MILITARY SPECIFICATION

WELDING, FUSION, ELECTRON BEAM, PROCESS FOR

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for the electron beam fusion welding process.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONS

MILITARY

MIL-I-6866 - Inspection, Penetrant, Method of
MIL-I-6868 - Inspection Process, Magnetic Particle

STANDARDS

MILITARY

MIL-STD-453 - Inspection, Radiographic

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

E 8 - Tension Testing of Metallic Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

NATIONAL BUREAU OF STANDARDS

Handbook 60 X-Ray Protection

(Application for copies should be addressed to National Bureau of Standards, Washington, D.C., 20234).

3. REQUIREMENTS

3.1 Equipment. The welding equipment shall be qualified in accordance with 4.1.

3.2 Operator certification. Electron beam welding equipment production operators shall be certified in accordance with 4.2.

3.3 Materials. Materials to be welded shall be in accordance with the material and heat-treatment requirements specified on the applicable engineering drawing.

3.4 Weld schedule. A welding schedule shall be established for each specific part to be welded (see page 31).

3.5 Weld joint design and dimensional tolerances. Weld joint design shall be such that all joint corners are square and sharp (see figure 1).

3.5.1 Dimensional fit-up tolerances shall be as follows:

Material thickness range	Maximum separation
.020 inch and under	Metal to metal contact required at all weld locations
.021 inch to .065 inch	.002 inch or less
.066 inch to .125 inch	.003 inch or less
.126 inch and above	.004 inch or less

3.6 Workmanship. Welded joints shall be examined as specified in 5.3 for conformance to the following requirements:

3.6.1 Appearance. Welded joints shall be suitable for the intended use and shall be free of cracks and metallic discontinuities.

3.6.2 Smoothness and contour. Weld beads shall be within the required tolerances and shall be free of excessive undercut, and spatter (see 3.6.3).

3.6.3 Penetration, buildup, and melt-through for butt, lap, and lap-butt joints. Unless otherwise specified by the applicable engineering drawing, all welds shall exhibit 100 percent penetration. Buildup and melt-through shall exceed the parent material thickness. Undercut shall not exceed 10 percent of the parent material thickness or 0.003 inch whichever is greater. Cosmetic passes may be used to smooth, blend, and increase build up and drop through (see figure 2).

3.6.4 Penetration for burn-through type "Tee" joints. Unless otherwise specified by the applicable engineering drawing, all welds shall penetrate the leg of a "Tee" joint at least equal to the thickness of the thinner member (see figure 2).

3.6.5 Metallurgically sectioned samples. Sectioned samples shall exhibit no cracks when examined at 20 X magnification. Weld penetration and metallurgical quality shall meet the requirements shown in the contract or order.

3.6.6 Weld bead widths. The width of the weld bead shall not exceed the following limits:

Depth of weld	Weld surface width
.010 inch to .125 inch	1 x depth
.125 inch to .250 inch	1/2 x depth
Greater than .250 inch	1/3 x depth

4. PROCEDURE

4.1 Equipment qualification. Electron beam welding equipment shall be qualified by the welding activity designated in the contract or order and quality control as follows:

4.1.1 Vacuum chamber pumping equipment and control system. The vacuum pumping system shall be considered acceptable if the system is capable of generating a working vacuum of 10^{-4} Torr within fifteen (15) minutes after the start of the pumping system.

4.1.2 Voltage meter and current meter shall be calibrated at 90 day intervals.

4.1.3 Electron gun, electrical power supply and control system. The general operating capability of the electron optics, welding parameter instrumentation, and work manipulating equipment shall be established through the verification of welding results. Welding shall be performed on test blocks of annealed 304 stainless steel conforming to Figure 3, or by continual surveillance of quality control samples.

4.1.3.1 Preparation of test blocks for welding. Surfaces of the test blocks to be welded shall be free from objectionable films such as oxides, scale, ink, grease, oil or other foreign material detrimental to the welding process.

4.1.3.2 Welding sequence. A series of two (2) butt welds, of each thickness shown in Figure 3, four (4) inches in length shall be made in the following order for all test welds:

(a) One test weld shall be made using appropriate schedule and a single pass.

(b) All electrical parameter instrumentation, including travel speed controls, shall be set back to zero.

(c) The identical welding schedule used in 4.1.3.2 (a) shall be re-established and the next test weld completed.

4.1.3.3 Test block evaluation. The welded test block shall be sectioned as shown in Figure 3.

4.1.3.4 Failure to meet qualification requirements. Failure of any individual weld pass to achieve the required penetration in any section shall be cause for failure of the machine qualification test.

4.1.4 X-Ray radiation monitoring. Check of X-ray radiation leakage shall be made on all external surfaces of the equipment. During the radiation leakage monitoring procedure, the electron beam welding equipment shall be operated at 90 percent of maximum power, with the electron beam grossly defocused.

4.1.4.1 X-Ray indication. In the event of any indication of X-ray radiation leakage, the area in question shall be rechecked with X-ray film to confirm radiation leakage.

4.1.4.2 X-Ray limitations. X-Ray radiation on any surface of the equipment indicated by the meter and confirmed by the X-ray film shall not exceed the permissible radiation levels outlined in NBS Handbook 60, X-ray protection.

4.1.4.3 Radiation tests failure. Electron beam welding equipment, not conforming to the maximum X-ray radiation limit as defined in NBS Handbook 60, shall be considered as having failed the equipment safety test.

4.2 Operator certification. Electron beam welding equipment production operators shall be certified by the designated welding activity and qualiity control as follows:

4.2.1 Certification test equipment. Certification tests of all electron beam welding equipment production operators shall be performed on previously qualified electron beam welding equipment.

4.2.2 Certification requirements. Certification of an electron beam welding equipment production operator shall be dependent upon his ability to set-up the machine, to weld parts and assemblies in accordance with the following procedures.

4.2.2.1 Column assembly and alignment. Starting with an electron beam welder in which the column is out of alignment and the filament has been removed, the oeprator shall prepare the machine for welding.

4.2.2.2 Certification procedure. Certification procedure shall consist of the operator setting up and welding two (2) consecutive, acceptable specimens of each of the configurations conforming to Figures 4, 5, and 6. Material shall be annealed 304 stainless steel.

4.2.2.3 Preparation of test specimens for welding. Surfaces of the test specimens to be welded shall be free from objectionable films such as oxides, scale, ink, grease, oil or other foreign material detrimental to the welding process. Parts shall be wiped clean with alcohol or acetone prior to welding.

4.2.2.4 Welding sequence. Each series of two (2) specimens, of each thickness shown in Figure 4, of all three configurations shall be made in the following order:

(a) One certification weld shall be made using the appropriate schedule and a single pass.

(b) All electrical parameter instrumentation shall be returned to zero.

(c) The identical welding schedule used in (a) above shall be re-established and the second certification weld completed.

4.2.2.5 Certification requirements. Failure of the operator to meet the requirements specified in 3.6, in any weld pass, shall be cause for his failure of the production operator certification test.

4.3 Establishment of weld schedules. Electron beam welding schedules shall be as established by the procuring activity for each specific application and for each machine to be used in production.

4.3.1 Samples. The number of samples required to establish a welding schedule shall be determined by the procuring activity, and shall be recorded on the welding schedule sheet (see attachment 1). The number of specimens required should reflect previous welding experience with related materials and configurations, part applicaton and life requirements. Samples used to establish a weld schedule do not necessarily have to be actual parts, but may be simulated joints. If a simulated joint configuration is used, a sketch, including the dimensions, must be included in the weld schedule sheet (see attachment 1).

4.3.2 Target location. Beam focusing targets shall be located in such a manner as to isolate the work piece from any target splatter and heat generated during column alignment and beam adjustment procedures.

4.3.3 Preheating. Preheating, by defocused beam techniques, shall not be permitted unless such procedure has been authorized by the procuring activity.

4.3.4 Filler material. The use of filler materials in electron beam welds shall be permitted when certified filler wire is used.

4.3.5 Repair welding. Repair welding by electron beam welding shall be permitted only when authorized by the procuring activity.

4.3.6 Joint efficiency. Electron beam welded joints shall meet the requirements of the applicable engineering drawing and 3.6.

4.3.7 Production welders identification. Each welded production assembly shall be marked so as to positively identify it with the welding operator who made the welds. The welder's identification symbol shall be assigned by the Quality Control Activity. Identification shall remain on the part at least until final inspection and acceptance of the weld.

4.3.7.1 Identification area. Unless otherwise specified by the applicable engineering drawing, the welder's identification symbol shall be marked in the vicinity of the weld. The marking shall not be injurious to the serviceability of the part.

4.4 Welding of carbon and low alloy steels. Carbon and low alloy steels shall be welded with the filler materials, when used, as detailed below.

4.4.1 Post-weld thermal treatment. All welded joints, with one or more members made from 4130, 4135, 4140, or 4340 steel shall be post-weld thermal treated. Weldments used in the annealed condition shall be post-weld process

annealed. Weldments made from details previously hardened to obtain high strength shall be post-weld stress relieved except the holding temperature shall be 50° below the tempering temperature. Weldments requiring other thermal treatments shall be processed in accordance with drawing requirements. T-1 steel shall not be post-weld thermal processed unless so designated by the applicable drawing.

4.4.2 Reweld. Weldments which have been thermal treated to obtain an ultimate strength above 160,000 psi shall be annealed before discontinuities are removed for welding.

4.4.3 Welding filler materials. Table I shows the appropriate filler metals to use with the various base metals.

4.5 Welding of stainless and high alloy steels. Stainless and high alloy steels shall be welded with the filler materials, when used, as shown below.

4.5.1 Post-weld thermal treatment. Type 410 stainless steel shall be process annealed within twelve (12) hours after welding.

4.5.2 Filler materials. Table II shows the appropriate filler metals to use with the various base metals.

4.6 Welding of nickel and cobalt base alloys. Nickel and cobalt-base alloys shall be welded with the filler materials, when used, as shown below.

4.6.1 Welding filler materials. Table III shows the appropriate filler metals to be used with the various base metals.

4.7 Welding of aluminum and aluminum alloys. Aluminum and aluminum alloys, after preheating to the applicable maximum temperature shown in table IV, shall be welded with the filler materials (when used) as shown in table V. Filler addition is mandatory for welding 6061, 6063, and 6066.

4.8 Welding of titanium and titanium alloys. Titanium and titanium alloys shall be welded with the filler material, when used, as designated in table VI.

4.9 Welding of refractory metals and alloys. The following refractory metals and alloys shall be welded only to the metal or alloy of the same designation. The filler metal, when used, shall be of the same designation as the parent metal.

Columbium and columbium alloys			Tungsten and Tungsten alloys	
Columbium	C-103	Cb-752	Tungsten	W-25Re
As-55	FS-80	D43	Sylvania "A"	W-30Mo
B-66	FS-82	D43		
C-129y	FS-85	SCb-291		

Tantalum and Tantalum alloys		Molybdenum and molybdenum alloys	
Tantalum	T-222	Molybdenum	TZM
T-111	TA-10w	Mo-50Re	Mo-0.5Ti

4.10 Welding of copper. Copper shall be welded with the filler materials, when used, as designated in table VII.

5. QUALITY ASSURANCE PROVISIONS

5.1 Equipment qualification. Electron beam welding equipment qualification shall be maintained by checking weld penetration and quality on sample parts welded with certified schedules. When the sample weldments reproduces the original weld penetration with ± 10 percent the welding equipment will retain qualification.

5.1.1 Witnessing of qualification. Quality control shall witness and verify the welding equipment's compliance to the requirements of section 4.1 of this specification.

5.1.2 Sectioning of qualification test blocks. If quality control samples are not used, the applicable welding activity shall section the welded qualification test blocks as shown in figure 7. All qualification welds shall meet the requirements of section 3.6.

5.2 Operator certification. Production electron beam welding operators shall be certified at twelve (12) month intervals or by continual surveillance of production welding and Q.C. specimens.

5.2.1 Witness of certification. Quality control shall witness and verify the welding operator's compliance to the requirement of section 4.2 of this specification.

5.2.2 Sectioning of certification test blocks. If there are no Q.C. specimens, the applicable welding activity shall section the welding certification test blocks as shown in figures 8, 9, and 10.

5.3 Weld schedules. Weld schedules shall satisfy the requirements of this specification and the applicable engineering drawing. All certification welds shall meet the requirements of section 3.6. A minimum of two samples are required for a certified weld schedule. See attachment 1 for a suggested certified weld schedule form. The welds shall be evaluated by:

(a) 20 X inspection of weld surface
(b) Mettalographic examination of welded joints @ 20 X magnification

5.4 Production welder's identification stamps. Unless otherwise specified by the applicable engineering drawing, the following methods of marking are acceptable:

(a) Impression stamping - when required by the contract,
(b) Ink marking,
(c) Cardboard or metal tag firmly attached to the part - when required by the contract.

5.5 Production quality control. Production quality control shall consist of the inspection methods shown below or shall be in accordance with the requirements of the applicable engineering drawing.

5.5.1 Magnetic materials. All magnetic materials shall be degaussed prior to electron beam welding.

5.5.2 Examination of product. All welds shall be visually examined to insure compliance with the requirements of 3.6.1 through 3.6.4. In addition, the following inspection procedures shall be used as specified in the contract or order.

(a) Magnetic particle inspection in accordance with MIL-I-6868
(b) Penetrant inspection in accordance with MIL-I-6866
(c) Radiographic inspection in accordance with MIL-STD-453 one-half values for porosity.

5.5.3 Tensile strength. When required by the contract or order, tensile strength tests shall be conducted in accordance with ASTM method E8.

5.5.4 Retests. If the results of the process control tests for a particular production set-up are not satisfactory, the weld schedule, the parent material, joint configuration, and the welding equipment shall be examined, and any unsatisfactory conditions corrected.

5.5.5 Weld final inspection report shall be used for production control (see attachment 2 for recommended form).

6. PREPARATION FOR DELIVERY

6.1 Packaging. Electron beam welded assemblies shall be packaged for handling and delivery in accordance with the applicable document (packaging data sheet or specification).

7. NOTES

7.1 Definitions.

7.1.1 Undercut and buildup. Undercut is evidenced by a reduction of the parent material thickness adjacent to the weld. Buildup is evidenced by an increase of parent material thickness at the weld (see figure 11).

7.1.2 Melt-through. Melt-through is evidenced by a deposit of weld material on the side opposite that weld (see figure 12).

Custodian:

Army - MR
Navy - AS
Air Force - 11

Review Activities:

Army - AT, MU,
Navy -
Air Force -

User activities:

Army - WC
Navy - MC. SH, YD

Preparing activity:

Army - MR

Project No. THJM-0025

(KBWP# ID-0423A/DISK 0167A. FOR AMMRC USE ONLY)

Table I. Filler Material Specifications for Welding of Similar and Dissimilar Metals, Low Alloy Steels

Base Metal	Armco Iron	ASTM-A7, ASTM-A36 Mild Steels ASTM-A441	Corten, Marten, Nay Yolloy and Jolloy	T1	4130	4135	4140	4340
Armco Iron	2							
ASTM-A-441, mild Steel ASTM-A7, ASTM-A36	2	2						
Corten, Marten, Nax Yolloy and Jalloy	3	3	3					
T-1		2	3	1				
4130		1	1	1				
4135		1	1	1		1		
4140		1	1	1		1	1	
4340								1

1. AMS 6458 (Vacuum Meld 17-22AS
2. ASTM-A251 GA65
3. AMS 6460 (Nax 9115)

Table II. Filler Material Specifications for Welding of Similar and Dissimilar Corrosion Resistant Steels

Base metal	430	304L	ARMCO 21-6-9	316	321 or 347	410	19-9DL 19-9DX	17-4PH	17-7PH	16-25-6	AM 350 AM 355	29-20 (20cb)	Invar 36
304EL		5											
ARMCO 21-6-9			1										
316		13		13									
321 or 347		5		2	2								
410						7							
19-ODL 19-9DX		3		6	3		3						
17-4PH		4		4	4		4	10					
17-7PH		4		4	4		4	11	11				
16-25-6		4		4	4					3			
AM 350		8		6	16						16	8	
AM 355		8		6	8						8	8	
29-20(20cb)		12			12							12	
Haynes 21										4			
29-9										9			
Invar 36		4		4	4								14
430	15												

1. 21-6-9 (Cr, Ni, Mn)
2. ASTM A 371-ER 347
3. MIL-R-5031 class 6 (349)
4. AMS 5786 (Hastelloy W)
5. MIL-R-5031 class 16 (308ELC)
6. AMS 5675 (Inconel 92)
7. AMS 5676 (ER410)
8. AMS 5780 (AM355)
9. ASTM A 371-ER312 (3)
10. AMS 5825
11. AMS 5824
12. 29-20 Cb (Ni, Cr)
13. MIL-R-5031 Class 4
14. 36% Ni content
15. ASTM A 371-ER430
16. AMS 5774 (AM350)

Table III. Filler Material Specifications for Welding of Similar and Dissimilar Ni and Co Base Alloys

Base metal	Nickel 200	Monel 400	K Monel 500	Inconel 600	Inconel X-750	Inconel 718	Hastelloy B	Hastelloy C	Hastelloy X	Haynes 21	Haynes 25	N-155	Rene 41	
Nickel 200	10													
Monel 400	10	9												
K-Monel 500	10	9	11											
Inconel 600	1			1										
Inconel X-750	1			5										
Inconel 718	1			5	5	7								
Hastelloy B	5			5	5	5	3							
Hastelloy C	5			5	5	5	5	4						
Hastelloy X	5			5	5	5	5	5	13					
Haynes 21	5			5	5	5	4	4	5	6				
Haynes 25	5			5	5	5	5	5	5	6	6			
N-155	5			5	5	5	5	5	5	5	5	2		
Rene 41				5			5	5					12	

1. Inconel 82
2. AMS 5794 (N-155)
3. ASTM B 304 ERNiMo-4 (Hastelloy B)
4. ASTM B 304 ERNiMo-5 (Hastelloy C)
5. AMS 5786 (Hastelloy W)
6. AMS 5796 (Hayes 25)
7. AMS 5832
8. AMS 5675 (Inconel 92)
9. ASTM B 304 RN40 (Monel)
10. ASTM B 304 RN41 (Nickel)
11. 00-R-571 FS-RNiCuAL
12. AMS 5800
13. AMS 5798 (Hastelloy X)

Table IV. Preheat Temperature for Designated Conditions

Alloy Designation	Maximum Preheat Temperature °F		
	Annealed	Solution Heat Treated	Precipitation Heat Treated
1100	750		
3003	750		
5052	750		
5083	750		
5086	750		
5356	750		
5456	750		
6061	750	920	295
6063	750	920	325
6066	750	920	325
356	750	920	275
Tens 50	750	920	275

Table V. Filler Wire Specifications for Welding of Similar and Dissimilar Metals, Aluminum Alloys

Base Metal	1100	3003	5052	5083	5086	5356	5456	6061	6063	6066	356	612	Tens 50
1100	2												
3003	2	2											
5052	4	4	4										
5083			4	5									
5086			4	5	5	5							
5456			4	5	5	5	5						
6061	3	3	4	5	5	5	5	1,3					
6063	3	3	4	5	5	5	5	1,3	1,3				
6066			4	5	5	5	5	1,3	1,3	1,3			
356			1,3	5	5	5	5	4	4	4	3		
612			1,3	5	5	5	5	4	4	4	3	3	
Tens 50			1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	

*1. ST0170GB0001-Tens 50
2. MIL-E-16053 Type 1100
3. MIL-E-16053 Type 4043
4. QQ-A-430 Type 5056
5. MIL-E-16053 Type 5356

*Denotes filler wire to be used when weldment is subsequently heat treated for increased strength.

Note: Alloy 718 may be used in conjunction with any of the alloy combinations listed in table V.

Table VI. Filler Material Specifications for Welding of Similar and Dissimilar Metals, Titanium Alloys

Base metal	Titanium	5Al-2.5Sn	6Al-4V	8Al-1Mo-1V	6Al-1Mo-1V
Titanium	1				
5Al-2.5Sn	1	2			
6Al-4V	1	3	3		
8Al-1Mo-1V	1	4	4	4	
6Al-1Mo-1V	1	4	4	4	5

1. MIL-T-9046 Type I
2. MIL-T-9046 Type II, Composition A
3. MIL-T-9046 Type III, Composition C
4. MIL-T-9046 Type II, Composition F
5. Ti 6Al-1Mo-1V

Table VII. Filler Wire Specifications for Welind of Similar and Dissimilar Copper Alloys

Base metal	Filler Wire	Filler Wire Specification
Copper deoxidized	Silicon Bronze	ASTM-B259 Class RCuSi-A
Copper	Deoxidized copper	QQ-R-571 Class FS-RCu-2
Deoxidized copper or copper, to nickel or monel	Nickel "41"	ASTM-B304 Class RN41
OFHC copper	Oxygen free copper	AMS4701 (OFHC copper)

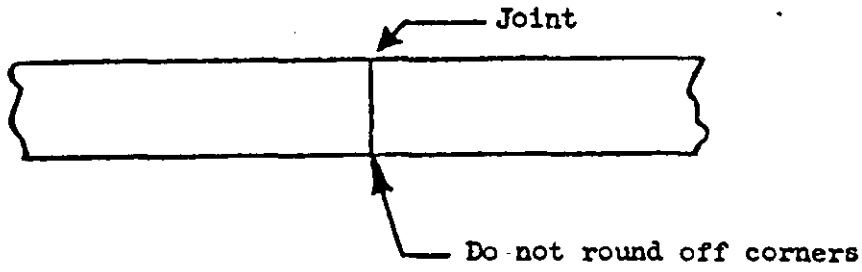
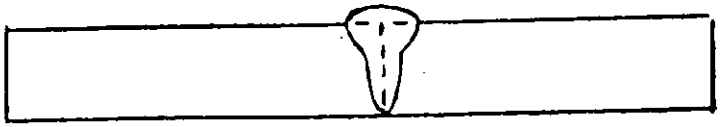
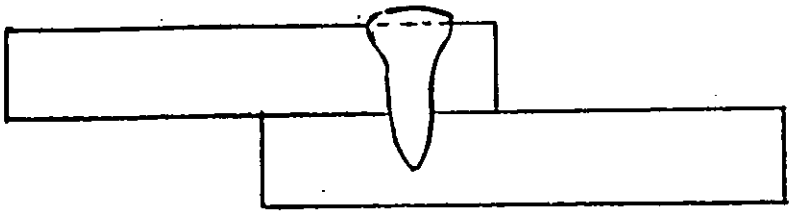


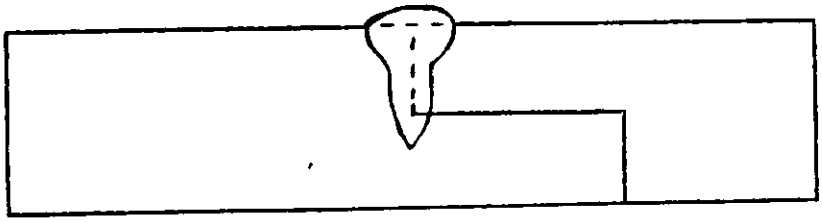
Figure 1. Typical Butt Joint Configuration



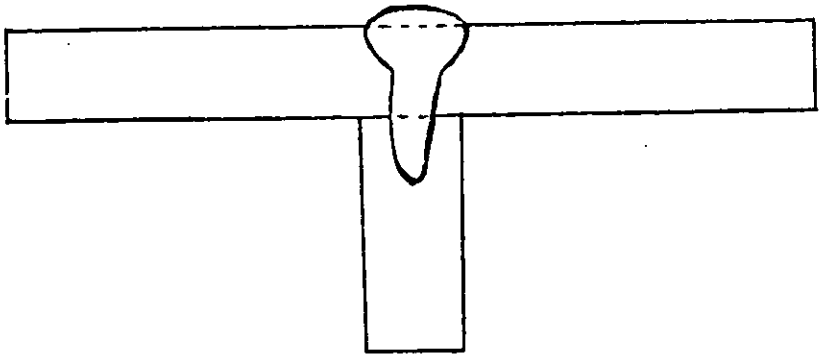
Butt type



Lap type

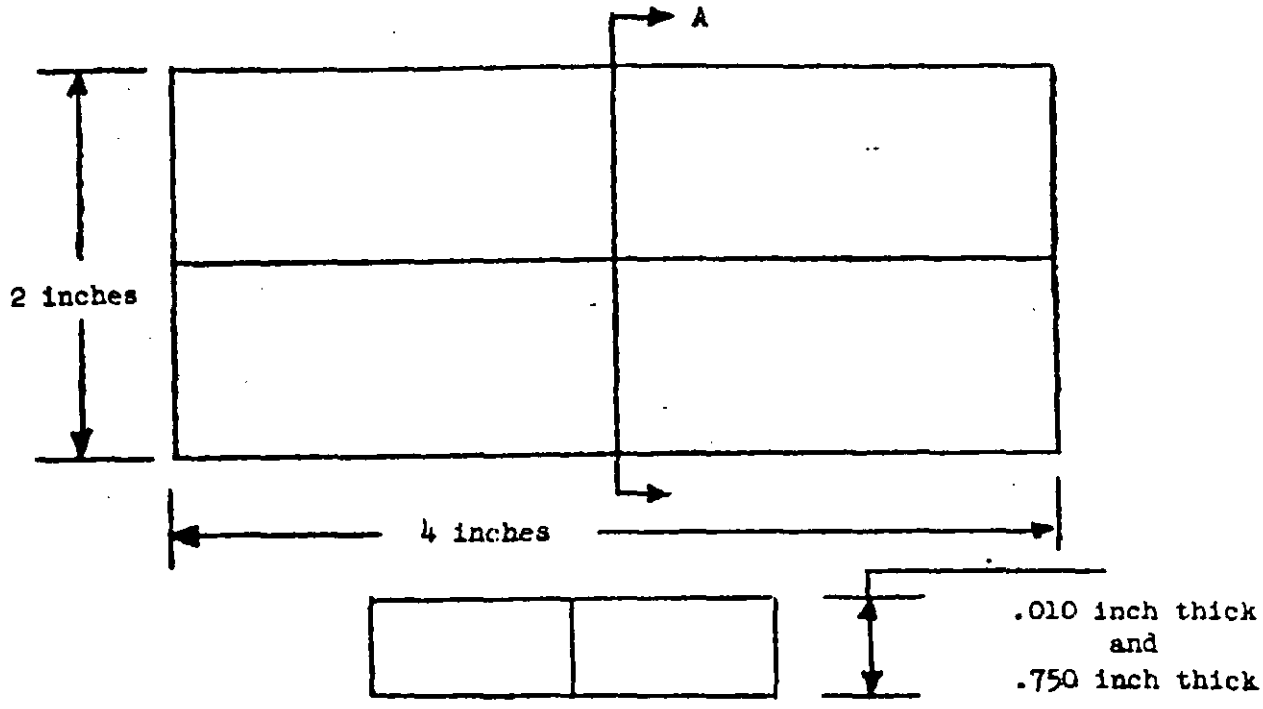


Lap-butt type



Burn-through "Tee" type

Figure 2. Typical Joint Configuration



Section A-A

Figure 3. Equipment Qualification Specimens

(A) Operator Certification Test Specimen I Butt

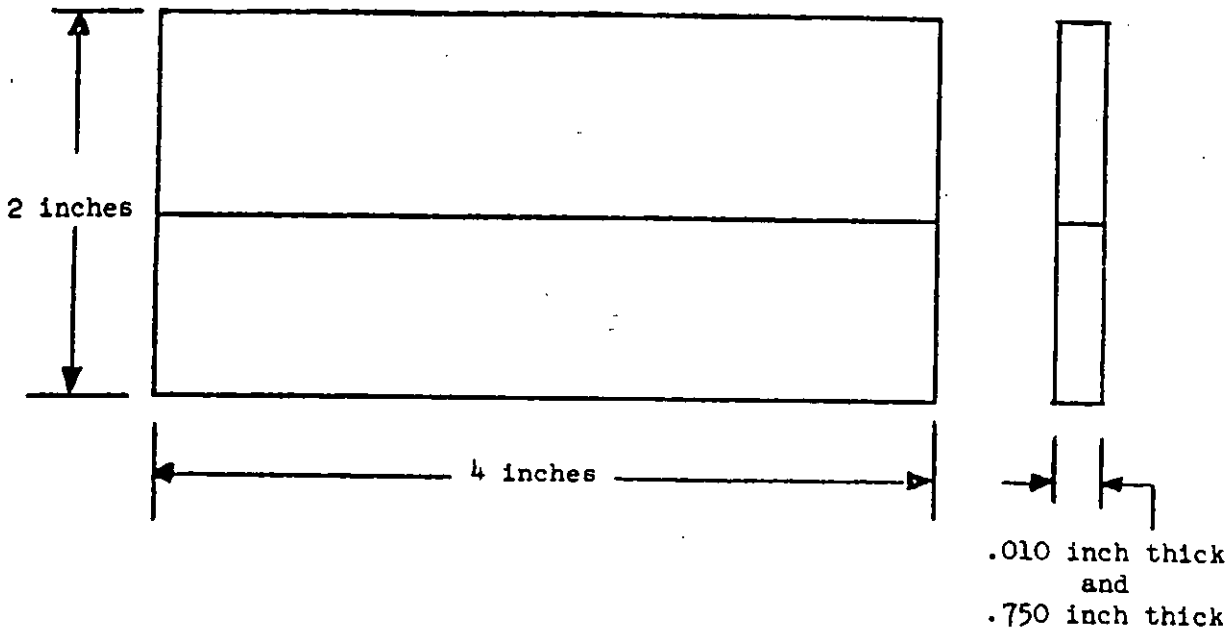
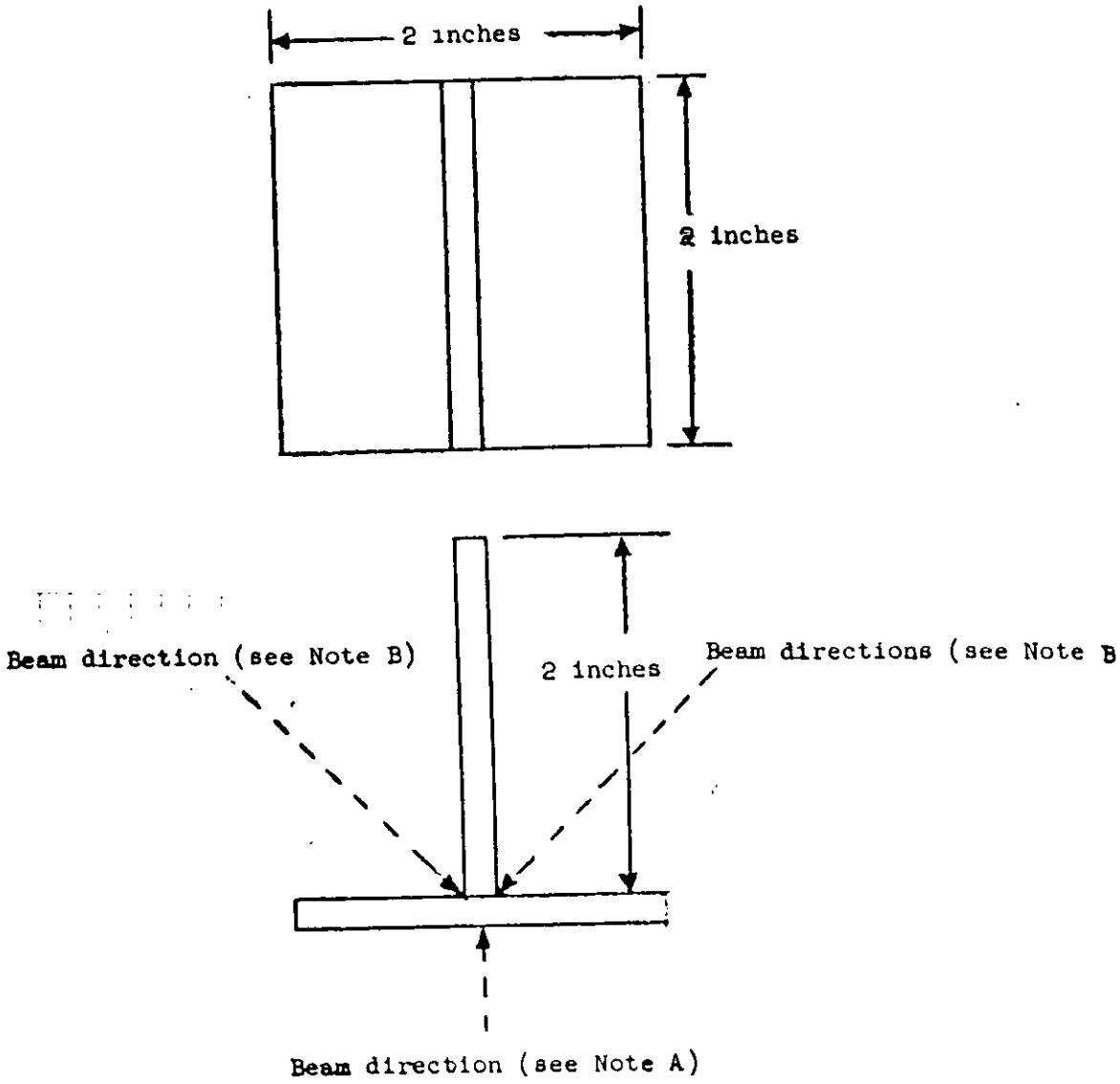


Figure 4

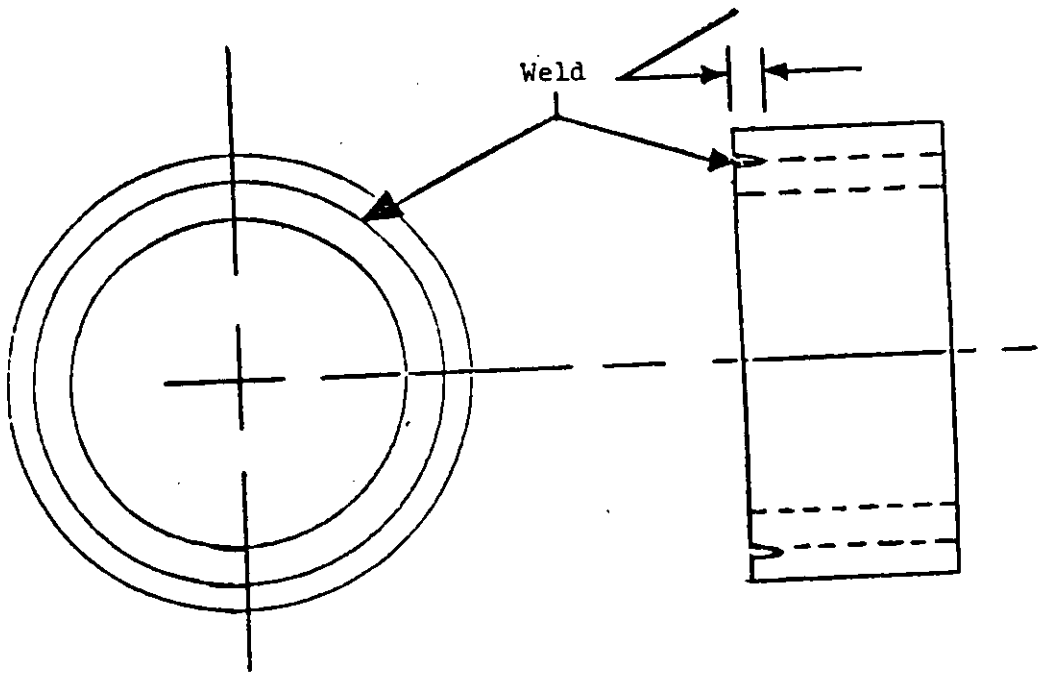
(B) Operator Certification Test Specimen II - "Tee"



Note A: Joint shall be welded from backside using a .032 inch material.
Note B: Joint shall be welded into the root of the joint using .015 inch material.

Figure 5

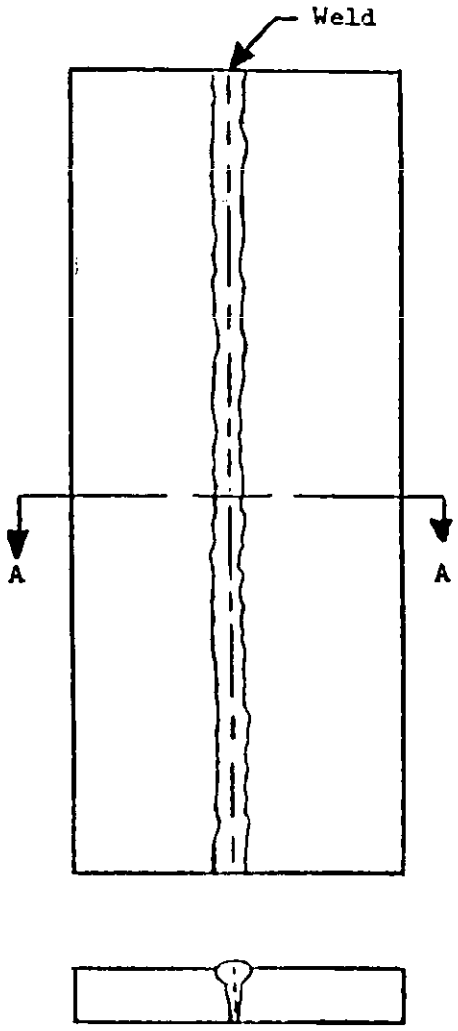
(C) Operator Certification Test Specimen III
Circular Edge Weld



Note: Test specimens shall be manufactured as a matched set with a maximum radial clearance of .002 inch. Diameters of cylinders shall be 2 inches. Wall thickness shall be .125 inch.

Figure 6

Sectioning of Weld Sample

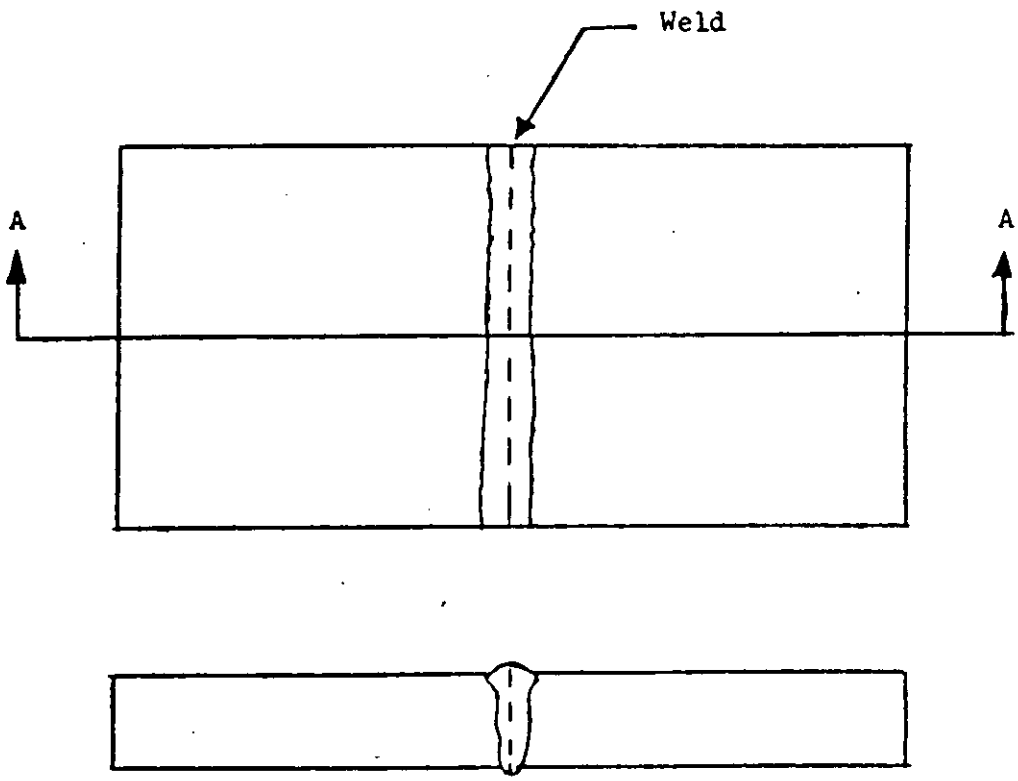


Section A-A

Test blocks shall be
sectioned at this line

Figure 7

(a) Sectioning of Certification Test Specimen I



Section A-A

Figure 8

(b) Sectioning of Certification Test Specimen II

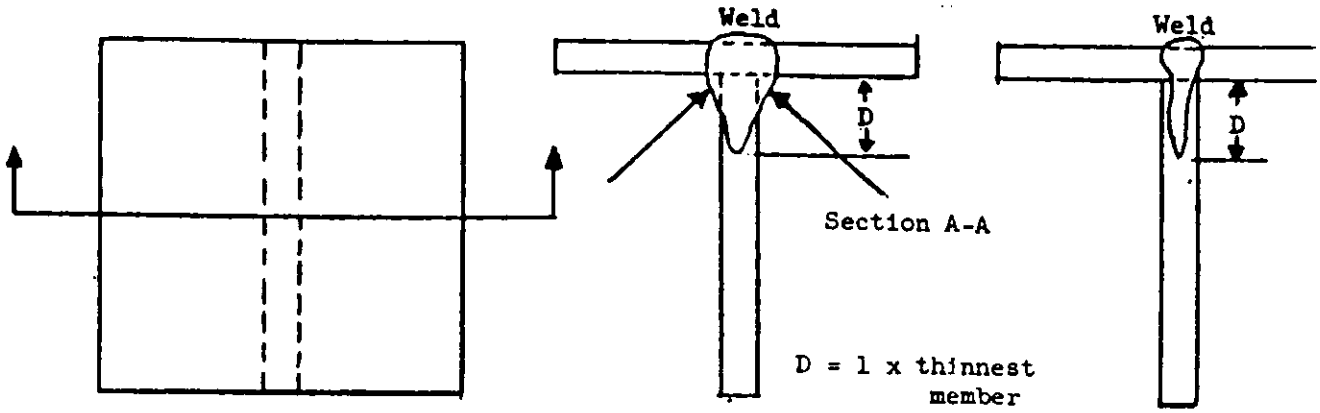
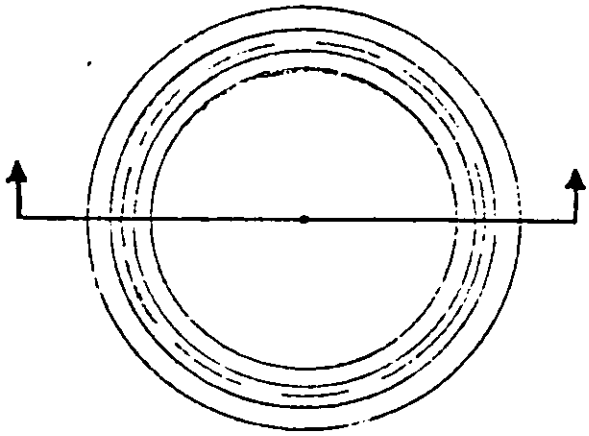
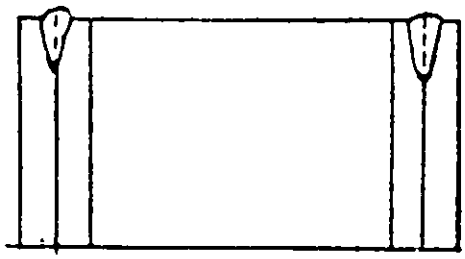


Figure 9

(c) Sectioning of Certification Test Specimen III





Section A-A

Figure 10

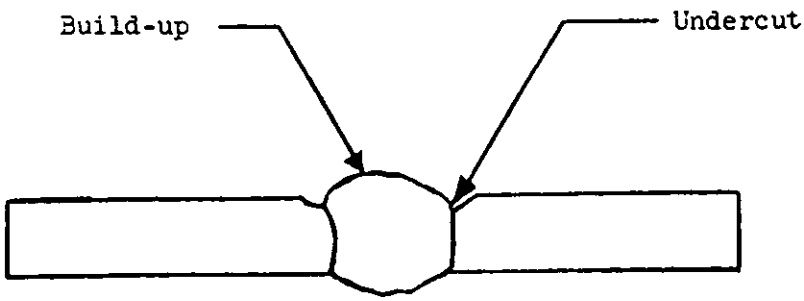


Figure 11

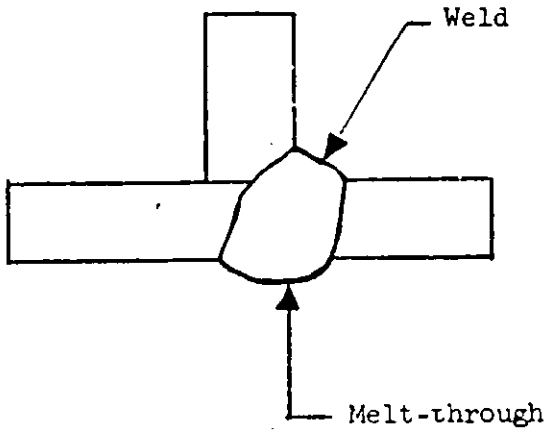


Figure 12

CERTIFIED D SCHEDULE

Number_____

_____K.V. _____Ma
_____Dial _____Dial
Beam Mode_____
Beam Diameter_____
Dial_____
Decay %_____Dial

Fixture Description:_____
_____
_____
_____

Travel Speed:
Range_____
Linear_____In/Min_____Dial

Rotation: Timer_____
Range_____RPM_____
Dial_____Weld Dia.____

Pulsation:
Pulse Width_____Dial_____
Pulse freq._____Dial_____

Beam Deflection:
AC Total_____DC_____

Circle:
Diameter_____

Other:_____
_____

Approved By:_____

Date_____
Company_____
Representative_____
Part Number_____
Part Name_____
Weld Type_____

Material_____
Cleaning Procedure:_____

Quality Control Requirement

TOOLING LAYOUT

PHOTOMACROGRAPH OF WELD STRUCTURE

Mag_____ Etchant_____

Results and Comments

Figure 13. Sample of a certified weld schedule form

CERTIFIED WELD SCHEDULE

Number _____

_____ K.V. _____ Ma
_____ Dial _____ Dial
Beam Mode _____
Beam Diameter _____
Dial _____
Decay % _____ Dial

Fixture Description: _____
_____
_____
_____

Distance of Work from Heat Shields:
_____
_____
_____

Travel Speed:
Range _____
Linear _____ In/Min _____ Dial

Rotation: Timer _____
Range _____ RPM _____
Dial _____ Weld Dia. _____

Pulsation:
Pulse Width _____ Dial _____
Pulse Freq. _____ Dial _____

Beam Deflection:
AC Total _____ DC _____

Circle:
Diameter _____

Other: _____
_____

Approved By: _____

Date _____
Company _____
Representative _____
Part Number _____
Part Name _____
Weld Type _____

Material: _____
Cleaning Procedure: _____
_____

Quality Control Requirement

TOOLING LAYOUT

PHOTOMACROGRAPH OF WELD STRUCTURE

Mag _____ Etchant _____

Results and Comments

MIL-W-46132

Figure 13. Sample of a certified weld schedule form

FINAL INSPECTION REPORT

Number _____
Sheet _____ of _____

Company _____
Part Name _____
Part Number _____
Customer Shipper _____
Quantity Assemblies _____
Quantity Detail _____

Weld Type _____
Joint Thickness _____
Material _____
Weld Schedule _____
Tool Number _____
Machine _____

Shipper _____
Date _____

(1) Pre-Weld Inspection

Part Fit-Up _____
Cleanliness _____
Remarks _____

(2) Q.C. Samples

Sample #1
Surface (20X) _____
Penetration _____
Quality _____

Sample #2
Surface (20X) _____
Penetration _____
Quality _____

Sample #3
Surface (20X) _____
Penetration _____
Quality _____

Serial No.	Final Visual Insp. (20X)	Non-Destructive Tests	Comments

Welded By _____
Approved _____ Q.C. Mgr.

Figure 14. Sample of a final inspection report form