Supersedes:
NOE: 3.11 Rev. 2
01/27/95

BASE OPERATIONS CONTRACTOR

NONDESTRUCTIVE OPERATING & EMERGENCY INSTRUCTION

OPERATION, DAILY, AND QUARTERLY MAINTENANCE OF GAMMA INDUSTRIES M-1006A SERIAL NUMBER: 3, TOMOGRAPHY EXPOSURE DEVICE

REVISED BY:

R. E. Castlen
NDE ARSO

APPROVED:

M. E. McDaniel
Manager: Nondestructive Evaluation
NDE RSO

R. E. Castlen
NDE ARSO

*NOTES REVISION

1.0. **PURPOSE**

This instruction details all steps necessary and required in order to properly operate and maintain the subject device in accordance with State and local regulations.

This instruction supersedes all previously submitted NDEI's, both 2.61 and 2.75. This NOE shall be used to perform QUARTERLY MAINTENANCE INSPECTION (Section 5.0) as well as for OPERATION and DAILY MAINTENANCE of the device.

2.0. **GENERAL**

2.1. Only personnel who are Qualified Radiographers or Assistant Radiographers under the supervision of a Radiographer may operate this device.

2.2. The Model 1006A device provides a highly collimated fan shaped gamma-ray beam which is approximately 36 degrees by 2" thick at 56" from the source. When the source is retracted it resides in a depleted uranium shield approximately 6.3" from it's center of activity to the outside vertical surface of the shield container.

2.3. Assure that all radiography personnel working in the cell area have two (2) currently calibrated and zeroed pocket dosimeters and a current TLD. In addition, all radiography personnel working in the area will have an operable and currently calibrated survey instrument. At least two (2) survey instruments will be available for use at the facility.

2.4. All required, permanently posted Radiation, High Radiation and Radioactive Material signs must be in place at all times.

2.5. Be sure that the exposure cell is cleared of personnel before closing and locking the cell door for any reason. At no time shall the CT exposure cell door be left open and unlocked if unattended. For protracted operations in the cell such as cell maintenance, (e.g. painting, electrical work, etc.) by personnel who are not radiographic safety qualified, the Co-60 device shall be removed and stored in a certified radioisotope storage facility.

3.0. **OPERATING INSTRUCTIONS**

3.1. Inspect the Model 1006A as detailed in Paragraph 4.0 prior to initial use each day. The inspection sequence, when completed, should result in a verification of interlocks, area monitor equipment and support utilities required to initiate the first exposure.

3.2. Verify turntable is at proper sample mounting position if necessary and enable key is not in control room isotopic source control lock.

3.3. Upon entering cell, with survey meter in hand, survey the exposure device to assure source is properly stored and confirm the device is locked.

3.4. Secure tomographic specimen on table.

3.5. Open and remove source plunger padlock. Pull plunger out and rotate counter-clockwise to the detent position.

3.6. Turn dry nitrogen gas valve on.

3.7. Verify no personnel in cell.

3.8. Leave cell, and lock door.

4.0. **DAILY INSPECTION REQUIREMENTS FOR THE GAMMA INDUSTRIES MODEL 1006A SYSTEM**

4.1. This inspection is to be made by the radiographic Technician each day/shift during the first use of the Tomography System and after any incident in which the device may be damaged.

4.2. Before opening the cell door, the enable key must be removed from the isotopic source control lock. Observe area (MARS) alarm reading. Enter cell with currently required personnel dosimetry, TLD and radiation survey devices.

NOTE

THE MARS ALARM IS NOT A CALIBRATED PERSONNEL MONITORING DEVICE AND IS USED ONLY AS AN INDICATOR FOR SOURCE WITHDRAWAL/RETRACTION. ENTRANCE INTO THE CELL MUST BE IN COMPLIANCE WITH SECTION 2.0.

*4.3. Survey 360 degrees around the exposure device to ensure that the source is in the stored position and the shielding is intact. Verify radiation levels are less than 200 mr/hr from any surface and less than 10 mr/hr at 39 inches. Record the highest reading measured on the DRSR.

*4.4. Check the manual lock mechanism for ease of operation:
Open and remove source plunger padlock. Pull plunger out and rotate counter-clockwise to the detent position.

*4.5. Inspect the nitrogen (gas) supply connections and check that cylinder pressure has at least 100 psig and a working pressure of 35 to 50 psig. Turn gas valve on.

NOTE

THE LOCK MECHANISM IS PRIMARILY USED TO SECURE THE SOURCE PLUNGER IN PLACE DURING TRANSPORTATION AND TO PROVIDE SECURITY FROM UNAUTHORIZED USE. LOSS OF ELECTRICAL POWER AND/OR GAS PRESSURE WILL RESULT IN THE SOURCE RETURNING TO THE SHIELDED POSITION BY SPRING FORCE (DOWN). THE SOURCE IS EXPOSED BY PULLING UP AGAINST THE SPRING USING THE NITROGEN GAS ACTUATOR FROM THE CONTROL CONSOLE.

4.6. **CAUTION**: Slowly close the cell door the last few inches to prevent damage to door mechanism and seals.

4.7. Insert console key and turn to "ENABLE". The yellow "ENABLE" and green "SOURCE RETRACT" lights should illuminate.

4.8. Depress the red "SOURCE EXPOSE" switch, green "SOURCE RETRACT" lamp extinguishes and red "SOURCE EXPOSE" light illuminates.

4.9. With the source exposed, and survey meter at hand, slowly open the cell door to approximately 2 inches from door stop, then close and lock door. The source should retract automatically. Confirm source retraction by observing the green "SOURCE RETRACT" lamp indicator on control panel, and reduction of area (MARS) monitor indication to that level observed in Step 4.2.

*4.10 If all checks are satisfactory record on DRSR and proceed with task, otherwise notify the NDE RSO and systems engineer of discrepancies.

NOTE

IN THE UNLIKELY EVENT AN INDIVIDUAL IS IN THE CELL WITH THE DOOR CLOSED AND THE SOURCE IS EXPOSED, QUICKLY MOVE TO THE SW CORNER OF THE CELL (AWAY FROM THE HIGH RADIATION AREA) AND CALL FOR ASSISTANCE ON THE TELEPHONE ADJACENT TO THE DOOR.

5.0. QUARTERLY INSPECTION REQUIREMENTS

5.1. Visually inspect the exterior of the exposure device for signs of damage.

*5.2. Conduct a complete survey (360 degrees and top) of the exposure device and record the highest and lowest readings at the surface, 6 inches and 39 inches from the surface of the device. Compare readings with the previous Quarterly Inspection data to assure the shield has not shifted or developed a crack.

5.3. Inspect all labeling including manufacturers label and "Caution Radioactive Material" label. If the labels are not legible, clean or replace as required.

5.4. Check compressed gas (nitrogen) line connections with suitable liquid leak check solution. Tighten as necessary.

5.5. Perform a complete functional system check-out per step 4.0.

6.0. DOCUMENTATION & APPROVAL

6.1. Document the quarterly exposure device inspection on the Quarterly Inspection Report.

6.2. Note acceptance and/or discrepancy conditions and submit to the NDE RSO for concurrence/approval.

6.3. Reports shall be maintained in the NDE central equipment maintenance file.

6.4. Daily equipment inspection results shall be recorded on the DRSR.

MATERIALS SCIENCE LABORATORY TASK REQUEST

REQUESTER INFORMATION

1. REQUESTER	2. COMPANY	3. PHONE	4. MAIL CODE
J. Arveson	EG&G Florida, Inc.	861-5131	BOC-321
5. TECHNICAL CONTACT	**6. PHONE**	**7. MAIL CODE**	**8. COMPANY**
R. Castlen	861-5158	BOC-321	EG&G Florida, In
9. DATE SUBMITTED	**10. DESIRED COMPLETION DATE**	**11. TEST OBJECTIVE**	
05/01/95	07/01/95	Tensile & Elongation	

MATERIAL TEST INFORMATION

12. MATERIAL NAME	13. MANUFACTURER
CRES 300 Series	Launch Equipment Shop (LES) Lockheed Martin Manned Space Systems

14. LOT NO.	15. BATCH NO.	16. PART NO.	17. SERIAL NO.
N/A	N/A	RST-20X	-1 & -2

18. SPECIFICATION	19. CHEMICAL CLASS	20. INTENDED APPLICATION
KSC-SPEC-0003	N/A	Rigid Source Tube/Stop

FOR NHB 8060.1 CERTIFICATION AND ENVIRONMENTAL TESTING

21. TEMPERATURE	22. USE ATMOSPHERE/FLUID	23. USE PRESSURE	24. USE THICKNESS
N/A	N/A	1000N	N/A
25. VEHICLE	**26. PROJECT**	**27. PART OR SERIAL NO.**	
N/A	Pressure Vessel RT	RST-20X	

28. SUPPORT REQUESTED (Please specify test method, if applicable)

Destructively Test Tension specimen to provide tensile strength and percent of elongation for welded members of .500" CRES Tubing to .375 - 16NC bolt.

29. REMARKS OR SPECIAL INSTRUCTIONS

Sample	Load (lbs)	Area (in^2)	Tensile (psi)	Elongation (%)
#1	6918.	0.0706	97,988	34.6
#2	6735.	0.0706	95,396	25.6

FOR LABORATORY USE ONLY

30. INVESTIGATOR	31. TASK NUMBER	32. DATE COMPLETED	33. PRIORITY
D. Lewis FAMEB/NASA	95-2T0248	06/16/95	N/A

KSC FORM 22-41 (REV. 6/92) PREVIOUS EDITIONS ARE OBSOLETE

1.1 PURPOSE

This manual is a guide to the NASA welding specifications and the AWS and ASME welding codes that are to be used by SPC/LES Shop and BOC/M&O Shop personnel when welding ground support equipment, systems and structures at KSC.

2.0 SCOPE

This manual contains the tests for qualification of welding technicians and weld joint procedures as specified in the referenced welding codes and specifications. Also included are the individual qualified weld joint procedures contained in Section 8 that are generated by the corresponding qualification tests in Section 7.

AWS and ASME welding codes referenced by NASA welding specifications require an independent weld joint procedure for every weld joint configuration. Also a change in any one of the essential variables some of which include the welding process, welding position, material thickness, pipe diameter and base metal specification, requires the qualification of a new weld joint procedure. This requirement leads to an enormous number of welding technician performance and weld joint procedure qualification tests that would be extremely difficult to administer and status.

In order to reduce the number of weld joint procedures, the qualification tests contained in Section 7 have been setup to include the most difficult test configuration. That is, a fixed pipe inclined at 45 degrees. This configuration qualifies the welding technician and weld joint procedures for all welding positions. Furthermore, the welding of a 3" schedule 40 and an 8" schedule 80 pipe coupon in most cases qualifies the welder and weld joint procedures for virtually all pipe, plate and structural sizes and thicknesses. By using this method of testing, approximately fifty weld joint procedures contained in Section 8 are qualified each time one corresponding weld joint procedure in Section 7 is qualified. These qualified weld joint procedures include all commonly used weld joint configurations.

3.0 REFERENCES

Copies of the following welding codes and specifications are essential components of this manual and are contained in Sections 9 and 10.

KSC-SPEC-Z-0002	Welding Aluminum Alloy Pipe, Tubing and Fittings
KSC-SPEC-Z-0003	Welding Austenitic Stainless Steel and Low Expansion Alloy Pipe, Tubing & Fittings
KSC-SPEC-Z-0004	Welding Structural Carbon Steel, Low Alloy Steel, Stainless Steel & Aluminum Alloys
KSC-SPEC-Z-0010	Welding T-1 and T-1 Types A and B Structural Steels
AWS D1.1-90	Structural Steel Welding Code
AWS D1.2-90	Structural Aluminum Welding Code
AWS D10.9	Qualification of Welding Procedures & Welders for Welding Pipe & Tubing
Section IX	ASME Boiler and Pressure Vessel Code, Welding Qualifications

4.0 SAFETY

Welders shall be thoroughly knowledgeable of the precautions and safe practices called for in Section 10 of this manual.

5.0 WORK CONTROL PLAN

The processing of documentation for qualification of weld joint procedures and welding technicians shall be performed as shown in Figure 1.

6.0 QUALIFICATION REQUIREMENTS

Welding procedures and welders shall be qualified in accordance with the appropriate qualification tests contained in Section 7 of this manual.

6.1 WELDING PROCEDURE QUALIFICATION

Welding procedure qualification tests in Section 7 shall be established for new requirements not contained in existing qualified weld joint procedures. The qualification test shall be setup in accordance with the applicable welding code and specification. The qualification documentation shall include the following:

6.1.1 Welding Procedure Specification (WPS)

A WPS shall be prepared to include the welding parameters as shown in Section 7.X.X.X.a. The WPS is a guide for the setup and performance of the qualification test coupon welding.

6.1.2 Procedure Qualification Record (PQR)

A PQR shall prepared to record the actual welding parameters employed for welding the test coupon as shown in Section 7.X.X.X.b. The completed PQR establishes the qualification parameters and is used to generate the corresponding qualified weld joint procedures contained in Section 8.

6.1.3 Qualification Test Record (QTR)

A qualification test record shall be prepared to record the results of visual and radiograph examination as well as destructive test results as shown in Section 7.X.X.X.c.

6.1.4 Welding Test Coupon

A welding qualification test coupon as shown in Section 7.X.X.X.d shall be prepared in accordance with the applicable welding codes and specifications.

6.1.5 Welding Test Specimen

Bend and tension test specimen for weld joint procedure qualifications that require destructive tests shall be prepared as shown in Sections 7.X.X.X.e of this manual.

6.2 WELDER PERFORMANCE QUALIFICATION

Personnel who perform welding in accordance with the weld joint procedures contained in Section 8 shall be qualified by the successful completion of the corresponding welding procedure test contained in Section 7. For example, a welder who performs welding of joints contained in Section 8.1.1 must be qualified by the passing the weld joint procedure test Section 7.1.1. The performance qualification test shall be the same as the weld joint procedure qualification test. A welder must perform welding in the process for which he is qualified within six months to maintain his qualified status.

6.3 QUALIFICATION TEST INSPECTION & EVALUATION

6.3.1 Upon the initial set up of a qualification test weld coupon, NASA Q/A and the appropriate SPC Q/A or 80C Q/A shall buy-off the setup and stamp the okay to proceed block on the WPS as shown in Section 7.X.X.X.a.

6.3.2 For procedure qualification only, SPC or 80C Quality Engineering shall witness the welding of the test coupon.

6.3.3 During initial welding of a coupon, SPC or 80C Q/A shall record the actual welding parameters on the PQR and shall sign off the on welding verified block. See Section 7.X.X.X.b.

6.3.4 Upon completion of welding, the coupon shall be submitted to NDE for radiographic evaluation.

6.3.5 For weld joint procedure qualification only, bend and tension test specimen shall be prepared from the weld coupon in accordance with 7.X.X.X.e. Specimen are to be submitted to the NASA Materials Testing Lab for destructive tests.

6.3.6 Upon receipt of x-ray and destructive test results, SPC Q/E or 80C Q/E shall evaluate the test reports and deny or accept qualification by signing off the qualification test record 7.X.X.X.c. If a qualification is denied, the qualification package shall be destroyed.

6.4 PERFORMANCE QUALIFICATION EFFECTIVITY

A welder's qualification status is effective for periods of six months. Renewal of a welder's qualified status is obtained by the successful performance of the applicable tests contained in Section 9.0.

7.3.1.a GENERAL PROVISIONS FOR GAS TUNGSTEN ARC WELDING OF 300 SERIES STAINLESS STEEL

This section provides the tests for qualification of welding technicians and the weld joint procedures contained in Section 8.3.1 for gas tungsten arc welding (GTAW) of structural stainless steel and pressure pipe in accordance with the following welding codes and specifications:

Stainless Steel Pressure Pipe KSC-SPEC-Z-0003 and AWS D10.9

Structural Stainless Steel KSC-SPEC-Z-0004 and AWS D1.1

Qualification tests shall be administered in accordance with the applicable welding codes and specifications listed above and Section 6.0 of this manual. When ever the welding specification and welding code are in conflict, the KSC welding specification shall take precedence over the AWS welding code.

7.3.1.b PREPARATION

Prior to performing the qualification tests contained in this section, the welder shall review the referenced welding specifications and welding codes.

7.3.1.c WORKMANSHIP

The preparation, assembly, repair and other associated preweld and post weld work shall be performed in accordance with KSC-SPEC-Z-0003, paragraphs 3.3 and 3.4, AWS D1.1, Section 3, and Sections 7.3.1.1 and 7.3.1.2 of this manual.

7.3.1.d TECHNIQUE

Qualification test welding shall be performed in accordance with KSC-SPEC-Z-0003, paragraph 3.6 and AWS D1.1, Section 4.

7.3.1.e QUALIFICATION

Qualification of weld joint procedures shall comply with the requirements of KSC-SPEC-Z-0003, paragraph 3.5, AWS D1.1, Section 5 for structural stainless steel, AWS D10.9 for stainless steel pressure pipe and Section 6.0 of this manual.

7.3.1.g LIMITATION OF ESSENTIAL VARIABLES

Procedure Qualification

Variances from the parameters listed in the WPS must be within the limitation of essential variables listed in KSC-SPEC-Z-0003 Paragraphs 3.4 and 3.5, AWS D1.1 Section 5.5 for structural and AWS D10.9, Section 2.3 for pressure pipe.

7.3.1.g Performance Qualification

Changes from the parameters listed in the WPS are limited by the variables contained in KSC-SPEC-Z-0003, Paragraphs 3.4 and 3.5, AWS D1.1 Section 5.16 for structural stainless steel and AWS D10.9 paragraph 3.3 for pressure pipe.

7.3.1.h RANGES COVERED BY THIS QUALIFICATION

Procedures

Ranges of material sizes and types covered by this section are listed in AWS D1.1 Tables 5.3 and 5.4 for structural steel and AWS D10.9, Table 1 for pressure pipe.

Performance

Ranges of material sizes and types covered by this section are listed in AWS D1.1, Tables 5.5 and 5.6 for structural stainless steel and AWS D10.9, Table 6 for pressure pipe.

7.3.1.i INSPECTION AND TEST REQUIREMENTS

Nondestructive and destructive tests reports shall be evaluated in accordance with KSC-SPEC-Z-0003, paragraph 3.7, AWS D1.1, Section 6 for structural stainless steel, AWS D10.9 Table 1 for pipe and Section 6.3 of this manual.

Procedure Qualificaiton Tests

Procedure qualification tests contained in this section require the following inspection and destructive tests in accordance with AWS D1.1, Table 5.1, AWS D10.9 Table 6 and Sections 7.3.1.1.e and 7.3.1.2.e of this manual.

Visual inspection	Required
100% x-ray	Required
Tensile test	2 Required
Face bend test	2 Required
Root bend test	2 Required

Performance Qualification Tests

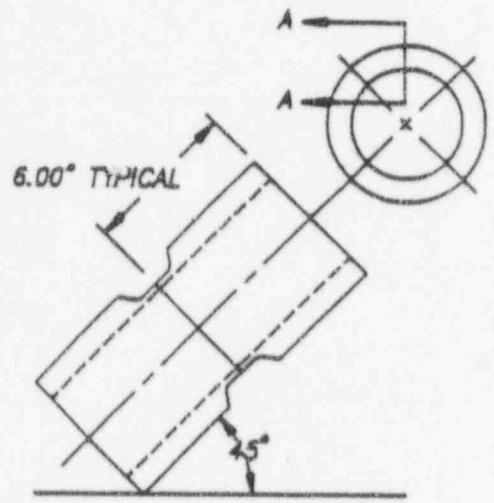
Procedure qualification tests contained in the section require the following inspection in accordance with AWS D1.1, Table 5.1 and AWS D10.9 Table 6.

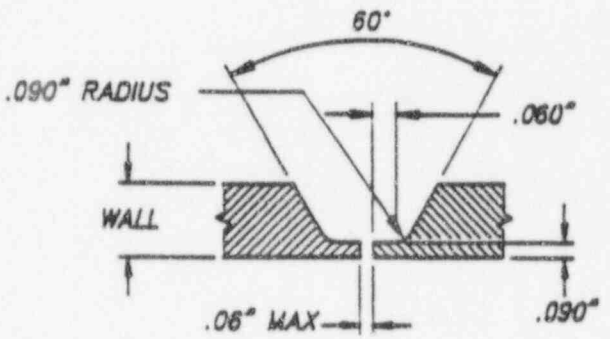
Visual inspection	Required
100% x-ray	Required

SET-UP VERIFIED
OKAY TO PROCEED

BOC Q/C 12-4-91
LSOC Q/C
NASA Q/A 12-4-91

SUPPORTING PQR	7.3.1.2b	TYPE OF ELECTRODE	2% THORIATED TUNGSTEN
TYPE OF JOINT	BUTT JOINT	WELDING CURRENT	DCSP
JOINT CONFIGURATION	J-GROOVE	SHIELDING GAS	ARGON
TYPE OF WELD	COMPLETE PENETRATION	GAS PURGE	ARGON
WELDING PROCESS	GTAW TIG	PREHEAT/INTERPASS TEMP.	NONE
PIPE SIZE	3" SCH 40	TECHNIQUE	KSC-SPEC-Z-0003B 3.6.3
WALL THICKNESS	.216"	JOINT PREPARATION	KSC-SPEC-Z-0003B 3.6.5
BASE METAL	300 SERIES	RESTRICTIONS	KSC-SPEC-Z-0003B 3.6.6
FILLER METAL	ER-308	CLEANING	KSC-SPEC-Z-0003B 3.6.7
MODE OF OPERATION	MANUAL	WELDING POSITION	6G

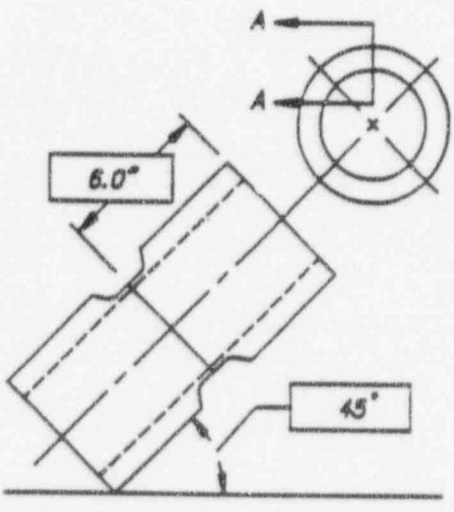


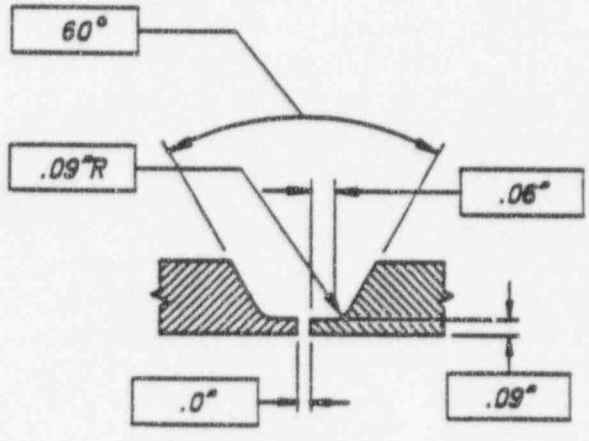


SECTION A-A

TUNGSTEN ELECTRODE DIAMETER	FILLER METAL DIAMETER	DCSP CURRENT RANGE	SHIELDING GAS FLOW RATE (CFH)	PURGE GAS FLOW RATE (CFH)	GAS CUP OF NOZZLE SIZE			WELDING SPEED IPM
					CERAMIC	HIGH IMPACT	METAL	
3/32"	3/32"	50 to 150	10	35	6 or 7	6 or 7	6 or 7	12

SUPPORTING PQR	7.3.1.2a	TYPE OF ELECTRODE	2% THORIATED TUNGSTEN	
TYPE OF JOINT	BUTT JOINT	WELDING CURRENT	DCSP	
JOINT CONFIGURATION	J-GROOVE	SHIELDING GAS	ARGON	
TYPE OF WELD	COMPLETE PENETRATION	GAS PURGE	ARGON	
WELDING PROCESS	GTAW TIG	PREHEAT/INTERPASS TEMP.	NONE	
PIPE SIZE	3" SCH 40	TECHNIQUE	KSC-SPEC-Z-0003B	3.6.3
WALL THICKNESS	.216"	JOINT PREPARATION	KSC-SPEC-Z-0003B	3.6.5
BASE METAL	300 SERIES	RESTRICTIONS	KSC-SPEC-Z-0003B	3.6.6
FILLER METAL	ER-308	CLEANING	KSC-SPEC-Z-0003B	3.6.7
MODE OF OPERATION	MANUAL	WELDING POSITION	6G	





SECTION A-A

TUNGSTEN ELECTRODE DIAMETER	FILLER METAL DIAMETER	DCSP CURRENT RANGE	SHIELDING GAS FLOW RATE (CFH)	PURGE GAS FLOW RATE (CFH)	GAS CUP OR NOZZLE SIZE			WELDING SPEED IPM
					CERAMIC	HIGH IMPACT	METAL	
3/32"	3/32"	50 to 150	10	35		#6		12

WELDING PERFORMED BY: R. E. WATERMOLEN LSOC 3341	ID STAMP	12-9-91 DATE	NASA SURVEILLANCE BY: D. F. DISSTON NASA QAS	ID STAMP	12-4-91 DATE
WELDING VERIFIED BY:	ID STAMP	DEC 06 '91 DATE	WELDING VERIFIED BY: D. MASHBURN BOC Q/A	ID STAMP	12-4-91 DATE

TENSION SPECIMEN TEST					
SPECIMEN NO.	AREA ACROSS REDUCED SECTION	ACTUAL LOAD	ACTUAL LOAD (KSI)	REQUIRED LOAD (KSI)	RESULTS
1	.057"	5,452#	95,649	75,000	PASSED
2	.058"	5,625#	96,982	75,000	PASSED

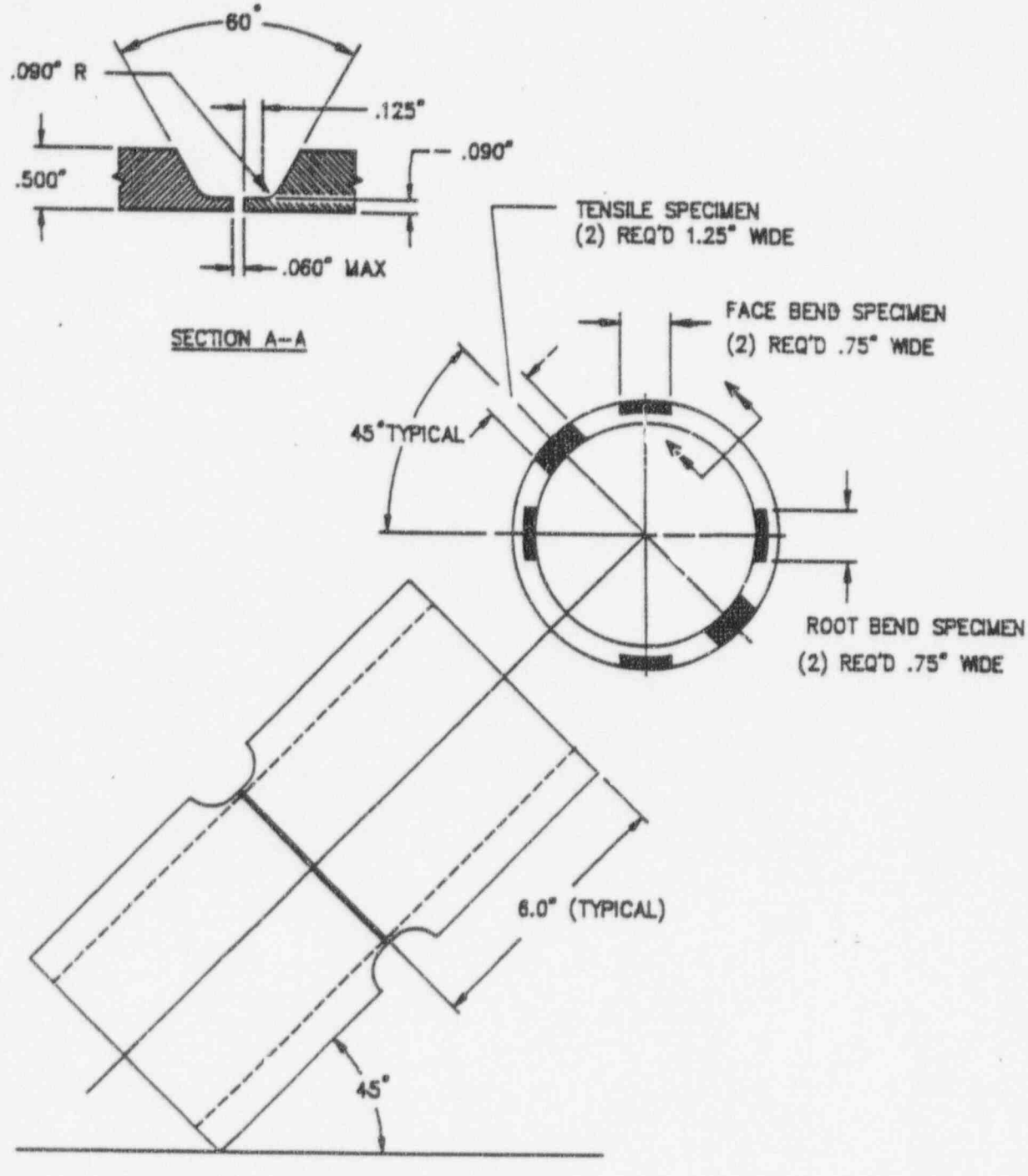
GUIDED BEND TEST			
SPECIMEN NO.	TYPE OF BEND	BEND JIG RADIUS	RESULTS
3	FACE BEND	.25"	PASSED
4	FACE BEND	.25"	PASSED
5	ROOT BEND	.25"	PASSED
6	ROOT BEND	.25"	PASSED

VISUAL EXAMINATION

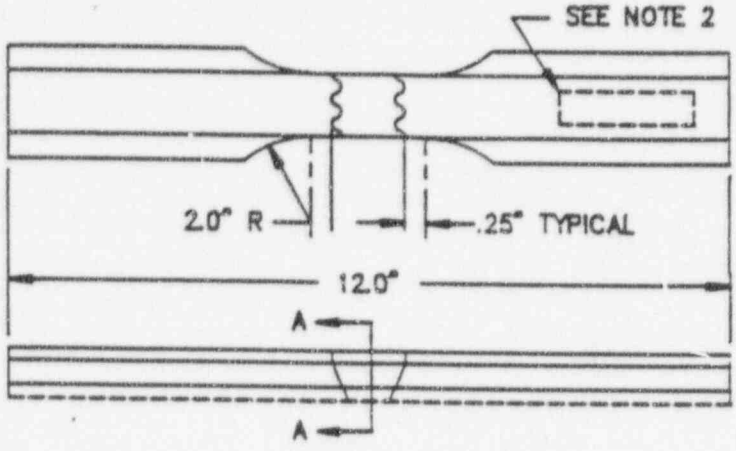
VISUAL EXAMINATION ACCEPTABLE ☐ REJECT ☐

TYPE AND CHARACTER OF FAILURE _____

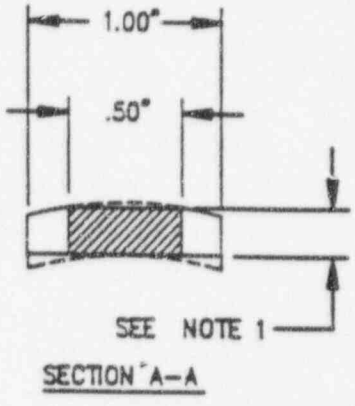
TESTS WITNESSED BY: James L Peyton J. L. PEYTON SPC Q/E SPC Q/E	QE 121 SPC ID STAMP	12-4-91 DATE	QUALIFICATION APPROVED BY: James L Peyton J. L. PEYTON SPC Q/E SPC Q/E	QC 121 SPC ID STAMP	12-4-91 DATE
TESTS WITNESSED BY: Beyo Mashburn BEYO MASHBURN BOC Q/A	87 ID STAMP	12-4-91 DATE	QUALIFICATION APPROVED BY: E Greer E. A. GREER BOC Q/E CWI	120 ID STAMP	12/11/91 DATE



SET--UP & SPECIMEN REMOVAL

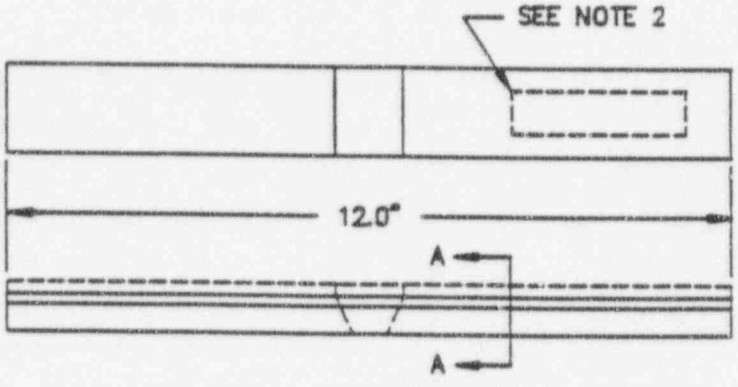


TENSILE SPECIMEN

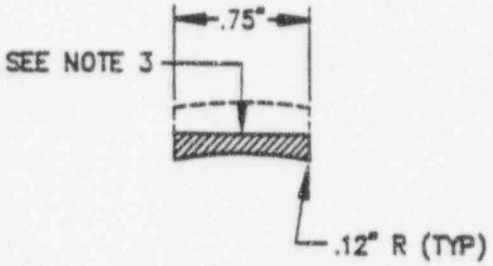


SECTION A–A

NOTE 1. MACHINE MINIMUM AMOUNT REQ'D TO OBTAIN PARALLEL SURFACES ACROSS THE REDUCED SECTION.

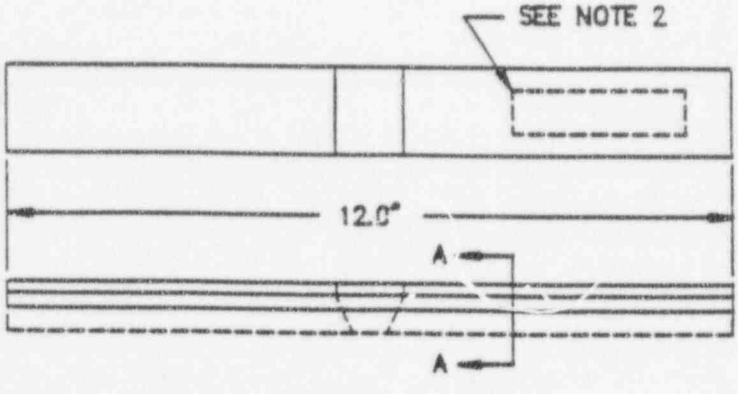


FACE BEND SPECIMEN

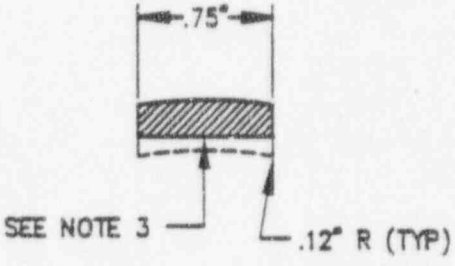


SECTION A–A

NOTE 2. ELECTROETCH WELDER'S I.D. NO., DATE & WORK ORDER NO.



ROOT BEND SPECIMEN



SECTION A–A

NOTE 3. MACHINE MINIMUM AMOUNT REQ'D TO OBTAIN FLAT SURFACE

SPC-80C WELDING MANUAL
PROCEDURE QUALIFICATION
DESTRUCTIVE TEST RESULTS

7.3.1.2f

NASA
DIRECTOR OF ENGINEERING DEVELOPMENT
DIRECTOR, MECHANICAL ENGINEERING
MATERIALS SCIENCE LABORATORY
FAILURE ANALYSIS AND MATERIAL EVALUATION BRANCH
PHYSICAL TESTING SECTION
DM-MSL-24, ROOM 1218, O&C BUILDING
KENNEDY SPACE CENTER, FLORIDA 32899

91-5363

SUBJECT: WELD CERTIFICATION / WELDING PROCEDURE QUALIFICATION FOR 304 CRES STAINLESS STEEL 3" PIPE.

WELDED BY R. WATERMOLEN, LSCC 3341, USING GTAW TIG.

REQUESTOR: JACK THOMPSON
MAIL CODE: LSO-071
PHONE # : 867-0733

TEST METHOD: PER KSC SPEC Z-0004 PROCEDURE 7.3.1.2.

SPECIMEN	LOAD (LBS)	AREA (SQ IN)	TENSILE STRENGTH (PSI)	PASS/FAIL
# 1.	5,452	0.057	95,649	PASS
# 2.	5,625	0.058	96,982	PASS

BEND TESTS

ROOT	FACE	REMARKS
# 1. PASSED	# 1. PASSED	NO CRACKS EXCEEDING 1/8"
# 2. PASSED	# 2. PASSED	MEASURED IN ANY DIRECTION

COMPLETED ON: 12/02/91

INVESTIGATOR: Dean C. Lewis
D. LEWIS, FAMEB/NASA

APPROVAL: N. Salvail
N. SALVAIL, CHIEF, FAMEB/NASA

SPC-BOC WELDING MANUAL
PROCEDURE QUALIFICATION
RADIOGRAPHIC TEST RESULTS

7.3.1.2g

R. WATERMELON / GTAW-TIG / 304 CRES / 3" SCH 40 PAGE 1 OF 1

NONDESTRUCTIVE EXAMINATION RADIOGRAPHIC INSPECTION REPORT	OPERATION NUMBER	WAP NUMBER	NDE REPORT NUMBER
	G079154	900667	44420

REQUESTING ORG.	REQUESTOR/PHONE	EXAM LOCATION	FLT. HDWARE/CRIT. GSE	REPORT DATE
LSOC	THOMPSON 7-0753	K7-549	☐ YES ☑ NO	11-9-91

REV.	NDE INSTRUCTION	REV	PROCESS SPECIFICATION	ACCEPTANCE SPECIFICATION	CLASS
F3704 B&R	431	10	MIL-STD-453C	KSC-SPEC-Z-0002=B	N/S 1/4 ARI

COMPONENT DESCRIPTION	SERIAL NUMBER		MATERIAL
TEST PIPE 3" (R. WATERMELON)	E47215	☑ PIPE ☑ WELD ☐ FORGING ☐ PLATE ☐ OTHER ____	SS

XRAY MACHINE/ EXPOSURE DEVICE	MODEL	S/N	KV (MEV)	MA (P/MIN)	SOURCE TYPE	SOURCE S/N	CURIES
	NORELCO	564658	180	4	-	-	-

FILM MFGR	TYPE	SIZE	SCREENS	FED/SFD:	EXPOSURE TIME	FOCAL SIZE
EKC	1(2) AA/M	8 x 10	F: .005 B: .010	24" 30"	6 1/2 MIN	1.5 MM²

PENETRAMETER SPEC	DESIGNATION	GROUP	PENE PLACEMENT	COMPONENT NOMINAL THICKNESS:	REINFORCEMENT:	BACKING STRIP
MIL-STD-453	.06	55	SS	.216	.030	-

QUALITY LEVEL	DENSITY REQUIREMENTS	SHIM THICKNESS	SHIM MATERIAL	VIEWING	
2-2T	MIN: 2.0 MAX: 4.0	.030	SS	☐ SINGLE WALL ☑ DOUBLE WALL ECCENTRIC ☐ OTHER ____	

RADIOGRAPHIC TECHNICIAN:	LEVEL	DATE EXPOSURES MADE:
J. HOFFMAN D. SPANGLER	II ASST.	11-8-91

EXAMINATION RESULTS

IDENTIFICATION	ACC	UNACC	REMARKS
0°	✓		TI
90°	✓		TI

ADDITIONAL INFORMATION

Document all deviations from NDE instruction or specification.

James L. Pyle
LSOC-NDE-QE
11-18-91

REMARKS: CR - CRACKS; IP - INCOMPLETE PENETRATION; P - POROSITY; AP - ALIGNED POROSITY; CP - CLUSTERED POROSITY; RS - ROUGH SURFACE; IUC - INTERNAL UNDERCUT; EUC - EXTERNAL UNDERCUT; CC - CRATER CRACK; US - UNDERSIZE; CV - CONVEXITY; CA - CONCAVITY; AS - ARC STRIKE; S - SLAG; CO - CORROSION; OX - OXIDATION; TI - TUNGSTEN INCLUSION; UI - UNCONSUMED INSERT; RR - ROOT REINFORCEMENT; PIT - SURFACE PITTING; LF - LACK OF FUSION; BT - BURN THROUGH; SB - SUCK BACK

☐ CUSTOMER EVALUATION (DO NOT MARK ACC OR UNACC)

TECH NAME	LEVEL	SIGNATURE	DATE
HOFFMAN	II	J. Hoffman	11-8-91

☐ SEE SUPLEMENTAL PAGE
☐ SKETCH ATTACHED
☐ PHOTOS ATTACHED

REVIEWED BY	REVIEW DATE
D. Kuell	11/8/91

SPC-BOC WELDING MANUAL 8.3.1
WELDING PROCEDURE SPECIFICATION (WPS)
GAS TUNGSTEN ARC WELDING (GTAW) STRUCTURAL STAINLESS STEEL 300 SERIES

WELDING PERFORMED IN ACCORDANCE WITH THIS WPS SHALL COMPLY WITH THE REQUIREMENTS OF KSC-SPEC-Z-0004D & AWS D1.1 THIS WPS & THE WELD JOINTS CONTAINED IN 8.3.1 ARE QUALIFIED BY THE TEST CONTAINED IN SECTION 7.3.1 OF THIS MANUAL.	ANY DEVIATION FROM THIS WPS OR WELD JOINT DRAWINGS CONTAINED IN THIS SECTION SHALL REQUIRE THE QUALIFICATION OF A NEW WPS. THE WELD JOINT PROCEDURES CONTAINED IN THIS SECTION ARE NOT VALID FOR PRESSURE PIPE AND TUBING.

WELDING PROCESS	GTAW-TIG		ELECTRODES	2% THORIATED TUNGSTEN	
WELDING CURRENT	DCSP		TECHNIQUE	KSC-SPEC-Z-0003B	3.6.3
SHIELDING GAS	ARGON		CLEANING	KSC-SPEC-Z-0003B	3.6.7
MODE OF OPERATION	MANUAL		JOINT PREP	KSC-SPEC-Z-0003B	3.6.5
BASE METAL	CRES 300 SERIES		PREHEAT/INTERPASS TEMP		NONE
FILLER METAL	ER-308X		POST WELD HEAT TREATMENT		NONE

SUGGESTED MATERIAL THICKNESS	TUNGSTEN ELECTRODE DIAMETER	FILLER METAL DIAMETER	A/C CURRENT RANGE	GAS FLOW (CFH)	WELDING SPEED (IPM)	GAS CUP or NOZZLE SIZE		
						CERAMIC CUP	HIGH IMPACT	METAL NOZZLE
1/16"	1/16"	1/16"	80-100	10	10-12	4,5,6	4,5,6	6
3/32"	1/16"	1/16"-3/32"	90-120	10	10-12	4,5,6	4,5,6	6
1/8"	1/16"	3/32"	110-140	10	10-12	4,5,6	4,5,6	6
3/16"	3/32"	1/8"	150-225	15	8-10	6,7,8	6,7,8	6,8
1/4"	1/8"	3/16"	200-375	15	6-10	—	—	8
>1/2"	1/8"-3/16"	1/8"-3/16"	225-475	15	1-8	—	—	8

TOLERANCES FOR GROOVE WELDS			
ROOT FACE	$\pm \frac{1}{16}$"	ROOT OPENING WITH BACKING	$\pm \frac{1}{16}$"
ROOT OPENING WITHOUT BACKING	$\pm \frac{1}{16}$"	JOINT GROOVE ANGLE	$+10^\circ -5^\circ$

MAXIMUM WELD LAYER THICKNESSES			
GROOVE WELDS	1/4"	FILLET WELDS	1/4"

MINIMUM WELD SIZES FOR PARTIAL PENETRATION GROOVE WELDS								
BASE METAL	$\frac{1}{8}$" to $\frac{3}{16}$"	$\frac{3}{16}$" to $\frac{1}{4}$"	$\frac{1}{4}$" to $\frac{1}{2}$"	$\frac{1}{2}$" to $\frac{3}{4}$"	$\frac{3}{4}$" to $1\frac{1}{2}$"	$1\frac{1}{2}$" to $2\frac{1}{4}$"	$2\frac{1}{4}$" to 6"	OVER 6"
MIN WELD SIZE	$\frac{1}{16}$"	$\frac{1}{8}$"	$\frac{3}{16}$"	$\frac{1}{4}$"	$\frac{5}{16}$"	$\frac{3}{8}$"	$\frac{1}{2}$"	$\frac{5}{8}$"

NOTES FOR WELD JOINTS 8.3.1.1 THROUGH 8.3.1.11

A BACKGOUGE ROOT TO SOUND METAL BEFORE WELDING OTHER SIDE.

B IF FILLET WELDS ARE USED IN STATICALLY LOADED STRUCTURES TO REINFORCE GROOVE WELDS IN CORNER OR T JOINTS, THEY SHALL BE EQUAL TO 1/4T BUT NEED NOT EXCEED 3/8". GROOVE WELDS IN CORNER & T JOINTS IN DYNAMICALLY LOADED STRUCTURES SHALL BE REINFORCED WITH FILLET WELDS EQUAL TO 1/4T BUT NEED NOT EXCEED 3/8".

C IF T > 3/4" A UGROOVE OR MODIFIED V GROOVE MAY BE USED.
IF FILLET WELDS ARE USED IN STATICALLY

D DOUBLE GROOVE WELDS MAY HAVE GROOVES OF UNEQUAL LENGTH, BUT THE DEPTH OF THE SHALLOWER GROOVE SHALL NOT BE LESS THAN ONE FOURTH OF THE THICKNESS OF THE THINNER PART JOINED.

E FOR CORNER JOINTS, THE OUTSIDE GROOVE PREP MAY BE IN EITHER OR BOTH MEMBERS PROVIDED THE BASIC GROOVE CONFIGURATION IS NOT CHANGED AND ADEQUATE EDGE DISTANCE IS MAINTAINED TO SUPPORT THE WELDING OPERATIONS WITHOUT EXCESSIVE EDGE MELTING.

F IN THE HORIZONTAL POSITION, THE BEVEL SHOULD BE IN THE UPPER MEMBER.

G THE ROOT NEED NOT BE BACKGOUGED BERFORE WELDING OTHER SIDE. THIS JOINT IS NOT APPLICABLE TO DYNAMICALLY LOADED STRUCTURES.

H JOINTS ARE WELDED FROM ONE SIDE ONLY. THESE WELD ARE NOT APPLICABLE TO DYNAMICALLY LOADED STRUCTURES.

J IF FILLET WELDS ARE USED IN STATICALLY LOADED STRUCTURES TO REINFORCE PARTIAL PENETRATION WELDS IN CORNER JOINTS, THEY SHALL BE EQUAL 1/4 TT.

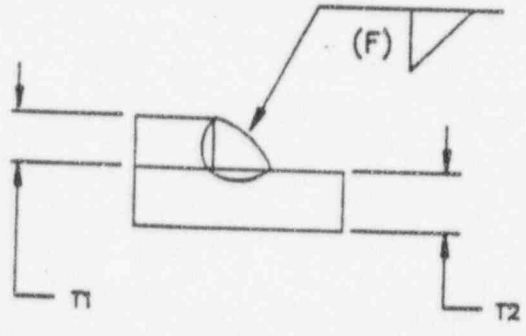
K DOUBLE GROOVE WELDS MAY HAVE GROOVES OF UNEQUAL LENGTH PROVIDED THEY CONFORM TO THE LIMITATIONS OF NOTE J. ALSO THE WELD SIZE E LESS ANY REDUCTION, APPLIES INDIVIDUALLY TO EACH GROOVE.

L THE UNBEVELED EDGE IS LOWER EDGE FOR HORIZONTAL WELDS.

M IF T IS LESS THAN 1.5", A DOUBLE U GROOVE OR MODIFIED DOUBLE V GROOVE MAY BE USED.

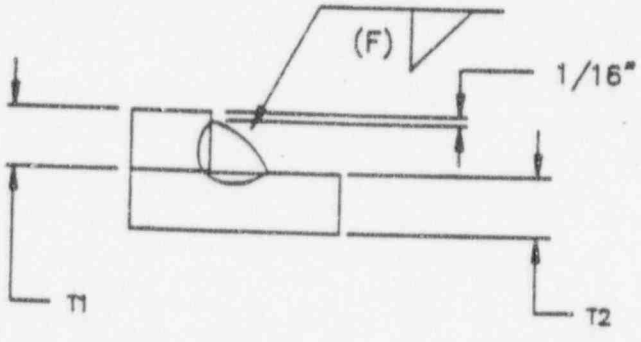
FILLET WELDS

F-1 THICKNESSES LESS THAN 1/4"



BASE METAL THICKNESS T1	MINIMUM FILLET WELD SIZE (F)	BASE METAL THICKNESS T2
0 to 1/4"	1/8"	NOT LIMITED

F-2 THICKNESSES GREATER THAN 1/4"



BASE METAL THICKNESS T1	MINIMUM FILLET WELD SIZE (F)	BASE METAL THICKNESS T2
1/4" to 1/2"	3/16"	NOT LIMITED
1/2" to 3/4"	1/4"	NOT LIMITED
3/4" to UNLIMITED	5/16"	NOT LIMITED