WLD 152
Wire Welding Certification Practice

Index

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National Science Foundation
Opinions expressed are those of the authors
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Course Assignments

Reading

Welding Principles and Applications 7th edition By Larry Jeffus
Chapter 24, Welder Certification

Math

Practical Problems in Mathematics 6th edition by Robert Chasan
Chapter 35, Angle Developement
Chapter 36, Angular Measurement
Chapter 37, Protractors

Recommended assignments

Complete review question following each assigned chapter

Quizzes

Complete Interactive Quiz in CourseMate for each assigned chapter

Welding Project Options

FCAW- Dual Shield
6" Vertical Groove (3G)
6" Overhead Groove (4G)
FCAW- Innershield
6" Vertical Groove (3G)
6" Overhead Groove (4G)
GMAW-Spray
7" Horizontal Groove (2G)
Bend Test Procedures

Final Exam

Closed Book Exam

Reference List

Standard Welding Terms and Definitions: ANSI/AWS A3.0-94
AWS D1.1 Structural Steel Welding Code
The Procedure Handbook of Arc Welding: By The Lincoln Electric Company.

Timeline

Open-entry, open-exit instructional format allows the students to work their own pace. It is the student's responsibility for completing all assignments in a timely manner. See your instructor for assistance.

Outcome Assessment Policy

The student will be assessed on his/her ability to demonstrate the development of course outcomes. The methods of assessment may include one or more of the following: oral or written examinations, quizzes, written assignments, visual inspection techniques, welding tests, safe work habits, task performance and work relations.

Accessing the Interactive ebook for Principles and Applications and Practical Problems in Mathematics

Here is a link to the publishers website that goes over some "getting started" procedures with CourseMate.
http://www.cengage.com/tlconnect/client/product/fcis.do?productId=535

For New Students

Your book bundle will contain an access code for both your Principles and Applications book and the Practical Problems in Mathematics.

For Returning Students

If you have the Seventh Edition of the Principles and Applications book you should have an access code. If not see your instructor. For the math book you will have to go to this site **http://www.cengagebrain.com/shop/isbn/9781111313593** and rent the ebook for either a six month or one year option.
Your math quizzes will be accessible through Desire 2 Learn. Your Instructor will assist you in accessing this.

Course Key There will be a master course key containing all of the courses available on CourseMate. You will find the course you are currently taking and enter the corresponding number in the appropriate area in CourseMate.

Note For each class there will be separate Access code and course key for Principles and Applications and Practical Problems in Mathematics

Helpful Hints for Wire Welding

Wire Stick out

When welding with the FCAW process it is essential to keep the required stick out. This length should be between ¾" and 1". This length can and should be adjusted while welding to ***OPTIMZE THE ARC***. This stick out provides electrical resistance heating to the electrode. This is important because the flux inside of the wire is preheated so it will react more efficiently in the puddle that will provide for more aggressive scavenging by the flux.

First and Second Layers of Groove Welds

When completing the first and second layers of a groove weld it is important to have a well-set machine. The parameters (volts & amps) may need to be changed because of the need for a "crisp" arc to reach the bottom of the groove. One of two things need to change to achieve this:

1. Increase the wire feed speed to accommodate for the increased stick out.
2. Use a shorter gas nozzle and set so contact tip is extending from it by 1/8" to 1/4". This will allow for the gun to reach the bottom of the groove with the normal stick out length. Either technique win provide for a suitable outcome. Just remember to make the correction back to normal operating procedures when room in the groove allows.

Common Causes for Porosity

Gas Diffuser is clogged
Insulator has unscrewed and is covering gas ports
Dirty Cup
Contact tip is not recessed 1/4".
Leaks in flow meter, hose and or connections (venturi effect)
Too little or too much gas flow
Too long of a stick out
Gun angle too steep (venturi effect)
Too short of a stick out
Dragging or bumping the cup
Gas supply depleted

Cover Pass Technique

Maximum bead width recommended 1/2"
Reduce WFS and leave the voltage the same
Reduce stick out to 1/2"
Do not fill the groove flush. Leave 1/16" shoulder so there is room for the finish beads.
Allow sufficient time between passes for the plate to cool.

Science

on

Steel

The Welding Fabrication Industry needs qualified welder fabricators who can deal with a variety of situations on the job. This portion of the training packet explores science as it relates to industry requirements.

Contents of this Packet

- *Importance of Code Qualification*
- *Why Mechanical Properties Testing?*
- *AWS D1.1 Structural Welding Code – Steel*
- *Significance of Bend Testing*
- *Bend Testing of Welds deposited with E7018 and other Low Hydrogen Electrodes*
- *Guided Bend vs. Free Bend Testing*
- *Tensile Testing and Charpy V-Notch Impact Testing*

Importance of Code Qualification

In all industries, there are applicable codes and standards to assure the quality, reproducibility, and adequacy of welded joints. Depending upon the application, a welded joint may need certain mechanical properties; for example, welds on bridges must pass tests for strength, tensile ductility, bend ductility, and Charpy impact toughness. These codes are based on many years of experience. Changes to codes are ongoing to reflect the dynamic changes that taking place in the industry. There are many welding codes to ensure quality welding. For example, the following is a list of only a few typical industries and governing codes for welding quality.

Pressure Vessels	ASME Boiler and Pressure Vessel Code (Vol. IX – Welding Qualifications)
Pipe and Pipelines	API Standard 1104; Standard for Welded Pipelines and Related Facilities
Pressure Piping	ASME Code for Pressure Piping B31
All Steel Structures	AWS D1.1 Structural Welding Code – Steel
Buildings	AISC Specification for Structural steel Buildings
Bridges	AASHTO/AWS D1.5; Bridge Welding Code
Ships	ABS Rules for Building and Classing Steel Vessels
Sheet Metal	AWS D9.1; Sheet Metal Welding Code
Automotive Frames	ANSI/AWS D8.8; Specification for Automotive Frame Weld Quality
Aircraft	MIL-STD-1595A; Qualification of Aircraft, Missile and Aerospace Fusion Welders

Why Mechanical Properties Testing?

In all codes for welded structures and pipe, various degrees of mechanical testing are performed to assure the quality and integrity of the structure. This includes both procedure qualification and welder qualification. For example, the procedure qualification for steel structures in accordance with the AWS D1.5 Bridge Welding Code–Steel requires that certain welds undergo all-weld-metal tensile testing, transverse-to-weld tensile testing, side bend testing, Charpy v-notch (CVN) impact testing as well as non-destructive testing. Mechanical testing is very important because it ensures that the welding procedure, welder qualification, consumables, and the resulting metallurgy of the weld and heat-affected zone were all acceptable.

AWS D1.1 Structural Welding Code – Steel

When a structure is going to be built, the owner and contractor agree on the appropriate welding code, which will be needed to govern the acceptability or rejection of structural welds being fabricated. AWS D1.1 Structural Welding Code – Steel is devised to provide welded joints with acceptable strength, ductility, and CVN impact toughness for the intended application, such as a building, general construction, motorized vehicle, etc. Procedure qualification requirements welder qualification and certification are required. The qualification and certification tests for welders are specially designed to determine the welder's ability to produce sound welds. To achieve these quality standards, the welder qualification and certification provide the means to ensure acceptable welds.

Significance of Bend Testing

Of all the tests prescribed by different welding codes, the bend test provides the best and most reliable measure of ductility of the entire weld joint, including the weld metal, heat-affected zone, and unaffected base metal. Bend tests are one way to determine qualification results. This is because the bend test is extremely sensitive to all types of metallurgical problems associated with welding. For example, weld joints which have inadequate ductility and fail the bend test may be have been affected by: (a) hydrogen assisted cracking, (b) micro fissuring due internal solidification cracking, (c) excessive slag inclusions, (d) excessive porosity, (e) wrong filler metal, causing embrittlement, (e) wrong welding parameters, causing embrittlement, and (f) other metallurgical factors affecting the ductility of the weld joint.

There are three types of bend tests, (1) side bend, (2) face bend, and (3) root bend. Side bend tests are required for welds that are greater than 3/8-inch thick for AWS D1.1 and over ½-inch thick for API-1104. For example, a 2-inch thick butt joint deposited by single-pass electroslag welding could not be tested by face or root bend testing, because the thickness is too great for practical testing. However, a 2-inch thick butt joint can be machined to several 3/8-inch thick side bend specimens and tested easily.

Face and root bending are used to test the ductility of butt joints that are 3/8" and thinner. Whether face bends, root bends, or both face and root bends specimens are required depends upon the code used. In AWS D1.1 Structural Welding Code, both face and root bends are required in most cases. The root bend test determines the adequacy of the root penetration and soundness of the root portion of the weld joint. This is particularly important in open root welding applications. Similarly, the face bend test determines the adequacy of the weld metal deposited on the face of the

joint. These specimens must be able to withstand bending strains that are produced when a plunger forces a 3/8-inch thick welded specimen into a guided bend fixture. The plunger, having a specified bend radius, forces the welded bend specimen into a die in order to endure a specified amount of bending (or plastic deformation), that is required by the code for structural applications. From Table 1, the plunger radius and plunger thickness increase with increasing yield strength of the base metal being tested. Bending becomes more difficult with increasing yield strength, because ductility decreases as the strength of the steel increases. Thus, AWS D1.1 permits the bend radius required for welder qualification to increase with increasing yield strength, as shown in Table 1.

Table 1 Specified Bending Parameters for Guided Bend Test for Steel Welds in accordance with AWS D1.1 Structural Welding Code - Steel

Yield Strength Of Base Metal	Plunger Thickness	Plunger Radius	Interior Die Opening	Die Radius
50,000psi and less	1 ½"	¾"	2 3/8"	1 3/16"
Over 50,000psi to 90,000psi	2"	1"	2 7/8"	1 7/16"
90,000psi and greater	2 ½"	1 ¼"	3 3/8"	1 11/16"

Bend Testing of Welds deposited by FCAW using E71T-1, T-8 and T-11 Electrodes

The bend test for steel welds is very sensitive to not only the presence of diffusible hydrogen in the weld, but also high levels of non-metallic inclusions. Typically, these welds will fail in the weld metal. E71T-1 gas shielded welds and E71T-8 self-shielded welds are generally minimally contaminated with non-metallic inclusions and will pass the bend tests prescribed by applicable codes like D1.1 Structural Welding Code. However, the self-shielded E71T-11 electrode contains substantial inclusion content and may be susceptible to reductions in ductility to possibly fail the bend test. In all cases, poor workmanship is the most probable of a bend failure. This may include slag inclusions, lack of fusion, excessive porosity, etc. If workmanship is adequate, then the weld metal deposited with electrodes, which must meet high Charpy impact requirements, will ultimately be the most successful in the bend test.

Guided Bend vs. Free Bend Testing

The most widely used bend test, which is required by most welding codes, is the guided bend test. The benefit of the guided bend test, like that required by the AWS/AASHTO D1.5 Bridge Welding Code and AWS D1.1 Structural Welding Code is that the weld metal, heat affected zone and the unaffected base metal are subject to bending equally. This test requires expensive fixturing and a hydraulic ram to perform the guided bend test.

There is another test called the free bend test. The free bend testing apparatus is less expensive to build and is hand-operated. The disadvantage of this test is that all of the zones of the weld joint (weld metal, heat affected zone and unaffected zone) are not bent equally. In free bend testing, the zone(s) having the lowest tensile strength will bend the most, while the zone(s) having the highest strength will bend the least. This effect may hide potential problems in the weld joint. This is why most codes insist on the guided bend test and not the free bend test.

Tensile Testing and Charpy V-Notch Impact Testing

For welder qualification and certification in accordance with AWS D1.1, tensile testing and Charpy v-notch (CVN) testing of the test weld are not required. However, in other codes, these tests are also used for welder qualification (in addition to bend testing).

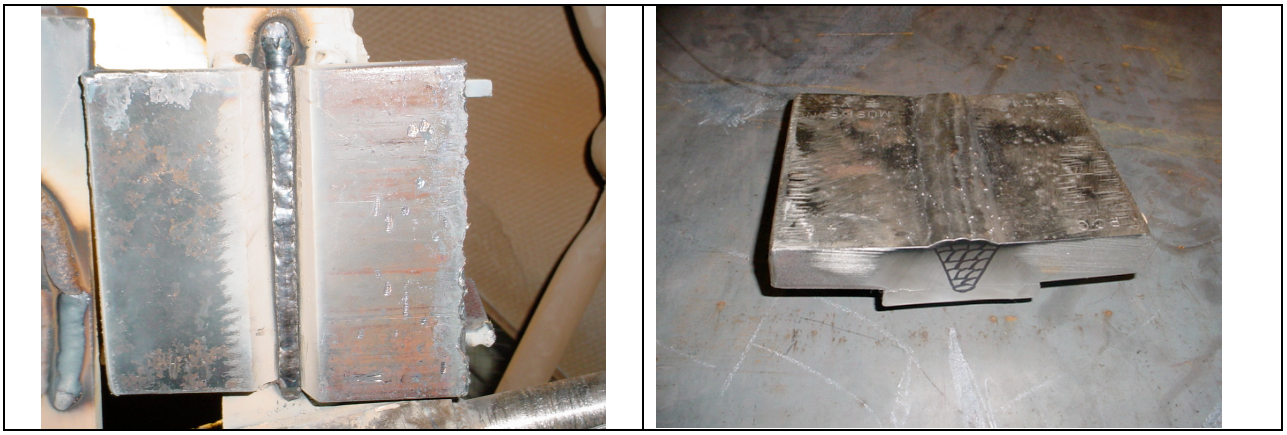
Craftsmanship Expectations for Welding Projects

The student should complete the following tasks prior to welding.

1. Thoroughly read each drawing.
2. Make a cutting list for each project. Cut at least two project assemblies of metal at a time this will save a great amount of time.
3. Assemble the welding projects per drawing specifications.
4. Review the Welding Procedure portion of the prints to review welding parameter information.
5. See the instructor for the evaluation.

Factors for grading welding projects are based on the following criteria:

Metal Preparation	**Project Layout**	**Post Weld Clean-up**
Oxyacetylene Cut quality	Accurate (+/- 1/16”)	Remove Slag/Spatter
Grind all cut surfaces clean	Limit waste	Remove sharp edges



Example of a High Quality Weld

Weld Quality per AWS D1.1

VT Criteria	Cover Pass
Reinforcement (groove welds)	Flush to 1/8”
Fillet Weld Size	See specification on drawing
Undercut	1/32” deep
Weld Contour	Smooth Transition
Penetration	N/A
Cracks	None Allowed
Arc Strikes	None Allowed
Fusion	Complete Fusion Required
Porosity	None Allowed
Overlap	None Allowed

Complete Joint Penetration (CJP) Information Sheets

All the pieces to assemble a Single V Groove Weld with Strong Backs.

E71T-1 Plate Fit Up
"Outer Shield or Dual Shield"

Note the special fit up requirements for the E71T-1 Dual Shield Electrodes.

Welding Procedure Specification

AWS D1.1 Job No.:

WPS Number: PCC FCAW-01
Rev. Number Original
Date:
PQR Number: Prequalified

Title: Flux Cored Arc—Groove with Carbon Steel Backing

Welding Process: Flux Cored Arc Type: Semi Automatic Mode:

Prepared by: Date: Approved by: Date:

JOINT DESIGN

Type: 45 degree Single V Groove BU-GF
Single or Double Weld: Single Backing: Yes
Backing Material: Carbon Steel
Root Opening-R: 1/4"
Land-L: 0-1/8" Radius (J-U): N/A

BASE METALS

Metal Specification: A36
Type or Grade: Grade A
Group 1 Plate Thickness: 1"
Thickness Groove: 1" Fillet: All
Diameter (Pipe) 24" and up Wall 1/8" and up

FILLER METALS

Classification: E71T-1
Specification No. AWS 5.20

SHIELDING

Gas: CO2 Composition: 100%
Flow Rate: 45 cfh
Gas Cup Size: N/A
Electrode-Flux (Class): N/A
Flux: N/A

POSITION

Position of Groove or Fillet: 1G, 2G, 3G, 4G, 1F, 2F, 3F, 4F
Vertical Progression: Up

POSTWELD HEAT TREATMENT

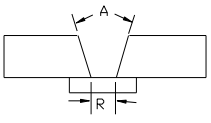
Temperature Range: None
Time:

PREHEAT

Preheat Temp. Min. 60°
Interpass Temp. Min: 60° F Max: 400°F

TECHNIQUE/ OTHER

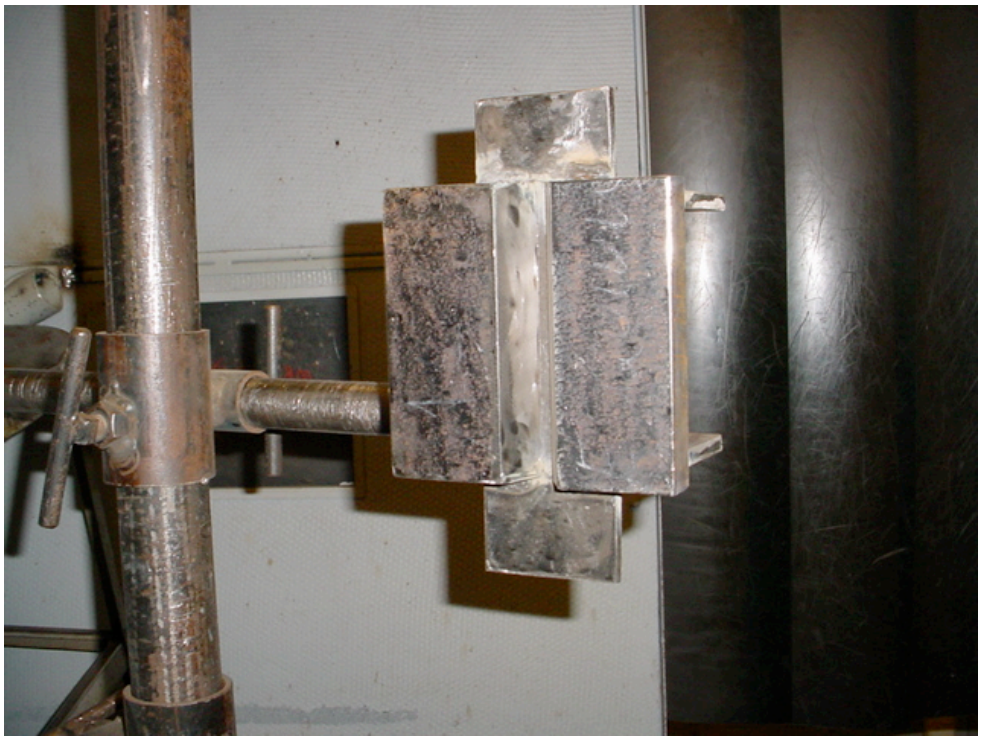
X Stringer X Weave Beads
X Multipass ☐ Single pass per side
☐ Single ☐ Multiple Electrodes
Contact Tube to Work Distance: ¾" – 1"
Peening: None on root/ cover
Initial Cleaning:
All areas to be welded shall be cleaned for oil, grease, paint, etc., for at least two (2) inches from the toes of the weld
Interpass Cleaning:
Remove all oxides and slag with a clean wire brush and/or chipping hammer
Notes:
1. A stringer or slight weave may be used as required to provide proper bead shape and side wall wetting.
2. Initial and interpass cleaning shall be accomplished by wire brushing, chipping, and no grinding.
3. Welder shall accomplish a visual inspection of previously deposited weld metal, prior to depositing the next bead.
4. Welding electrode shall be stored in dry area and located in close proximity to the work area.
5. Preheating shall be accomplished using oxy-fuel torches.
6. Weld shall be allowed to cool slowly, keeping air drafts to a minimum.

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed (IPM)	Joint Details
		Class	Dia.	Type and Polarity	Amps or wire feed speed			
All	FCAW	E71T-1	1/16"	DCEP	170-280A	22-27	4-6	

E71T-1 Butt Joint- Single V Groove Weld (3G) Project #1

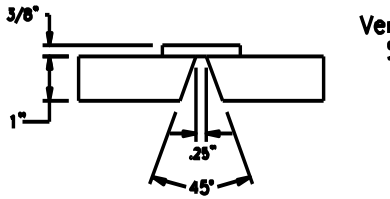
Welding Sequence

E71T-1-- Root Pass	Single pass technique with slight weave to ensure the weld metal is fusing into all three pieces of metal.
E71T-1—Fill	Use the multi-pass bead technique with stringer beads ensuring even fill.
E71T-1 Finish Beads	Use stringer bead technique keeping the electrode in the puddle at all times.

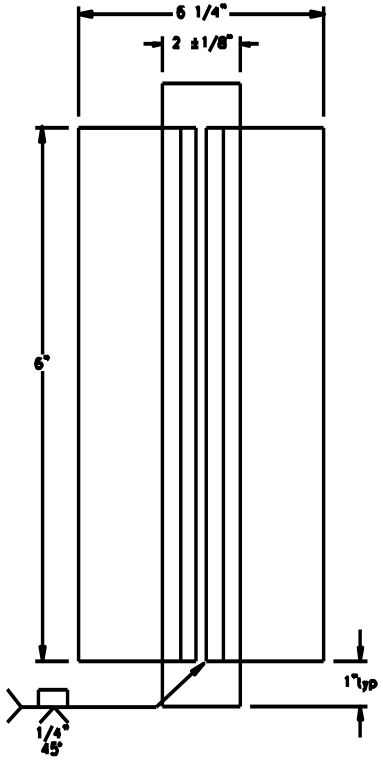


Successful completion of this project will require the student to complete ***two welds*** that meet both visual testing requirements and bend test requirements set forth in AWS D1.1 Structural Steel Welding Code.

VT Criteria	Project #1	Project #2
Reinforcement		
Undercut		
Bead Contour		
Cracks		
Arc Strikes		
Fusion		
Porosity		
Bend Test		
		Grade Date

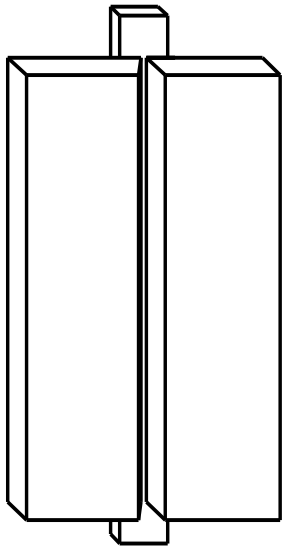


WLD 152
Vertical Position (3G)
Single "V" Groove
with Backing



Welding Procedure

1. Electrode	E71T-1
2. Diameter	1/16"
3. Polarity	DCRP
4. Voltage	22-26
5. Amperage	180-220
6. Stick Out	3/4"-1"
7. Welding Position	Vertical Up (3G)
8. Travel Angle	20° to 30°
9. Work Angle	Varies
10. Technique	Stringer Bead
11. Shielding gas	100% CO_2
12. Gas Flow	45 cfh



Inch	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

Part	No. Required	Size (WxHxL)	S.I. Conversion

Portland Community College
Welding Technology

Tolerance (Unless otherwise Specified)
Dimensional ± 1/16" Angle ± 5°

WLD 152-01

Drawn By: John Deering

Size: | Dc No. | Rev.

Chk By: TANNER SCOTT Date: 8/19/08

Approve | Date | Sheet

E71T-1 Butt Joint- Single V Groove Weld (4G) Project #2

Welding Sequence

E71T-1-- Root Pass Single pass technique with slight weave to ensure the weld metal is fusing into all three pieces of metal.

E71T-1—Fill Use the multi-pass technique with stringer beads ensuring even fill.

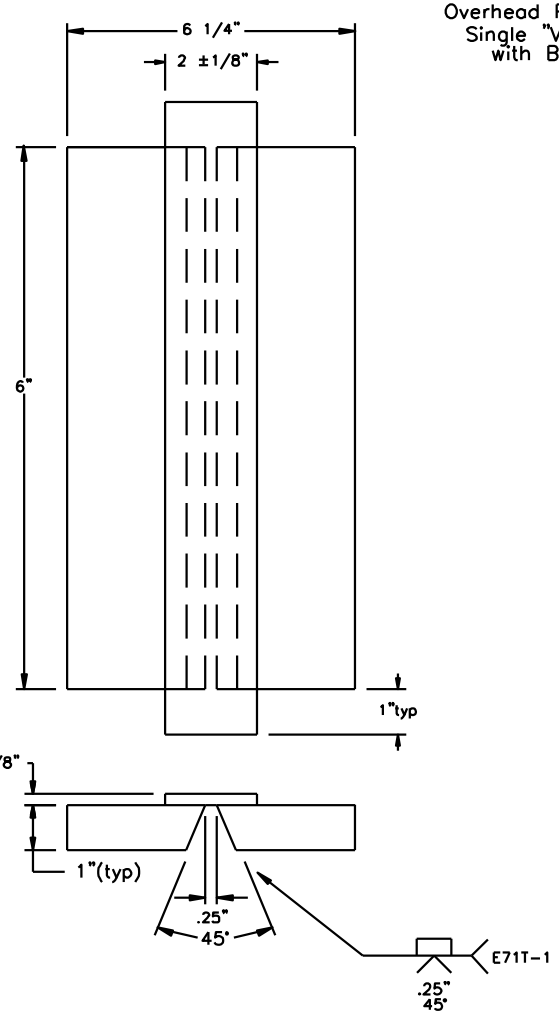
E71T-1—Finish Beads Use stringer bead technique keeping the electrode in the puddle at all times.

Successful completion of this project will require the student to complete ***two welds*** that meet both visual testing requirements and bend test requirements set forth in AWS D1.1 Structural Steel Welding Code.

VT Criteria	Project #1	Project #2
Reinforcement		
Undercut		
Bead Contour		
Cracks		
Arc Strikes		
Fusion		
Porosity		
Bend Test		
		Grade Date

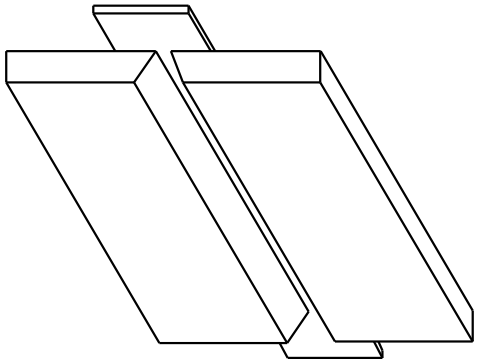
WLD 152

Overhead Position (4G)
Single "V" Groove
with Backing



Welding Procedure

1. Electrode — E71T-1
2. Diameter — 1/16"
3. Polarity — DCRP
4. Voltage — 22-26
5. Amperage — 180-220
6. Stick Out — 3/4"-1"
7. Welding Position — Overhead (4G)
8. Travel Angle — 20° to 30°
9. Work Angle — Varies
10. Technique — Stringer Bead
11. Shielding gas — 100% CO_2
12. Gas Flow — 45 cfh



Inch	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

Part	No. Required	Size (WxHxL)	S.I. Conversion

Portland Community College
Welding Technology

Tolerance (Unless otherwise Specified)
Dimensional ± 1/16" Angle ± 5°

WLD 152-02

Drawn By: John Deering

Size: | Qc No. | Rev.

Chk By: TANNER SCOTT Date: 8/19/08

Approve | Date | Sheet

Welding Procedure Specification

AWS D1.1 Job No.:

WPS Number: PCC FCAW - 02
Rev. Number Original
Date:
PQR Number: Prequalified

Title: Flux Cored Arc—Groove with Carbon Steel Backing

Welding Process: Flux Cored Arc Type: Semi Automatic Mode:

Prepared by: Date: Approved by: Date:

JOINT DESIGN

Type: 45 degree Single V Groove BU-GF
Single or Double Weld: Single Backing: Yes
Backing Material: Carbon Steel
Root Opening-R: 1/2”
Land-L: 0-1/8” Radius (J-U): N/A

BASE METALS

Metal Specification: A36
Type or Grade: Grade A
Group 1 Plate Thickness: 1”
Thickness Groove: 1” Fillet: All
Diameter (Pipe) 24” and up Wall 1/8” and up

FILLER METALS

Classification: E71T-8
Specification No. AWS 5.20

SHIELDING

Gas: N/A Composition: N/A
Flow Rate: N/A
Gas Cup Size: N/A
Electrode-Flux (Class): N/A
Flux: N/A

POSITION

Position of Groove or Fillet: 1G, 2G, 3G, 4G, 1F, 2F, 3F, 4F
Vertical Progression: Up

POSTWELD HEAT TREATMENT

Temperature Range: None
Time:

PREHEAT

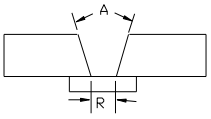
Preheat Temp. Min. 200°
Interpass Temp. Min: 200° F Max: 400°F

TECHNIQUE/ OTHER

X Stringer X Weave Beads
X Multipass ☐ Single pass per side
☐ Single ☐ Multiple Electrodes
Contact Tube to Work Distance: 3/4”
Peening: None on root/ cover
Initial Cleaning:
All areas to be welded shall be cleaned for oil, grease, paint, etc., for at least two (2) inches from the toes of the weld
Interpass Cleaning:
Remove all oxides and slag with a clean wire brush and/or chipping hammer
Notes:
1. A stringer or slight weave may be used as required to provide proper bead shape and side wall wetting.
2. Initial and interpass cleaning shall be accomplished by wire brushing, chipping, and no grinding.
3. Welder shall accomplish a visual inspection of previously deposited weld metal, prior to depositing the next bead.
4. Welding electrode shall be stored in dry area and located in close proximity to the work area.
5. Preheating shall be accomplished using oxy-fuel torches.
6. Weld shall be allowed to cool slowly, keeping air drafts to a minimum.

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed (IPM)
		Class	Dia.	Type and Polarity	Amps or wire feed speed		
All	FCAW	E71T-8	1/16”	DCEN	180–280A	19-23	4-6

Joint Details



E71T-8 Butt Joint- Single V Groove Weld (3G) Project #3

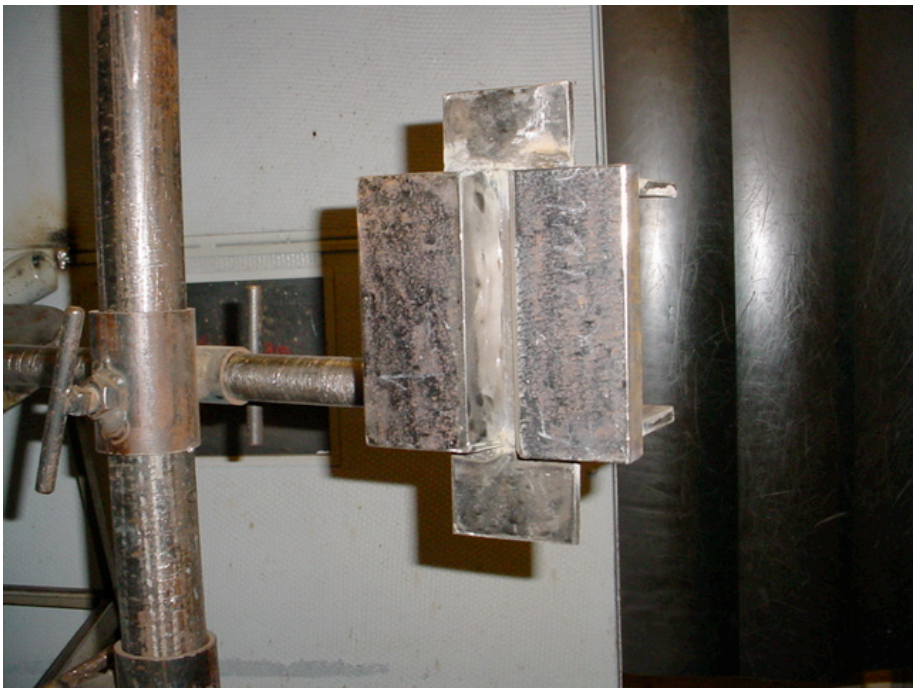
Preheat to 300+ degrees and run the plate out hot!

Welding Sequence

E71T-8-- Root Pass Single pass technique with slight weave to ensure the weld metal is fusing into all three pieces of metal.

E71T-8—Fill Use the multi-pas technique with stringer beads ensuring even fill.

E71T-8—Finish Beads Use stringer bead technique keeping the electrode in the puddle at all times.

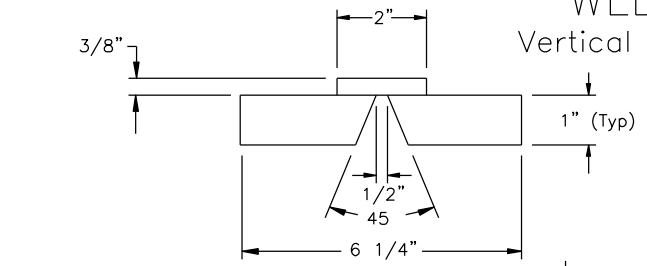


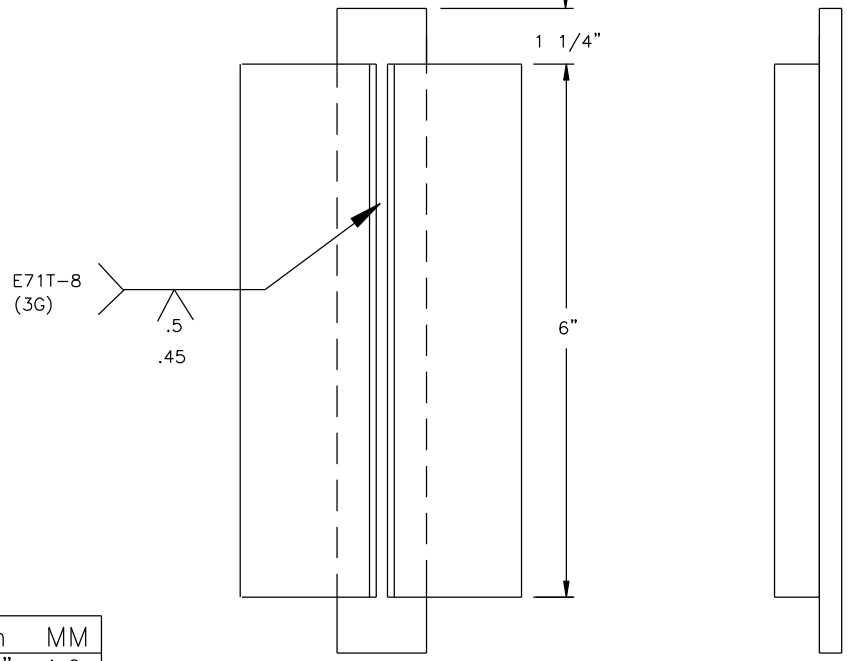
Successful completion of this project will require the student to complete ***two welds*** that meet both visual testing requirements and bend test requirements set forth in AWS D1.1 Structural Steel Welding Code.

VT Criteria	Project #1	Project #2
Reinforcement		
Undercut		
Bead Contour		
Cracks		
Arc Strikes		
Fusion		
Porosity		
Bend Test		
		Grade Date

WLD 142

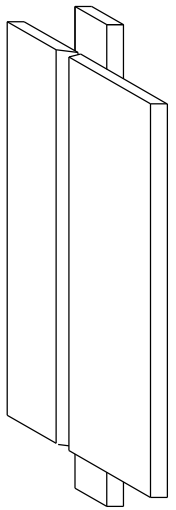
Vertical Groove (3G)





Welding Procedure

1. Electrode — E71T-8
2. Diameter — 1/16"
3. Polarity — DCSP
4. Voltage — 20-25
5. Amperage — 160-260
6. Welding Position — Vertical (3G)
7. Material — 1" Plate
8. Travel Angle (Drag) — 20°-30°
9. Work Angle — Varies
10. Stick out — 3/4"



Inch	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

Part	No. Required	Size (WxHxL)	S.I. Conversion

Portland Community College
Welding Technology

Tolerance (Unless otherwise Specified)
Dimensional ± 1/16" Angle ± 5°

Drawn By: John Deering

Chk By: Tanner Scott Date: 6/29/09

WLD 142-04

Size:	Qc No.	Rev.
Approve	Date	Sheet

E71T-8 Butt Joint- Single V Groove Weld (4G) Project #4

Preheat to 300 degrees and run the plate out hot!

Welding Sequence

E71T-8-- Root Pass Single pass technique with slight weave to ensure the weld metal is fusing into all three pieces of metal.

E71T-8—Fill Use the multi-pass technique with stringer beads ensuring even fill.

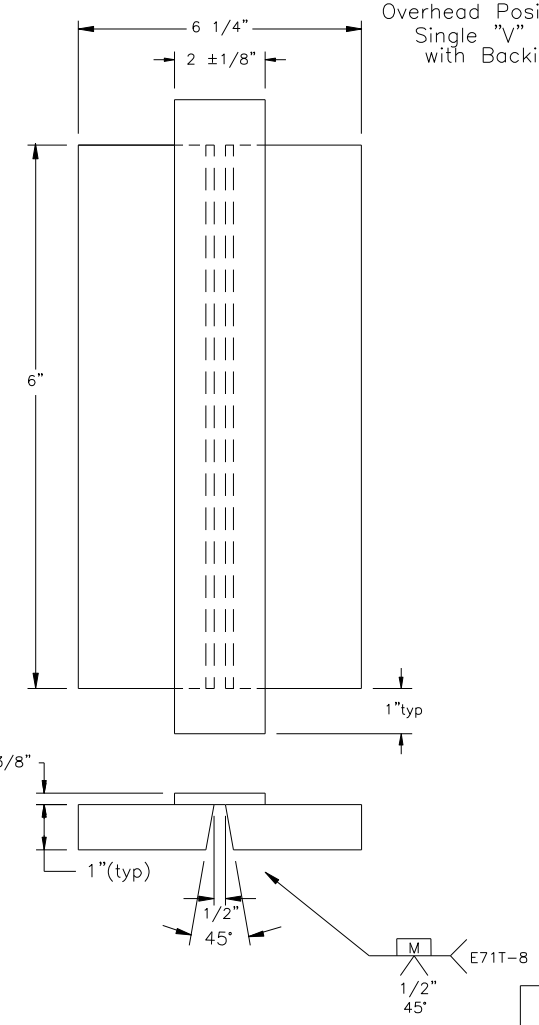
E71T-8—Finish Beads Use stringer bead technique keeping the electrode in the puddle at all times.

Successful completion of this project will require the student to complete ***two welds*** that meet both visual testing requirements and bend test requirements set forth in AWS D1.1 Structural Steel Welding Code.

VT Criteria	Project #1	Project #2
Reinforcement		
Undercut		
Bead Contour		
Cracks		
Arc Strikes		
Fusion		
Porosity		
Bend Test		
		Grade Date

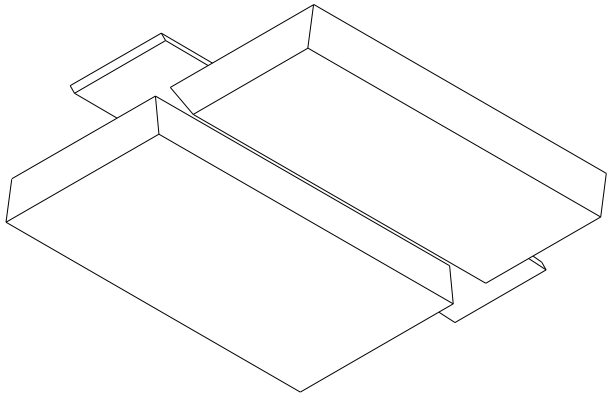
WLD 152

Overhead Position (4G)
Single "V" Groove
with Backing



Welding Procedure

1. Electrode — E71T-8
2. Diameter — 1/16"
3. Polarity — DCSP
4. Voltage — 20-25
5. Amperage — 160-260
6. Arc Length — Balanced
7. Welding Position — Overhead (4G)
8. Travel Angle — 10° - 20° drag
9. Stick Out — 3/4"
10. Technique — Stringer Bead



Inch	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

Part	No. Required	Size (WxHxL)	S.I. Conversion

Portland Community College
Welding Technology

Tolerance (Unless otherwise Specified)
Dimensional ± 1/16" Angle ± 5°

WLD 152-04

Drawn By: John Deering

Size: | Qc No. | Rev.

Chk By: TANNER SCOTT Date: 6/29/09

Approve | Date | Sheet

Welding Procedure Specification

AWS D1.1 Job No.:

WPS Number: PCC GMAW - 01
Rev. Number Original
Date:
PQR Number: Prequalified

Title: Gas Metal Arc—Groove with Carbon Steel Backing

Welding Process: Gas Metal Arc Type: Semi Automatic Mode: Spray Transfer

Prepared by: Date: Approved by: Date:

JOINT DESIGN

Type: 45 degree Single V Groove BL-GF
Single or Double Weld: Single Backing: Yes
Backing Material: Carbon Steel
Root Opening-R: 1/4”
Land-L: 0-1/8” Radius (J-U): N/A

BASE METALS

Metal Specification: A36
Type or Grade: Grade A
Group 1 Plate Thickness: 3/8”
Thickness Groove: 3/8” Fillet: All
Diameter (Pipe) 24” and up Wall 1/8” and up

FILLER METALS

Classification: E70S-6
Specification No. AWS 5.18

SHIELDING

Gas: 98/2 Composition: Argon/Oxygen
Flow Rate: 45 cfh
Gas Cup Size: N/A
Electrode-Flux (Class): N/A
Flux: N/A

POSITION

Position of Groove or Fillet: 1G, 2G, 1F, 2F
Vertical Progression: N/A

POSTWELD HEAT TREATMENT

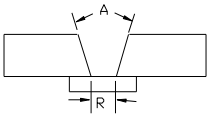
Temperature Range: None
Time:

PREHEAT

Preheat Temp. Min. 60°
Interpass Temp. Min: 60° F Max: 400°F

TECHNIQUE/ OTHER

X Stringer ☐ Weave Beads
X Multipass ☐ Single pass per side
☐ Single ☐ Multiple Electrodes
Contact Tube to Work Distance: ¾”
Peening: None on root/ cover
Initial Cleaning:
All areas to be welded shall be cleaned for oil, grease, paint, etc., for at least two (2) inches from the toes of the weld
Interpass Cleaning:
Remove all oxides and slag with a clean wire brush and/or chipping hammer
Notes:
1. A stringer or slight weave may be used as required to provide proper bead shape and side wall wetting.
2. Initial and interpass cleaning shall be accomplished by wire brushing, chipping, and no grinding.
3. Welder shall accomplish a visual inspection of previously deposited weld metal, prior to depositing the next bead.
4. Welding electrode shall be stored in dry area and located in close proximity to the work area.
5. Preheating shall be accomplished using oxy-fuel torches.
6. Weld shall be allowed to cool slowly, keeping air drafts to a minimum.

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed (IPM)	Joint Details
		Class	Dia.	Type and Polarity	Amps or wire feed speed			
All	GMAW	E70S-6	0.035”	DCEP	220-320A	24--29	4-6	

E70S-6 Butt Joint- Single V Groove Weld – "Spray Arc" (2G) Project #5

Welding Sequence

E70S-6-- Root Pass	Single pass technique with slight weave to ensure the weld metal is fusing into all three pieces of metal.
E70S-6—Fill	Use the multi-pass technique with stringer beads ensuring even fill.
E70S-6—Cover Pass	Use stringer bead (also known as finish bead) technique keeping the electrode in the puddle at al times.

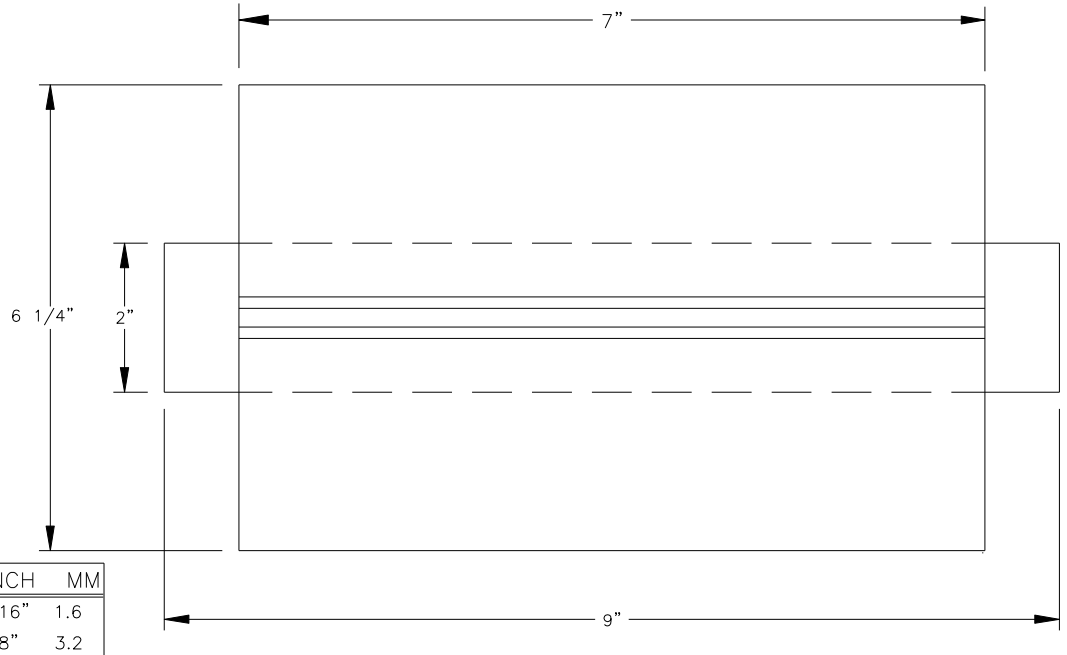
Successful completion of this project will require the student to complete ***two welds*** that meet both visual testing requirements and bend test requirements set forth in AWS D1.1 Structural Steel Welding Code.

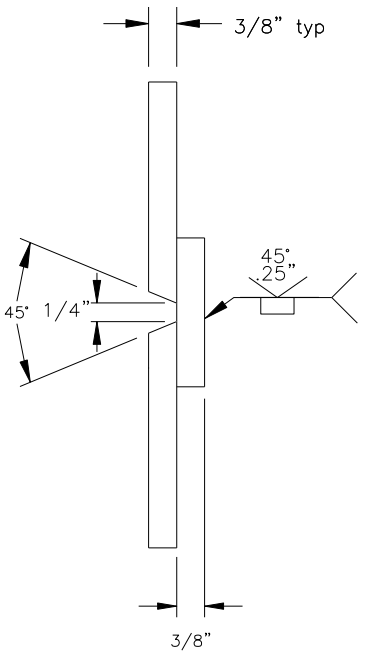
VT Criteria	Project #1	Project #2
Reinforcement		
Undercut		
Bead Contour		
Cracks		
Arc Strikes		
Fusion		
Porosity		
Bend Test		
		Grade Date

WLD 152
GMAW Spray, Mild Steel
Horizontal Groove (2G)

Welding Procedure

1.	Volts	24–30
2.	WFS (IPM)	380–440
3.	Polarity	DCRP
4.	Gas	98% Argon 2% Oxy
5.	Gas Flow	45 cfh
6.	Welding Position	Horizontal (2G)
7.	Material Thickness	3/8" Plate
8.	Stickout	3/4"
9.	Electrode Diameter	.035"
10.	Electrode	ER70S-6
11.	V350Pro Program	CV MIG GMAW Gas Shielded





INCH	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

Part	No. Required	Size (WxHxL)	S.I. Conversion

Portland Community College
Welding Technology

Tolerance(Unless otherwise Specified)
Dimensional ± 1/16" Angle ± 5°

Drawn By: John Deering

Chk By: TANNER SCOTT Date: 8/20/08

WLD 152 – 05

Size:	QC NO.	Rev.

Approve	Date	Sheet

Final Exam

Part One
This portion of the final exam is a closed book test. You may use the review questions you completed at the end of the assigned chapters as a cheat sheet. Consult with your instructor to determine items that you may need to review. Once you determine that you are ready for the exam, see your instructor.

Study Guide

Safety

- Oxyacetylene safety
- FCMAW safety
- Hand Tool Safety

FCAW, GMAW and OAC Processes

- Power source specifics
    - Polarity
    - Current out put
    - Welding gun components
    - Wire feed components
    - Types of transfers
    - Shielding gases
- AWS electrode classification
- OAC
    - Theory of cutting
    - Flame types
    - Safety

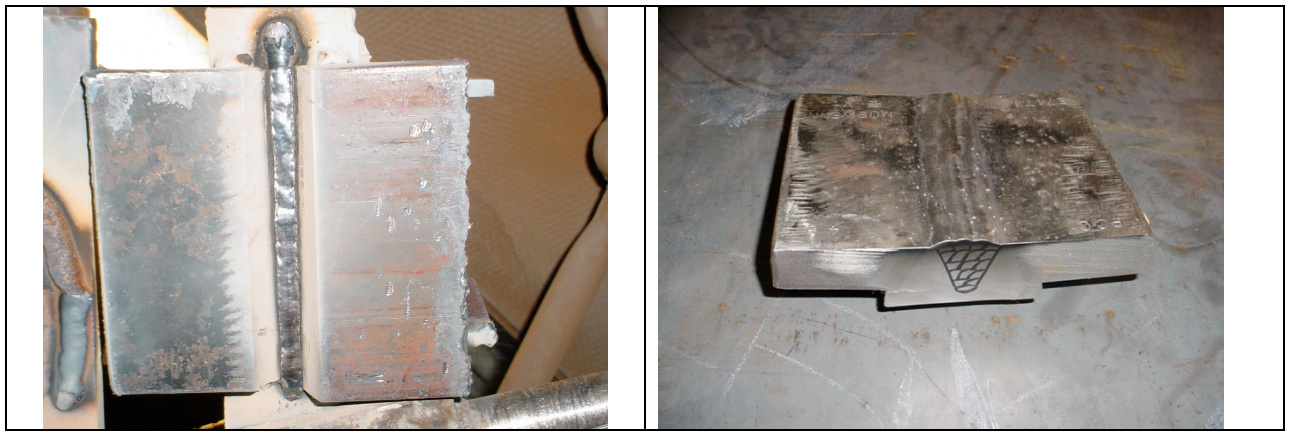
Welding Symbols and Blueprints

- Orthographic views
- Isometric views
- Welding symbol
    - Weld symbols
    - Reference line
    - Tail

Math and Math conversions

- Adding and subtracting fractions
- Reading a tape measure
- Metric conversions

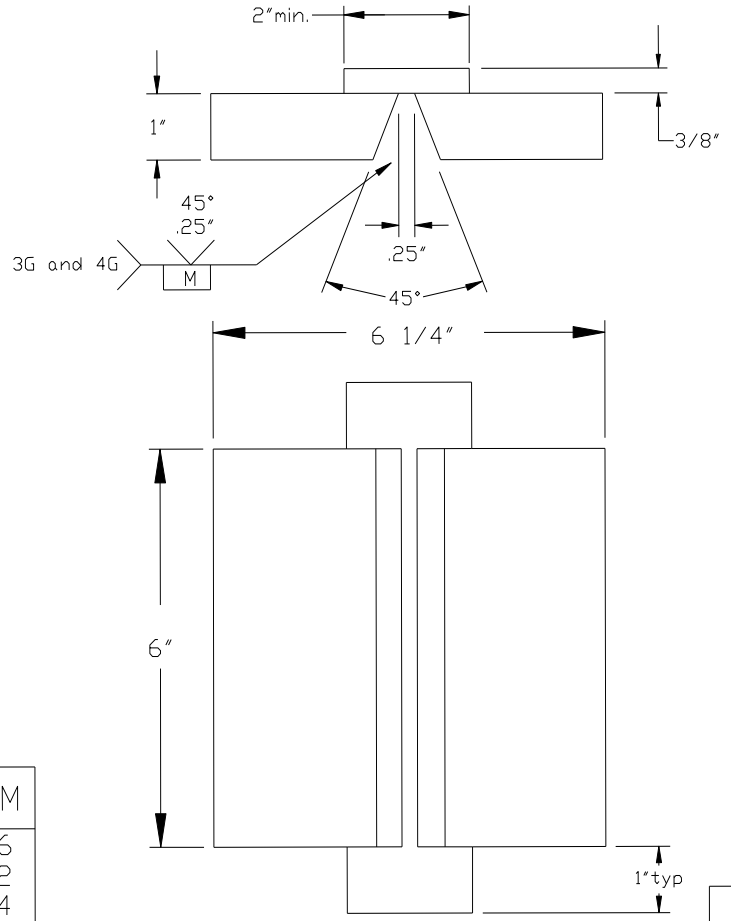
Part Two
This portion of the exam is a practical test where you will weld out a vertical and an overhead one-inch certification test plate in accordance with AWS D1.1 requirements using either **"Dual Shield"** or **"Innershield."** The evaluation of this portion of the exam will be based on AWS D1.1 Structural Steel Welding Code.

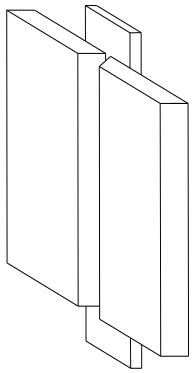


Example of a High Quality Weld

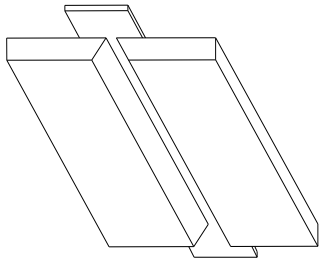
WLD 152
Final Exam-Option A
E71T-1

* Bend Test required Per AWS D1.1 for both 3G and 4G plates.
* Use welding procedure from project drawings.





3G



4G

Inch	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

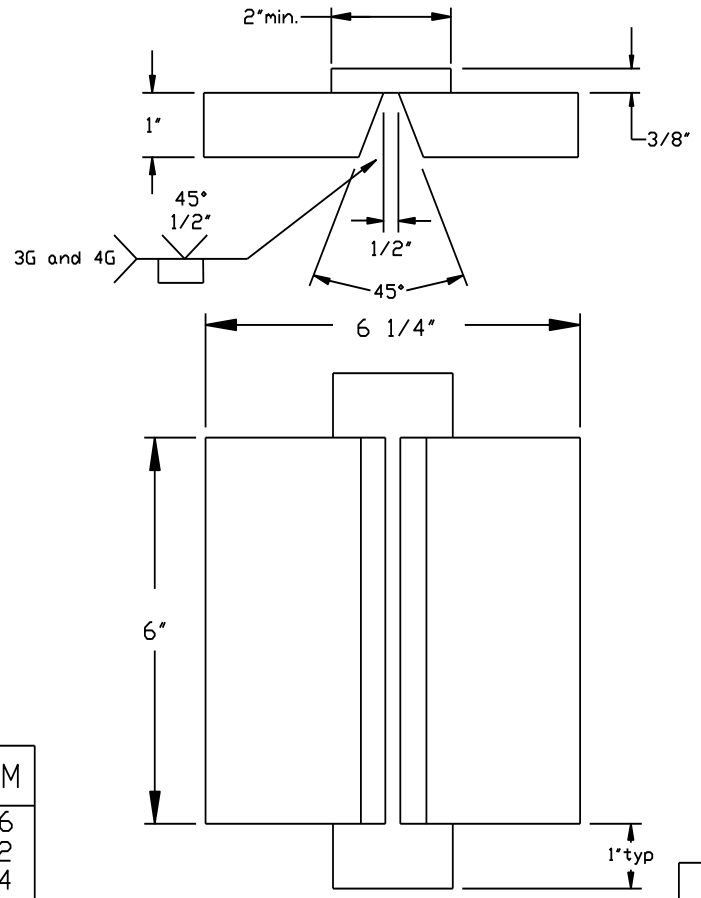
Part	No. Required	Size (WxHxL)	S.I. Conversion

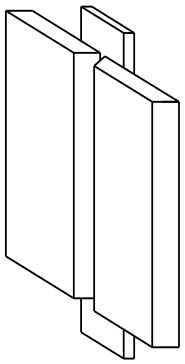
Portland Community College
Welding Technology

Tolerance (Unless otherwise Specified) Dimensional ± 1/16" Angle ± 5°		WLD 152 Final-A	
Drawn By: John Deering		Size:	Qc No. / Rev.
Chk By: TANNER SCOTT	Date: 8/20/08	Approve / Date	Sheet

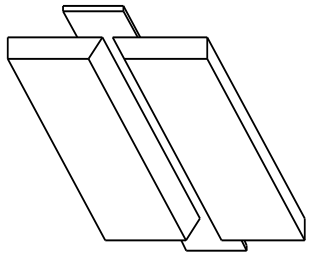
WLD 152
Final Exam-Option B
E71T-8

* Bend Test required Per AWS D1.1 for both 3G and 4G plates.
* Use welding procedure from project drawings.





3G



4G

Inch	MM
1/16"	1.6
1/8"	3.2
1/4"	6.4
1/2"	12.7
1"	25.4

Part	No. Required	Size (WxHxL)	S.I. Conversion

Portland Community College
Welding Technology

Tolerance (Unless otherwise Specified) Dimensional ± 1/16" Angle ± 5°		WLD 152 Final-B	
Drawn By: John Deering		Size:	Qc No. / Rev.
Chk By: TANNER SCOTT	Date: 8/20/08	Approve / Date	Sheet

WLD 152
"Final" Traveler

Name: _____ Date: _____

Each step must be "checked off" by your instructor before the student progresses to the next phase in the Final Weld out process.

Inspection Points	***3G***	***4G***
Fit Up and assembly		
Plate Positioning		
Root Pass Inspection		
Interpass Inspection		
Take down Day #1		
Plate Positioning Day #2		
Cover Pass Inspection		
Final	***Pass Fail***	***Pass Fail***

Final Grades - WLD 152

Name: _____ Instructor: _____ Date: _____

Welding Projects = 40%

Out of 10	~~Out of~~	~~Out of~~
Out of 10	~~Out of~~	~~Out of~~
Out of 10	~~Out of~~	~~Out of~~
Out of 10	~~Out of~~	~~Out of~~
Out of 10	~~Out of~~	~~Out of~~
~~Out of~~	~~Out of~~	~~Out of~~
A Total Project pts. _____ / Total pts. Possible _____ X 40 = _____ **%**		

Quizzes = 20%

Out of	Out of	Out of
Out of	Out of	Out of
Out of	Out of	Out of
B Total Project pts. _____ / Total pts. Possible _____ X 20 = _____ **%**		

Attendance = 10% The following attributes will be assessed - attendance, attitude, time management, team work, interpersonal skills, etc.. Daily points (there are no excused absences, hence no points earned for days missed) 3 pts = present and working for the entire shift; 2 pts = late; 1 pt = late and left early; 0 pts = no show.

Out of	Out of	Out of	Out of	Out of	Out of
Out of	Out of	Out of	Out of	Out of	Out of
Out of	Out of	Out of	Out of	Out of	Out of
D Total pts. earned _____ / Total pts. Possible _____ X 10 = _____ **%**					

Final Exams 30%

Written Exam	Out of
Practical Exam	Out of
E Total Project pts. _____ / Total pts. Possible _____ X 30 = _____ **%**	
Add Lines A + B + C + D + E. This will give you your Final Grade TOTAL % _____ FINAL GRADE _____	