

LESSON PLAN

Date _____

Trade:- Welder

Name _____

Unit/Lesson:-Forty Six

Subject:- Welding codes and standards. Reading of assembly drawing. Welding procedure specification and procedure qualification records.

Motivation:- In previous lesson we discuss about Metalizing- types of metalizing, principles, equipments, advantages and applications. Manual oxy-acetylene powder coating process. Principles of operations and applications.

PREPARATION

- 1) (Materials, Tools, Models, Charts and other aids)

INTRODUCTION:- Welding codes and standards are very important in welding science. They are very useful in assembly drawing and product design.

Topic	Information Point	Spot Hint
Welding Codes and standards		
<p>There are a number of different types of standards that are generally written by consensus standards writing bodies. These bodies are made up of volunteers who are experts in the field and represent all facets of the industry. The standards are written and presented for public review and vote so that they truly become the best consensus documents with wide expertise.</p> <p>These standards fall into 6 major categories: Codes are generally associated with a process and they spell out MANDATORY use of materials or actions. Specifications likewise are mandatory but they are generally associated with a product. Recommended practices and guides are documents offered as an aid to the practitioner to help in manufacturing. Classification and methods provide lists of established practices or products.</p> <p>As we have already seen, there is a whole variety of things that are covered by standards including products and consumables used to make products, manufacturing processes, health and safety concerns in the workplace, terminology so that all engineers talk the same language, and even testing procedures to confirm the quality of the manufactured product as we discussed in the last module. Each standards writing body takes responsibility for these items within their own sector of the industry.</p> <p>In some cases, a single standards writing body may have standards which are applicable to a wide variety of products such as the American Welding Society (AWS) listed above. In other cases, the applicable standards may reside in very few standards writing bodies. This table give you a feeling for responsibilities and overlap.</p>		

Types of Weld	Cross Section	Symbol
A Double Bevel Butt		
B Single-J Butt		
C Double-J Butt		
D Stud		
E Edge		
F Seal		
G Single-V Butt Sealing Run		

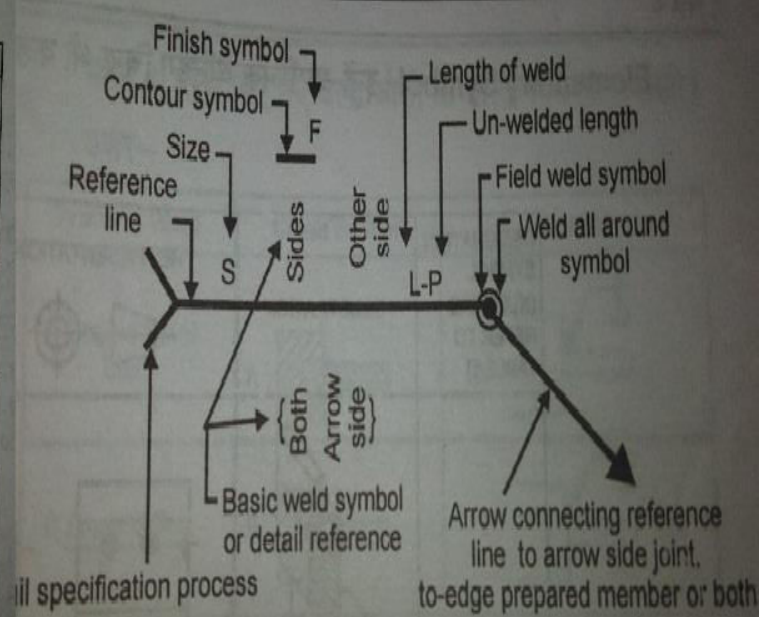


Fig. 4 Welding Symbol Element

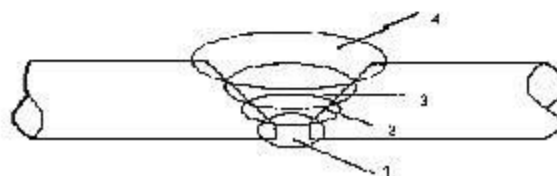
Welding Joints	Symbols

Description	Sectional Representation	Symbol
1. Butt weld between flanged plates (Flanges melted) down completely		
2. Square butt weld		
3. Single-V butt weld		
4. Single-E-bevelbutt weld		
5. Single-V butt weld with broad rootface		
6. Single-bevel butt weld with broad rootface		
7. Single-U butt weld		
8. Single-J butt weld		
9. Backing or sealing run		
10. Fillet weld		
11. Plug weld (circular or elongated hole, completely filled)	Illustration 	
12. Spot weld (resistance or arc welding) or projection weld	 (a) Resistance (b) Arc	
13. Seam Weld		

Fig. 1 Elementary Symbols

Type of defects		Designation Group	Schematic defect description		Acceptable Sizes			Additional requirements
			On weld	On film	Isolated Defects		Total For 304.8 mm	
					Length mm	Width or Diameter mm	Length mm	
Inadequate penetration	Inadequate penetration of weld root	IP			25.4	N/A	25.4	N/A
	Inadequate penetration due to high-low	IPD			50.8	N/A	76.2	N/A
	Incomplete fusion at root or at lap of joint between weld metal and base metal	IF			25.4	N/A	25.4	N/A
	Incomplete fusion due to cold lap	IFD			50.8	N/A	50.8	N/A
	Internal concavity	IC			N/A	N/A	N/A	Not darker than base metal full weld perimeter
Internal concavity Burn-through	Burn-through for pipe over 60 mm O.D.	BT			6.35	N/A	12.7	N/A
	Burn-through for pipe below 60 mm O.D.				6.35	N/A	N/A	Not more than one
Slag Inclusions	Elongated slag inclusions for pipe over 60 mm O.D.	ESI			50.8	1.59	50.8	N/A
	Elongated slag inclusions for pipe below 60 mm O.D.				3S	1.59	N/A	Parallel slag lines to be considered as separate if the width of either of them exceeds 0.79 mm
	Isolated slag inclusions for pipe over 60 mm O.D.	ISI			N/A	3.17	12.7	The aggregate length of ESI and ISI indications exceeds of not less than 8% of the weld length
	Isolated slag inclusions for pipe below 60 mm O.D.				N/A	1/2S	2S	
Gas Cavity	Spherical porosity	SP			N/A	2-3	N/A	25% S ; max 3.17
					N/A	1.6-2	N/A	
					N/A	0.6-1	N/A	
	Cluster porosity in finish pass	CP			N/A	12.7	12.7	
	Hollow bead	HB			12.7	N/A	50.8	N/A
Cracks	Crater cracks	CC			3.96	N/A	N/A	Other not allowed
Under Cuts	External Under Cuts	EU			50.8	N/A	50.8	Depth - 0.4 mm Max
	Internal Under Cuts	IU			Depth < 0.4 mm - acceptable regard less of length			

- 1. Root Pass -RP
- 2. Hot Pass -HP
- 3. Filled Pass -FP
- 4. Cap Pass -CP



Assembly Drawings

An **assembly drawing** shows how all of the parts of a multi-component design fit together, and are generally depicted as one or more orthographic projections.

One or more full section views are often used in an assembly drawing to show necessary internal features.

Assembly drawings may contain the following:

- One or more views, including sections or auxiliaries
- Enlarged views to show small details
- Overall or specific dimensions needed for assembly

- Notes on manufacturing processes required for assembly
- Balloons to indicate item numbers
- Parts list or bill of materials (BOM)

Types of Assembly Drawings

- Design Assembly
- General Assembly
- Detail Assembly
- Erection Assembly
- Subassembly
- Pictorial Assembly

Welding Procedure Specification (WPS):- A document that provides in detail required welding conditions for a specific application.

Procedure Qualification Record (PQR):- A record of actual welding conditions used to produce an acceptable test joint and the results of the qualification tests.

The system to do these qualifications and certifications have three major parts. They are:

- 1) the procedure qualification record (PQR) which is a written record of the weld procedure and the tests performed on the weld to ascertain that the procedure did indeed produce an acceptable weld.
- 2) The welding procedure specification (WPS) which is the document detailing the proper procedure and required welding conditions to make the weld. The WPS is the document often given to the welder who is told to reproduce this procedure in the welds performed.
- 3) The welder performance qualification and certification is record of the test given to the welder which proves that the welder is capable of making quality welds. It does not guarantee that the welder will make perfect welds each weld but certifies that the welder is capable of doing quality work. Thus final weld inspection should not be ignored in any quality weldment production.

Welding requires skill. Determining “how to weld” requires knowledge regarding the materials being welded and welding process, among numerous other factors. Because of huge number of variables involved, the knowledge of the welding engineer and the skill of the welder need to be validated by a series of tests. All this information is documented on Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), Welding Procedure Qualification Record (WPQR), and associated Test Reports.

What is Welding Procedure Specification (WPS)?

A WPS is a document that describes how welding is to be carried out in production. Its purpose is to aid the planning and quality control of the welding operation. They are recommended for all welding operations and most application codes and standards make them mandatory.

What is Procedure Qualification Record (PQR)?

A PQR is required when it is necessary to demonstrate that your company has the ability to produce welds possessing the correct mechanical and metallurgical properties.

A welding procedure must be qualified in accordance with the requirements of an appropriate welding procedure standard, such as ASME Sec IX, as follows:

1. Produce a welding procedure specification (WPS) as stated above.
2. Weld a test piece in accordance with the requirements of your specification. The joint set up, welding and visual examination of the completed weld should be witnessed by a certified welding inspector such as an AWS certified CWI or an Inspection Body. The details of the test such as the welding current, pre-heat etc., must be recorded during the test.
3. Once the welding is complete the test piece must be subject to destructive and non destructive examination such as radiography and mechanical tests as defined by the

- welding procedure standard. This work must be carried out in a qualified laboratory but the Inspection Body may require witnessing the tests and viewing any radiographs.
4. If the test is successful you or the test body completes the appropriate documents which the test body's surveyor signs and endorses.

ANNEX N

AWS D1.1/D1.1M:2010

WELDING PROCEDURE SPECIFICATION (WPS) Yes
PREQUALIFIED _____ QUALIFIED BY TESTING _____
or PROCEDURE QUALIFICATION RECORDS (PQR) Yes

Company Name _____
 Welding Process(es) _____
 Supporting PQR No.(s) _____

Identification # _____
 Revision _____ Date _____ By _____
 Authorized by _____ Date _____
 Type—Manual Semiautomatic
 Mechanized Automatic

JOINT DESIGN USED
 Type: _____
 Single Double Weld
 Backing: Yes No
 Backing Material: _____
 Root Opening _____ Root Face Dimension _____
 Groove Angle: _____ Radius (J-U) _____
 Back Gouging: Yes No Method _____

POSITION
 Position of Groove: _____ Fillet: _____
 Vertical Progression: Up Down

ELECTRICAL CHARACTERISTICS
 Transfer Mode (GMAW) Short-Circuiting
 Globular Spray
 Current: AC DCEP DCEN Pulsed
 Power Source: CC CV
 Other _____
 Tungsten Electrode (GTAW)
 Size: _____
 Type: _____

BASE METALS
 Material Spec. _____
 Type or Grade _____
 Thickness: Groove _____ Fillet _____
 Diameter (Pipe) _____

FILLER METALS
 AWS Specification _____
 AWS Classification _____

SHIELDING
 Flux _____ Gas _____
 Composition _____
 Electrode-Flux (Class) _____ Flow Rate _____
 Gas Cup Size _____

TECHNIQUE
 Stringer or Weave Bead: _____
 Multi-pass or Single Pass (per side) _____
 Number of Electrodes _____
 Electrode Spacing Longitudinal _____
 Lateral _____
 Angle _____
 Contact Tube to Work Distance _____
 Peening _____
 Interpass Cleaning: _____

PREHEAT
 Preheat Temp., Min. _____
 Interpass Temp., Min. _____ Max. _____

POSTWELD HEAT TREATMENT
 Temp. _____
 Time _____

WELDING PROCEDURE

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			

Form N-1 (Front)

**Procedure Qualification Record (PQR) # _____
Test Results**

TENSILE TEST

Specimen No.	Width	Thickness	Area	Ultimate Tensile Load, lb	Ultimate Unit Stress, psi	Character of Failure and Location

GUIDED BEND TEST

Specimen No.	Type of Bend	Result	Remarks

VISUAL INSPECTION

Appearance _____
 Undercut _____
 Piping porosity _____
 Convexity _____
 Test date _____
 Witnessed by _____

Radiographic-ultrasonic examination
 RT report no.: _____ Result _____
 UT report no.: _____ Result _____

FILLET WELD TEST RESULTS

Minimum size multiple pass		Maximum size single pass	
Macroetch		Macroetch	
1. _____	3. _____	1. _____	3. _____
2. _____		2. _____	

Other Tests

All-weld-metal tension test
 Tensile strength, psi _____
 Yield point/strength, psi _____
 Elongation in 2 in, % _____
 Laboratory test no. _____

Welder's name _____

Clock no. _____ Stamp no. _____

Tests conducted by _____

Laboratory _____

Test number _____

Per _____

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (_____) *Structural Welding Code—Steel*.
 (year)

Signed _____
 Manufacturer or Contractor

By _____

Title _____

Date _____

Form N-1 (Back)

Questions:-

1. What is welding codes and standards and how they useful in industry?
2. What is assembly drawing?
3. Write the meaning of WPS.

Next lesson:-Hard facing: necessity, methods of preparation, various hard facing alloys and advantages of hard facing.

Assignments:-

Welding codes and standards. Reading of assembly drawing. Welding procedure specification and procedure qualification records.

Checked by.....

Instructor.....