

EMCO WHEATON

A Gardner Denver Product

Engineering Specification

Number 8

Weld Specifications & Procedures

ISO11052 008	S	11/3/2008	JWG
RN21876	R	10/04/03	BMB
RN21866	Q	09/19/03	BMB
RN21520	P	4/23/2002	PCG
RN21458	N	2/20/2002	PCG
RN20898	M	1/11/99	JF
RN20813	L	7/1/98	KRM
RN20646	K	9/16/97	KRM
RN13521	I	1/15/93	PJE
ECN	Revision	Date	By

INDEX

PAGE

0.0	Purpose	3
1.0	Material	4
2.0	Preparation	5
3.0	Procedure	7
4.0	Welders	11
5.0	Heat Treatment	13
6.0	Quality Standard	15
7.0	Misc. Shop Standards	18
8.0	Welding Symbols	20
9.0	Welding Machine Calibrations	20

Appendix

I	Calculation of Carbon Equivalent	21
II	References	22

0.0 Purpose

The purpose of this document is to:

- 0.1** Provide a written, qualified welding procedure-giving direction for making production welds. Welds will fall into one of three classes, according to the weld required
- Class 1a weld
 - Conform to *ASME Section IX* (ASME Boiler and Pressure Vessel Code) Chapters V and VI.
 - Conforms to ASME B31.3 chapter VI requirements for severe cyclic conditions.
 - Class 1b welds
 - Conform to *ASME Section IX* (ASME Boiler and Pressure Vessel Code) Chapters V and VI.
 - Conforms to ASME B31.3 chapter VI requirements for normal fluid service.
 - Class 2 welds
 - Conform to EMCO Wheaton USA standard designated by the drawing and QC procedures.
- 0.2** Outline the requirements for qualification of a welder to ensure their competence in each welding process to be used in production welding.
- 0.4** Provide essential and supplementary information concerning the specific welding processes to be used by EMCO Wheaton USA.
- 0.5** A weld map will be prepared for each job where ultrasonic or x-ray testing is performed. The weld map will consist of a drawing marked to indicate the weld joint tested to the corresponding the UT / x-ray and Welder ID number.

Note: -

This guide is not to be used as a replacement for the ASME/ANSI Code, but as a supplement. If there is a discrepancy between this guide and the ASME/ANSI Code, the welder is responsible to follow the ASME/ANSI Code.

1.0 Materials

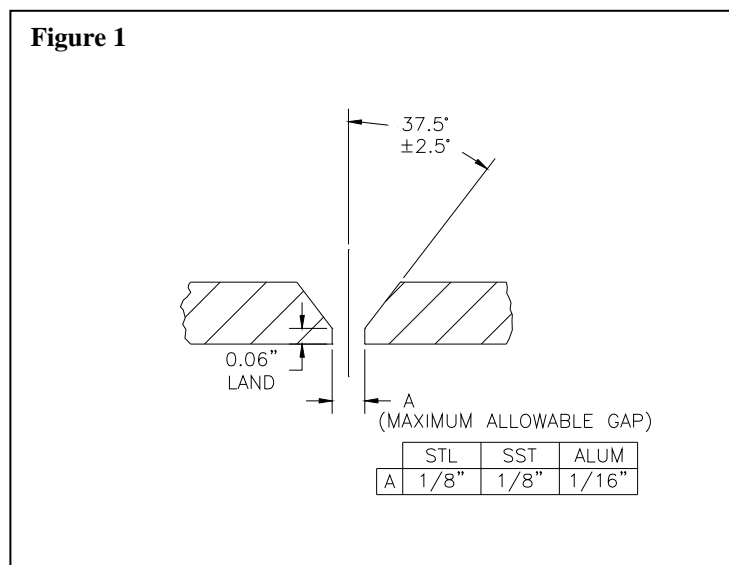
- 1.1 Filler materials should conform to requirements of the *ASME Boiler and Pressure Vessel Code, Section IX*. These materials are called out specifically on the Weld Procedure Specifications (WPS) held by the QC department.
- 1.2 Filler material must be approved as a part of the welding procedure. Changes in filler material will require engineering department approval and weld qualification.
- 1.3 EMCO Wheaton USA

Material	C %	Mn%	Si%	P%	S%	CE
API SL Grade B	0.27	1.15		0.04	0.05	0.46
ASTM A53 Grade B	0.30	1.20		0.05	0.06	0.50
ASTM A234-WPB	0.35	0.90		0.05	0.05	0.50
ASTM A106 Grade A	0.25	0.27-0.93	0.10	0.048	0.058	0.295-0.405
ASTM A106 Grade B	0.30	0.29-1.06	0.10	0.048	0.058	0.348-0.477
ASTM A105	0.22-0.35	0.60-1.05	0.35	0.04	0.05	0.320-0.525
AISI C1045	0.43-0.50	0.60-0.90		0.04	0.05	0.55-0.65
En 32B	0.10-0.18	0.60-1.0	0.05-0.35	0.05	0.07	0.20-0.34
En 8D	0.40-0.45	0.70-0.90	0.05-0.34	0.06	0.06	0.51-0.60
CK 35	0.32-0.39	0.80	0.35	0.035	0.035	0.32-0.523
ST 35	0.18	0.40	0.35	0.05	0.05	0.247
TTST 35	0.17	0.40	0.35	0.045	0.045	0.237
STKM 17A	0.45-0.55	0.40-1.00	0.40	0.04	0.04	0.517-0.717
A36	0.26			0.04	0.05	0.26
A500 Grade B	0.30			0.05	0.06	0.30
A501	0.30			0.05	0.06	0.30
Note :- single figures are maximums						

2.0 Preparation

- By gas cutting, grinding, machining, or filing.
- Parts burned with Airarc or Metallarc must be subsequently ground before welding.
- For butt welds, preparation will be generally as per Figure 1 (Unless otherwise noted on the welding procedure).
- All pipe ends to be butt-welded must be beveled 37.5 degrees (+/-2.5 degrees) leaving 0.06" land on I.D.

Caution: Gas cutting should NOT be used for steel having a carbon content greater than 0.35 due to their tendency to harden in the heat affected zone.



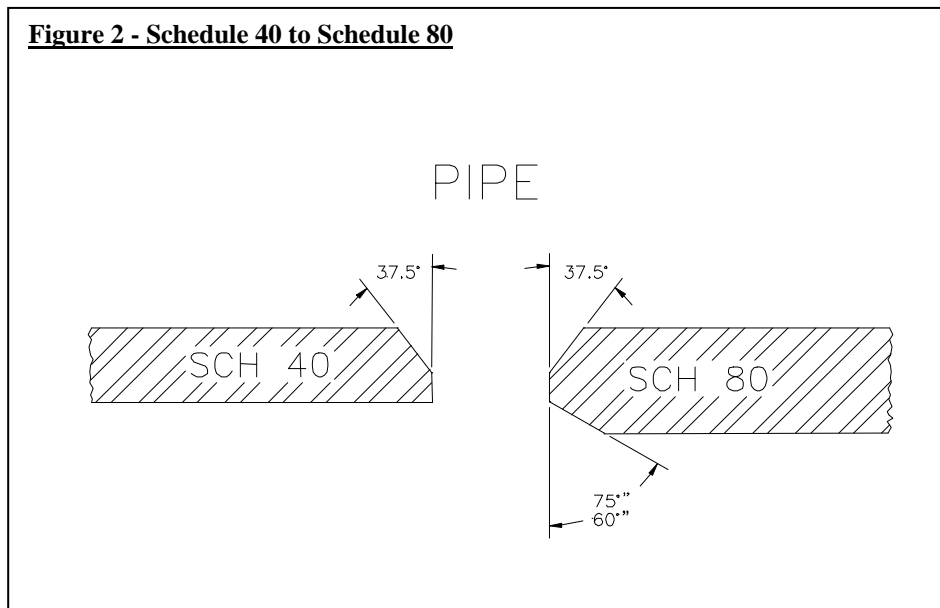
2.1 Cleaning :

- The surface edge of the parts to be joined by welding shall be prepared by having all scale, rust, paint, coatings, etc. removed for a distance of 1" back from the weld face and 3/8" back from the root.
- Cleaning should be done as soon as practical before welding to avoid build up of oxidation.
- For Carbon Equivalent less than 0.55 slag build up between passes must be removed prior to starting the next pass.

2.0 Preparation

2.2 Alignment :

- Components to be butt-welded must be aligned at the root as accurately as possible to allow full penetration of the root weld pass, and so that full fusion of the land is obtained.
- Where misalignment is excessive, the root side may be taper trimmed to match the other component, if the trimming does NOT reduce the wall thickness below the allowable tolerance (*ASME B31.3 Section 328.4.2*)
- When welding Schedule 40 pipe to Schedule 80 pipe the Schedule 80 pipe must be prepared according to Figure 2.
- Open V butt welds should not have gaps over 1/8 on steel and stainless steel, 1/16 on aluminum.
- Where bracketing is added to pressure piping using fillet welds, the fillet weld should not cross a butt weld in the piping.
- Attachments shall be notched radially to clear the butt weld reinforcement, and the notch shall be of a smooth contour.



3.0 Procedures

3.1 General Objectives:

- To establish the standards and procedures for welding EMCO Wheaton USA products. The qualifications are all based on *ASME Boiler and Pressure Vessel Code, Section IX*.
- When required by the customer, welders must be able to meet the *ASME B31.3 Chemical Plant and Petroleum Refinery Piping Code*.

3.2 Tack Welds:

- A minimum of three tack welds will be used to maintain alignment during welding unless a suitable fixture is available. Tack welds must be ground or feathered before the first pass is made or be consumed by the process to allow full penetration.

3.3 Root Penetration:

- Root penetration will not require grinding on the root side unless excessive build-ups or gaps are present and then only where the build-up occurs.

3.4 Weld stop and start points :

- Shall not be coincident between passes.
- Each pass should not show any cracks, blowholes, or other surface defects including undercut and crater cracks.
- Any defects shall be removed prior to welding the following pass.
- DO NOT use gas cutting or gouging to remove defects in hardenable materials (Over 0.35 carbon).
- Edges should be feathered for appearance.

3.5 Time Delay:

- It is preferred that welding be completed as so the component is only heated and cooled once. This practice will cause the increase and decrease in weldment temperature to be a smooth gradient.
- A continuous process is compulsory for components having carbon equivalent of more than 0.55 requirement. In addition, preheat and post heat may be required (where specified in the procedure).

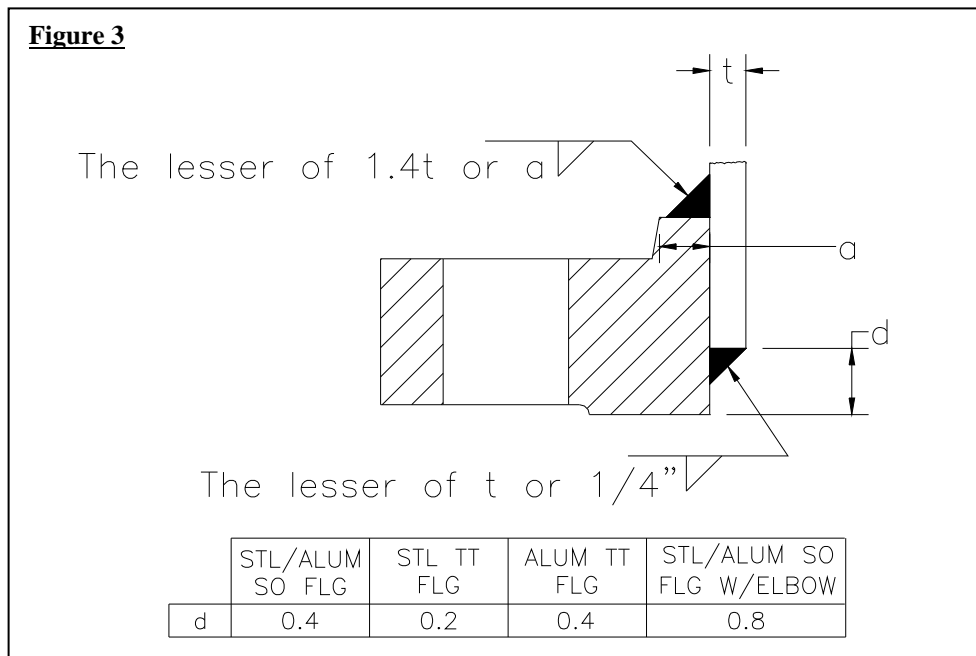
3.0 Procedures - continued

3.6 Climatic Conditions:

- No welding shall be done in or under the influence of rain, snow, sleet, or high wind on the welding area.
- Electrodes and filler metals must be kept dry and free of condensation.
- Special care should be taken in the storage of shielded arc welding rods to ensure If rods are suspected of being damp heat in a dryer oven at 255-300 degrees f.
- Any time condensation is present or the ambient temperature is less than specified by the WPS/PQR, the weld area should be preheated until warm to the touch, before starting the weld.

3.7 Slip-on Tank Truck Flange Welds (TTMA):

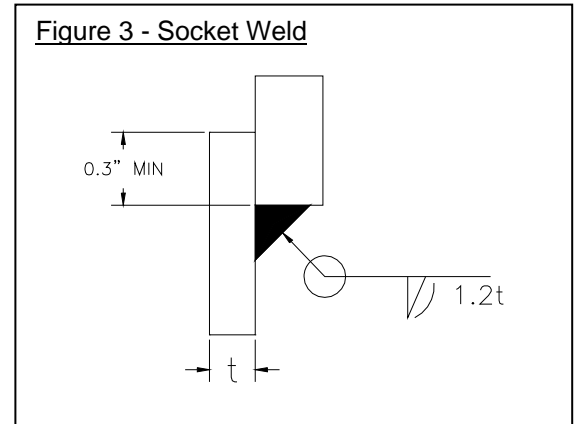
- Welding will consist of a main fillet weld and a seal weld as described in figure 3. All welds to be horizontal or flat.
- No undercutting or bridging allowed.



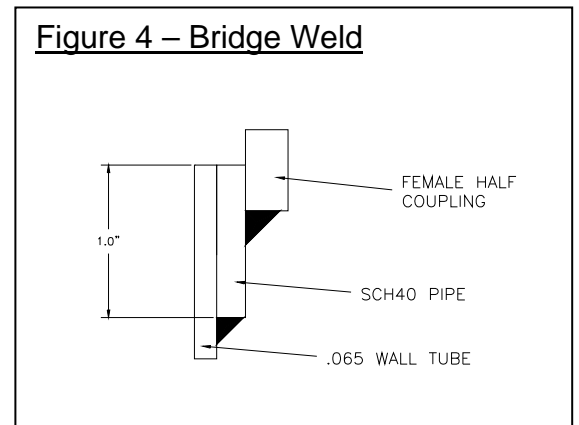
Procedures - Continued

3.8 Socket Welds:

- Refer to specific Weld Procedure Specification (WPS) for number of passes.
- Assembly must conform to figure 3 :

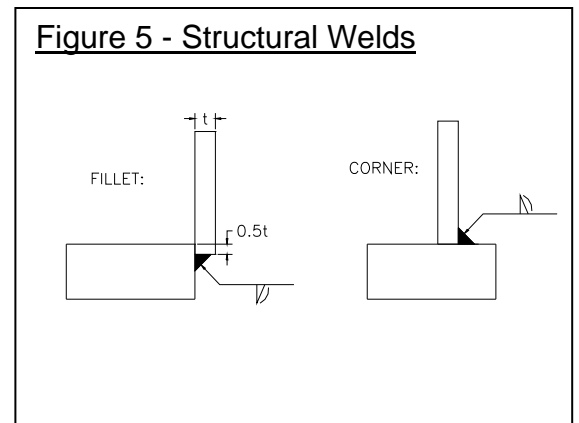


- Where tubing must be welded to a pipe connection, a pipe spacer is required to bridge the gap.
- Assembly is shown in figure 4:



3.9 Structural Welds:

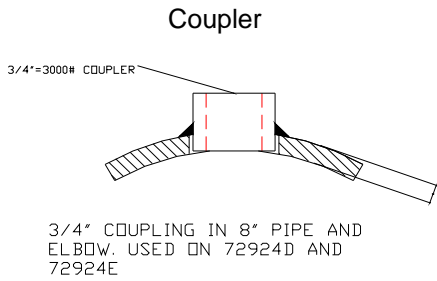
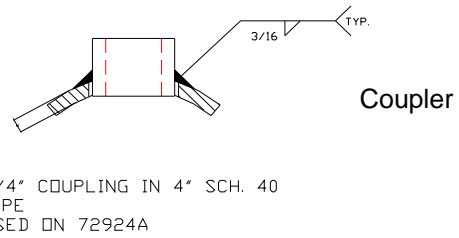
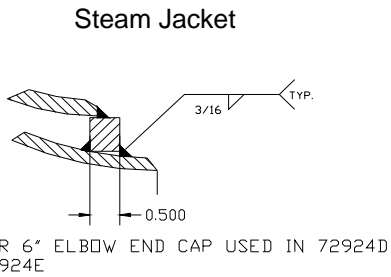
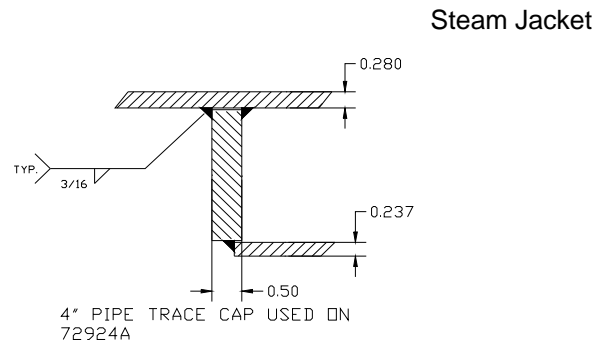
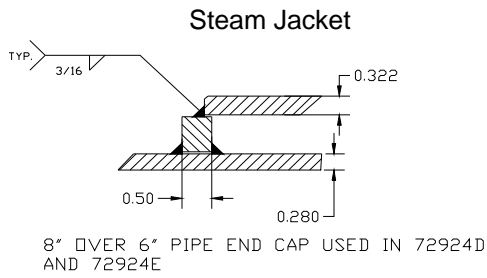
- Assembly is shown in figure 5:



3.9.1 Coupler and Steam Jacket Welds

- Assembly is shown in figure 6:

Figure 6 - Coupler and Steam Jacket Welds



NOTE:
DETAILS ARE FOR 75psi WORKING PRESSURE OR LESS.

Procedures - continued

3.10 Swivel Assemblies

- All swivels are to be disassembled prior to welding.
- Care is to be given to ensure that all raceways are free of weld splatter and other damage after welding.
- For all swivels from EMCO Wheaton USA, each body and sleeve combination must be marked as a matched set prior to disassembly. The pair must be matched back together again in final assembly.

4.0 Welding

4.1 Purpose

- To ensure proper control is maintained for welding processes performed by EMCO Wheaton USA

4.2 Responsibilities

- The Manager, Engineering is responsible for establishing and maintaining (WPS) Weld Procedure Specifications and (PQR's) Procedure Qualification Records for the welding processes employed.
- The Manager, Engineering is also responsible for assigning qualified welders to any code welding.
- The Manager, Engineering is responsible for certifying the WPS, PQR's by way of a signature on the relevant documents.
- The Quality Control is responsible for maintaining the master copy of WPS, PQR's and Welder qualification records.
- QC personnel are responsible for maintaining the welder continuity forms (form Q030)
- Inspection of welded assemblies will be in accordance with QP 8.1D Distribution Product (loading arms) Inspection.

4.3 Welding Identification :

- Each welder shall be assigned a welder identification number which will be used for marking welds done by that welder.
- In the case of different passes being done by different welders, each welder shall mark the weld with their number closest to the weld.
- The assigning of numbers and maintenance of the record will be done by Quality Control.

4.4 Welder Qualification :

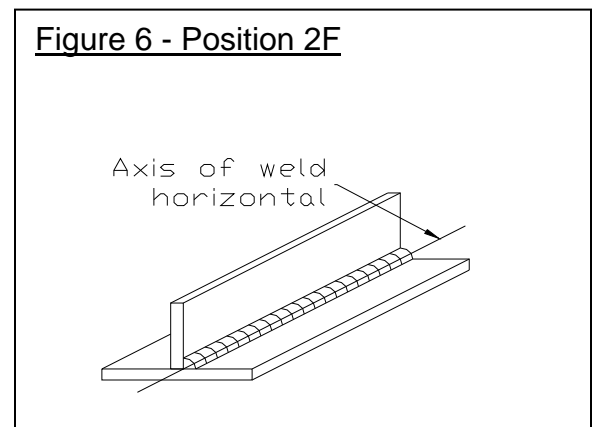
- Welders will be required to qualify as required under the *ASME Boiler and Pressure Vessel Code, Section IX*.
- Per ASME Section IX, QW-300, welders must be individually qualified for each type of weld they are to perform in production.
- This qualification will be based solely on the essential variables listed in QW-350 through QW-360 (*ASME Section IX, Article IV Welding Data*).

4.0 Welding / continued

- A welder shall be re-qualified whenever a change is made in one or more of the essential variables listed for each welding process.
- A welder is qualified by radiography of a test piece (or test coupon), radiography of the welder's initial production welding, or by bend tests taken from a test coupon.
- EMCO Whaeton USA shall maintain test results verifying the competency of each welder (by name) for each welding process they are qualified.
- Welders may weld only those welds for which they are qualified.
- All welders performing product welds are initially certified by an approved outside source to weld using various materials and procedures. (See welder qualification records, maintained by QC department, for individual welder qualifications).
- Re-certification shall be required only if a welder is prevented from welding to a particular process for more than a 6-month period. Qualification is maintained by use of the Welder Continuity Log record (form Q030) for each welder.

4.5 Trade Test :

- The trade test may be used at time of application. Interview, or hiring.
- The trade test is NOT to be used as part or all of the welder's qualification. The trade test is comprised of a 3/8 fillet - position 2F figure 6 (Mild steel plate)
- The welds must be 6" long and present a good appearance for at least 4".
- Each shall show a stop and start within the 4" length.
- The welder shall prepare the parts for welding using a grinder.
- The test weld is to be inspected visually for appearance, lack of cracks, and undercut.
- This test is to be performed using the GMAW process.



5.0 Heat Treatment

- 5.1 Shall conform to *ASME B31.3 section 331* unless authorized by the engineering department. The information in this section outlines general procedures.
- 5.2 Heavy sections greater than one inch thick must be preheated until warm to the touch. (*ASME B31.3 section 330 table 330.1.1 Preheat Temperatures*).
- 5.3 Post weld stress relieving of welds when specified is performed to relieve the stresses that occur in the weld and the heat affected zone adjacent to the weld.

5.3.1 Heating Method :

Heating for post weld stress relieving should be done in a manner that will control the rate of temperature rise, cooling rate, and maintain the stress relieving temperature within tolerances specified.

Stress relieving may be done by:

- (a) Localized heat application to the weld.
- (b) Heating of a position of the weldment.
- (c) Heating of the complete weldment.

The choice of method will be selected on the basis of the method, which is most suitable for the weldment, and its location.

5.3.2 Steam Conditioning Temperatures:

The weld area being steam conditioned should follow the following temperature time sequences:

- (1) Increase from ambient to 400^oF at an unlimited rate.
- (2) Hold @ 400^oF for 8 hours
- (3) COOL to ambient from 400^o

5.3.3 Records:

After completion of the stress relieving/steam conditioning operation, the contractor is to provide EMCO Wheaton USA with a fully documented time/temperature chart.

5.3.4 Temperature Recording Methods:

Temperature measuring devices shall be secured to the weld and the temperature gradients recorded preferably in chart form.

5.0 Heat Treatment / Continued

5.3.5 Swing Joint Welds:

- Welds between swing joint bodies or sleeves having hardened raceways must be stress relieved by localized heating of the weld.
- Overheating of the raceway during the stress relieving will reduce the hardness, extreme care must be exercised to ensure that the raceway and an area ¼" on either side of the raceway does not exceed 400°F at any time.
- The temperature of this area must be recorded during the stress relieving process and a permanent record be provided. The temperature-sensing device must be placed in the race and adjacent to the race at approximately 2 times spacing on the diameter.
- Welds between swing joint components not having hardened races (e.g. flanges) may be heated to higher temperatures, however, care must be taken to heat evenly so as to minimize distortion and protect from scale formation on the seal surfaces.

Caution: During stress relieving or steam conditioning, the swing joint will be disassembled exposing the machined surfaces and seal areas. Care must be taken to protect the areas from handling damage until re-assembly.

6.0 Quality Standards

- 6.1 Visible cracks, blowholes, or porosity appearing in any root or fill pass must be ground out before depositing additional weld. Start and stop points for fillet welds must be blended. For details concerning acceptance criteria for welds, refer to *Table 341.3.2 ASME B31.3*.

Welding will have 3 different classes of standards depending on the design and application of the finished product.

Class 1a

- In addition to Class 1b requirements
- Product is deemed poisonous by inhalation from the MSDS sheet.

Or

- Customer specifies that welds are to conform to *ASME B31.3 Code* radiography inspection to severe cyclical duties.

Class 1b

- Welds of excellent quality conforming to *ASME B31.3* for normal fluid Service applications.

Or

- Pressures at or above 300 psi.

Or

- Arm is of Stainless Steel construction

Or

- When the customer specifies that welds are to conform to *ASME B31.3 Code* radiography inspection or ultrasonic testing will be required.

Class 2.

- Welds of excellent quality for general use in fabrication where welding procedure MAY DEVIATE from the ASME B31.3 code.

The Engineering Department will specify the class. If not noted, welding will be class 2.

Quality Standards - Continued

6.2 Inspection Standards Class 1a & 1b :

Class 1a

- Welds must be inspected to *ASME B31.3 Sections 341 - 346* for severe cyclical conditions. This information details the acceptance criteria for the examination of weld imperfections and the methods necessary to properly make examinations.
- Butt welds – girth and other when specified shall conform to the limitations of defects for 100% radiograph as per *ASME B31.3 Table 341.3.2* for severe cyclical conditions
- Fillet welds shall conform to the limitations of defects for 100% radiography as per *ASME B31.3 Table 341.3.2* for severe cyclical conditions.

Class 1b.

- Welds must be inspected to *ASME B31.3 Sections 341 - 346* for normal fluid service. This information details the acceptance criteria for the examination of weld imperfections and the methods necessary to properly make examinations.
- Butt welds – girth and other when specified shall conform to the limitations of defects for 5% radiograph as per *ASME B31.3 Table 341.3.2* for Normal fluid service. EMCO Wheaton USA inspection may use random radiography inspection under this standard if approved by the Engineering Department.
- Fillet welds shall conform to the limitations of defects for 5% radiography as per *ASME B31.3 Table 341.3.2*. EMCO Wheaton USA may use random radiography inspection under this standard if approved by the Engineering Dept.

6.3 Inspection Standards – Class 2 :

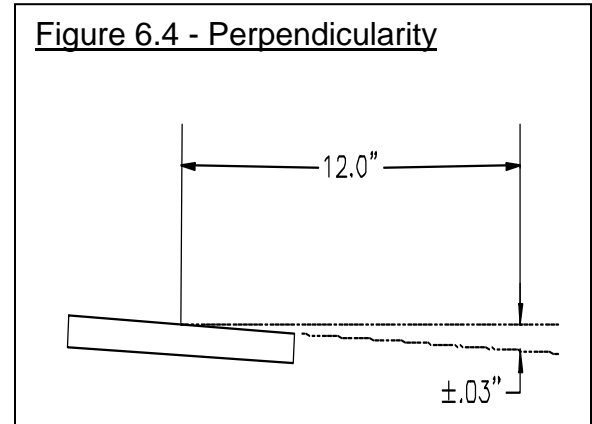
Class 2

- All welding under this standard may deviate from ASMEI B31.3. The inspector and/or the Engineering Department will establish the limitations of defects.

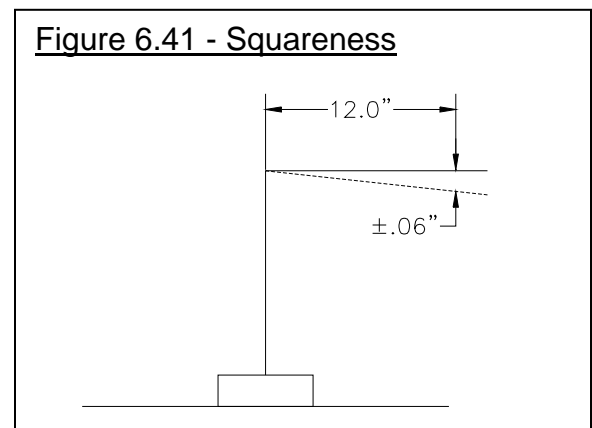
Quality Standards - Continued

6.4 Assembly Tolerance Specifications:

- Flanges, nipples, couplings, etc. must be perpendicular to $\pm 1/32$ per foot: (figure 6.4)



- Squareness of booms and large welded assemblies must not exceed ± 0.06 per foot: (figure 6.41)



6.5 Leak Testing

Air and hydrostatic. Unless specified by the Engineering department air testing can be performed under liquid or by using soap spray.

- For Class 1a and Class 1b, welds must conform to *ASME B31.3 section 345.2.2*, which states that a leak test must be maintained for 10 minutes.
- Leak testing must take place **AFTER** the heat treatment.
- For class 2 welds, use EMCO Wheaton USA standard test procedures unless otherwise specified by the Engineering Department.

Note :- All test pressure must be obtained by gauges connected directly to the blanking flanges and not on the supply tubing.

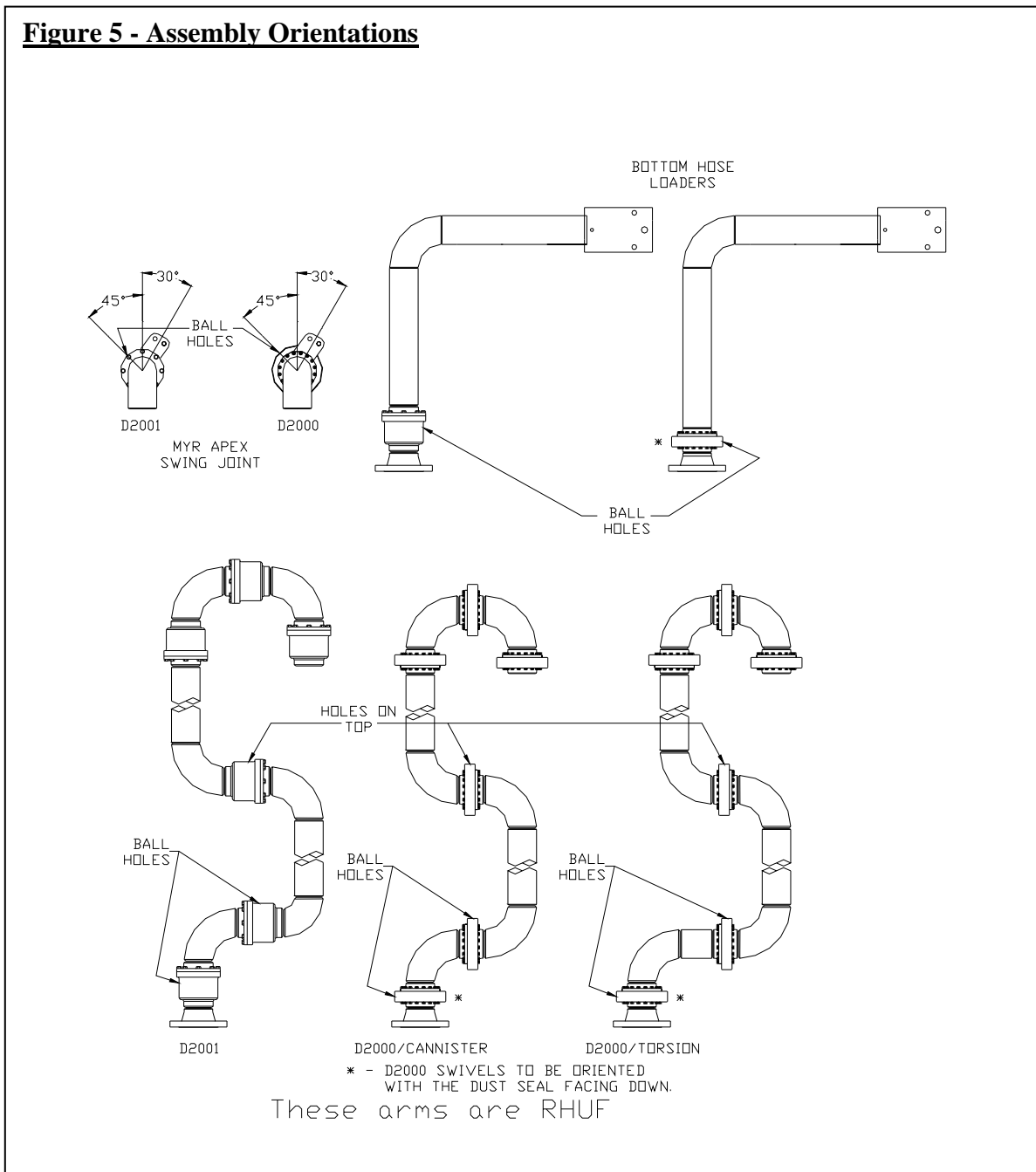
7.0 Miscellaneous Shop Standards

7.1 Flanges :

- Welded with bolt holes straddled unless otherwise specified.

7.2 Swing joints:

- Welded or assembled with ball retainer holes as shown in Figure 5.



7.0 Miscellaneous Shop Standards / Continued

7.3 Lubrication:

7.3.1 Swing joints (normal use)

- Lubricate with lithium base grease (see specification ES-53).

7.3.2 Swing joints (steam jacket)

- Lubricate with high temperature grease (see specification ES-53).

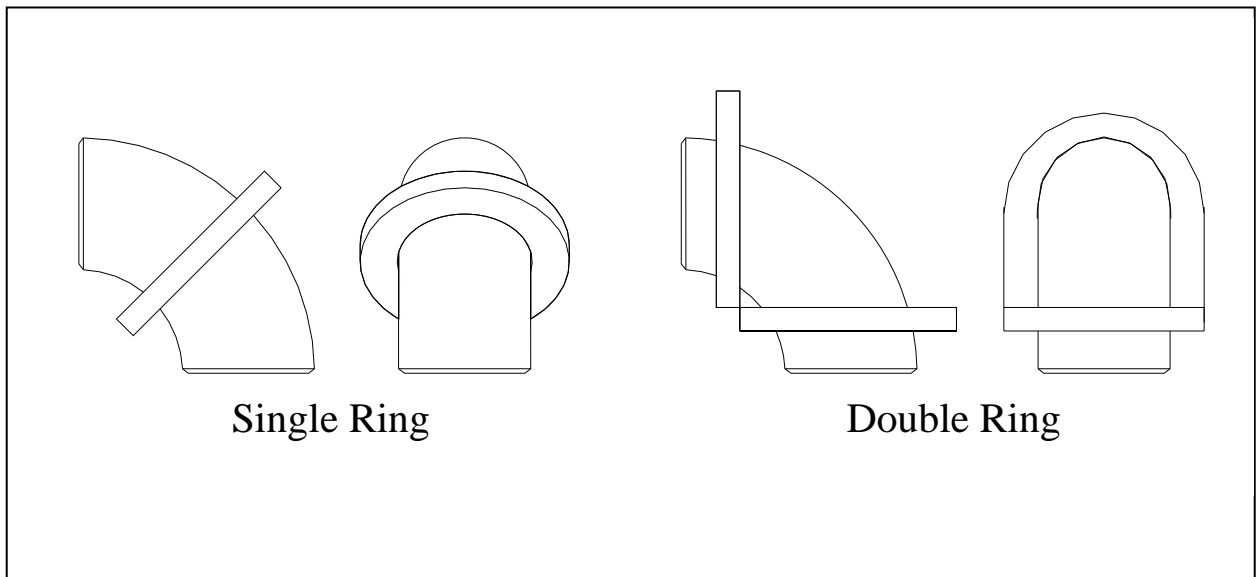
7.3.3 Non-Lubricated Swing Joints

- Lubricate with medium weight oil prior to assembly.

7.4 Elbow Reinforcement Rings

- All drawings requiring elbow reinforcement rings, per elbow stress calculations, shall use the configurations shown in Figure 4.

Figure 4 – Elbow Reinforcements



7.5 Flat bar reinforcements

- When flat bar is required to maintain minimum deflection, fit-up should be as follows on the boom and primary sections of loading arm. See figure 7.0 and 7.1

Figure 7.0

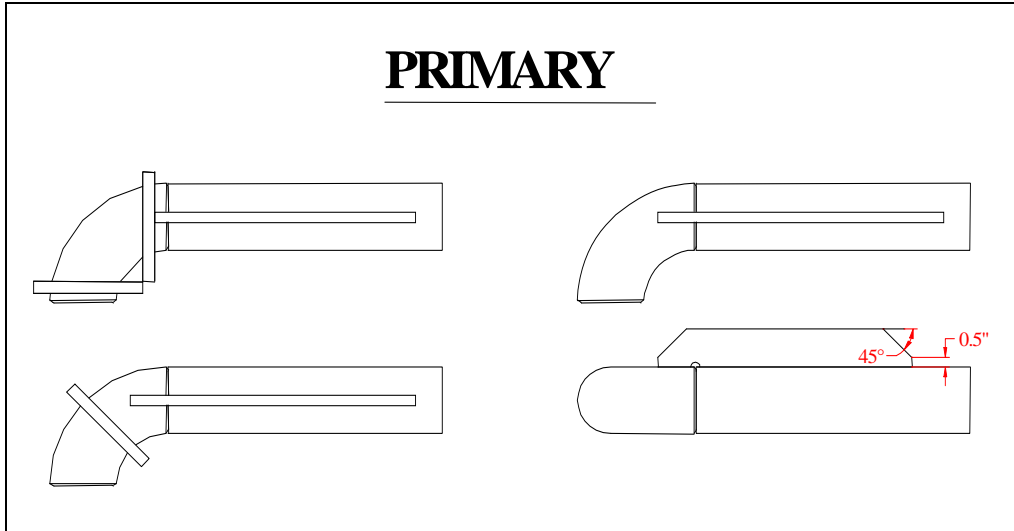
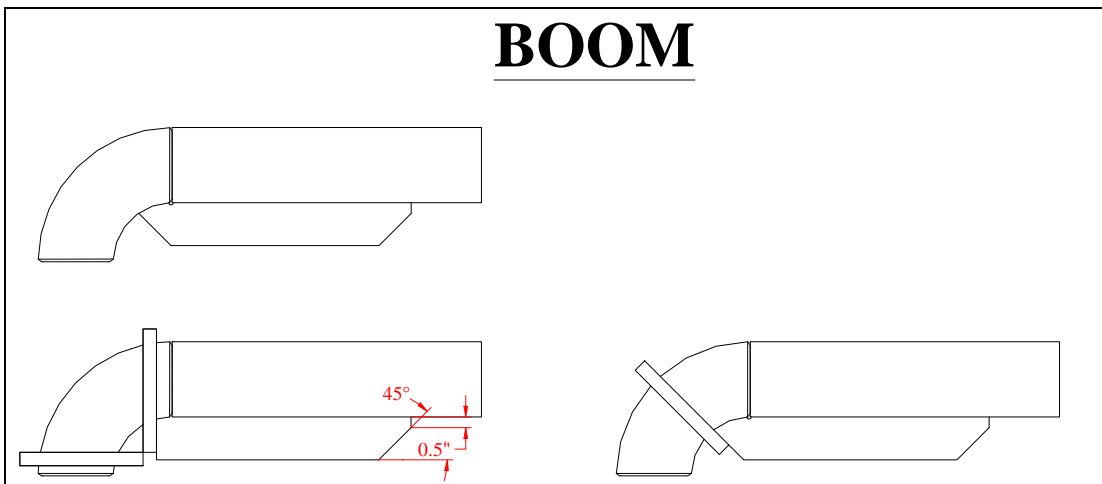


Figure 7.1



8.0 Welding symbols

- Welding symbols used on drawings and specifications shall conform to the :-
AWS Standard number EW-477

9.0 Welding Machine Calibration

- Welding machines used in production are calibrated by an approved outside source yearly.
- Yearly preventive maintenance, (as determined necessary by the calibration source) is performed at the time of calibration.
- Calibration records are maintained by the EMCO Wheaton USA QC personnel. As directed by the Manager, Engineering.

10.0 Dimensional Tolerances

- For over-all lengths of Loading Arms such as "A", "B", "C" etc. dimensions, the tolerance is $\pm 3/4$ " or $\pm 1\%$ (whichever is greater).
- For welded tube & pipe assemblies, the tolerance is $\pm 3/4$ " or $\pm 1\%$ (whichever is greater).
- For sub-assemblies that do not contain a pipe or tube, the tolerance is $\pm 1/8$ " per weld.
- For miscellaneous welded components & fittings, the tolerance is $\pm 1/4$ ".

Appendix I

Calculation of Carbon Equivalent (CE)

- Where materials are welded which do not have a specification number under the ASME or ASTM specification, the carbon equivalent may be calculated from the following formula: -

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Where :

CE	=	carbon equivalent
C	=	percent carbon
Mn	=	percent manganese
Cr	=	percent chromium
Mo	=	percent Molybdenum
V	=	percent Vanadium
Ni	=	percent Nickel
Cu	=	percent copper

- Materials with a carbon equivalent over 0.55 may require preheat, post heat or special procedures.
- Those will be specified in the individual procedures.
- Where materials of CE greater that 0.55 is to be welded, and no procedure is available the engineering department should be consulted before welding is started.

Appendix II

References - ASME B31.3 - 2004 Edition

- Section 328.4.2 Page 59-66
 - Section 330 Page 66-67
 - Section 341 Page 75-82
 - Section 341 Table 341.3.2 Page 77-79
-