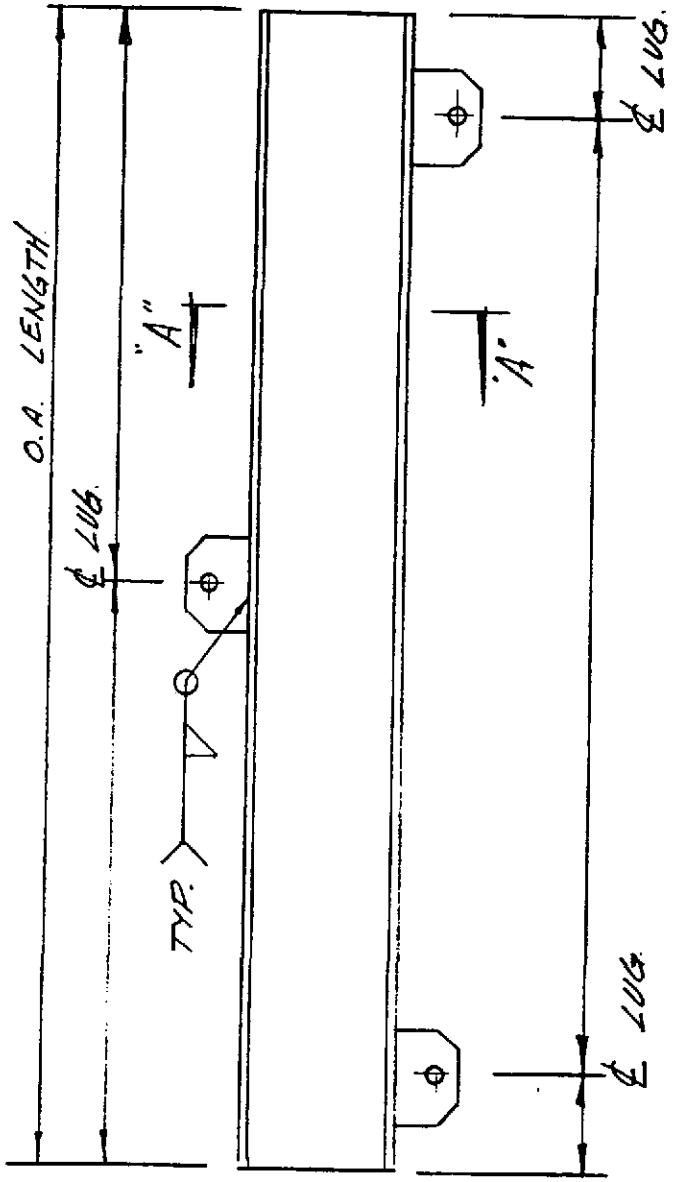
TITLE: ERECTION LIFTING SEQUENCE

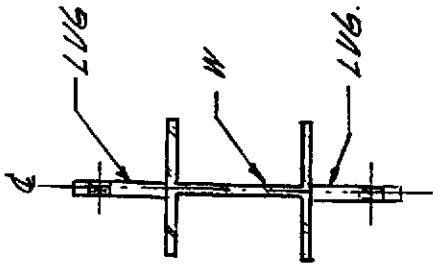
SHEET 2 OF 3
PAGE ____ OF ____

SAMPLE

PROCESS SYSTEMS INTERNATIONAL INC.
20 WALKUP DR. WESTBOROUGH, MASSACHUSETTS 01581 USA
(508) 366-9111 / TELEX 92-0331

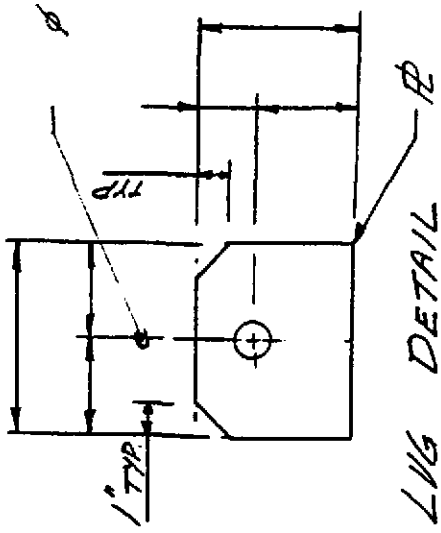
ENGINEERING DESIGN STANDARDS
MADE BY: _____ CHK'D _____
DATE: _____ APPV'D _____





SECTION A-A

LUG FOR USE W/ TON ANCHOR SHACKLE



LUG DETAIL
3 REQ'D

REVISION:	A	B	C	D	E	F
CHK'D:						
DATE:						

TITLE: SPREADER BAR

SHEET 3 OF 3
PAGE ____ OF ____

SPECIFICATION FOR

CONTROL OF NON-CONFORMANCES

PREPARED BY: ALAN BRADBROOK

PROJECT ENGINEER: N/A

QUALITY ASSURANCE: Alan K Bradbrook

MANUFACTURING ENGR: Phillip Fisher

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	5/1/96	REB 5/1/96	RELEASED PER DEO 158

PROCESS SYSTEMS INTERNATIONAL, INC.					SPECIFICATION	
INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number A V049-2-124	Rev. Ø
	A Bradbrook	5/1/96	REB	5/1/96		

TABLE OF CONTENTS

1.0 Scope

2.0 General Procedure

Exhibit 1 Tags

Exhibit 2 Discrepancy Report Form

1.0 SCOPE

This specification covers the minimum requirements for control, identification and the disposition of nonconforming items. This procedure applies to receiving inspection, in-process inspection, final inspection, testing documentation and procedural matters.

2.0 GENERAL PROCEDURE

2.1 A noncomformance is any condition that does not comply with a specific job specification or the customer specifications.

2.2. The Quality Assurance Engineer or the Quality Control Inspector places a Reject Tag or a Stop Work Tag (Exhibit 1) on the material which has failed to pass the required inspections and tests or on material that is determined to be otherwise nonconforming and generates a Discrepancy Report (Exhibit 2) for review by the MQA or the QAE.

2.3 The DR is then forwarded to the Project Manager for dispositions. The Project Manager reviews the nonconformance and enters a disposition appropriate for the product and its condition and processes the DR, as follows:

a. The Project Manager or a competent member of the project team, documents the technical justification for the acceptability of USE-AS-IS or REPAIR dispositions and obtains the customer's approval for those which do not comply with the customer's specification requirements.

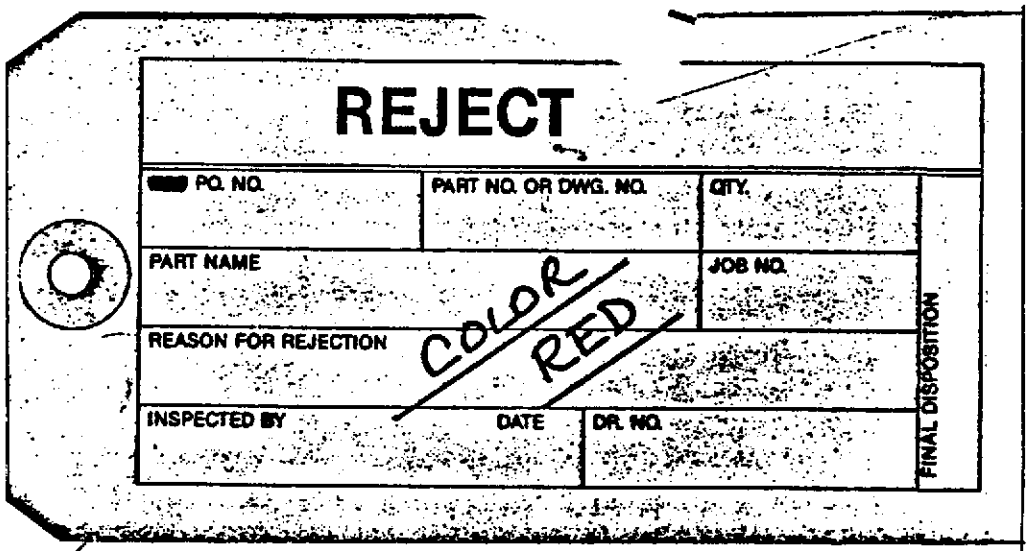
b. When the disposition is complete, the Project Manager or his designee shall sign and date in this space provided and return the DR to the MQA or the QAE.

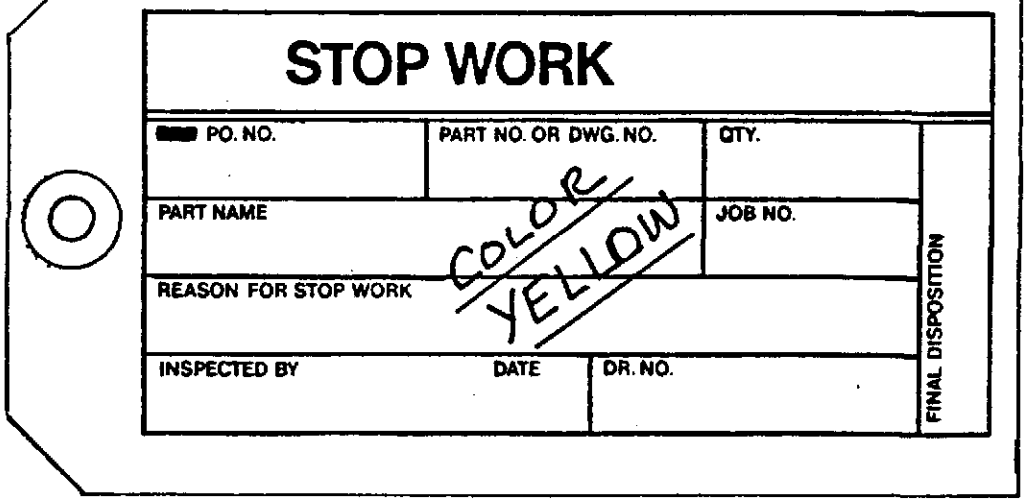
2.4 Acceptance of the completed disposition is then documented by the MQA, the QAE or the Quality Control Inspector, on the bottom section of the DR. When all of the required signatures have been provided and the item is acceptable, the Reject Tag or the Stop Work Tag can be removed by the individual accepting the completed disposition on the DR. Once the nonconformance has been corrected, the item or component is considered to be acceptable.

2.5 When documentation or procedural matters are suspect of being nonconforming, a DR is initiated and forwarded to the MQA or the QAE for disposition.

a. DR's generated for documentation or procedural deficiencies will not require disposition concurrence from Engineering. However, when Engineering input is required, the MQA or the QAE obtains concurrence with the disposition from Engineering, as applicable.

EXHIBIT 1


REJECT
[redacted] PO. NO.
PART NO. OR DWG. NO.
QTY.
PART NAME
JOB NO.
REASON FOR REJECTION
COLOR RED
INSPECTED BY
DATE
DR. NO.
FINAL DISPOSITION


STOP WORK
[redacted] PO. NO.
PART NO. OR DWG. NO.
QTY.
PART NAME
JOB NO.
REASON FOR STOP WORK
COLOR YELLOW
INSPECTED BY
DATE
DR. NO.
FINAL DISPOSITION

Process Systems International, Inc.

DISCREPANCY REPORT

ROUTE TO _____

D.R. NUMBER 6589

JOB NUMBER	P.O. NO.	VENDOR	SHEET
T10001-	468500	ABC NUT & BOLT	1 OF 1

PROJECT	ORIGINATOR	DATE	REFER TO D.R. NUMBER
KOREA	J. JONES	6-1-95	—

ITEM	DWG. ZONE	DISCREPANCIES (LIST CHARACTERISTICS, SPECIFICATIONS AND ACTUAL)	NO. ACC.	FOR REVIEW	QTY. OF PCS./DISPOSITION: USE NO. CHGE	USE DWG. CHGE	RWK IN SHOP	RET. TO SUP.	SCRAP	REMARKS
1		1/2"-13 X 4" LONG - BOLTS SA-193 B7	0	50						
		WE RECEIVED								
		1/2"-13 X 3" LONG - BOLTS SA-490						X		WRONG LENGTH
										WRONG MATERIAL

EXHIBIT 2

DISPOSITION ---

(1) SA-490 WILL MEET THE REQUIREMENTS OF THE JOB HOWEVER THE 3" LENGTH IS - NO GOOD.

B. SMITH DESIGN ENG.

(2) RETURN TO SUPPLIER FOR REPLACEMENT.
IF SA-490 IS USED ADVISE ME PRIOR TO ORDER PLACEMENT SO AN RFC CAN BE WRITTEN AND APPROVED TO CHANGE DRAWING AND BILL OF MATERIAL.

SIGNATURE B. SMITH DATE 6-2-95

DISPOSITION CONCURRENCE

PROJECT MGR.	DATE	MFG. ENG.	DATE	QUALITY ASSURANCE	DATE
J. BOYD	6-2-95	N/A		J. JONES	6-2-95

REINSPECTION RETURNED TO SUPPLIER 6-2-95

REC'D. 1/2-13 X 4" LG. SA-193 B7 ON 6-3-95

SIGNATURE J. JONES DATE 6-3-95

CORRECTIVE ACTION --- VENDOR DID NOT SUPPLY CORRECT MATERIAL. NOTIFY VENDOR OF THIS PROBLEM AND HAVE THEM REVIEW TRAINING.

SIGNATURE J. JONES DATE 6-3-95

AI/ANI AI DATE 6-4-95 — CLOSED —

Title: SPECIFICATION FOR MATERIAL CONTROL

SPECIFICATION FOR

MATERIAL CONTROL

PREPARED BY:	ALAN BRADBROOK
PROJECT ENGINEER:	N/A
QUALITY ASSURANCE:	Alan L Bradbrook
MANUFACTURING ENGR:	Phillip Faland
TECHNICAL DIRECTOR:	D. A. McWatters
PROJECT MANAGER:	Richard Boyd

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
Ø	5/1/96	RES 5/1/96	RELEASED PER DEO 158

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number A V049-2-125	Rev.
	A Bradbrook	5/1/96	RES	5/1/96		Ø

Title

SPECIFICATION FOR MATERIAL CONTROL

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1.0 Scope

2.0 General Procedure

2.1 Procurement

2.2 Receiving Inspection

2.3 Material Identification

Exhibit 1 Dock Receipt

Exhibit 2 Purchase Order

Exhibit 3 Tag

Number

Rev.

SPECIFICATION

Number	Rev.
A V049-2-125	

2.2.3 The Receiving Inspector verifies the identification markings on the material, size, thickness, evidence of damage and conformance of the Material Test Reports to the applicable material specification.

2.2.4 Material that is found to be discrepant shall be processed in accordance with the Control of Nonconformance procedure.

2.2.5 When material test reports are required on the purchase order, a Material Identification Code (MIC) number. The receiving inspector shall assign a MIC No. to each lot of material and mark each piece of material with the assigned MIC NO., PO No., Job No., and the Part No.

2.2.6 When the material or item has been accepted, the Receiving Inspector will attach a green tag (Exhibit 3) and forward the material or item to the stockroom with the dock receipt.

2.3 Material Identification

2.3.1 It is the responsibility of the Stockroom Attendant to assure that only the intended material purchased for a specific order be released to the shop operation department and that all the required materials are properly marked prior to release.

2.3.2 Material such as plate, pipe or bar issued to the shop operation department that has to be subdivided by cutting, sawing or shearing shall be appropriate marked with MIC No., Job No., and the assembly No. or Spool No. All material shall be identified prior to subdividing or cutting to maintain traceability (when traceability is required).

2.3.3 Vibro-etching on the external surface is the only acceptable marking means. No marking is allowed on the interior surfaces or on flange vacuum surfaces.

2.3.4 It material is found to be suspect or traceability of material is lost, further material testing shall be required to be performed. A sample of the suspect material shall be sent to an outside lab to verify complete compliance to the material specification. The results of the testing willle verified through Receiving Inspection.

1.0 SCOPE

This specification covers the minimum requirements for the control of LIGO materials at PSI. The purpose of this specification is to define the method employed by PSI to purchase materials, receipt inspect materials and items and to identify and control materials and items during manufacturing.

2.0 GENERAL PROCEDURE

2.1 Procurement

2.1.1 Materials are purchased to either ASTM or ASME material specification.

2.1.2 Materials listed on the Bill of Material are reviewed during the final drawing review. The Bill of Material is then entered and electronically released to Purchasing through MRP II (EMS) computer system. The requirements for material test reports (MTR's) are included in the material description and the material part number assigned to each part on the Bill of Material.

2.1.3 Once the Bill of Material is entered into the MRP II (EMS) computer system, the system sets up a demand for the Buyer to procure the materials or items.

2.1.4 Materials specified on the Bill of Materials and/or on the Purchase Order cannot be substituted without prior approval of the Design Engineer. The Design Engineer is responsible for reviewing the Design Calculations, reconcile the substitution of material and revise the calculations as necessary.

2.2 Receiving Inspection

2.2.1 LIGO material requires special handling to prevent material contamintion. See PSI V049-2-120 "Raw Material Handling Procedure" and V049-2-119 "Contamination Control Plan".

The shipper/receiver off-loads the material, inspects the packaging for damage, verifies the shipment against the packing slip, prints a Dock Report (Exhibit I) from the MRP II (EMS) computer system and forwards the dock receipt and the material or time to Quality Control Receiving Inspections.

Purchasing - Receipts PO#: 553647-00 Type:N Sts:P

Vendor: 40648 Buy-From: 40648
STAINLESS PIPE & FITTINGS
128 YORK AVE.
RANDOLPH, MA 02368

Ship to location:01
PROCESS SYSTEMS INTERNATIONAL
20 WALKUP DRIVE
WESTBORO, MA 01581-5003

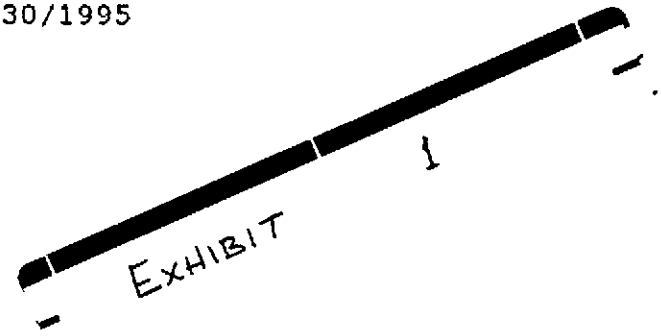
Buyer: 03
Terms: 1
Col/Ppd: C
Chg/Cnc: N

ATTN: BARRY

Line: 003 Item:C222240-01 1 Vendor Item: Comm:M6
FLANGE,SST F304L,SA182 CMTR, BLIND ,1" 150#, RF
Job#:N00581 Qty Ord: 2 EA Received to date: 0
Notify: PUR Request: 05/30/1995 Rejected: 0
Move to:STK Promise: 05/30/1995 Due: 2

1. Qty Received: 2 UM:EA
2. Qty Rejected: 0
3. User Comment:
4. Received By: CEW
5. Receipt Date: 05/30/1995
6. Receiver:

Field to change __



PROCESS SYSTEMS INTERNATIONAL, INC.

20 Walkup Drive • Westborough, Massachusetts 01581-5003

508 / 366-9111 • Fax 508 / 870-5930

PURCHASE ORDER

P/O NUMBER	PAGE
553037-00	01

P/O DATE	CHANGE/CANCEL
02/17/1995	

(Ship to the above address unless specified below.)

ORDERED FROM

TIERNEY DALTON
43 HOPKINTON ROAD
WESTBORO, MA 01581
ATTN: STEVE

SHIP TO

PROCESS SYSTEMS INTERNATIONAL
20 WALKUP DRIVE
WESTBORO, MA 01581-5003

ORDER TYPE	BUYER	ACKNOW-LEDGE	CONFIRM	TERMS	F.O.B.	SHIP VIA	COL
NORMAL	LARRY MAURIELLO	YES	YES	NET 30	SHIPPING	BEST WAY	CO

LINE NUMBER	QUANTITY ORDERED / BLANKET TYPE	U/M	OUR ITEM NUMBER / DESCRIPTION/NOTES / YOUR ITEM NUMBER	PRICE/UNIT	REQUESTED DATE	CHAN CANC
001	1	EA	C025111-D ELBOW,STL,A105,90 LR , 0.500" 3000# THD, JOB NUMBER: T55100	2.780	02/24/1995	
002	C.W 2-24-95 1	EA	C085102-06 1 FLANGE,STL,SA105 CMTR,WN , 6" 150#, RF SCH 40 MATERIAL MANUFACTURER'S CERTIFIED MILL TEST REPORT TO APPLICABLE ASME II SPECIFICATIONS ARE REQUIRED AND MUST ACCOMPANY SHIPMENT. IDENTIFY MATERIAL WITH TYPE, GRADE AND HEAT NUMBERS. JOB NUMBER: N00581	26.250	02/24/1995	
003	1	EA	C025109-F ELBOW,STL,A105,90 LR , 0.750" 3000# SW, JOB NUMBER: N00581	3.060	02/24/1995	
004	2	EA	C045109-F TEE,STL,A105,STR , 0.750" 3000# SW, JOB NUMBER: N00581	4.280	02/24/1995	
005	2	EA	C145119-01 COUPLING,STL,A105,STR FULL , 1" 3000# SW	2.110	02/24/1995	

HT-EKW

EXHIBIT 2

INSTRUCTIONS TO VENDORS:
- PARTIAL SHIPMENTS ARE ACCEPTABLE UNLESS OTHERWISE INDICATED.
- A COPY OF THE BILL OF LADING AND THE PACKING LIST MUST BE SENT TO PROCESS SYSTEMS INTERNATIONAL, INC.

INVOICE TO: ACCOUNTS PAYABLE
PROCESS SYSTEMS INTERNATIONAL, INC.
20 WALKUP DRIVE
WESTBOROUGH, MASSACHUSETTS 01581-5003

MASS. SALES TAX: EXEMPT # 043126695

THIS PURCHASE ORDER IS BUYER'S OFFER TO SELLER AND ACCEPTANCE IS EXPRESSLY LIMITED TO ITS TERMS CONDITIONS AS SET FORTH ON THIS AND THE REVERSE SIDE HEREOF AND TO THE GENERAL AND SUPPLEMENT TERMS, CONDITIONS AND PROVISIONS. IF ANY, ATTACHED HERETO OR INCORPORATED BY REFERENCE, ALL OF WI ARE MADE A PART OF THIS OFFER.

ORDERED BY _____

PO 553037 JOB V59049.

PN C02S111-D HT* EKW

SIZE 1/2" SCH 3000#

SA 105 GR —

Color Green

EXHIBIT 3

CMTR X

C of C □

Title: SPECIFICATION FOR COMPONENT RGA TEST PROCEDURE

PROCEDURE FOR COMPONENT RGA TEST

LIGO VACUUM EQUIPMENT

Hanford, Washington and Livingston, Louisiana

JOB NO. V59049

PREPARED BY: Roberto Tacca

QUALITY ASSURANCE: ALAN BRADBROOK /RCB

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
		RCB 5/4/96	INITIAL RELEASE PER DEO 166

PROCESS SYSTEMS INTERNATIONAL, INC.			SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE	Approved DATE RCB 5/4/96	Number: V049-2-127 A	Rev.0

1.0 PURPOSE

The purpose of this procedure is to define the steps necessary to carry out an RGA scan on a vacuum vessel.

2.0 GENERAL

This procedure is generally applicable for any RGA, but specific reference will made to the Balzers Quadstar software for the PRISMA RGA.

3.0 REFERENCE DOCUMENTS

Balzers QUADSTAR 421 SOFTWARE MANUAL.

4.0 RESPONSIBILITY

The procedure is applicable to PSI Personnel.

5.0 RGA CONDITION

5.1 Bake out

For measurements on a clean chamber the RGA must be baked before use on the clean chamber. For the Balzers PRISMA RGA, the detector head can be baked to 200°C with the electronics package removed.
Requirements for bakeout is that warmup shall not occurs until the pressure is below 10^{-4} Torr to prevent bakeon of contaminants

6.0 Readings

Readings can be taken once the Vacuum vessel has cooled to ambient and the pressure is below 10^{-6} Torr.

6.1 Setup

Connect the RGA electronics package to the RGA detector head and the communications cable to the computer.

Data acquisition
Data will be taken by three methods: A complete 1-200 AMU Scan in SCAN mode. An ion current scan in the Multiple Ion Detection (MID) mode using all available channels. And a concentration scan using the Quantitative Analysis Module: Multiple Concentration Detection (MCD) mode to get partial pressures from solving the raw data with known cracking patterns. The scans shall be made with the Faraday cup only and another set of scan shall be made with the Electron Multiplier on.

Summary of the reading sequence

FARADAY CUP ONLY
Perform offset calibration
Perform Full AMU scan in SCAN and save data.
Perform Ion current scan in MID mode and save to file
Perform Concentration scan in MCD mode and save to file

Switch on Electron Multiplier

WITH EM ON
Perform offset calibration
Perform Full AMU scan in SCAN and save data.
Perform Ion current scan in MID mode and save to file
Perform Concentration scan in MCD mode and save to file

Dwell Time should be set to slow: 60 ms.

6.2 FARADAY CUP ONLY

Perform offset calibration. Follow instruction in the Manual for performing a offset calibration. This is recommended if the dwell time is changed or when switching between the Faraday cup and Channeltron.

6.2.1 SCAN

Perform a full range AMU scan to record intensities over the AMU range.
To check for hydrocarbons, the data shall be taken over the range from 1 to 200 AMU.
Take data for 10 cycles.

6.2.2 MID

Perform Ion current scan in MID mode and save to file
Follow instruction in the Manual for performing a MID scan
This gives the ion current intensities,same as the SCAN, for selected AMU's
Take data for 10 cycles.

6.2.3 MCD

Perform Concentration scan in MCD mode and save to file
Follow instruction in the Manual for performing a MCD scan
Take data for 10 cycles.
This will give concentration of the selected gasses by solving the raw data by matrix inversion using the spectra library of the RGA.

Gas species selection for Multiple Concentration Detection mode (MCD)

GAS SPECIES	
H2	N2
He	NO
CH4	O2
H2O	AR
NE	CO2
CO	CnHm

6.3 WITH ELECTRON MULTIPLIER ON

Switch on Electron Multiplier
Perform offset calibration. Follow instruction in the Manual for performing a offset calibration. This is recommended if the dwell time is changed or when switching between the Faraday cup and Channeltron. It is recommended to use the same SEM voltage for all readings. This can be set during the parameter setup process.

6.3.1 SCAN

Perform a full range AMU scan to record intensities over the AMU range.
To check for hydrocarbons, the data shall be taken over the range from 1 to 200 AMU.

6.3.2 MID

Perform Ion current scan in MID mode and save to file
Follow instruction in the Manual for performing a MID scan
This gives the ion current intensities,same as the SCAN, for selected AMU's

6.3.3 MCD

Perform Concentration scan in MCD mode and save to file
Follow instruction in the Manual for performing a MCD scan
This will give concentration of the selected gasses by solving the raw data by matrix inversion using the spectra library of the RGA.

Perform offset calibration
Perform Full AMU scan in SCAN and save data.
Perform Ion current scan in MID mode and save to file
Perform Concentration scan in MCD mode and save to file

Dwell Time should be set to slow: 60 ms.

6.5 Leak Detection by air signature method.

Finding a leak by an air signature method may be more difficult because of the presence of o-ring. The outgassing and permeation of the o-rings may be dominated by the same gas species found in air. For very small leaks in a large vessel with o-rings this may not be practical. Outgassing from o-ring after baking is expected to be dominated by H_2O, CO and CO_2.

Tests using a calibrated air leaks at 10^{-7} Torr-L/s, 10^{-8} Torr-L/s, 10^{-9} Torr-L/s will be performed on the BSC prototype to determine feasability of this method for a chamber with many o-ring joints.

6.6 Cleaniless and hydrocarbon contamination

Fore a scan after bake-out:
Inspect the full analog scan obtained in the SCAN mode for hydrocarbon contamination.
This is represented by ion current intensities throughtout the spectrum up to 200AMU.
For a well cleaned and well baked system the intensities above mass 44 should be very low.

Criteria for cleaniless

RGA intensities values or partial pressures for determining acceptable cleaniless

SPECIES	Partial Pressure	CRITERIA
	Torr	
H2		
He		
CH4		
NE		
H2O		
CO		
N2		
NO		
O2		
AR		
CO2		
CnHm		TBD
TOTAL		

6.7 Conversion

Ion current to mass species partial pressure

Very Rough conversion

An approximate partial pressure can be obtained by knowing the instrument sensitivity and by apply the following formula.

$$PP_{gas} = \frac{I}{SF}$$

where PP_{gas}: Partial pressure of gas
I: Ion current in Amperes
SF: Sensitivity factor instrument

The Balzers sensitivity is factory determined using Argon and a certificate is supplied with the unit Without the Faraday cup operating only, the sensitivity is for example $6X10^{-4}$ A/mbar. and with the Electron Multiplier operating it is for example 2.1A/mbar at a SEM Voltage of 1300 V.

More Accurate Conversion

$$PP_a = I_b \bullet \frac{FF_{N28}}{S} \bullet FF_{ab} \bullet XF \bullet TF \bullet DF$$

where
PP_b: partial pressure of a given molecular species

FF_{N28} : Fragmentation factor for N2+ ions from nitrogen

S: Sensitvity for nitrogen (unit current /unit pressure) A/mbar

TF: transmission factor relative to N2 Typically TF=28/M

DF: Detection factor Relative current per ion at mass b compared to current at mass N2
Typically DF=1

FF_{N28} / S , the basic instrument sensitvity is typically independent of gas species.

thus a basic instrument sensitivity can be used: SI

For this example RGA from the Factory test sheet the SI (Faraday cup) =1666 mbar/A
and SI (with EM) = 0.476 mbar/A

The conversion of to partial pressure with these formulas is only useful if the components in the vacuum chamber do not have many overlaps e.g when there is a lot of hydrocarbon present.

In order to get a more accurate composition the raw data is transformed into partial pressures for each mass species and using the spectra library of the desired gasses for that RGA a solution is found for composition of each gas. In the Balzers software, the solution of the matrix is done using the technique by *Givens,* which allows for super-determinate matrices (A least square fit is employed to find the best solution).

Since the sensitvity for each mass species differs between RGAs, as a results the cracking pattern for a gas will differ from the actual cracking pattern. The pattern as measured by the RGA is stored as a spectra library.

RGA DATA POST BAKE

RESULTS OF THE RGA TEST	
RGA TEST :	
DATE:	
TIME:	
TESTI.D.:	
PSI TEST ENGINEER:	
QUALITY ASSURANCE:	

SPECIES	MEASURED ION CURRENT	Partial Pressure
	A	Torr
2		
4		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
24		
25		
26		
27		
28		
29		
30		
31		
32		
etc to 200		

RGA DATA POST BAKE

RESULTS OF THE RGA TEST	
RGA TEST :	POST BAKE
LOCATION OF RGA	
COMPONENT NAME:	
COMPONENT SERIAL #:	
DATE:	
TIME:	
TEST I.D.:	
PSI TEST ENGINEER:	
QUALITY ASSURANCE:	

SPECIES	Partial Pressure	ACCEPTANCE
	Torr	
H2		
He		
CH4		
NE		
H2O		
CO		
N2		
NO		
O2		
AR		
CO2		
CnHm		
TOTAL		

	ENGINEER NAME & TITLE	SIGNATURE
	TEST ENGINEER	
	QUALITY ASSURANCE	

RGA DATA PRE BAKE

RESULTS OF THE RGA TEST	
RGA TEST :	
DATE:	
TIME:	
TESTI.D.:	
PSI TEST ENGINEER:	
QUALITY ASSURANCE:	

SPECIES	MEASURED ION CURRENT	Partial Pressure
	A	Torr
2		
4		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
24		
25		
26		
27		
28		
29		
30		
31		
32		
etc to 200		

RGA DATA PRE BAKE

RESULTS OF THE RGA TEST	
RGA TEST :	PRE BAKE
LOCATION OF RGA	
COMPONENT NAME:	
COMPONENT SERIAL #:	
DATE:	
TIME:	
TEST I.D.:	
PSI TEST ENGINEER:	
QUALITY ASSURANCE:	

SPECIES	Partial Pressure	ACCEPTANCE
	Torr	
H2		
He		
CH4		
NE		
H2O		
CO		
N2		
NO		
O2		
AR		
CO2		
CnHm		
TOTAL		

	ENGINEER NAME & TITLE	SIGNATURE
	TEST ENGINEER	
	QUALITY ASSURANCE	

APPENDIX A

TABLES

TESTSHEET

balzers

Prisma

QUADRUPOL MASS-SPEKTROMETER

Order No. 409190

QMS 200	BK M25	002	/
QME 200	BG D28	501	1.062528.V008
QMA 200	BK M25	252	1.074762.V015
SP 200	B 5181 408 K		/

P_{Argon}: 5·10⁻⁷ mbar

Sensitivity for Argon without SEM: 6·10⁻⁴ A/mbar

Sensitivity for Argon with SEM by HV 1300: 21 A/mbar

Resolution Cal.

M 84 $\frac{M}{\Delta M}$ = 84

Balzers 14.7.95 BEHA

Table 16:
Fragmentation Factor (Fraction of Total Ions) For Major Peaks of Selected Materials

MASS	FF
Acetone $(CH_3)_2CO$	
43	.63
58	.23
42	.04
27	.03
Argon Ar	
40	.88
20	.12
Benzene C_6H_6	
78	.53
51	.11
52	.11
50	.10
Carbon Dioxide CO_2	
44	.85
28	.05
16	.05
12	.02
Carbon Monoxide CO	
28	.91
12	.05
16	.02
Ethanol C_2H_5OH	
31	.49
45	.21
27	.09
29	.07

MASS	FF
Helium He	
4	1.00
Hydrogen H_2	
2	.98
1	.02
Krypton Kr	
84	.57
86	.18
82	.11
83	.11
Methane CH_4	
16	.46
15	.40
14	.07
13	.04
Methanol CH_3OH	
31	.43
32	.31
29	.18
28	.04
Neon Ne	
20	.90
22	.10
Nitrogen N_2	
28	.94
14	.05
29	.01

MASS	FF
Oxygen O_2	
32	.95
16	.05
Toluene $C_2H_5CH_3$	
91	.46
92	.34
39	.07
65	.05
Trichlorethylene C_2HCl_3	
95	.22
130	.22
132	.21
97	.14
60	.13
Water H_2O	
18	.75
17	.19
1	.05
16	.02
Xenon Xe	
132	.26
129	.25
131	.20
134	.10
136	.08

FF = fraction of total ions that occur at the indicated mass

N.B. This table should not be confused with a spectrum library. The spectra displayed by an instrument are influenced by the mass discrimination of the quadrupole filter. Typically ions of low mass will be emphasized and ions of high mass will be diminished, relative to the abundances given in Table 16. A spectrum library lists the relative abundances as the instrument shows them.

Table 17:
Ionization Probability Table

Substance	Formula	Relative Ionization Gauge Sensitivity, S/S_{N_2}
Acetone	$(CH_3)_2CO$	3.6
Air		1.0
Ammonia	NH_3	1.3
Argon	Ar	1.2
Benzene	C_6H_6	5.9
Benzoic acid	C_6H_5COOH	5.5
Bromine	BR	3.8
Butane	C_4H_{10}	4.9
Carbon dioxide	CO_2	1.4
Carbon disulfide	CS_2	4.8
Carbon monoxide	CO	1.05
Carbon tetrachloride	CCl_4	6.0
Chlorobenzene	C_6H_5Cl	7.0
Chloroethane	C_2H_5Cl	4.0
Chloroform	$CHCl_3$	4.8
Chloromethane	CH_3Cl	3.1
Cyclohexane	C_6H_{12}	6.4
Deuterium	D_2	0.35
Dichlorodifluoromethane	CCl_2F_2	2.7
Dichloromethane	CH_2Cl_2	3.7
Dinitrobenzene	$C_6H_4(N_2O_4)$	7.8
Ethane	C_2H_6	2.6
Ethanol	C_2H_5OH	3.6
Ethylene oxide	$(CH_2)_2O$	2.5
Helium	He	0.14
Hexane	C_6H_{14}	6.6
Hydrogen	H_2	0.44
Hydrogen chloride	HCl	1.6
Hydrogen floride	HF	1.4
Hydrogen iodide	HI	3.1
Hydrogen sulfide	H_2S	2.2
Iodine	I_2	
Krypton	Kr	1.7
Lithium	Li	1.9
Methane	CH_4	1.6
Methanol	CH_3OH	1.8
Neon	Ne	0.23
Nitrogen	N_2	1.0
Nitric oxide	NO	1.2
Nitrous oxide	N_2O	1.7
Oxygen	O_2	1.0
n-Penthane	C_5H_{12}	6.0
Phenol	C_6H_5OH	6.2
Phosphine	PH_3	2.6
Propane	C_3H_8	3.7
Silver perchlorate	$AgClO_4$	3.6
Stannic iodide	SnI_4	6.7
Sulfur dioxide	SO_2	2.1
Sulfur hexafloride	SF_6	2.3
Toulene	$C_6H_5CH_3$	6.8
Trimitrobenzene	$C_6H_3(NO_2)_3$	9.0
Water	H_2O	1.0
Xenon	Xe	3.0
Xylene	$C_6H_4(CH_3)_2$	7.8

Scanning Characteristics—Constant M versus Constant Transmission

Table 18:
Spectra Interpretation Guide

AMU NO.	CHEMICAL SYMBOL	SOURCES (F = Fragment, P = Parent Ion, DI = Doubly Ionized)
1	H	Water F or Hydrogen F
2	H_2, D	Hydrogen, Deuterium (H^2)
3	HD, H^3	Hydrogen-Deuterium, Tritium (H^3)
4	He	Helium
5		No known elements
6	C^{++}	Doubly Ionized C^{13} Rare
7	N^{++}	DI N^{14} Rare
8	O^{++}	DI O^{16} Rare
9		No known elements
10	Ne^{++}	DI Ne^{20} Rare
11	Ne^{++}	DI Ne^{22} Rare
12	C	Carbon, Carbon Monoxide F, Carbon Dioxide F
13	CH, C^{13}	Methane F, Carbon Isotope
14	N, CH_2	Nitrogen, Methane F or Note 1
15	CH_3	Methane F or Note 1
16	O, CH_4, NH_2	Oxygen or Carbon Monoxide F, Methane P, Ammonia F
17	OH, NH_3	Water F, Ammonia P
18	H_2O	Water P
19	F	Fluorine or Freon F
20	Ar^{++}, Ne, HF	DI Argon, Neon Hydrofluoric acid
21		
22	Ne^{22}	Neon isotope
23		
24	C_2	See Note 1
25	C_2H	See Note 1
26	C_2H_2CN	See Note 1. Hydrogen Cyanide F
27	C_2H_3, Al, HCN	See Note 1. Aluminum, Hydrogen Cyanide
28	N_2, CO, C_2H_4, Si	Nitrogen, Carbon Monoxide, Ethylene P, Silicon
29	CH_3CH_2	Ethane F or Ethanol F or Isopropyl alcohol F
30	C_2H_6, NO	Ethane P, Nitric Oxide
31	P, CH_2OH, CF	Phosphorus, Methanol F, Ethanol F, Freon F
32	O_2, CH_3OH, S	Oxygen, Methanol P, Sulfur
33	HS	Hydrogen Sulfide F
34	$^*H_2S$, S^{34}	Hydrogen Sulfide P, Sulfur Isotope
35	$^*Cl$	Chlorine isotope. See Note 2
36	$^*HCl$, Ar^{36}	Hydrochloric acid, Argon isotope
37	$^*Cl^{37}$	Chlorine isotope. See Note 2
38	HCl^{37}	Hydrochloric acid or See Note 2
39	C_3H_3	See Note 3
40	Ar, C_3H_4	Argon. See Note 1
41	C_3H_5	See Note 1
42	C_3H_6	See Note 1
43	C_3H_7, CH_3CO	Note 1. Acetone F or Methyl Ethyl Ketone F
44	CO_2, C_3H_8	Carbon dioxide. See Note 3
45	CH_3CH_2O	Ethanol F or Isopropyl alcohol F
46	CH_3CH_2OH	Ethanol P
47	CCl^{35}	See Note 2
48	$HCCL^{35}$, SO	See Note 2, Sulfur Dioxide F
49	CCl^{37}, SiOH	See Note 2, pump oil F
50	CCl^{37}, CF_2, C_4H_2	See Note 2, Freon F, Note 3

NOTE 1
Fragments of several hydrocarbons, such as mechanical pump oil, diffusion pump oil, vacuum grease, cutting oil, and organic solvents.

NOTE 2
Fragments of several chlorinated hydrocarbons, such as carbon tetrachloride, trichloroethylene and many Freons.

NOTE 3
Fragments for both straight chain hydrocarbons and benzene ring hydrocarbons.

*See Isotopic Ratio Chart in Table 19.

Title: LIGO VISUAL INSPECTION PROCEDURE

LIGO VISUAL INSPECTION PROCEDURE

LIGO VACUUM EQUIPMENT

Hanford, Washington

and

Livingston, Lousiana

PREPARED BY: Alan L Bradbrook

QUALITY ASSURANCE: Alan L Bradbrook

MANUFACTURING ENGR: Philip [illegible]

TECHNICAL DIRECTOR: D.A. McWilliams

PROJECT MANAGER: [illegible]

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
1	D. McWalish	REB 11/15/96	RELEASED PER DEO 351
	GS 10/10/96		Release to fab Per DEO #0302
ϕ	ALB 5/3/96		ISSUED PER DEO 0168 FOR PDR

PROCESS SYSTEMS INTERNATIONAL, INC.		SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE: ALBradbrook 5/3/96	APPROVED DATE: REB 5/3/96	Number A V049-2-128	Rev. 1

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1.0 Scope

2.0 General Procedure

2.1 Control of Documents, Codes and Standards

2.2 Technical Requirements

2.3 Examination Requirements

2.4 Acceptance Standards

1.0 SCOPE

This document contains the methods and acceptance criteria for visual inspection for the LIGO project.

2.0 GENERAL PROCEDURE

2.1 Control of Documents, Codes and Standards

2.1.1 The Quality Plan, the fabrication drawings and other procedures specify the required visual inspection and physical dimensions. It is not the intent of this procedure to duplicate those requirements. It is however, the intent of this procedure to provide a consistent method of performing visual inspection.

2.2 Technical Requirements

2.2.1 Illumination - lighting, natural or artificial shall be sufficient to illuminate the area being examined.

2.2.2 Personnel - Personnel performing visual examination shall be familiar with the welding technique being used, welding procedure requirements, machining operations, liquid penetrant testing, and the type of discontinuities that may occur in the weld or base material being examined.

2.2.3 Direct visual examination shall be used when access is sufficient to place the eye within 24 inches of the surface to be examined and at an angle not less than 30 degrees to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as a magnifying lens may be used to assist examinations.

NOTE: Unless impossible, direct visual examinations will be used for all visual examinations performed to this procedure.

In some cases, remote visual examinations may have to be substituted for direct examination. Remote visual examinations may use visual aids such as mirrors, borescopes, cameras, or other suitable instruments.

2.3 Examination Requirements

2.3.1 Visual Examination of Welding

A. Equipment

1. Artificial Light Source
2. Mirrors
3. Magnifiers
4. Straight Edges or Rules
5. Weld Gages

B. Visual Inspection and Identification of Base Material and Joint Preparation as follows:

1. Base material type compatible with the detailed weld procedure.
2. Weld being made in accordance with drawing.
3. Weld preparation and adjacent base material clean free of paint, scale, rust, oil, grease and any other foreign material that would be deleterious to the process.
4. Weld preparation has fairly smooth surfaces free from deep notches, grooves, nicks, and other gross irregularities.
5. Weld preparation free from base material defects such as laminations, laps, non metallic inclusions, pin holes, porosity, that are open to the surface.

C. Visual Inspection of Weld Preparation Geometry as follows:

1. Alignment of parts to be welded.
2. Size of root face (land) and root gap.
3. Groove angle.
4. I.D. mismatch of Butt Joints.

D. Visual Inspection of Tack Welds as follows:

1. Tack welds are properly prepared to be incorporated into the weld or completely removed. When left in place, each end should be feathered.
2. Examine tacks for discontinuities.
3. Check for cleanliness.

E. Visual Inspection of Intermediate Weld Passes as follows:

1. Cleanliness
2. Weld spatter
3. ARC strikes
4. Slag
5. Oxide removal
6. Discontinuities

F. Visual Inspection of Final Surfaces of Welding shall be verified as follows:

1. Cleanliness
2. Weld spatter
3. ARC strikes
4. Butt weld reinforcement (1/8" max)
5. Fillet weld size
6. Fillet weld throat
7. Fillet weld length/spacing
8. Concavity/Convexity
9. Transition must be minimum of 3 to 1 taper
10. Surface porosity
11. Overlap
12. Undercut
13. Inadequate penetration
14. Cracks
15. Underfill

G. Visual Examination of Machined Surfaces shall be verified as follows:

1. Surface Finish
2. Discontinuities
3. Cleanliness

2.4 Acceptance Standards

2.4.1 Cleanliness

Reference should be made to the LIGO Cleaning Procedure, for specific methods. Prior to welding, the weld preparation and adjacent base material (1 inch minimum beyond each side of weld joints) shall be free of moisture, oil, grease, paint, scale, chips and other foreign matter on the final weld surface. The affected area shall be cleaned of slag and oxidation. Iridescent temper films and black, tightly adherent films resulting from welding, are acceptable on finished weld surfaces.

Prior To Welding

Weld preparations and adjacent base material (1 inch for carbon steel and 2 inches for stainless steel beyond each side of weld joint) shall be free of moisture, oil, grease, paint, scale, chips and other foreign matter.

After Welding

The affected area of the final weld surface shall be cleaned of slag and oxidation. Iridescent temper films resulting from welding are acceptable on finished weld surfaces.

2.4.2 Tack Welds

Tack welds shall show no cracks or linear indications. Slag deposits or indication of surface porosity shall also be cause for rejection. Edges of tack welds shall be feathered (when necessary) to provide a smooth transition during root pass welding.

2.4.3 Final Weld Condition

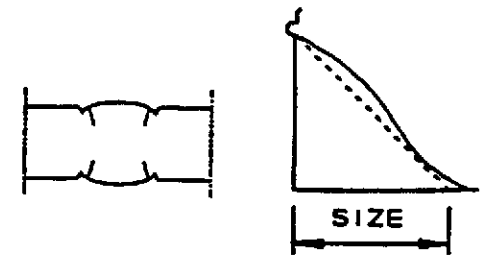
A. As welded, as-cast or as-forged surfaces are permitted, provided the surface of welds are sufficiently free form coarse ripples, overlaps and abrupt ridges and valleys.

B. Cracks or other linear indications are unacceptable.

C. Porosity open to the surface is unacceptable.

D. Undercut shall not exceed 1/32" in. depth.

E. Weld reinforcement on all butt welds may be flush with the surface or may have a crown up to 1/8" max.



EXCESSIVE UNDERCUT

F. Concavity on the root side of a single side welded circumferential butt weld is permitted when the resulting thickness of the weld is at least equal to the thickness of the thinner member of the two (2) sections being joined and the contour of the concavity is smooth.

G. Offset of final butt welded joints shall not be greater than the following:

Nominal Wall Section Thickness. in. (mm)	Maximum Offset, in. (mm) All LIGO Project Joints
0060" Thru 0.500"	1/4t

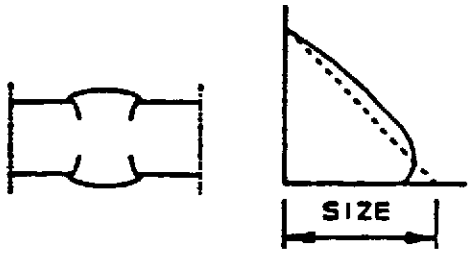
Note: t is the nominal thickness of the thinner section of the joint.

H. Any offset within the allowable tolerance shall be flared at a three to one taper over the width of the finished weld, or if necessary, by adding additional weld metal beyond what would otherwise be the edge of the weld.

2.4.4 Examples Of Conditions That Are Unacceptable.

OVERLAP

Welds shall be free from overlap.



OVERLAP

CRATERS

All craters shall be filled to the full cross section of the weld.

CRACKS

Welds shall have no cracks. When cracks are observed visually, the crack shall be completely removed and re-welded. Refer to repair procedure.

SLAG INCLUSIONS

Welds having slag inclusions larger than 3/32" are unacceptable. Also unacceptable are groups of slag inclusions when the sum of their greatest dimension exceeds 3/8" in any linear inch of weld.

INCOMPLETE FUSION

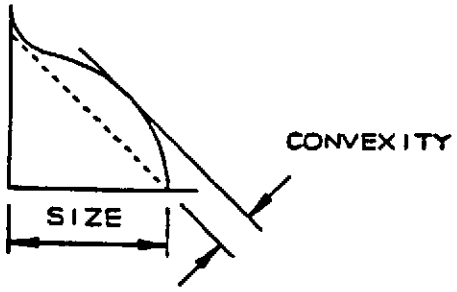
Acceptability requirements are the same as those for slag inclusions.

MISALIGNMENT AND WARPING

Tolerances shall be within the drawing tolerances governing the work. ASME Section VIII allows a maximum misalignment of 1/4" the thickness of the thinner section at the joint for thickness to 1/2".

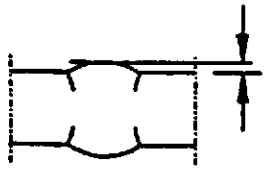
CONVEXITY FILLET

Convexity shall not exceed 0.1 S + 0.03", where S is the size of the fillet weld in inches.



CONVEXITY, GROOVE WELDS

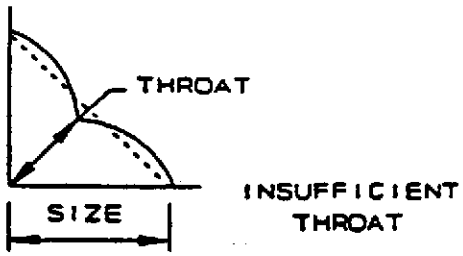
Reinforcement to be 1/8" max, and shall have a gradual transition to the plane of the base metal surface when the thinner base metal is less than 1/2" thick.



REINFORCEMENT

INSUFFICIENT THROAT, FILLETS

The throat shall not be under an imaginary profile line drawn form each leg end.



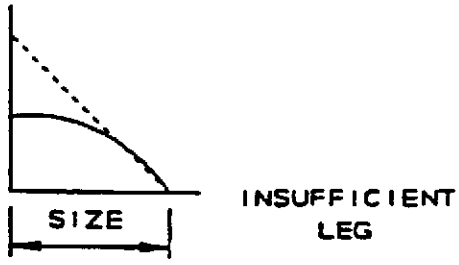
INSUFFICIENT THROAT, GROOVE WELDS

The weld shall be slightly convex.

INSUFFICIENT
THROAT

INSUFFICIENT LEG

The leg dimension of a fillet weld shall not be less than the thickness of the lighter of the two sections being welded, providing configurations allow this.



SPECIFICATION FOR

BLACK LIGHT INSPECTION PROCEDURE

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY: Thomas M. Stan

QUALITY ASSURANCE: ALAN BRADBROOK/RES

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER: Richard Bagley

REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE
0	TMS 5-5-96	RCB 5/5/96	INITIAL RELEASE PER DCO # 0171 FOR FDR

PROCESS SYSTEMS INTERNATIONAL, INC.				SPECIFICATION	
INITIAL APPROVALS	PREPARED	DATE	APPROVED	DATE	Number V049-2-130 / Rev. 0
	TMS	5-5-96	RCB	5/5/96	

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1.0 PURPOSE

This specification covers the procedure to be used for black light inspections of vessels and components cleaned for the LIGO vacuum system.

2.0 GENERAL

2.1 Cleaning shall be performed by an engineer, technician or shop worker familiar with this procedure and the manual for use of the ultraviolet lamp.

2.2 Inspection shall be done in a darkened area.

2.3 A 100 watt ultraviolet lamp with a wavelength of 365 nm shall be used.

3.0 RESPONSIBILITIES

3.1 Cleaning shall be performed by an engineer, technician or shop worker familiar with this procedure and the manual for use of the ultraviolet lamp.

3.2 This procedure shall be maintained and modified as required by the cognizant engineer.

4.0 PROCEDURE

4.1 Turn on the lamp and allow it to warm up for 3-5 minutes.

4.2 The operator shall enter the darkened area and allow 2-3 minutes for his eyes to adapt to the low light level.

4.3 Inspect the cleaned surfaces, holding the lamp 8-12 inches from the surface. Be careful to distinguish between ultraviolet fluorescence and reflected purple visible light.

4.4 Record the description and location of any detected contamination and issue a Discrepancy Report.

5.0 REQUIRED DOCUMENTATION

Inspection results shall be recorded on the component cleaning data sheet.

Title: CONFLAT FLANGE ASSEMBLY PROCEDURE

CONFLAT FLANGE ASSEMBLY PROCEDURE

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY:
MANUFACTURING
QUALITY ASSURANCE:

TECHNICAL DIRECTOR:

PROJECT MANAGER:

Information contained in this specification and its attachments is proprietary in nature and shall be kept confidential. It shall be used only as required to respond to the specification requirements, and shall not be disclosed to any other party.

Ø	SM 10/29	RGG 11/12/96	Released per DEO 0335
REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE

PROCESS SYSTEMS INTERNATIONAL, INC.					SPECIFICATION	
INITIAL APPROVALS	PREPARED SM	DATE 10/29/96	APPROVED RGG	DATE 11/12/96	Number **V049-2-168**	Rev. Ø

1.0 PURPOSE

This procedure controls the final assembly of conflat flanges.

2.0 GENERAL

All conflat flanges shall be assembled in class 100 cleanrooms after the component (i.e. BSC, HAM, door) has been final cleaned. Handling and assembly should be done wearing clean room clothing and gloves. The knife edges of each flange should be carefully inspected for nicks or other damage which might cause leaks.

Materials Req'd: (ref. BOM)

New copper gasket

SST bolts

Silicon bronze nuts

SST washers (2 per bolt)

Appropriate torque wrench

Recommended Torque

2 3/4"OD = 16 ft-lbs (192 in-lbs)

3 3/8" OD thru 16 1/2" OD = 26 ft-lbs (312 in-lbs)

3.0 RESPONSIBILITIES

The manufacturing group and the site contractors are responsible for installation of conflats.

PSI Q.A. is responsible for monitoring that procedures are being followed.

4.0 PROCEDURE

4.1 Initial Assembly:

Washers should be used under each bolt head and each nut. It is critical that the copper gasket be properly positioned between the flanges. When properly positioned ,the gasket is captured in a close tolerance groove formed by machined recesses in each of the mating flanges. With the gasket properly positioned and the bolts finger tight, a uniform gap of approximately 1/32" is visible between the flanges. Initial assembly is complete when all bolts are finger tight.

4.2 Torqueing:

Bolt tightening is to be done in a cross-flange " star" pattern. The recommended final torque values are shown in sect. 3.0 above. The bolts should be torqued in ~25% increments (see table I).Note: as the copper gasket yields during the torqueing sequence, bolts may become loose, this is normal and the torqueing sequence should continue until the recommended torque value is reached.

Torque %	25%	50%	75%	100%
2 3/4"OD	4 ft-lbs	8 ft-lbs	12 ft-lbs	16 ft-lbs
3 3/8"-16 1/2"OD	7 ft-lbs	13 ft-lbs	20 ft-lbs	26 ft-lbs

Table I

4.3 Final Torque Check:

The last step in the bolt tightening procedure is a final torque check done in a sequential fashion going around the flange. The cross-flange " star" pattern is not required for the final torque check.

5.0 TAGGING

After the final torque check has been done, the assembled flanged joint should be tagged with a label indicating the date of assembly, final torque value, and assembler's signature. The metal tag shall be attached to each conflat with a stainless steel wire.

Title: O-Ring Installation And Flange Assembly Procedure

O-RING INSTALLATION AND FLANGE ASSEMBLY PROCEDURE

FOR

LIGO VACUUM EQUIPMENT

Hanford, Washington
and
Livingston, Louisiana

PREPARED BY:
MANUFACTURING
QUALITY ASSURANCE:

TECHNICAL DIRECTOR: D. A. McWilliams

PROJECT MANAGER:

Information contained in this specification and its attachments is proprietary in nature and shall be kept confidential. It shall be used only as required to respond to the specification requirements, and shall not be disclosed to any other party.

φ	SM 10/29	BEB 11/7/96	Released per DEC 0336
REV LTR.	BY-DATE	APPD. DATE	DESCRIPTION OF CHANGE

PROCESS SYSTEMS INTERNATIONAL, INC.		SPECIFICATION	
INITIAL APPROVALS	PREPARED DATE SM 10/29/96	APPROVED DATE BEB 11/7/96	Number **V049-2-169**	Rev. φ

1.0 PURPOSE

This procedure controls the final installation of viton o-rings and flanges on vacuum equipment.

2.0 GENERAL

Installation of the o-rings should be done in class 100 clean room areas. Handling and assembly should be done wearing the appropriate clean room protective clothing and clean gloves. The vessel receiving the o-rings should be clean and dry.

The o-ring grooves and mating flat face flange should be inspected for local contamination including dirt, water, metal chips, detergent or washing process residue etc.

Spot Cleaning

Spot cleaning of small local dirty areas (such as the bottom of the o-ring groove) may be done using lint free wipers and isopropyl alcohol or a CO_2 cleaning gun.

Vacuum Baked O-Rings

Each size flange has two o-ring grooves. Each groove has a specific o-ring(PSI part number)designed for an exact fit. These part numbers are referenced in O-Ring Spec. V049-2-045.

The o-rings that are to be used for final flange assembly must be vacuum baked (by PSI) to remove volatile compounds prior to installation. Before installing the o-ring, the assembler must verify that the o-ring has been vacuum baked by PSI. The o-ring package will state that the o-ring is baked. O-rings will be given a different part number after baking.

3.0 RESPONSIBILITIES

The manufacturing group and site contractors are responsible for installation of o-rings and flanges.

PSI Q.A. is responsible for monitoring that procedures are being followed.

4.0 PROCEDURE

4.1 O-ring Installation

Due to the large flange diameters, three people are required to hold the o-ring in position during installation. The o-rings are easily inserted into the groove by starting at the top and working down. They fit snugly on their ID and are held in place by the groove dovetail. Care should be taken not to role or twist the o-ring during installation.

4.2 Mating Flange Installation

After the o-rings are installed, the mating flange is carefully positioned parallel to the o-ring flange. A centering pin is used in one bolt hole to align the flange for bolting. The bolts are inserted with a washer under the head and under the nut. All bolts should be installed hand tight. The mating flange should be in contact with the o-rings but not compressing the o-rings. After contact with the o-rings is made, it is important not to move the mating flange to preclude rolling or twisting the o-ring.

4.3 Torqueing the Flange

Bolt tightening for 7/8 in. bolts is to be done in a cross-flange " star" pattern. The recommended final torque value is 220 ft-lbs. The bolts should be torqued in ~25% increments:

Torque %	25%	50%	75%	100%
	55 ft-lbs	110 ft-lbs	165 ft-lbs	220 ft-lbs

The last step in the bolt tightening procedure is a final torque check done in a sequential fashion going around the flange. The cross-flange " star" pattern is not required for the final torque check.

4.4 Tagging

After the final torque check has been done, the assembled flanged joint should be tagged with a label indicating the date of assembly, final torque value, and assembler's signature. The metal tag shall be attached to a flange bolt using stainless steel wire.