# WLD 141
# Flux Cored Arc Welding I
# (Gas Shielded)

# *Index*




| | |
|---|---|
|  | This project was supported, in part,<br>by the<br>**National Science Foundation**<br>Opinions expressed are those of the authors<br>And not necessarily those of the Foundation |

# *Course Assignments*

## Required Text Book

**Welding Principles and Applications 7th edition** by Larry Jeffus,

Chapter 12, Flux Cored Arc Welding Equipment, Setup, and Operation
Chapter 26, Weldability of Metals

## Math

Practical Problems in Mathematics 6th edition by Robert Chasan

Chapter 28, Volume of Cubes and Rectangular Shapes
Chapter 29, Volume of Rectangular Containers
Chapter 30, Circumference of Circles, and Perimeter of Semicircular-Shaped Figures
Chapter 31, Area of Circular and Semicircular Figures
Chapter 32, Volume of Cylindrical Shapes

## Recommended assignments

Complete review question following each assigned chapter

## Quizzes

Complete Interactive Quiz in CourseMate for each assigned chapter

## Reference List

- **The Procedures Handbook of Arc Welding** by Lincoln Electric
- **IPT's Metal Trades Handbook** (Revised Edition-1993) by Ronald G. Garby and Bruce J. Ashton
- **Gas Metal Arc Welding Handbook** by William H. Minnick
- **D1.1 Structural Steel Code Book** by the American Welding Society

## Video Training

View the DELMAR FCAW VIDEOS before starting this course work. They are Located in the classroom 132/a.

## Timeline

The Welding Department's Open-entry, open-exit instructional format allows the students to work at their own pace. It is the student's responsibility to complete all assignments in a timely manner. See your instructor if you need 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

# Equipment for Shielded Flux Cored Welding Process

## *Power Sources*

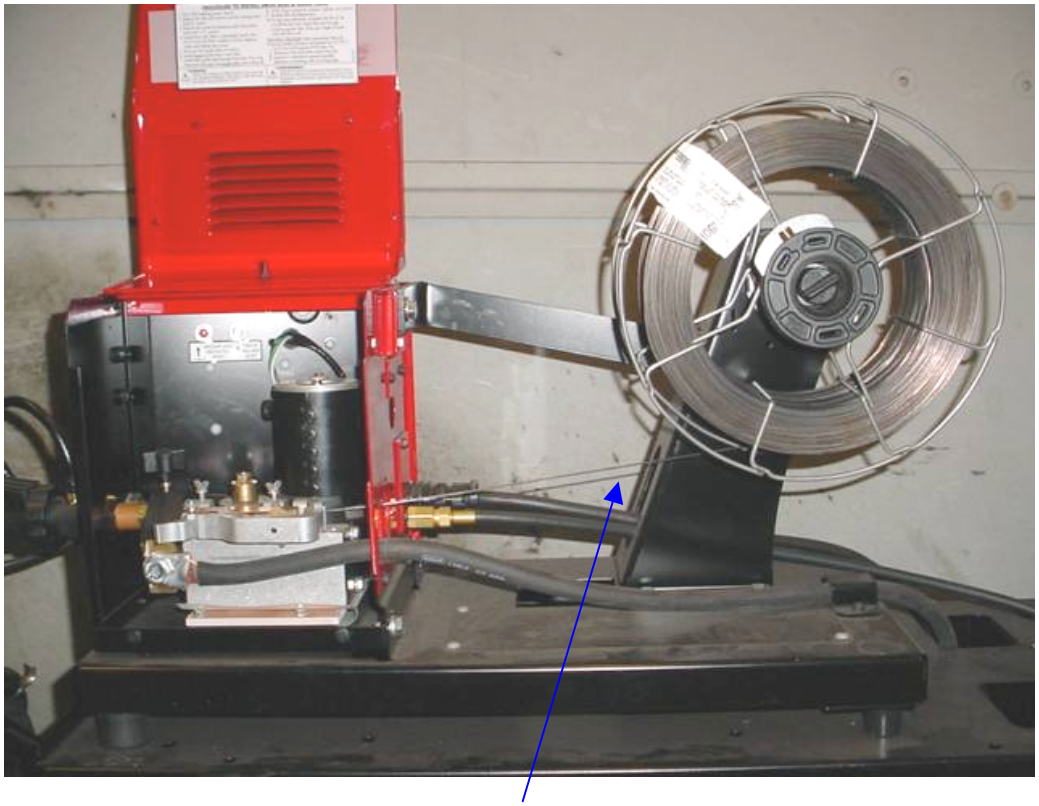
The flux-core process utilizes the same basic equipment as any of the other gas metal arc welding processes that incorporates a power source, wire drive-control, gun, and a system for supplying a shielding gas.

A constant voltage type power source is required to obtain the maximum efficiency from the flux-core process. This type of power source automatically supplies the correct amperage to maintain constant arc voltage.

Since most constant voltage welding machines are rated for 100% duty cycle at rated current, they provide power for automatic and semi-automatic welding equipment. This factor provides a safety margin when the welding machines are operated for short periods of time at currents above their rated capacity.

An outstanding advantage provided by constant voltage welding machines is the simplicity of welding operation. The electrode feed speed is adjusted to give the desired welding amperage that is automatically provided by the constant voltage-welding machine.

### Electrode Feed Controls

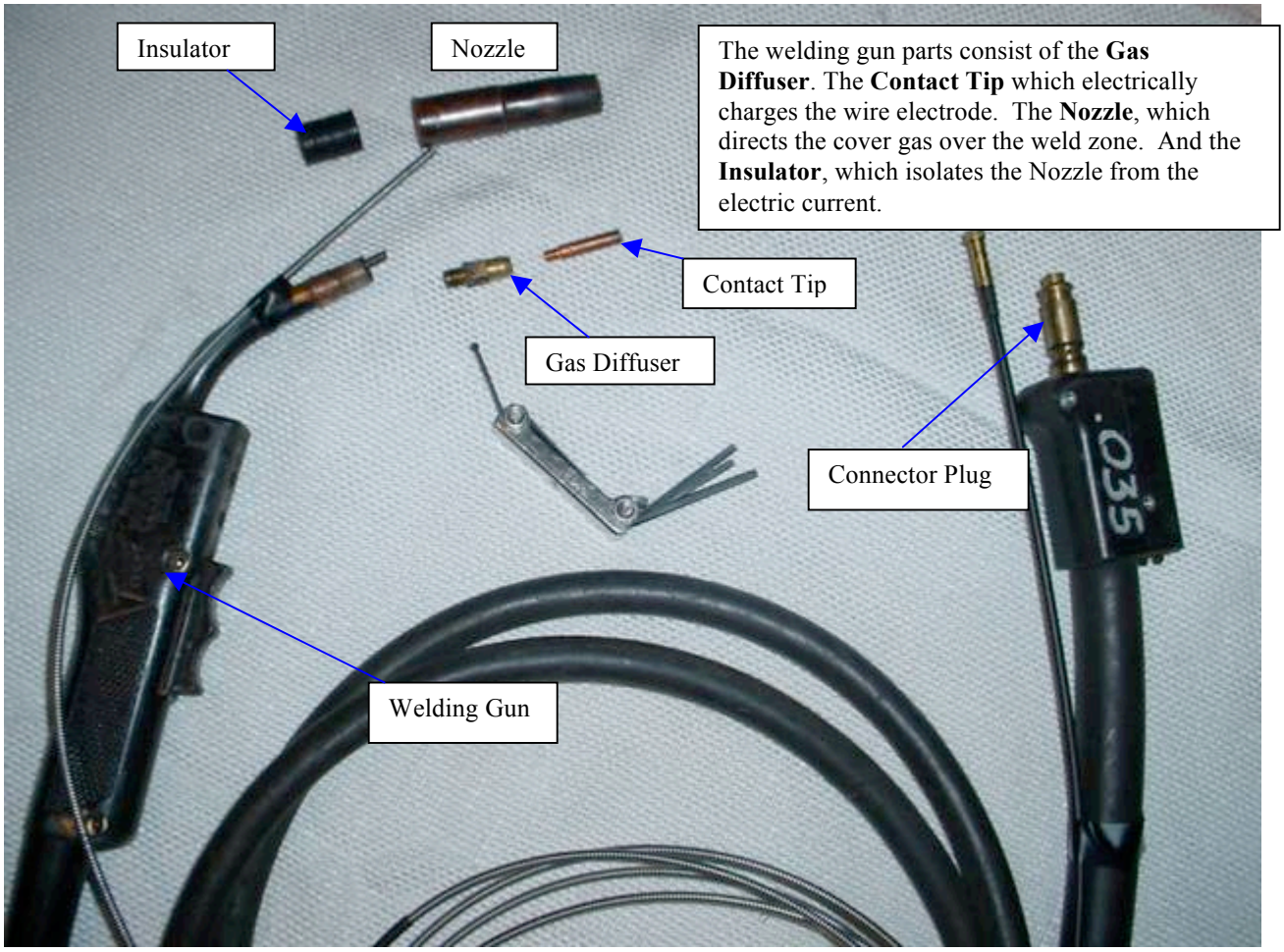



The purpose of the electrode feed control is to supply the continuous electrode (wire) to the welding arc at a preset rate. The electrode feed speed controls the welding amperage from the constant voltage

power source. Flux-core electrodes used in the process require V-grooved feed rolls of correct size so that the electrodes are not flattened or distorted.

## Welding Guns

Welding guns used in the flux-core process serve the purpose of providing transfer of the welding current to
the electrode, shielding gas coverage, and control of the arc. The guns may be air cooled or water cooled depending upon the service conditions. Contact tips are subject to wear and should be changed periodically to insure correct size and reliable current pickup. Inside diameter tolerance on the contact tip is important to assure reliability of the process.



# *Wire Conduit Installation*

SINCE YOU WILL BE USING THE "TWECO MIG-GUNS" ON THE EQUIPMENT, IT IS ESSENTIAL THAT YOU BE ABLE TO REPLACE PARTS AS NEEDED, THE WIRE GUNS FROM MOST OTHER MANUFACTURERS ARE SIMILAR; BUT, IF DIFFICULTY IS ENOUNTERED, YOU SHOULD READ THE APPROPRIATE INSTRUCTION SHEET.

## *Installing a New Wire Conduit in Tweco Mig Guns*

The procedure for removal and installation of a wire conduit in either the No. 4 AN or No. 6 MIG GUN is identical. The No. 6 MIG GUN wire conduit stop has two O-ring gas seals. The No. 4 AN MIG GUN wire conduit stop has a sleeve type gas seal only. (See appropriate drawing.)

1. (See the appropriate drawings.) Be sure the MIG GUN is stretched in a straight line free from twists when removing or installing a wire conduit. To remove old wire conduit, first remove the MIG-GUN
   nozzle, contact tip, and nozzle insulator. No. 4 AN MIG GUNS have a sliding adjustable style nozzle (see drawing) and the No. 6 MIG GUN has a fixed threaded style nozzle (see drawing). Loosen the Allen screw in the Gas Diffuser (see drawings) and remove the Gas Diffuser. Loosen the Allen screw in the MIG KWIK Connector Plug (see drawings) and pull the old wire conduit out of the Cable hose at the MIG KWIK Connector end.

2. To install a new Wire Conduit Liner, first inspect the gas seal O-rings or sleeve type gas seal for cuts or damage. Start from the MIG KWIK Connector end of the assembly and begin pushing the conduit through the MIG KWIK Connector Plug, the Cable hose, and into the gun. If the conduit should lodge along the way, gently whip or work the Cable hose to aid forward movement.

3. When the wire conduit stop meets the end of the MIG KWIK Connector Plug (see pictures), the small Allen screw in the Connector Plug must be securely tightened onto the conduit to prevent its backward movement.

4. **IMPORTANT:** When the conduit is fully inserted into the Cable hose and the conduit stop is firmly against the Connector Plug, the "raw end" of the conduit will protrude out of the open end of the gun conductor tube (see picture). Cut the conduit end off squarely outside the conductor tube according to dimensions in (see picture). The cut end which seats in the Gas Diffuser must be filed and reamed perfectly smooth on the inside and outside radii so that the wire feed will not be obstructed.

5. Seat the smoothed end of the wire conduit into the end of the Gas Diffuser and screw the diffuser into the conductor tube. When the Gas Diffuser is fully tightened, remove the small Allen screw to make sure that the conduit is visible through the screw hole. This inspection will assure that the wire conduit is fully seated in the Gas Diffuser. Replace and securely tighten the Allen screw onto the wire conduit. DO NOT OVERTIGHTEN CAUSING DISTORTION OF THE CONDUIT!

## *Wire Conduit Installation*

# *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** |

## E71T-1 Bead Plate — Project #1

### Welding Sequence

E71T-1—Apply a new surface on the base metal by overlapping stringer beads. Alternate welding directions (i.e. right to left then left to right).

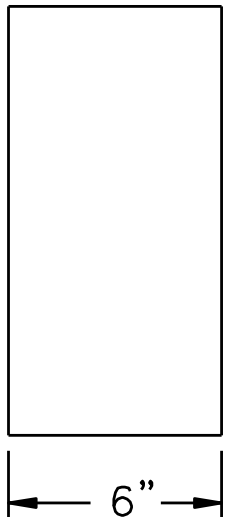
| VT Criteria | Student Assessment | Instructor Assessment |
|---|---|---|
| **Reinforcement** | | |
| **Undercut** | | |
| **Bead Contour** | | |
| **Cracks** | | |
| **Arc Strikes** | | |
| **Fusion** | | |
| **Porosity** | | |
| **Bend Test** | | |
| | | Grade Date |

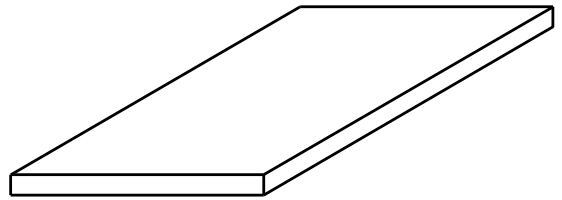
# WLD 141

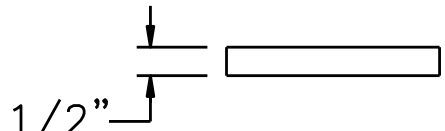
Bead Plate
Flat Position

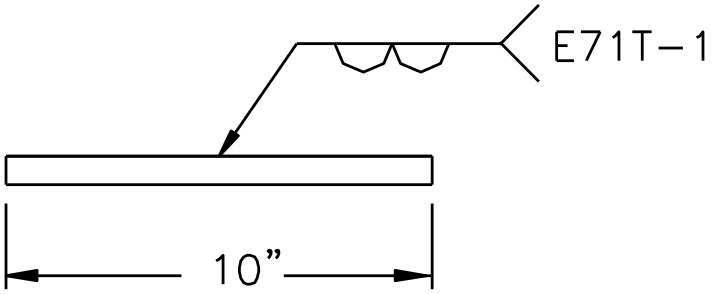
## Welding Procedure

1. Electrode — E71T-1
2. Diameter — 1/16"
3. Polarity — DCRP
4. Voltage — 24-26
5. Amperage — 200-220
6. Welding Position — Flat
7. Material — 1/2" Plate
8. Travel Angle (Drag) — 20°-30°
9. Work Angle — Varies
10. $CO_2$ Shielding gas — 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 141-01

Drawn By: John Deering

Chk By: TANNER SCOTT Date: 8/18/08

| Size: | Qc No. | Rev. |
|---|---|---|
| Approve | Date | Sheet |

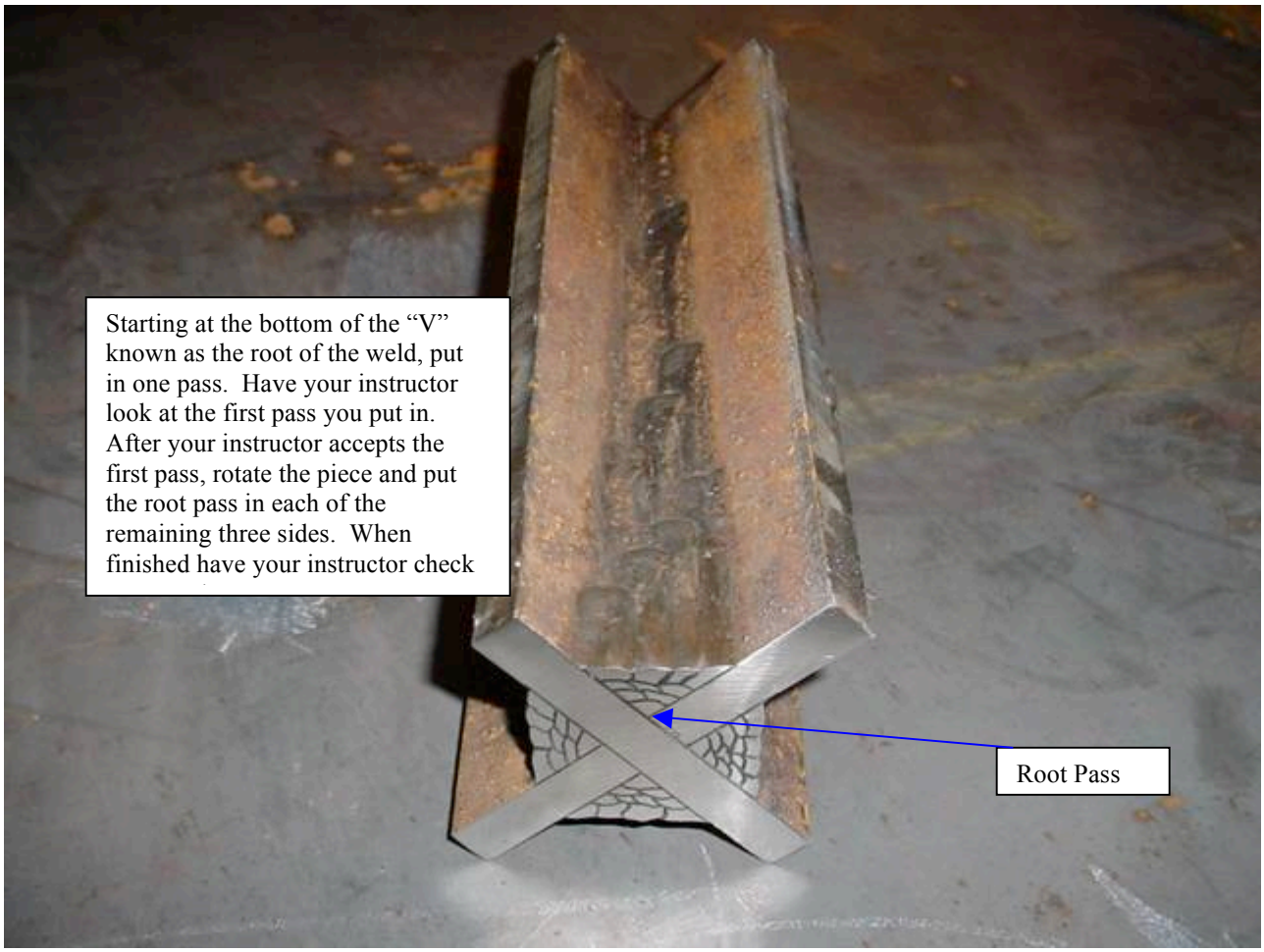
## E71T-1 T-Joint (1F) Project #2

### Welding Sequence

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

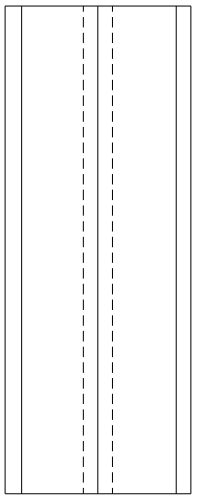
E71T-1—Fill Use the split bead technique with stringer beads ensuring even fill.

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



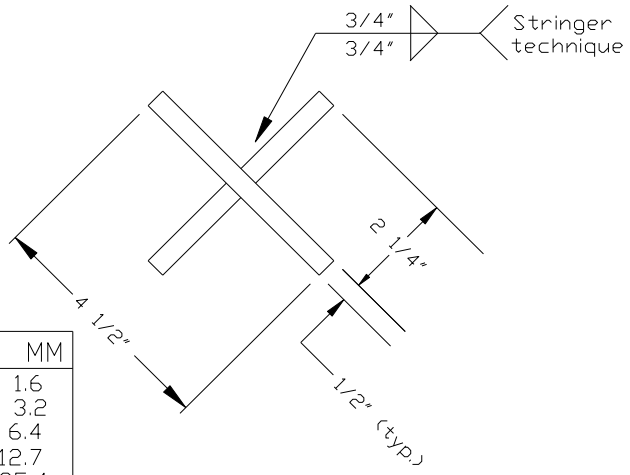

| VT Criteria | Student Assessment | Instructor Assessment |
|---|---|---|
| **Reinforcement** | | |
| **Undercut** | | |
| **Bead Contour** | | |
| **Cracks** | | |
| **Arc Strikes** | | |
| **Fusion** | | |
| **Porosity** | | |
| **Bend Test** | | |
| | | Grade Date |

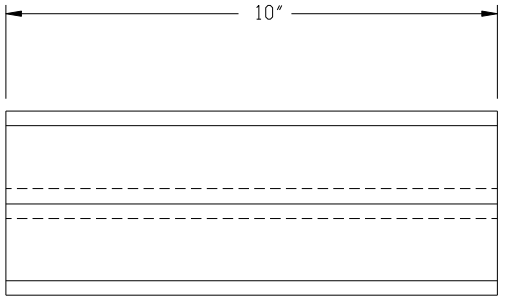
# WLD 141
## Flat (1F)
## T-Joint



## Welding Procedure

1. Electrode — E71T-1
2. Diameter — 1/16″
3. Polarity — DCRP
4. Voltage — 24-28
5. Amperage — 180-230
6. Welding Position — Flat (1F)
7. Material — 1/2″ Plate
8. Travel Angle (Drag) — 20°-30°
9. Stickout — 3/4″
10. C2 Shielding gas — 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 |
|---|---|---|---|
| | | | |
| | | | |
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Portland Community College
Welding Technology

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

Drawn By: John Deering

Chk By: TANNER SCOTT Date: 8/18/08

WLD 141-02

| Size: | Qc No. | Rev. |
|---|---|---|
| Approve | Date | Sheet |

## E70T-1 T 3/32" *Hog Wire* -Joint (2F) Project #3

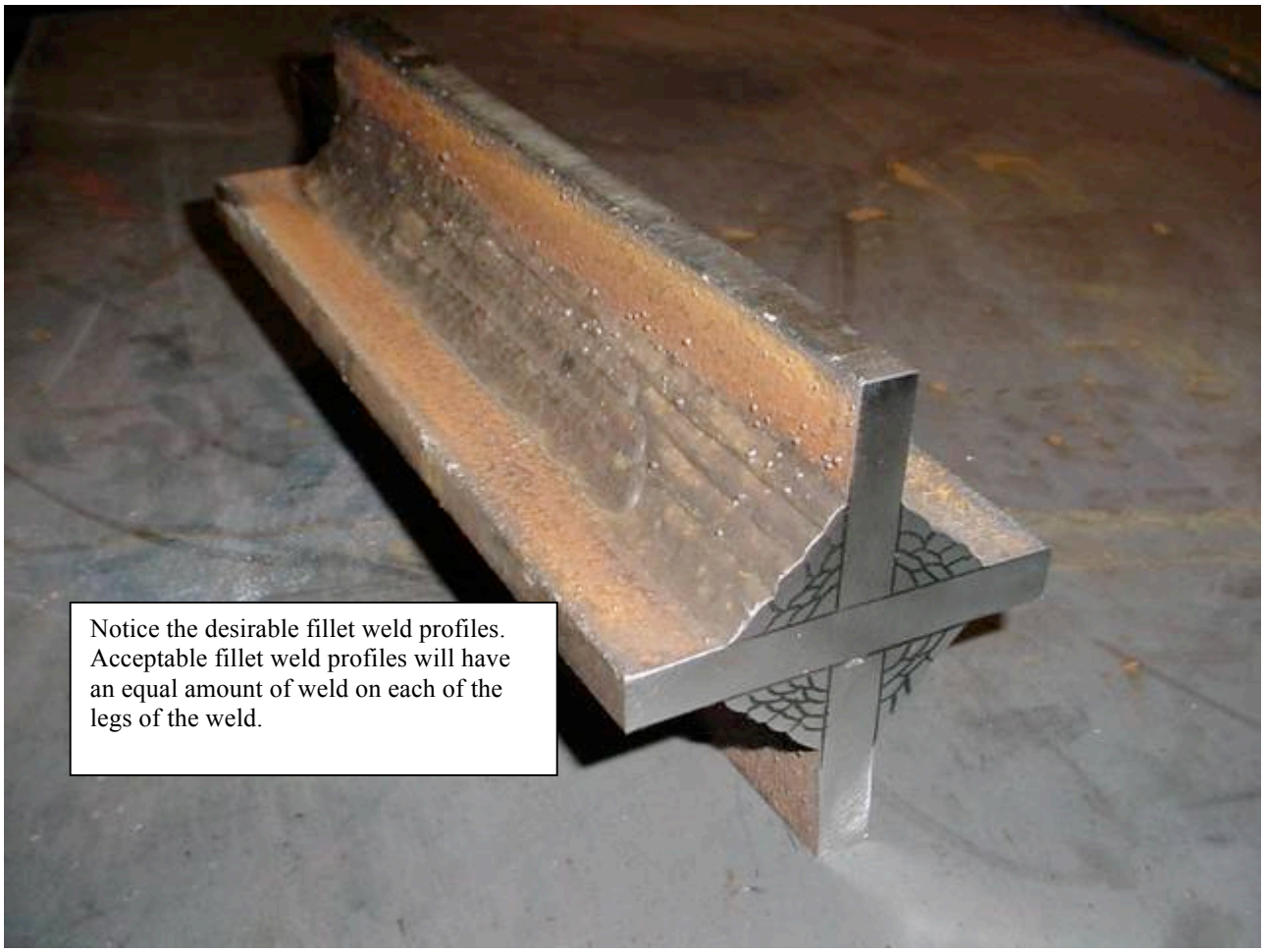
**Welding Sequence**

| | |
|---|---|
| E71T-1-- Root Pass | Single pass technique where the focus of the wire is on the bottom plate by one diameter's width. The weld metal with then "float" into the vertical plate. |
| E71T-1—Fill | Use the split 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. |

The weld joint pictured above is what is known as a 2F or Horizontal Fillet Weld. Notice that the joint has been securely tacked at each end prior to starting the weld. Make sure your project is tacked on all four sides before you start to weld. If you do not tack your piece before you start welding or if your tacks are too small, the parts will pull or move while you are welding them. Begin the weld at one end of the joint and continue to weld at a constant even speed all of the way to the other end without stopping. After you finish the first root pass have your instructor check your work.

**E70T-1 Dual Shield 3/32" wire (Hog Wire) Information**

- Use big tacks where you are going to stop and start
- 5/16" is the largest fillet weld allowed per AWS D1.1
- "Double Pump" Stop to fill crater

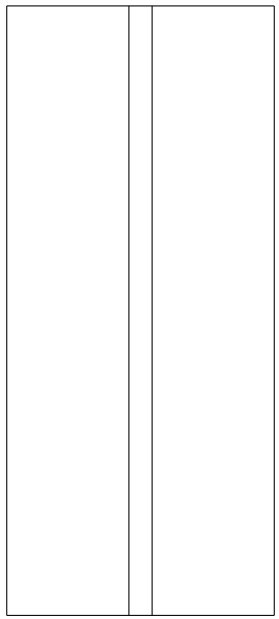


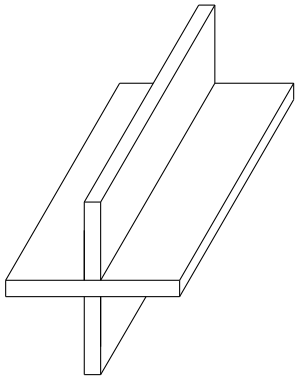

| VT Criteria | Student Assessment | Instructor Assessment |
|---|---|---|
| **Reinforcement** | | |
| **Undercut** | | |
| **Bead Contour** | | |
| **Cracks** | | |
| **Arc Strikes** | | |
| **Fusion** | | |
| **Porosity** | | |
| **Bend Test** | | |
| | | Grade Date |

# WLD 141

"Hog Wire"

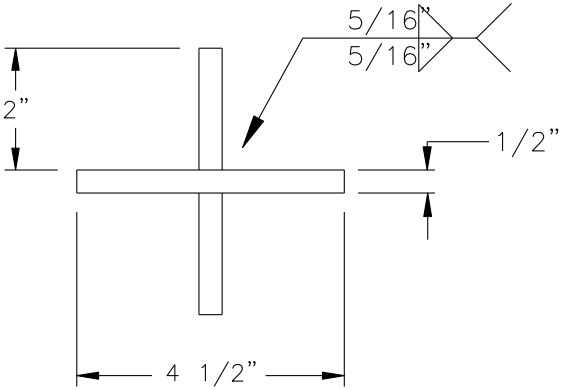
T–Joint

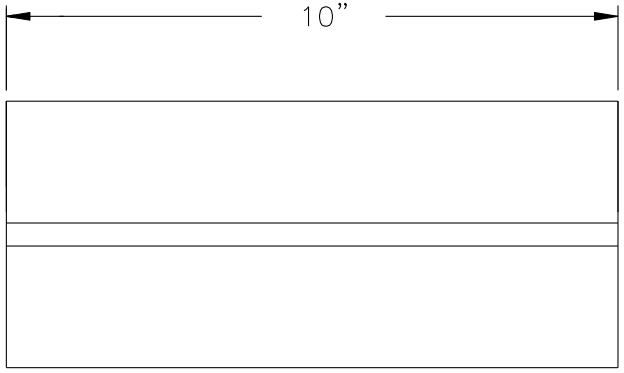




## Welding Procedure

1. Electrode — E71T–1
2. Diameter — 3/32"
3. Polarity — DCRP
4. Voltage — 27–29
5. Amperage — 400 – 460
6. Welding Position — Horizontal (2F)
7. $CO_2$ Shielding Gas — 45 cfh
8. Material — 1/2" Plate
9. Travel Angle (Drag) — 20°–30°
10. Stick Out — 3/4" to 1"




| 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 |
|---|---|---|---|
| | | | |
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Portland Community College

Welding Technology

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

WLD 141–03

Drawn By: John Deering

Size: | Qc No. | Rev.

Chk By: TANNER SCOTT Date: 7/7/09

Approve | Date | Sheet

## E71T-1 T-Joint (3F) Project #4

**Welding Sequence**

| | |
|---|---|
| E71T-1-- Root Pass | Single pass technique with slight weave to ensure the weld metal is fusing into both pieces of metal. |
| E71T-1—Fill | Use the split 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. |

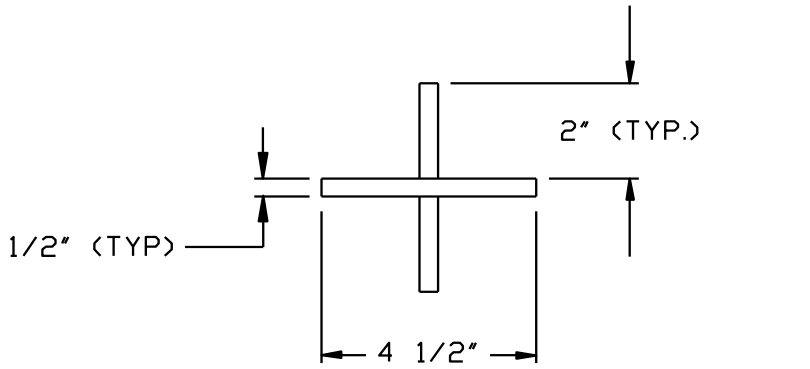
The weld joint pictured above is in the 3F or Vertical position. This weld will be started from the bottom of the joint and weld to the top. It is important to remember while you are welding this type of a joint that one side of the weldment is the edge of the plate and the other side of the weldment is the center of the plate. The reason this is important is the edge of the piece being welded will be effected by the heat of the weld much sooner then the piece you are centered on.
Once you begin the weld watch for the puddle to form. When you see the puddle form and fill out into a circle begin to move upward slowly keeping the wire electrode in the center of the puddle. If you move to quickly and get ahead of the puddle the wire electrode will burn a hole in the metal.

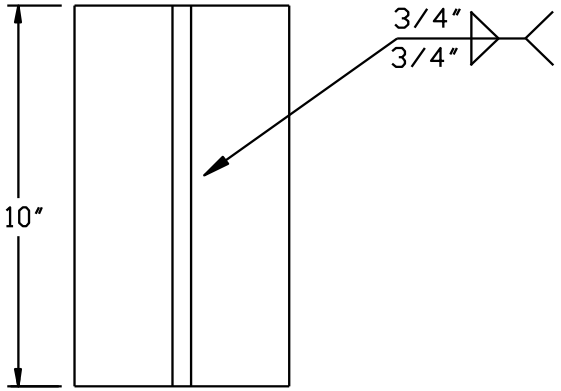
| VT Criteria | Student Assessment | Instructor Assessment |
|---|---|---|
| **Reinforcement** | | |
| **Undercut** | | |
| **Bead Contour** | | |
| **Cracks** | | |
| **Arc Strikes** | | |
| **Fusion** | | |
| **Porosity** | | |
| **Bend Test** | | |
| | | Grade Date |

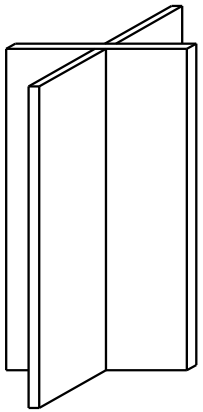
# WLD 141
## Vertical Fillet (3F)

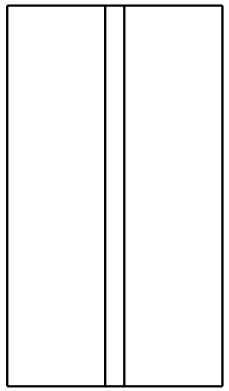
### Welding Procedure

1. Electrode — E71T-1
2. Diameter — 1/16"
3. Polarity — DCRP
4. Voltage — 24-26
5. Amperage — 200-220
6. Welding Position — Vertical (3F)
7. CO2 Shielding Gas — 45 cfh
8. Material — 1/2" Plate
9. Travel Angle — 20°-30°
10. Work Angle — Varies





| 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 |
|---|---|---|---|
| | | | |
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Portland Community College
Welding Technology

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

Drawn By: John Deering

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

WLD 141-04

| Size: | Qc No. | Rev. |
|---|---|---|
| Approve | Date | Sheet |

## E71T-1 T-Joint (4F) Project #5

**Welding Sequence**

| | |
|---|---|
| E71T-1-- Root Pass | Single pass technique with slight weave to ensure the weld metal is fusing into both pieces of metal. |
| E71T-1—Fill | Use the split 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. |

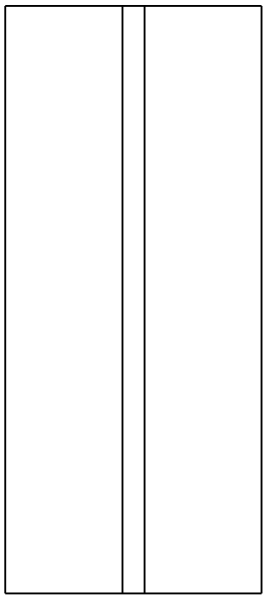
Pictured above is a weld project fixtured in the 4F or overhead position. Although the overhead position may seem like a difficult position to weld in, it is very similar to welding in the horizontal position. The force of the arc coming off of the end of the electrode actually helps to lay the weld down. It does help to work the gun up and down slightly when putting this weld in to facilitate positioning the weld equally into both sides of the root.

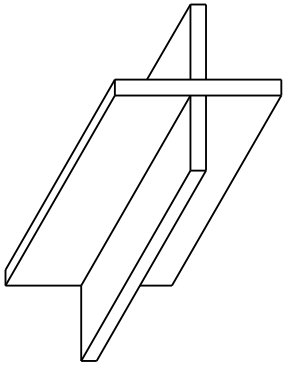
| VT Criteria | Student Assessment | Instructor Assessment |
|---|---|---|
| **Reinforcement** | | |
| **Undercut** | | |
| **Bead Contour** | | |
| **Cracks** | | |
| **Arc Strikes** | | |
| **Fusion** | | |
| **Porosity** | | |
| **Bend Test** | | |
| | | Grade Date |

# WLD 141

Overhead (4F)

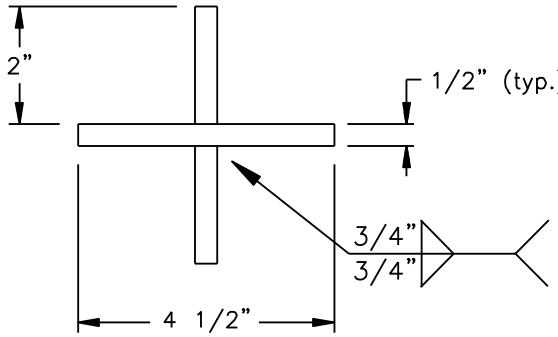
T–Joint

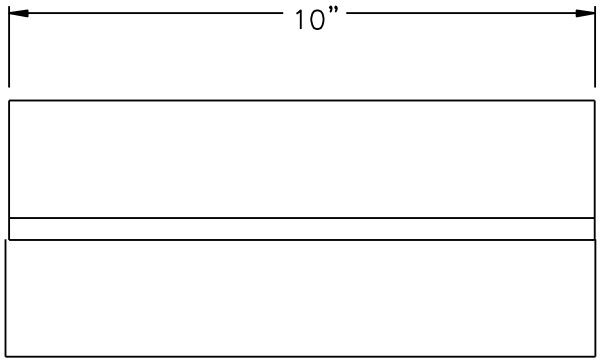




## Welding Procedure

| | | |
|---|---|---|
| 1. | Electrode | E71T–1 |
| 2. | Diameter | 1/16" |
| 3. | Polarity | DCRP |
| 4. | Voltage | 24–26 |
| 5. | Amperage | 200–220 |
| 6. | Welding Position | Overhead (4F) |
| 7. | Material | 1/2" Plate |
| 8. | Travel Angle (Drag) | 20°–30° |
| 9. | Work Angle | Varies |
| 10. | CO Shielding gas | 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°

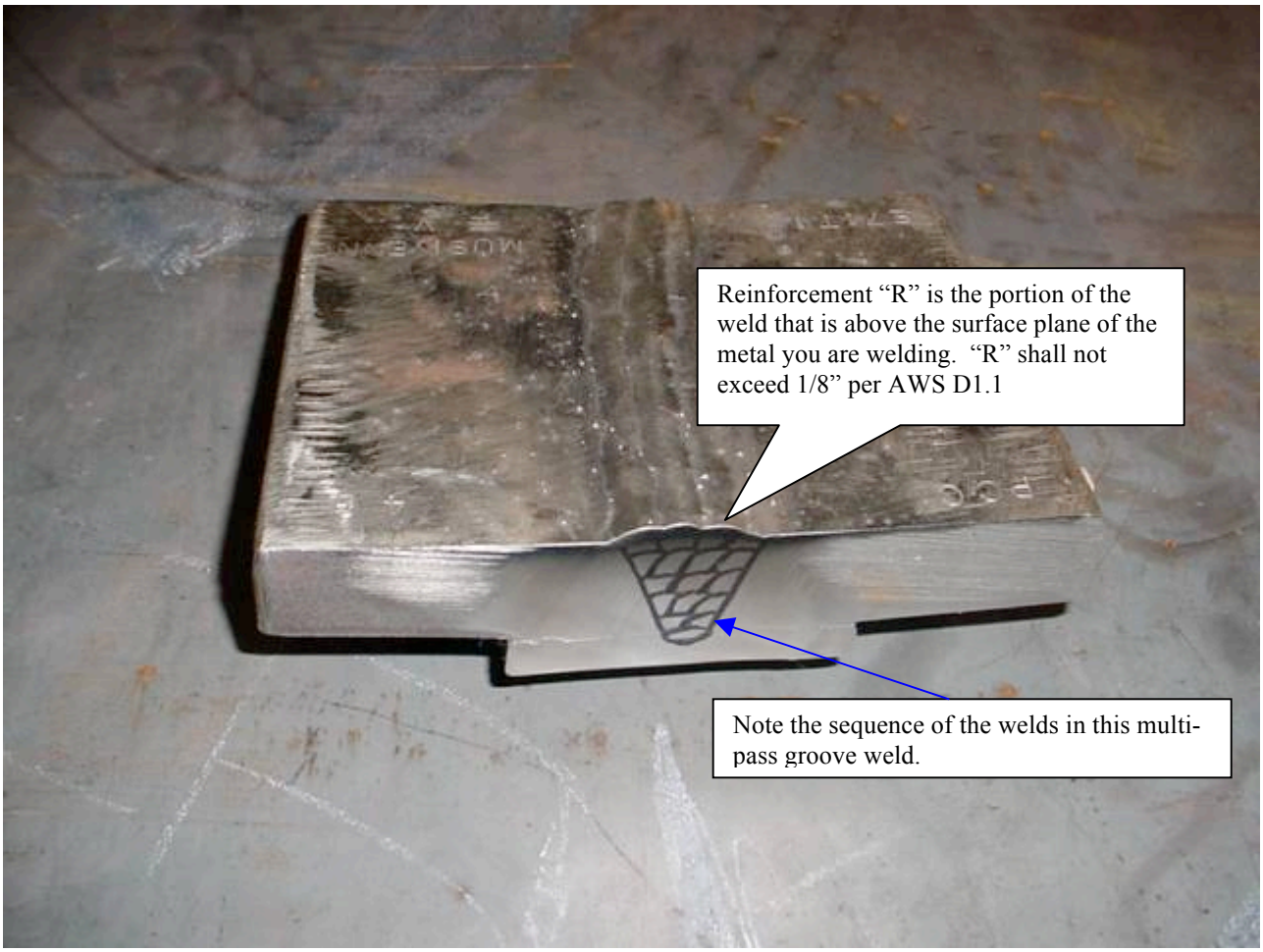
Drawn By: John Deering

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

WLD 141–05

| Size: | Qc No. | Rev. |
|---|---|---|
| Approve | Date | Sheet |

# *Groove Welding Information Sheet*




**Acceptable butt weld or groove weld profile.**

## *COMMENTARY ON TECHNIQUES WITH PICTORIAL ILLUSTRATIONS*

The practicality of multipass welding will depend upon many factors in each individual application. Multipass welding is usually done with smaller beads deposited at lower heat inputs than would be employed in a single pass. This procedure is used when there is a need for rapid cooling in the heat affected zone and weld toughness which develops in a multipass weld deposit resulting from grain refinement and the tempering effect of stringer beads. The desirability of multipass welding and the finesse with which it must be applied is judged from the weldability of the steel and the toughness estimated to be required in the weld joint area. Small beads are more susceptible to stress cracking and cause more distortion than large beads. Stress cracking and distortion can be minimized by using procedures such as back stepping, alternating the stringer beads, etc.

The purpose of minimizing weaving motion is to obtain a reasonably fast travel speed and, thus, avoid an excessively high heat input. The maximum temperature attained and the length of time at temperature is not only dependent upon the welding process employed, but also the technique exercised

by the welder. Some fabricators insist on welding with high heat inputs in order to deposit larger beads and, thus, more quickly accomplish the welding of a particular joint.

The grains will be much coarser in a large, single-pass weld made at slow speed than in a thin single bead deposited at high speed. It is better to maintain preheat and interpass temperatures within recommended limits, and to use higher welding current and fast travel. Coarse-grains are undesirable because they lack ductility and impact strength. This effect is especially pronounced where each bead is the full width of the groove.


In the picture above slag and or gas was trapped because there was too little space between the sidewall and the bead or between beads. Undercut must be avoided with any of the beads because this can trap slag. The defects in this weld can be corrected by grinding or air arc gouging before proceeding with the welding.

# *Shop Pre-Test Bend Test Procedure for 1" Test Plate*

Bend tests are used to determine the ductility and soundness of a weld joint. The test will determine if fusion was obtained in the weld joint. Use the following procedure in preparing and bending your coupons.

1. Reference the AWS D1.1 Structural Welding Code to determine the dimensional layout of the bend coupons (use this diagram for all positions).

2. Flush back up strip off of the plate. **Note: flushing of the backing strip maybe removed by flushing provided that at least 1/8 inch of its thickness is left to be removed by grinding.**

3. Layout four 3/8" thick coupons and cut using the track burner**. Do Not Bend coupons greater than 3/8" thick. This will damage the machine.**

4. Allow coupon to air cool. **Do Not Quench!**

5. Grind coupon's smooth, ensuring grinding marks are going with the length of the coupon's and all edges are rounded.

6. Request permission from your instructor to use the bend test machine.

7. **CAUTION**: ***Keep hands and fingers clear when operating equipment.***

8. Ensure guard is in the correct position. The coupons sometimes eject out the end of the machine rapidly.

9. Place coupon in the machine taking care to not position your hands/fingers in the way. Locate weld in the center of the die. Position coupons for side bends only.

10. Actuate the machine by the lever on top of the machine and stand clear of end where the coupon will exit.

11. Inspect the coupon for fusion type defects. **Reference AWS D1.1 Structural Welding Code, for acceptance criteria**.

| | |
|---|---|
| **Inspection by instructor:** | **Instructors signature:** _____ |
| **Date:** _____ | **Student signature:** _____ |

# *Bend Test Procedure*
## *For 1" Test Plate*

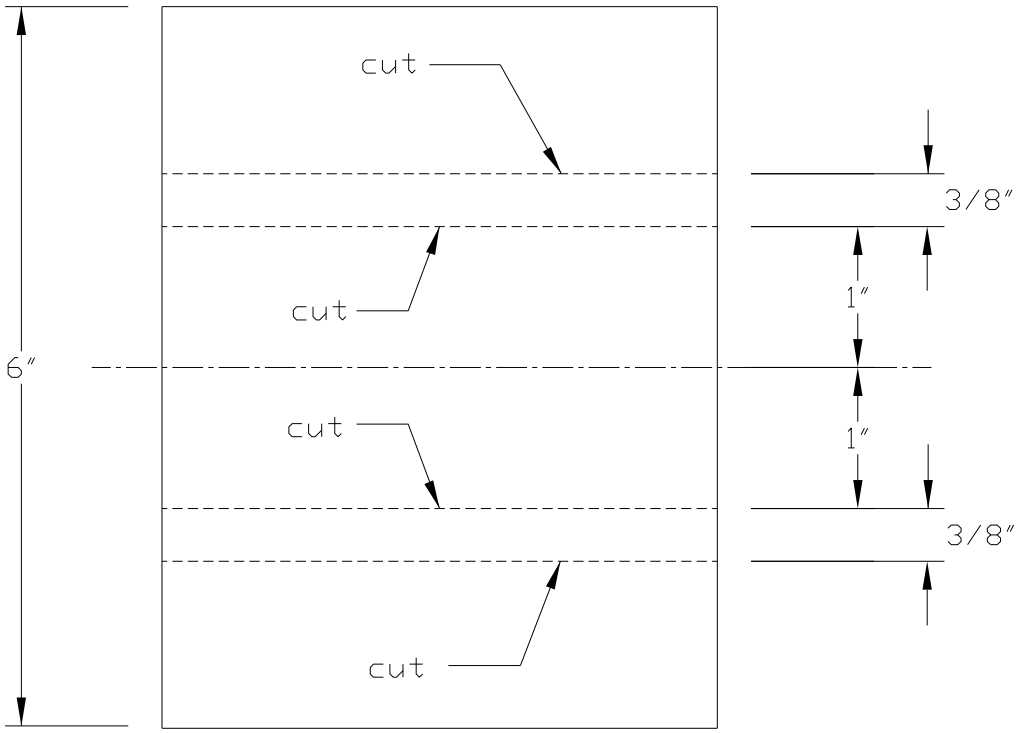
Bend tests are used to determine the ductility and soundness of a weld joint. The test will allow the welder to determine if she or he has obtained fusion in the weld joint. Use the following procedure in preparing and bending your coupons.

1. Flush back up strip off of the plate at the flushing station.

2. Layout four 3/8" coupons and cut using the track burner**.** **Do Not Bend** coupons greater than 3/8 " thick it will damage the dies in the bending machine!

# SHOP TEST

BEND TEST COUPON PREPERATION FOR SHOP TEST




TEST COUPONS SHALL BE FREE OF ALL DEFECTS SUCH AS UNDERCUT, POROSITY, SLAG INCOMPLETE FUSION, AND OTHER DEFECTS PER AWS D1.1

| 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(WxLxT) | S.I. Conversion |
|---|---|---|---|
| | | | |

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Welding Technology

| | | | |
|---|---|---|---|
| Tolerance (Unless otherwise Specified) Dimensional ± 1/16″ Angle ± 5° | | WLD 141 Bend Test Layout | |
| Drawn By: John Deering | | Size: | Qc No. / Rev. |
| Chk By: | Date: 5/22/05 | Approve Date | Sheet |

3. Allow coupon to air cool. **Do Not Quench!**

4. Grind coupon's smooth, ensuring grinding marks are going with the length of the coupon's and all edges are rounded.

5. Request permission from your instructor to use the bend test machine.

6. **CAUTION**: ***Keep hands and fingers clear when operating equipment.***

**Watts Bend Test Machine**

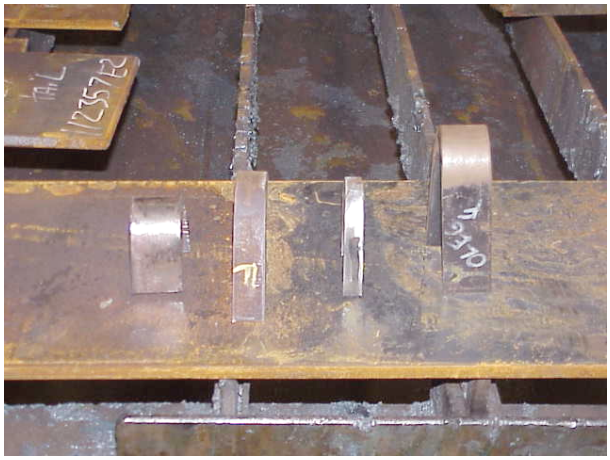
7. Ensure guard is in the correct position. The coupons sometimes eject out of the end of the machine rapidly.

**Guard**

8. Place coupon in the machine taking care not to position your hands/fingers in the way. Locate weld in the center of the die. Bend one coupon (from each plate) to test the face and one to test the root.
9. Actuate the ram by the lever on top of machine and stand clear of the guard area where coupon will exit.

10. Inspect the convex surface of the bend specimen for fusion type defects.

**<u>Reference the AWS D1.1 Structural Welding Code for Acceptance Criteria for Bend Tests</u>**.



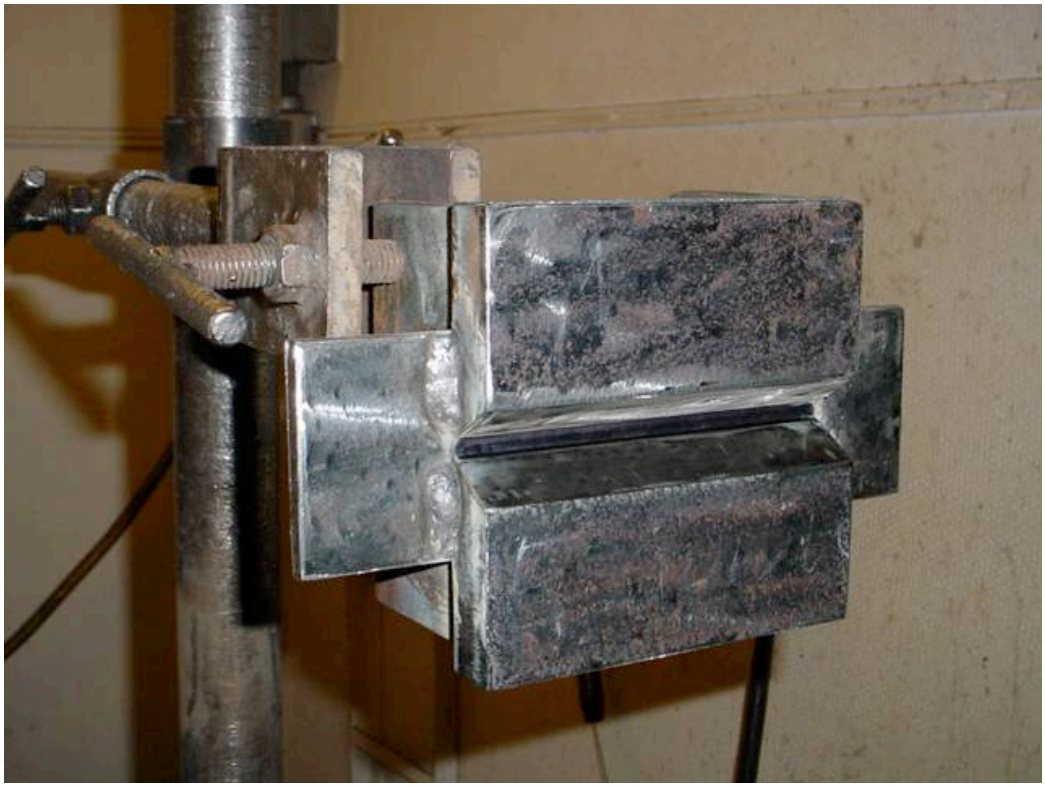
**Four types of bend samples are shown above. Left to right are: face bend, face bend, root bend and a side bend**

**The bend samples shown above differ in the radius that they were bent. This is a requirement set forth by the code or standard that is being used.**

## E71T-1 Groove Weld (2G) Project #6

**Welding Sequence**

| | |
|---|---|
| E71T-1-- Root Pass | Single pass technique with slight weave to ensure the weld metal is fusing into both pieces of metal. |
| E71T-1—Fill | Use the split 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. |



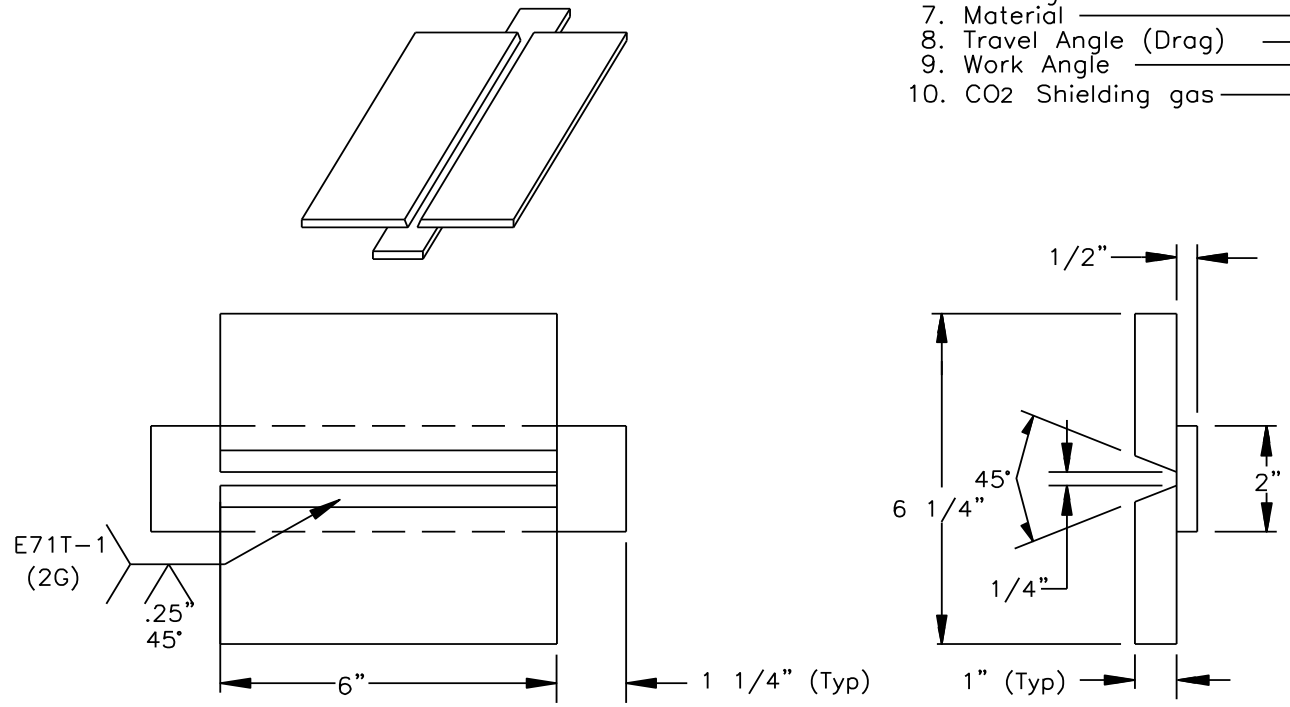
| VT Criteria | Visual Inspection | Bend Tests |
|---|---|---|
| **Reinforcement (0” –1/8”)** | | Acceptable<br><br>Not Acceptable |
| **Fillet Weld Size** | | |
| **Undercut (1/32”)** | | |
| **Bead Contour (smooth)** | | |
| **Penetration** | | |
| **Cracks (none)** | | |
| **Arc Strikes (none)** | | |
| **Fusion (complete)** | | |
| **Porosity (none)** | | **Grade Date** |

# WLD 141

## Horizontal Groove (2G)

### Welding Procedure

1. Electrode — E71T-1
2. Diameter — 1/16"
3. Polarity — DCRP
4. Voltage — 24-26
5. Amperage — 200-220
6. Welding Position — Horizontal (2G)
7. Material — 1" Plate
8. Travel Angle (Drag) — 20°-30°
9. Work Angle — Varies
10. $CO_2$ Shielding gas — 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 |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

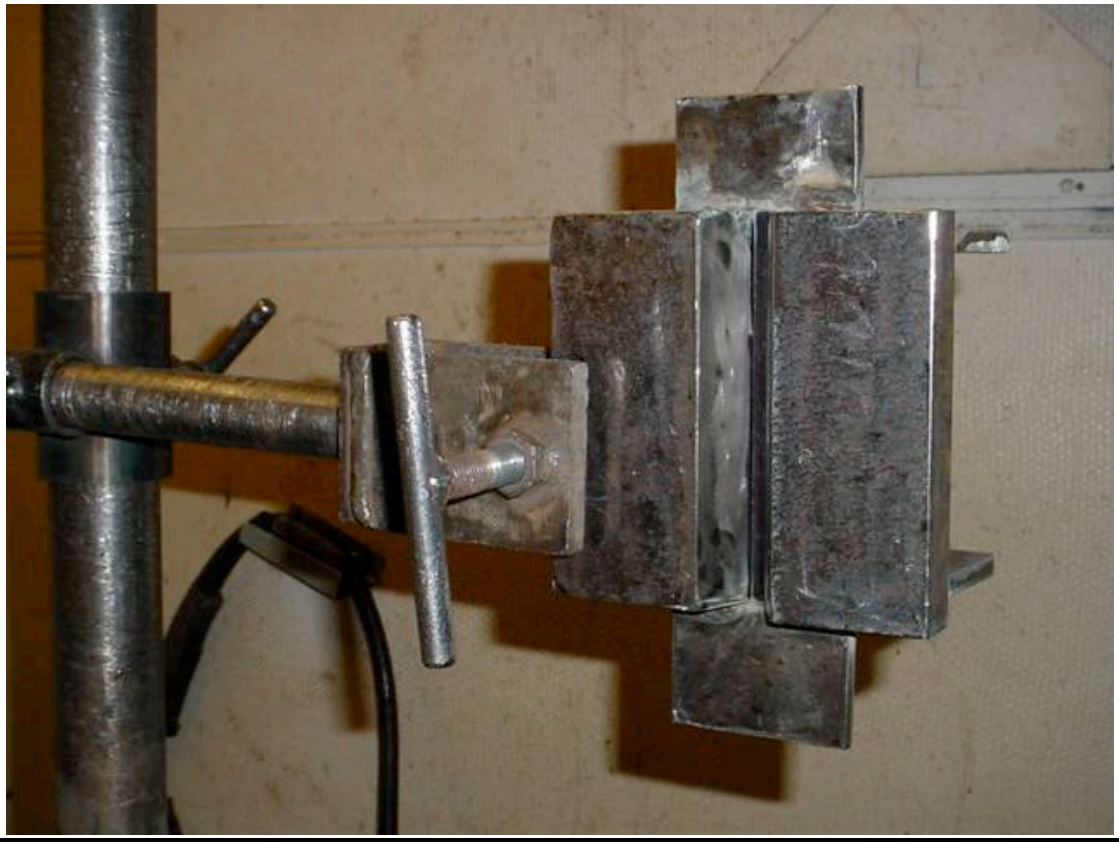
Portland Community College
Welding Technology

| | | | |
|---|---|---|---|
| Tolerance (Unless otherwise Specified) Dimensional ± 1/16" Angle ± 5° | | WLD 141-06 | |
| Drawn By: John Deering | | Size: | Qc No. / Rev. |
| Chk By: TANNER SCOTT | Date: 8/19/08 | Approve / Date | Sheet |

## E71T-1 Groove Weld (3G) Project #7

### Welding Sequence

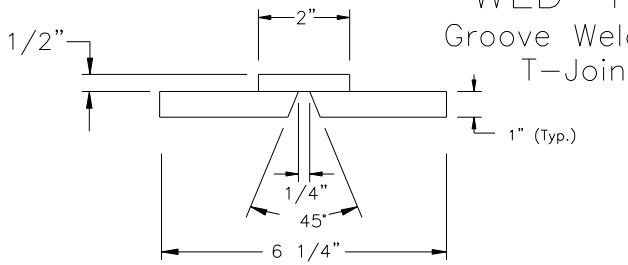
| | |
|---|---|
| E71T-1-- Root Pass | Single pass technique with slight weave to ensure the weld metal is fusing into both pieces of metal. |
| E71T-1—Fill | Use the split bead technique with stringer beads ensuring even fill. |
| E71T-1—Finish Beads | Use stringer bead technique keeping the electrode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



| VT Criteria | Visual Inspection | Bend Tests |
|---|---|---|
| **Reinforcement (0” –1/8”)** | | |
| **Fillet Weld Size** | | |
| **Undercut (1/32”)** | | Acceptable |
| **Bead Contour (smooth)** | | |
| **Penetration** | | |
| **Cracks (none)** | | Not Acceptable |
| **Arc Strikes (none)** | | |
| **Fusion (complete)** | | |
| **Porosity (none)** | | |
| | | **Grade** **Date** |

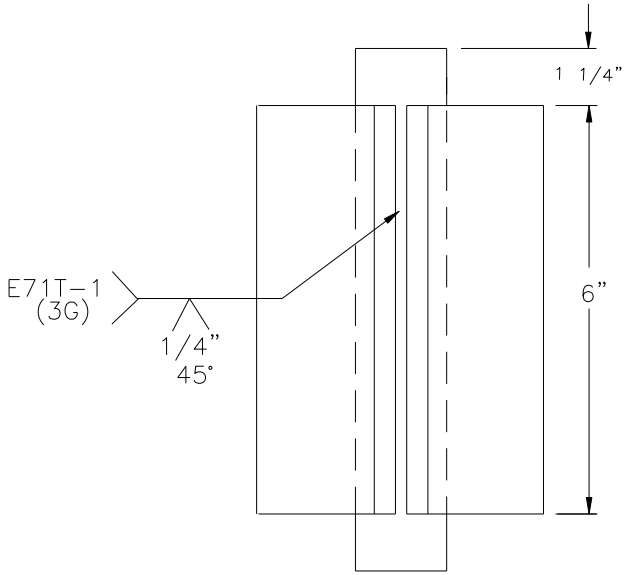
# WLD 141

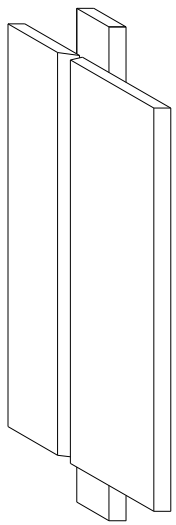
## Groove Weld (3G)
## T–Joint




## Welding Procedure

| | | |
|---|---|---|
| 1. | Electrode | E71T–1 |
| 2. | Diameter | 1/16" |
| 3. | Polarity | DCRP |
| 4. | Voltage | 24–26 |
| 5. | Amperage | 200–220 |
| 6. | Welding Position | Vertical (3G) |
| 7. | Material | 1" Plate |
| 8. | Travel Angle (Drag) | 20°–30° |
| 9. | Work Angle | Varies |
| 10. | $CO_2$ Shielding gas | 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 |
|---|---|---|---|
| | | | |
| | | | |
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Welding Technology

| | | | |
|---|---|---|---|
| Tolerance (Unless otherwise Specified) Dimensional ± 1/16" Angle ± 5° | | WLD 141–07 | |
| Drawn By: John Deering | | Size: | Qc No. / Rev. |
| Chk By: | Date: 10/01/03 | Approve / Date | Sheet |

## E71T-1 T-Joint (4G) Project #8

**Welding Sequence**

| | |
|---|---|
| E71T-1-- Root Pass | Single pass technique with slight weave to ensure the weld metal is fusing into both pieces of metal. |
| E71T-1—Fill | Use the split 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. |

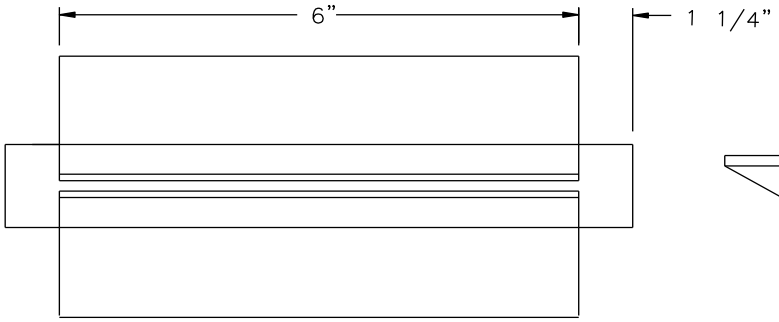
| VT Criteria | Visual Inspection | Bend Tests |
|---|---|---|
| **Reinforcement (0” –1/8”)** | | |
| **Fillet Weld Size** | | |
| **Undercut (1/32”)** | | Acceptable |
| **Bead Contour (smooth)** | | |
| **Penetration** | | |
| **Cracks (none)** | | Not Acceptable |
| **Arc Strikes (none)** | | |
| **Fusion (complete)** | | |
| **Porosity (none)** | | |
| | | **Grade Date** |

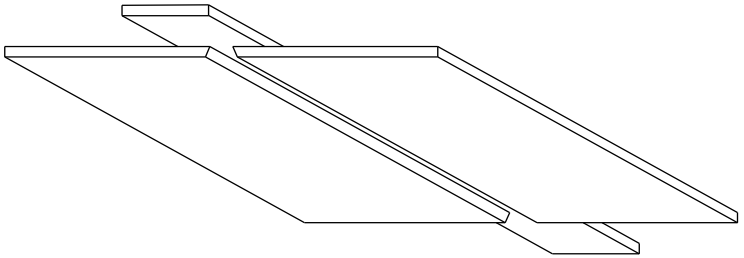
# WLD 141

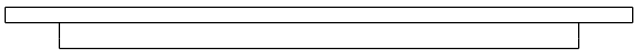
## Overhead Groove (4G)

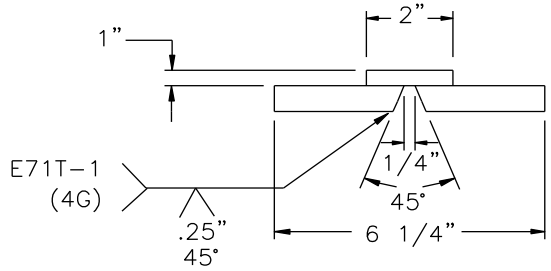
### Welding Procedure

1. Electrode — E71T-1
2. Diameter — 1/16"
3. Polarity — DCRP
4. Voltage — 24-26
5. Amperage — 200-220
6. Welding Position — Overhead (3G)
7. Material — 1" Plate
8. Travel Angle (Drag) — 20°-30°
9. Work Angle — Varies
10. $CO_2$ Shielding gas — 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°

Drawn By: John Deering

Chk By: Date: 10/01/03

WLD 141-08

| Size: | Qc No. | Rev. |
|---|---|---|
| Approve | Date | Sheet |

# *Final Exam*

**Part One**

This portion of the final exam is a closed book test. Consult with your instructor to determine items that you may need to review. Once you determine that you are ready for the exam, request it from your instructor. Complete the exam and write all answers on the answer sheet provided. Once completed, return the exam to your instructor for grading.

# *Study Guide*

**Safety**
- **Electrical**
- **Oxyacetylene**

**Machine Components**
- **Power Source**
- **Wire Feeder**
- **Gun and Ground Clamps**
- **Polarity**
- **Gas Cylinders**

**Metal Transfer**
- **Globular**

**Gases**
- **Mixed gases**

**Wire**
- **AWS Classification System**

**FCAW Vocabulary**

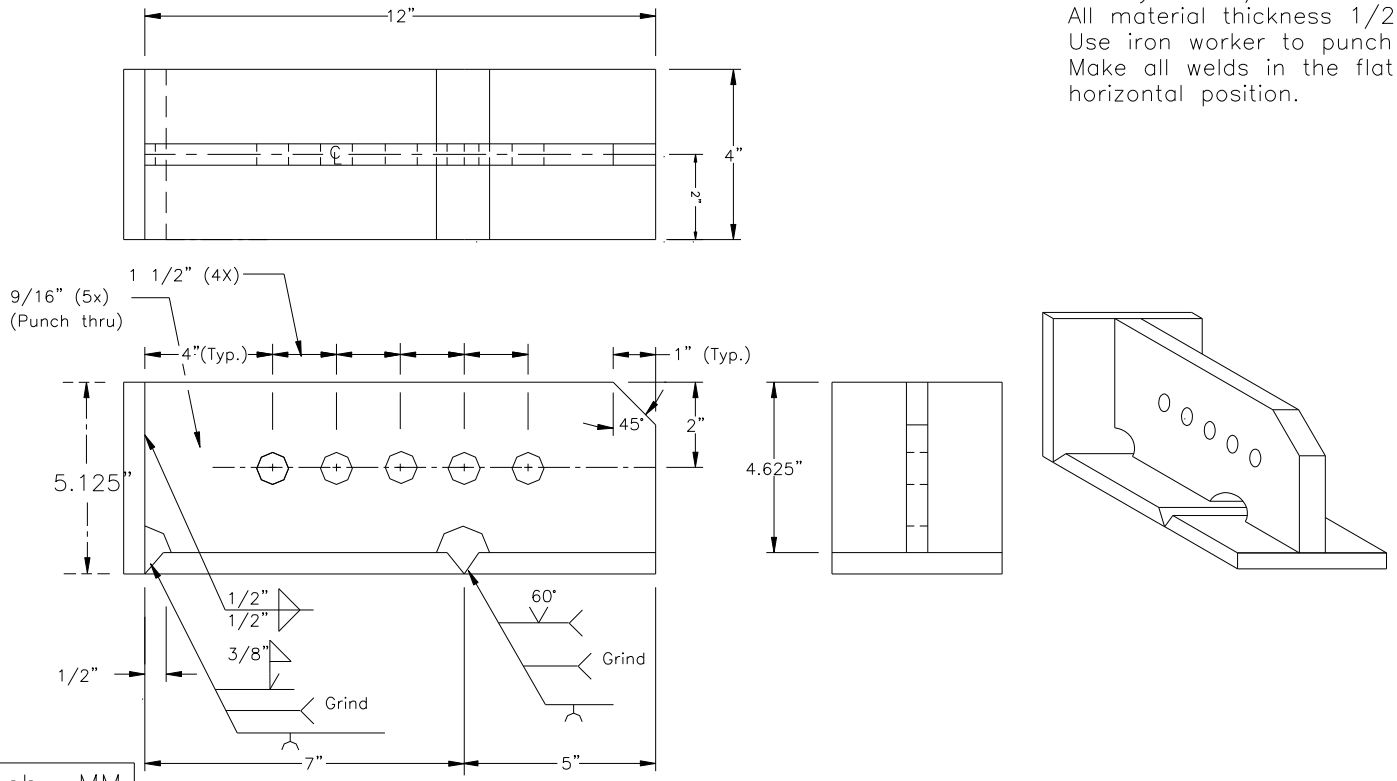
**Weld Defect Vocabulary**

**Part Two**

This portion of the exam is a practical test where you will fabricate and weld a weldment from a "blue print." The evaluation of this portion of the exam will be based on the ***Traveler***.

# WLD 141
## Practical Final

Note:
All Keyholes 3/4" Radius
All material thickness 1/2"
Use iron worker to punch holes.
Make all welds in the flat and horizontal position.




| 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 |
|---|---|---|---|
| | | | |
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Portland Community College
Welding Technology

| | | | |
|---|---|---|---|
| Tolerance (Unless otherwise Specified) Dimensional ± 1/16" Angle ± 5° | | WLD 141–Practical Final | |
| Drawn By: John Deering | | Size: | Qc No. / Rev. |
| Chk By: | Date: 10/01/03 | Approve / Date | Sheet |

# *Grading Traveler for the WLD 141 Practical Exam*

**Hold Points are mandatory points in the fabrication process, which require the inspector to check your work. You will have the following hold points that you instructor will check**

| ***Points Possible*** | ***Hold Points*** | **Instructor's Evaluation** |
|---|---|---|
| **5 points** | **Blueprint Interpretation and Material Cut List**<br>5 points = 0 errors, all parts labeled and sized correctly<br>3 points = 1 error in part sizing and/or identification<br>2 points = 2 errors or more rework required (max points) | |
| **10 points** | **Material Layout and Cutting (Tolerances +/- 1/16")**<br>10 points<br>Layout and cutting to +/-1/16"<br>Smoothness of cut edge to 1/32"<br>7 points<br>Layout and cutting to +/- 1/8" Smoothness of cut edge to 1/16"<br>5 points (Rework required max points)<br>Layout and cutting to +/-3/16"<br>Smoothness of cut edge to 3/32" | |
| **10 points** | **Fit-up and Tack weld (Tolerances +/- 1/16")**<br>10 points<br>Tolerances +/- 1/16"<br>Straight and square to +/-1/16"<br>7 Points<br>Tolerances +/- 1/8"<br>Straight and square to +/-1/8"<br>5 Points (Rework required - Max points)<br>Tolerances +/- 3/16"<br>Straight and square to +/-3/16" | |
| **15 points** | **Weld Quality**<br>Subtract 1 point for each weld discontinuity,<br>incorrect weld size and incorrect spacing sequence. | |
| ***35 points*** | ***Minimum points acceptable. This equates to the minimum AWS D1.1 Code requirements.*** | |
| | **Total Points** | **/40** |

# Final Grades - WLD 141

Name: _____ Instructor: _____ Date: _____

**Welding Projects = 40%**

| | | |
|---|---|---|
| Out of 10 | Out of 10 | ~~Out of~~ |
| Out of 10 | Out of 10 | ~~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~~ |
| **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 _____ | |