Welding Technology

1555 South Raisinville Road Monroe Michigan 48161

WELD 115 QC10

AWS Entry Welder

Student Package

This Document is prepared in accordance to American Welding Society (AWS) QC10 Specification for Qualification and Certification for Entry Level Welder Certification and its supplements.

By: Edward L. Baltrip
April 2016
Revision 1.4

Updated By: Stephen Hasselbach
September 2019

Foreword

This forward is not part of the AWS QC10/11 standards and supplements or the MCCC Student Package and Instructor's Manual, but is included for informational purposes.

The AWS Schools Excelling through National Skill Standards Education (SENSE) program was released in 1995 as a result of being awarded grant number: **V244B3006-95** from the U.S. Department of Education and matching in kind funds from AWS. The QC10 and QC11 standards were updated and released in 2017 along with their respective supplements. The specifications, guidelines, and supplements for SENSE welder training and welder training program accreditation are:

AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders*
AWS EG2.0, *Guide for the Training of Welding Personnel: SENSE Level I—Entry Welders*
AWS EG2.0 Supplement, *Supplement SENSE Level I—Entry Welder Training Performance Testing Procedures*

AWS QC11, *Specification for Qualification and Certification of SENSE Level II—Advanced Welders*
AWS EG3.0, *Guide for the Training of Welding Personnel: SENSE Level II—Advanced Welders*
AWS EG3.0 Supplement, *Supplement SENSE Level II—Advanced Welder Training Performance Testing Procedures*

AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*
AWS EG21, *Specification for the Qualification of SENSE Welder Training Programs*

The latest revision of AWS QC10 and QC11 represents the AWS Education Committee's consensus on the requirements for trainees of SENSE training organizations to receive an AWS SENSE training certificate for full or partial completion of Level I and Level 2 Welder programs, and to be registered in the AWS SENSE Certificate Database.

In 2009, Monroe County Community College (MCCC) was awarded grant number: **CB18204-09-60-A-26** from the U.S. Department of Labor Community-Based Job Training Grant totaling $1.7 million. In 2010, MCCC was donated an off campus facility located at 1004 W. Hurd Rd, by the founders and investors of the former Pump Engineering Inc. In 2011, MCCC used a portion of the DOL grant to renovate the Hurd Rd property into a welding technology center dubbed "Welding Center of Expertise".

The remaining grant funds were used by the college's Applied Science and Engineering Division to offer accelerated 10-week courses to prepare students for the American Welding Society's (AWS) QC10 Specification for Qualification and Certification of Entry Level Welders and QC11 Specification for Qualification and Certification of Advanced Welders. In creating these offerings, the MCCC QC10 and QC11 Student Packages along with Instructor Manuals were developed by Ed Baltrip – MCCC Welding Technology Instructor. The documents were intended to guide both students and teaching personnel through the American Welding Society's National Skill Standards.

In 2018, MCCC was awarded funds from the National Science Foundation (NSF) for an Advanced Technological Education (ATE) grant DUE Number: 1801078. With a portion of the NSF ATE funds, the MCCC Student Package and Instructor manual have been updated, by Stephen Hasselbach CWI/CWE – MCCC Welding Technology Instructor, to reflect the revisions in the 2017 AWS QC documents and supplements.

References:

American Welding Society. (1998). *Standard symbols for welding, brazing, and nondestructive examination*. Miami, Fla.

American Welding Society. (2012). *Safety in welding, cutting, and allied processes*. Miami, FL.

American Welding Society. (2015). *D1.1/D1.1M:2015 STRUCTURAL WELDING CODE-STEEL.* Miami, Fla.

American Welding Society. (2017). *QC10:2017-Specification for the Qualification and Certification of SENSE Level I-Entry Welders*. Miami, Fla.

American Welding Society. (2017). EG2.*0:2017-Guide for the Training of Welding Personnel: SENSE Level I-Entry Welders*. Miami, Fla.

American Welding Society. (2017). EG2.*0:2017 Supplement-Supplement SENSE Level I-Entry Welder Training Performance Testing*. Miami, Fla.

BOWDITCH, WILLIAM A. (2018). *Modern Welding*. GOODHEART-WILLCOX CO.

Grading Methodology:

Partial Certification:
Students may receive partial certification by completing the following:

1. The four mandatory written tests listed above*.
2. The welding process exam for each certification desired.
3. OFC/OAC Evaluation Rubric.
4. Complete a minimum of 235 class hours.

Workmanship Qualification Tests	Written Tests	Grade
OFC/OAC Evaluation Rubric	*Safety (35 ques.)	
Performance Welding Objectives	*Thermal Cutting (55 ques.)	
	*Drawing/Welding Symbols (39 ques.)	
	*Weld Inspection & Testing (39 ques.)	
EDU-1 FCAW-G EDU-1 FCAW-S	FCAW (30 ques.)	D (All the above plus both FCAW projects)
EDU-2 GMAW (Spray) EDU-3A GMAW-S (Short Circuit)	GMAW (29ques)	C (All the above plus both GMAW projects)
EDU-3B GTAW (CS) EDU-4 GTAW (SS) EDU-5 GTAW (Alum)	GTAW (49 ques.)	B (All the above plus three GTAW projects)
EDU-6A SMAW 2G (CS Plate) EDU-6B SMAW 3G, (CS Plate)	SMAW (40 ques.)	A (All nine projects)

Full Certification:

WQT Workmanship Qualification Tests	Point Value	WRITTEN EXAMS *Written Exams issued after Welding Projects are completed*	Points Value
1. EDU-1 FCAW-G	100	1. *Safety (35 ques.)	100
2. EDU-1 FCAW-S	100	2. *Thermal Cutting (55 ques.)	100
3. EDU-2 GMAW (Spray)	100	3. *Drawing/Welding Symbols (39 ques.)	100
4. EDU-3A GMAW-S (Short Cir.)	100	4. *Weld Inspection & Testing (39 ques.)	100
5. EDU-3B GTAW (CS)	100	5. FCAW (30 ques.)	100
6. EDU-4 GTAW (SS)	100	6. GMAW (29ques)	100
7. EDU-5 GTAW (Alum)	100	7. GTAW (49 ques.)	100
8. EDU-6A SMAW 2G (CS Plate)	100	8. SMAW (40 ques.)	100
9. EDU-6B SMAW 3G, (CS Plate)	100		
10. Performance Objectives	300		
SUBTOTAL	1200	SUBTOTAL	800
		GRAND TOTAL	**2000**

A	1850 - 2000 pts.	**C**	1450 - 1529 pts.
A-	1800 - 1849 pts.	**C-**	1400 - 1449 pts.
B+	1730 - 1799 pts.	**D+**	1330 - 1399 pts.
B	1650 - 1729 pts.	**D**	1250 - 1329 pts.
B-	1600 - 1649 pts.	**D-**	1200 - 1249 pts.
C+	1530 - 1599 pts.	**F**	<1199 pts.

Students receiving a WQT score of less than 80% should repeat the process demonstration and repeat the WQT project. Safety & Health of Welders Exam (100% minimum), All other written test (75% minimum), *(3 retakes allowed for each test)*

Method of Student Evaluation:

Course requires the participant to successfully complete 7 (Seven) projects that receive only a Visual Test (VT) and 2 (two) projects requiring VT and a "Guided-Bend Test" for a total of 9 projects.

1) All welds shall receive a visual inspection in accordance with AWS EG2.0-2017. (See pg.11 Student Package "Visual Inspection Criteria")
2) Destructive testing of Performance Qualification: AWS2-6 shall be in accordance with AWS QC10-2017.
3) Obeying all safety rules, housekeeping activities and attendance requirements may receive bonus points of up to 10% of final grade.
   - Records must be provided by students to receive extra credit.

WEEKLY OUTLINE OF INSTRUCTION

(Weekly topics are approximate and subject to change.)

Week 1: Safety, OFC/OAC, PAC, GMAW
Lecture: Introduction, records, housekeeping
Lecture: PPT Review Safety
Administer: Exam 1 Safety (35 ques.)
Lecture: Gas House operations
Lecture: Reading a Rule, Basic Math
Lecture/Demo: Shear, Bandsaws
Lecture/Demo: OFC/OAC, PAC Cutting, Line Burner, CAC, etc.
Lecture: PPT Review Exam Thermal Cutting
Lecture/Demo: Hand tools & grinders
Skills Practice: Thermal Cutting
Lecture/Demo: EDU-1 Fabrication
Lecture: PPT Review Exam 2 Drawing & Symbols
Administer: Exam 2 Drawing & Weld Symbols
Administer: Exam 3 Thermal Cutting (55 ques)

Week 2: GMAW-S (short circuit)
Lecture: GMAW Set up and operations
Skills Demo/Practice: GMAW-S Stringers & Weaves, Butt, Lap, Tee All Positions
Begin Project: EDU-3A GMAW-S
Complete Project: EDU-3A GMAW-S

Week 3: GMAW Spray
Lecture: GMAW Spray
Lecture: Exam 5 Welding Inspection & Testing
Administer: Exam 5 Welding Inspection & Testing
Skills Practice: GMAW Spray Pad of Beads, Fillets
Begin Project: EDU-2 GMAW Spray
Complete Project: EDU-2 GMAW Spray

Week 4: FCAW-S (self-shielded)
Lecture: FCAW-S Setup & Operations
Skills Practice: FCAW-S Pad of Beads, Fillets
Begin Project: EDU-1B, FCAW-S, CS
Complete Project: EDU-1B, FCAW-S, CS

Week 5: FCAW-G (gas shielded)
Lecture: FCAW-G Setup & Operation (Review)
Lecture: PPT Exam Review 4 FCAW
Administer: Exam 4 FCAW
Assignment: Begin EDU-1A FCAW-G
Skills Practice: FCAW-G Pad of Beads, Fillets
Lecture: Exam 3 Thermal Cutting
Complete Project: EDU-1A FCAW-G

Week 6: GTAW-CS
Lecture: GTAW Equipment & Setup (Carbon Steel)
Lecture: PPT Review Exam 7 GTAW
Skills Practice: GTAW Pad of Beads, Tee Fillets CS
Begin Project: EDU-3B GTAW (Carbon Steel)
Complete Project: EDU-3B GTAW (Carbon Steel)

Week 7: GTAW-SS
Lecture: GTAW Equipment & Setup (Stainless Steel)
Skills Practice: GTAW Pad of Beads, Tee Fillets SS
Begin Project: EDU-4 GTAW (Stainless Steel)
Complete Project: EDU-4 GTAW (Stainless Steel)

Week 8: GTAW-AL
Lecture: GTAW Equipment & Setup (Aluminum)
Lecture: Review EDU-4 GTAW Aluminum
Skills Practice: GTAW Pad of Beads, Tee Fillets AL
Begin Project: EDU-5 GTAW (Aluminum)
Complete Project: EDU-5 GTAW (Aluminum) Skills Practice: Thermal Cutting, GTAW
Administer: Exam 7 GTAW

Week 9: SMAW 2G carbon steel
Lecture: SMAW Process
Lecture: PPT Review Exam 8 SMAW
Administer: Exam 8 SMAW
Skills Practice: 2F Flat Fillets, Horiz Pad of Beads
Begin Project: EDU-6A SMAW 2G (CS)
Complete Project: EDU-6A SMAW 2G (CS)

Week 10: SMAW 3G carbon steel
Lecture\Demo: SMAW 3G
Skills Practice: 3F Fillets, vertical Pad of Beads
Begin Project: EDU-6B SMAW 3G (CS)
Complete Project: EDU-6B SMAW 3G (CS)

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WELDING SHOP RULES

All safety rules will apply: (You will be immediately ejected from class for any of the following violations.)

Failure to wear safety glasses at all times.
Failure to wear proper eye protection for grinding, cutting or welding
Wearing frayed clothing, shorts, polyester clothing, sandals or open toed shoes.
Removing machine guards. (Including hand grinder guards.)
Practicing any unsafe activities as determined by the Instructor.

You will receive a lower grade for any of the following reasons:

Classroom Management:

Arriving late or leaving early will NOT be tolerated! (You will receive a lower grade!)
Loosing Paperwork. Documents & Handouts are the student's responsibility. (Lost paperwork will not be replaced!)
Failure to sign-in or sign-out for class honestly and accurately. You MUST notify the instructor if you are leaving early!
Failure to complete assigned specific duties. (Gas House, Inventory etc)
Failure to attend class "Debrief Meetings" held during final 15 minutes of class. (Updating of paperwork)
Unprofessional attitude, arguing or causing class disruptions as determined by the Instructor. (Lying or being untruthful.)
Cell phone usage during lectures is not allowed and excessive cell phone usage in weld shop is not allowed!

Shop Management and Housekeeping:

Cleanup begins 1/2 hour before the end of class (30 minutes). All tools must be returned to their proper locations.
Stealing tools, supplies or equipment from MCCC or other students is forbidden and will not be tolerated.
Students are not allowed to enter any part/tool cabinets without permission.
Students must return tools to proper locations.
Slothful and lazy work habits will not be tolerated.
Students not in the shop during class time are considered absent!
Grinding room must be cleaned at the end of every class. No tools are allowed to be left in grinding room.
If you drop it…YOU pick it up! If you open it…YOU close it! If you sign it out…YOU return it!

Welding Electrodes:

A maximum of ten (10) SMAW electrodes allowed to be taken at any one time. (Two filler rods for GTAW)
All rod stubs to be burned down to the numbers and rod stubs must be return to class rod stub bucket.
No welding electrodes or rod stubs on floor at any time.
Full/unused electrodes must be returned to proper location in rod oven or marked boxes.
All welding electrodes and wire spools must be removed from welding booths.

Supplies:

All metal stock to be returned to the proper location. Metal stock must be returned to the proper shelves.
All welding parts and supplies must be returned to the proper location(s).
Opening and riffling through shop cabinets without Instructor's permission.

Tools and Equipment:

You are responsible for any tool that is lost or stolen while in your possession.
All tools or equipment must be returned, to its proper location, at end of each class session.
Horizontal bandsaw must be in the lowered (down) position when completing operation.
All welding scrap will be placed in the appropriate scrap bins.
DO NOT wear gloves while operating drill press, pedestal grinders or hand held grinders with wire brushes.
MCCC supplied lockers are subject to inspection at any time by the Instructor, campus security or administrative personnel.

Welding Booths:

Welding booths must be maintained in a clean and organized fashion throughout class.
Welding on any table top without permission.
Downdraft tables must be maintenance daily. (Hurd Rd. Only)
All booth vent dampers must be "OPEN" (vertical) position at beginning of class to protect trainee from harmful fumes.
All booth vent dampers must be in the "OFF" (horizontal) position at end of class.
All welding machines must be turn "OFF" and electrical disconnect placed in the down position.
All welding and work leads MUST be disconnected and rolled up neatly.
Welding helmets must be cleaned and in working order at the end of each class and returned to their proper rack position.
All booth gas valves must be in the "OFF" (horizontal) position at end of class.
Booth inspections begin at 20 minutes before end of class. (Students must be at booth for inspection.)
All stools to be placed on top of welding booth tables at end of class to facilitate cleaning.
No spitting into welding booth rod stub buckets!
Tobacco, in any form, including vaporizing substitutes, are NOT allowed to be used on school property.

I agree to all the rules and regulations listed above. (Please sign and return to instructor for student's personal file.)

_____	_____	_____
Student's Name (Please Print)	Student's Signature	Date

Monroe County Community College
Welding Technology Contacts

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Grading of projects
1 point deducted each time one of the following occurs: cold lap, overlap, undercut, oversize, undersize, incomplete fusion or inerrant arc strike.

AWS QC10 Partial Completion (Alternate Grading): To receive partial certification the participant must successfully pass the four core written exams: "Health and Safety", "Thermal Cutting", "Drawing and Weld Symbols" and "Welding Inspection and Testing." The participant must also pass the written exam for the welding process in which they desire certification. If the participants desire is only the GMAW certification they must successfully complete the GMAW written exam and both Workmanship Qualification Tests GMAW-S (EDU-3A) and GMAW-Spray (EDU-2). They would then be eligible for QC10 GMAW-S and GMAW-Spray certification only. Full graduation is not required for QC11 Advanced Welder Certification course (WELD215), however you will only be eligible for the same process QC11 Certification. If you only received partial certification, please see Stephen Hasselbach for full completion options. T-127, p: 734 384 4118, e: shasselbach@monroeccc.edu

Method of Evaluation:

1) All welds shall receive a visual inspection in accordance with AWS EG2.0-2017.
2) Destructive testing of Performance Qualification: AWS2-6 shall be in accordance with AWS QC10-2017.
3) Students must have the proper welding documents in their possession at all times during class. This includes: Project Prints, WPS (welding procedure specification) and Inspection sheets.
4) Students are responsible for recording all personal training activities and certification records.
5) Students must sign-in/out of each class and honestly recording accurate arrival and departure times.
6) Attendance is mandatory! Excessive absenteeism (15 class hours) will receive a lower grade.
7) All classes begin and end with short lectures. Lectures are NOT repeated!
8) Students arriving late will miss important information, which will affect their final grades.
9) One 20-minute break is allowed. Students must be working in the weld shop or classroom at all other times. Excessive breaks, nonperformance and loitering will be monitored and will result in a lower grade.
10) Students must maintain their weld booths and shop in a clean and organized fashion. (see shop rules)
11) All verbal and written instructions (lectures) are for your safety and the safety of others. Failure to accurately follow all verbal and written instructions will result in a lower grade.
12) Operating equipment in unsafe manner, horse play, stealing or any activity deemed unsafe will result in immediate removal from class.

EXTRA CREDIT of an additional 10% will be added to grade if:

1. Absences total 0 days (0 class hours) or less.
2. No late arrivals (tardy) or early quits.
3. Housekeeping is maintained.

There are no acceptable excuses for absenteeism or tardiness!

Your grade will be reduced by:

1 (one) full letter grade after the 3rd absence or 15 hours.
2 (two) full letter grades after the 6th absence or 30 hours.
3 (three) full letter grades after the 9th absence or 45 hours.
Dropped after 9 absences.
3 Tardies = 1 absence (Activated by habitual offenders who are tardy more than 10% of the time.)

Student attendance will be reviewed at every Friday's debrief meeting.

- Other documents and reference material can be found on the MCCC Welding Technology Learning Management System (LMS). Currently, MCCC is using Brightspace. Your instructor will show you how to access content using Brightspace during orientation.

- All written exams will be taken at www.senseonline.org where all scores will be stored. Certification will be granted using this website as well. To gain access, you will need to access your My.MCCC email, search AWS and follow the links using the temporary login password provided.

WELD 115 AWS QC10
Entry Level Welder Certification Documents

FORMS AND RECORDS

All students should select a personal welder's ID that is not shared by other students. This consists of one letter and a one-digit number (i.e. E4 or 4E). Your Welder ID MUST be stamped into all "2G & 3G Performance Qualification Test" (weld test specimens) for identification. This is to prevent theft of weld test specimens.

TAR (Training Achievement Records)
Students will receive a Performance Welding Objectives packet that will account for the AWS TAR. **It is up to the student to get instructor approval once meeting the criteria of the objective.** The documentation MUST be retained by student for a period of at least one year. In the event of course repeat, student may continue using the same PWO/TAR.

Time Cards
Each student will maintain Job/Time Cards that reflect accurate attendance and activities each day. All Job/Time Cards MUST match the Instructor's MASTER Attendance records. The documentation MUST be retained by the student for a period of one year. Instructors may retain a digital or paper copy.

Inspection Reports:
All digital inspection forms are to be completed by the Instructor/Test Supervisor and should be maintained by the instructor in a digital folder created for each student. All Inspection forms must be maintained for a period of one year. Students may retain a copy in their shared digital folder for their personal records.

Instructor(s)/Test Supervisors MUST input the results of the visual examination for each workmanship and performance qualification tests at www.senseonline.org.

Records of Welder Certification

(AWS SENSE QC10:2017 – Clause 10 – Page 10)

10. Records of Welder Training Certificate

10.1 The ATP shall submit the trainee's records for full or partial program completion to the AWS Education Department, along with the appropriate fee.

10.2 The individual will be placed in the AWS SENSE Certificate Database.

10.3 In recognition of successful full or partial completion, AWS will issue a SENSE certificate and wallet card to the individual listing the modules and tests completed.

ALL STUDENT CERTIFICATIONS ARE ACCESSIBLE ON WWW.SENSEONLINE.ORG ONCE ALL REQUIREMENTS HAVE BEEN SATISFIED

Note: it will be the student's responsibility to download and print their own certifications.

Workmanship and Performance Qualification Tests
Procedures for completing the "Workmanship Tests" are VERY important for success! All students MUST follow the instructions below "Procedure for Fitting Workmanship Sample Assemblies."

PROJECT FITUP PROCEDURES

1. Prepare bill of materials in U.S customary units of measure.
2. Convert bill of materials to S.I. metric units of measure.
   Multiply measurement times 25.4 to convert to millimeters (mm)
3. Instructor to check completed parts list prior to cutting materials.
4. Cut all parts mechanically or by machine OFC unless specified to be done manually.
5. Inspect beveled edges. If the groove face exhibits a land, condition the face to a feathered edge with a grinder or file.
6. Remove any obstruction that prevents a tight fit-up at the root.
7. Fit and tack entire assembly on bench before attaching to the weld fixture arm.
8. Instructor must inspect and verify test assembly in final position prior to welding.
9. Employ boxing technique where applicable.
   The "Boxing Technique" refers to NOT STOPPING OR STARTING a weld bead in corner. All inside corner welds must be wrapped.

8. Inspection, Testing, and Acceptance Criteria

8.1 All cut edges shall be visually examined and the cut surfaces shall meet the criteria of AWS C4.1 Sample 2 with grinding. After inspection, the cut surfaces may be conditioned to bright metal.

8.2 All assemblies shall be visually examined and the welds shall meet the acceptance criteria shown in Table 8.1.

Table 8.1 Visual Examination Criteria for Level I—Entry Welders

The Test Supervisor shall visually examine the weld for acceptable appearance, and shall be satisfied that the welder is skilled in using the process and procedure specified for the test. Acceptance criteria shall be as following:
1. No cracks or incomplete fusion.
2. No incomplete joint penetration in groove welds except where partial penetration groove welds are specified.
3. Undercut depth shall not exceed the lesser of 10% of the base metal thickness or 1/32 in (0.8 mm).
4. Face reinforcement or root reinforcement shall not exceed 1/8 in (3 mm).
5. No single pore shall exceed 3/32 in (2 mm).
6. Where visual examination is the only criterion for acceptance, all weld passes are subject to visual examination, at the discretion of the Test Supervisor.

8.3 Face- and root-bend specimens shall be conditioned as shown in Figure 8.1, and bent in a bend fixture similar to Figure 8.2 or 8.3 (guided bend test) or Figure 8.4 (wrap-around bend test) in accordance with AWS B4.0, *Standard Methods for Mechanical Testing of Welds*.

8.4 Face- and root-bend specimens after bending shall meet the acceptance criteria listed in Table 8.2.

Table 8.2
Acceptance Criteria for Face- and Root-Bends

For acceptance, the convex surface of the face- and root-bend specimens shall meet both of the following requirements:
1. No single indication shall exceed 1/8 in (3.2 mm), measured in any direction on the surface.
2. The sum of the greatest dimensions of all indications on the surface, which exceed 1/32 in (0.8mm), but are less than or equal to 1/8 in (3.2mm), shall not exceed 3/8 in (9.6mm).
Cracks occurring at the corner of the specimens shall not be considered unless there is definite evidence that they result from slag inclusions or other internal discontinuities.

Monroe County Community College
1555 S Raisinville Rd
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TIME SHEET

Trainee Name: _____ Course: _____

Trainee Number: _____ Instructor: _____

Building: _____ Week #: _____

Date	Start Time	End Time	Total Hours	Lab Work Completed
		Weekly Totals		

All students are required to record and document class hours. Time/Job Cards must reflect accurate dates and times spent on-the-job in preparation for completing assignments.

Trainee signature: _____ Date: _____

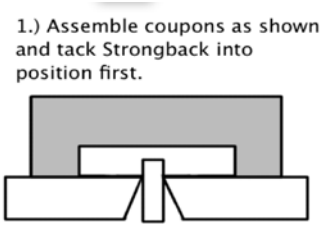
Instructor signature: _____ Date: _____

Students will complete time/job cards, reports or other written records as needed. Written records must be completed in a neat and legible order. These records must be turned in with the completed weld projects and will be considered in the overall evaluation of the student's skill. Similar records are required by most large welding companies to determine the productivity of welders and to ensure that each job is charged correctly for time and materials.

Notes:

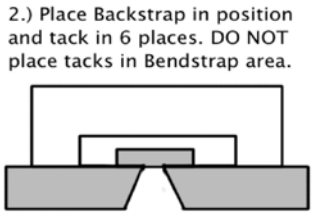
REFERANCE MATERIALS

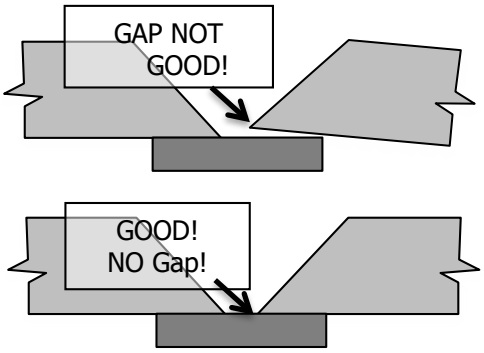
Assembling the 2G/3G Final Test Project (EDU-6)



1. The weld test should take about twelve 3/32" E7018 electrodes. Smaller electrodes are recommended because they are can reach deeper into the groove. This allows the Welder to hold a very tight arc in order to prevent weld defects. 1/8" electrodes should only be used by experienced welders.

2. Place beveled plates, bevel side down, on a flat surface. Place the ¼" backing strap in the position shown. This maintains the ¼" gap between the plates. Place the strongback in the center of the beveled plates and place ½" welds on only one side (as shown in drawing below).



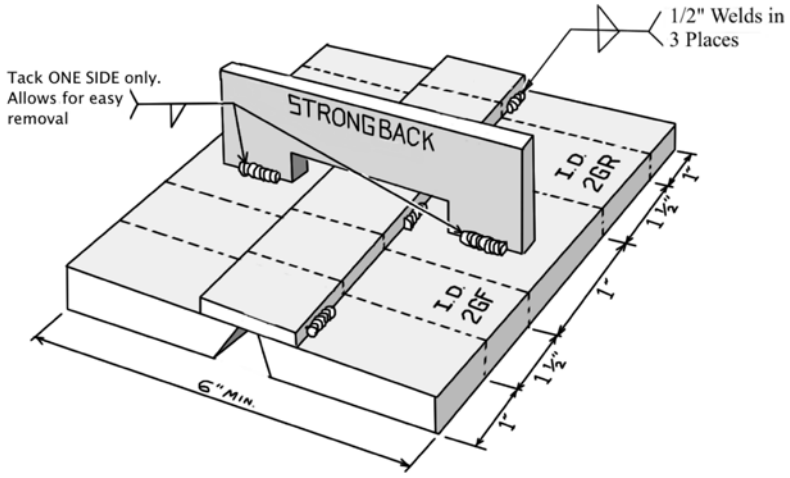


3. During fitup make sure the toe of the bevel is flush against the backstrap. A gap in the fitup could cause incomplete fusion in the weld and your bend test will fail. A great weld begins with a great fitup!

4. Place weld tacks at the locations shown on the drawing at the right. Be careful! Any "ARC MARKS" present on your test piece results in an immediate failure and you will have to begin again.

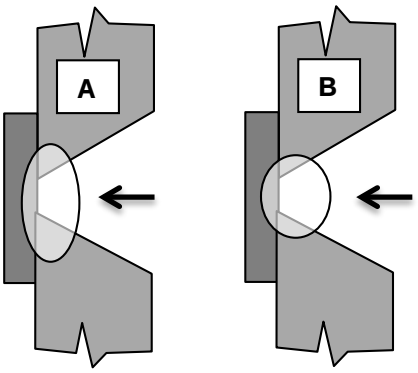
5. There should be no tack welds on bend straps. After tacking your project together mark out the bending strap areas. Stamp each strap with your "Welder's I.D." and the test position and bend test type.
   2GF means 2G (horizontal groove) Face bend
   2GR means 2G (horizontal groove) Root bend
   3GF means 3G (vertical groove) Face bend
   3GR means 3G (vertical groove) Root bend

6. The weld test should take 6-7 passes.

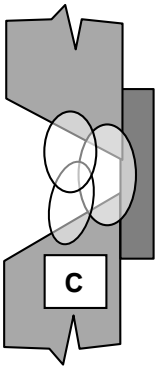


*Center piece is 2" wide, 1" scrap on either side of center. Refer to diagram on SMAW WPS.

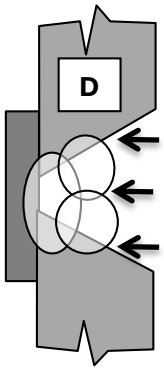
7. ROOT PASS: The first (root) pass should resemble a nice flat bead or one with a slight crown (see drawing "A"). If your bead looks like a worm in a valley (drawing "B") you will have to start over or grind the weld out. Valleys like this result in incomplete fusion which causes welds to fail during a bend test. The key is to make sure the toes of the weld transition smoothly into the base metal.



8. HOT PASS/FILL PASS: This second pass is typically called the "Hot Pass" because some welders increase their amperage 2-3 amps, hold a close arc and burn out any trapped slag or porosity from the root pass. Since the material is only 3/8" thick the "Hot Passes" are also the "Fill Passes." The placement of these "fill passes" are very important! Fill passes should be kept as flat as possible so as not to allow valleys to form at the edges.

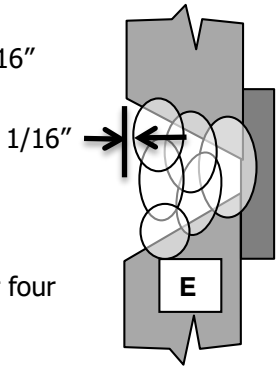


9. Drawing "C" show properly made fill passes without valleys and 1/16" below the surface of the plate.

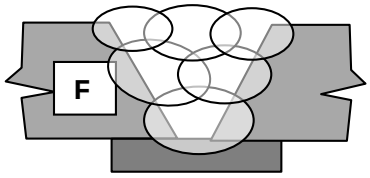


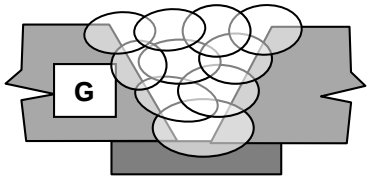
10. Drawing "D" shows poorly made filler passes with 3 valleys that will eventually cause the test bend to break. The two fill passes in drawing "D" must be ground flat or removed.

11. The final filler passes should be 1/16" below the cap, so top of the plate. This allows room for the cap, so that it does not stick up more than 1/8" above the plate. (see drawing E)



12. FINAL CAP: Your final cap will probably be three or four stringer beads wide. (see drawings F and G).





13. Cutting Test Straps

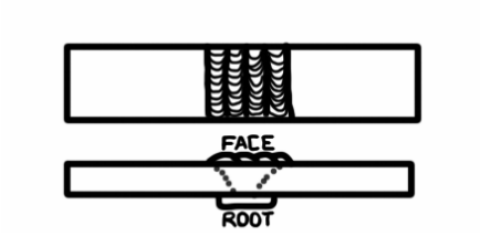
A. Cut straps approximately 1-3/4" wide.

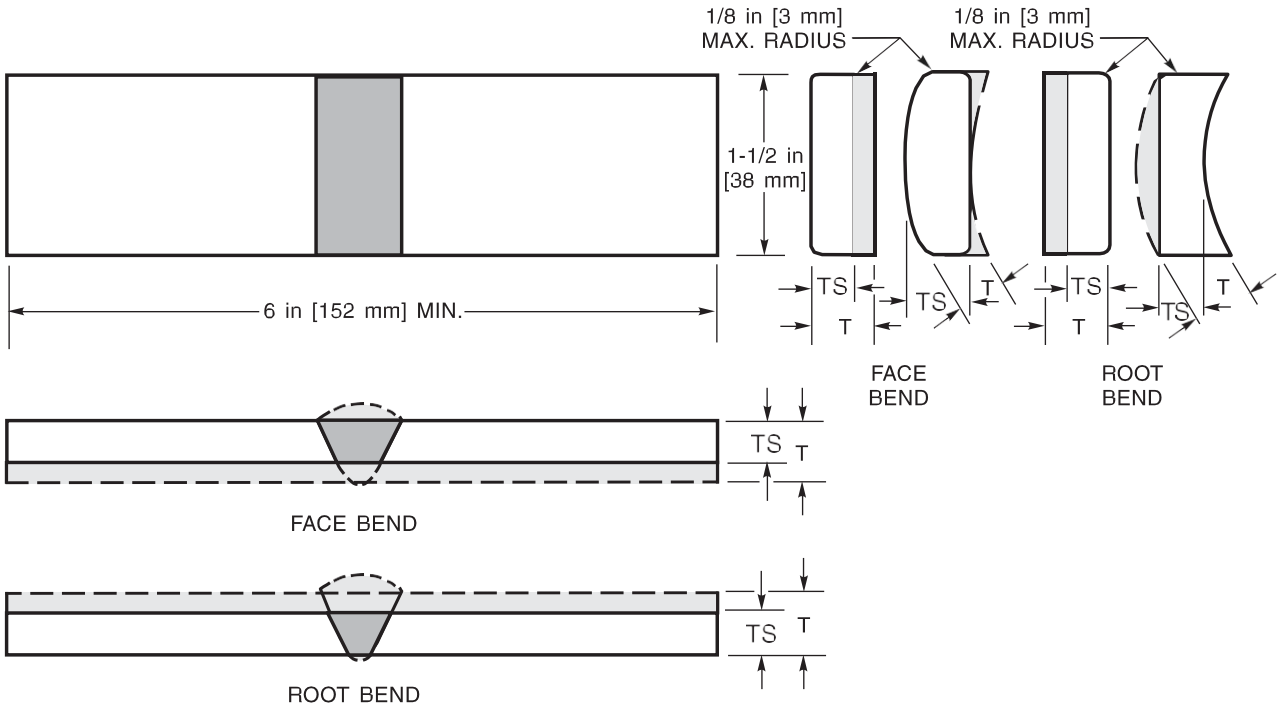
B. Grind straps to no less than 1-1/2" wide and smooth the edges.

C. Grind face area of weld to make strap no less than 3/8" thick.

D. Assure the test straps have grind marks running the length of strap. Grinding marks running across the strap may open up during the bend test.

Note: If straps are less than 1-1/2" wide or less than 3/8" thick the test will be VOID and you will have to take the test again!





INCHES			MILLIMETERS		
	Specimen Thickness (TS)			Specimen Thickness (TS)	
Thickness of Base Materials (T)	All Base Metal Welded with F-23 Filler Metals	All Other Materials	Thickness of Base Materials (T)	All Base Metal Welded with F-23 Filler Metals	All Other Materials
1/16 to 1/8	T	T	1.5 to 3	T	T
1/8 to 3/8	1/8	T	3 to 10	3	T
Over 3/8	1/8	3/8	Over 10	3	10

Notes:
1. Weld reinforcement and backing strip or backing ring, if any, shall be removed flush with the surface of the specimen.
2. If thermal cut, the edges shall be dressed by grinding, except in M-1 materials.
3. For pipe diameters of 2 in through 4 in [51 mm through 102 mm] NPS, the width of the bend specimen may be 3/4 in [19 mm] for pipe diameters of 3/8 in to 2 in [10 mm through 51 mm]. NPS, the bend specimen width may be 3/8 in [10 mm], with an alternative (permitted for pipe 1 NPS in and less) of cutting the pipe into quarter sections, in which case the weld reinforcement may be removed and no other preparation of the specimens is required.

Figure 8.1—Transverse Face and Root Bend Specimens per AWS 2.1

Errata for AWS A2.4-98, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
The following is the corrected Welding Symbol Chart for AWS A2.4-98, pages 106 and 107.

Basic Welding Symbols and Their Location Significance

Location Significance	Fillet	Plug or Slot	Spot or Projection	Stud	Seam	Back or Backing	Surfacing	Edge
Arrow Side								
Other Side				Not Used			Not Used	
Both Sides		Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	
No Arrow Side or Other Side Significance	Not Used	Not Used		Not Used		Not Used	Not Used	Not Used

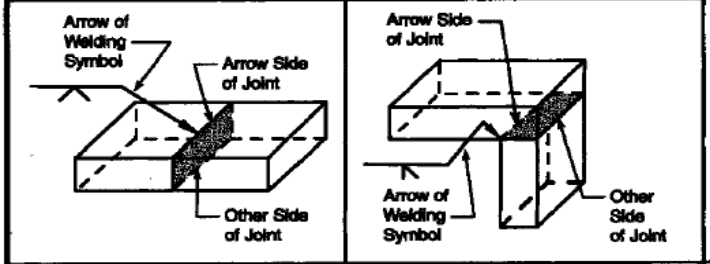
Location Significance	Groove							Scarf for Brazed Joint
	Square	V	Bevel	U	J	Flare-V	Flare-Bevel	
Arrow Side								
Other Side								
Both Sides								
No Arrow Side or Other Side Significance		Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Supplementary Symbols

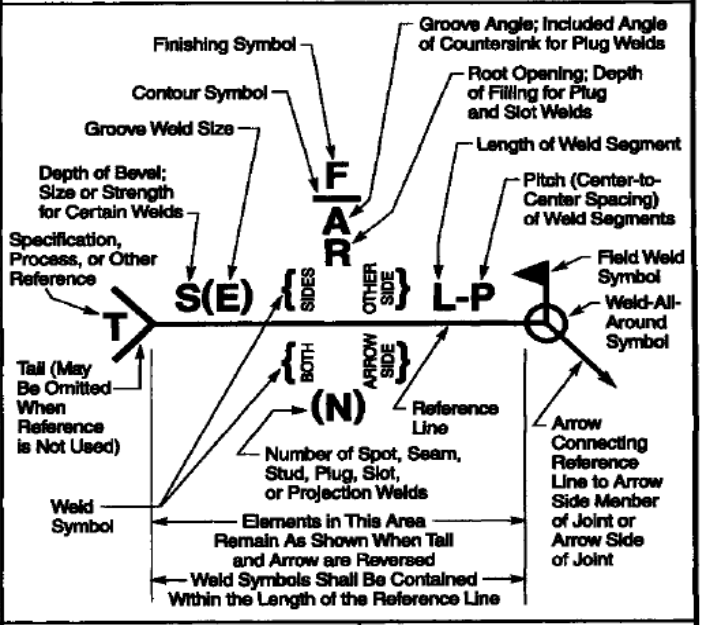
Weld-All-Around	Field Weld	Melt-Thru	Consumable Insert
			(Square)

Backing/Spacer (Rectangular)	Contour		
Backing / Spacer	Flush or Flat	Convex	Concave

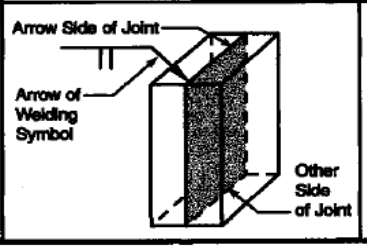
Basic Joints
Identification of Arrow Side and Other Side Joint



Location of Elements of a Welding Symbol



Edge Joint



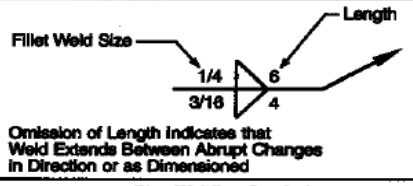
Letter Designations

Where letter designations are to be included in the tail of the welding symbol, reference is made to Table 1, Letter Designations of Welding and Allied Processes and Their Variations, of AWS A2.4-98.

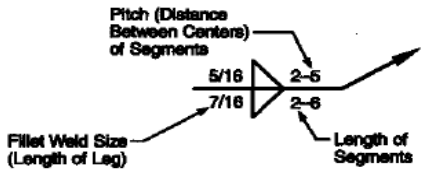
American Welding Society
550 N.W. LeJeune Road
Miami, Florida 33126

Typical Welding Symbols

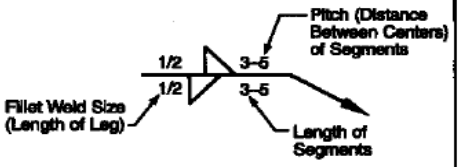
Double-Fillet Welding Symbol



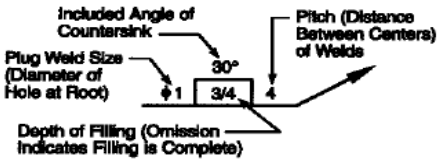
Chain Intermittent Fillet Welding Symbol



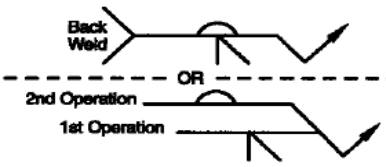
Staggered Intermittent Fillet Welding Symbol



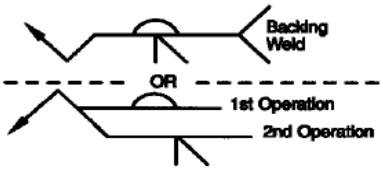
Plug Welding Symbol



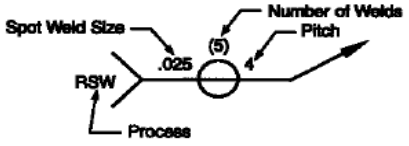
Back Welding Symbol



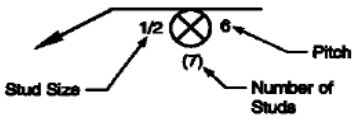
Backing Welding Symbol



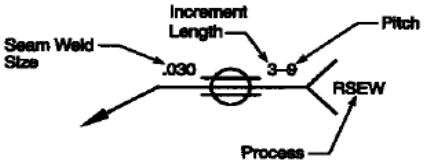
Spot Welding Symbol



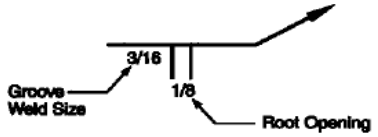
Stud Welding Symbol



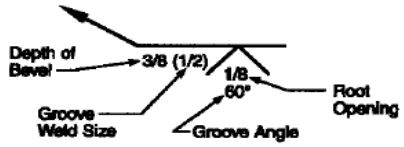
Seam Welding Symbol



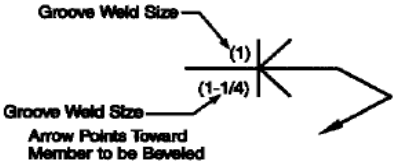
Square-Groove Welding Symbol



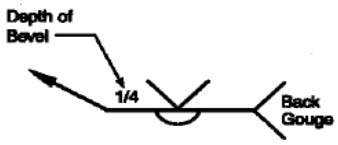
V-Groove Welding Symbol



Double-Bevel-Groove Welding Symbol

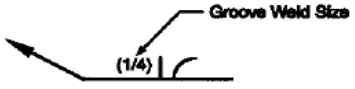


Symbol with Backgouging

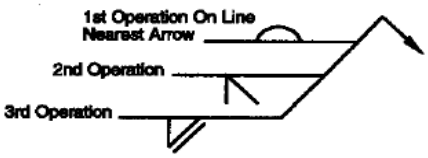


Flare-V-Groove Welding Symbol

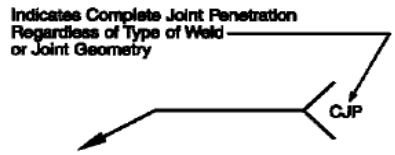
Flare-Bevel-Groove Welding Symbol



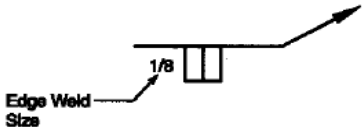
Multiple Reference Lines



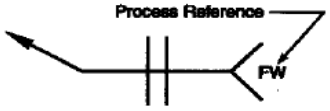
Complete Joint Penetration



Edge Welding Symbol

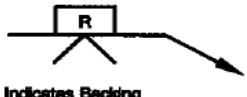


Flash or Upset Welding Symbol

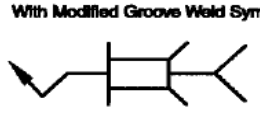


Melt-Thru Symbol

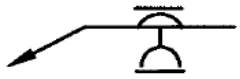
Joint with Backing



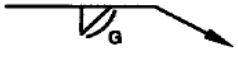
Joint with Spacer



Flush Contour Symbol



Convex Contour Symbol



It should be understood that these charts are intended only as shop aids. The only complete and official presentation of the standard welding symbols is in AWS A2.4-98, Standard Symbols for Welding, Brazing, and Nondestructive Examination.

WPS

WELDING PROCEDURE SPECIFICATIONS

Review each WPS and Print carefully before beginning a project. Pay particular attention to any notes and weld symbol details.

Projects will not be accepted without fit-up inspection and materials list filled out completely.

WPS WELDING PROCEDURE SPECIFICATION
(WPS): AWS1.1-GMAW-S
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

GMAW (Gas Metal Arc Welding – Short Circuit)

Welding Process: GMAW-S	**Method:** Semi Automatic	**Supporting SWPS No:** AWS B2.1-1-004

BASE METAL		
Material:	**Product Form:**	**Thickness:**
ASTMA569 or A36 (or equivalent M-1)[1] M#, P#1, Group 1 or 2	Sheet Metal	10 Gage per drawing 0.134in Nominal (T)

FILLER METALS				
Electrode F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**	**Transfer Mode:**
F6	ANSI/AWS 5.18	Per Drawing AWS EDU-3	ER70S-6	Short Circuit

JOINT DESIGN			
Joint Design:	**Backing:**	**Backing Material:**	**Welding Positions/Progression:**
See Drawing AWS EDU-3	None	None	Multiple / Uphill when applicable

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50°F minimum	N/A	As Welded Condition

ELECTRICAL CHARACTERISTICS							
Electrode		**Current**					
Classification	**Diameter**	**Volts**	**Amperage**	**Polarity**	**WFS (IPM)**	**Travel Speed**	**CTWD**
ER70S-6	.035	17-20	100-140	DCEP	150-250	N/A	½”

SHIELDING GAS		
Composition	**Flow Rate**	**Nozzle Size**
75% Ar/25%CO2	20-30 CFH	1/2” ID Minimum

WELD TECHNIQUE			
Weave or Stringer	**Cleaning**	**Maximum Bead Thickness**	**Peening**
Stringer	Mechanical Brushing	Per Drawing AWS EDU-3	No

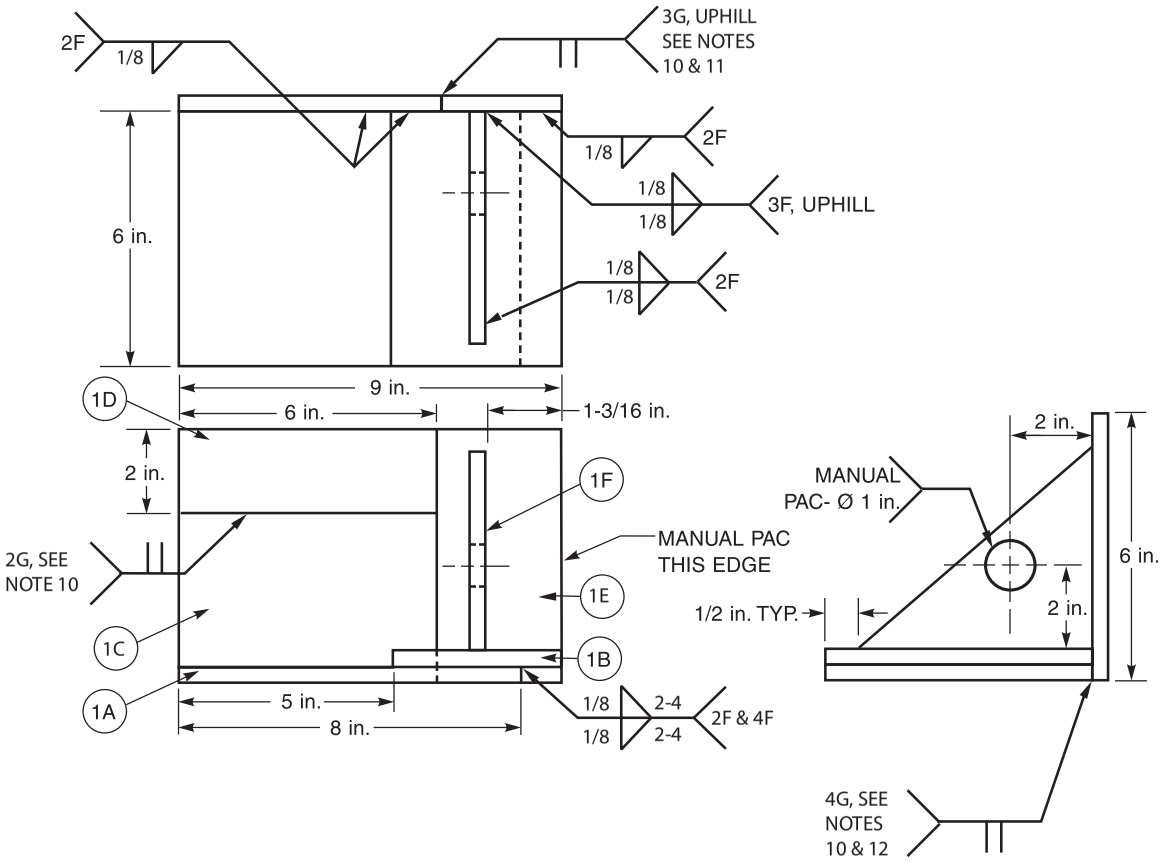
SUPPORTING PQR(S) AWS-EDU-PQ7

SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: September 2018 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor
Date: _____ Approved By: _____ Title: _____

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.

Notes: 1. Base Metal Groupings (M Numbers) per AWS B2.1



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 10 ga.-14 ga. thickness carbon steel. Optional choice of thickness within range specified.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
6. All welds GMAW-S (Short Circuiting Transfer) or GTAW as applicable.
7. Fit and tack entire assembly on bench befoRe attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Weld joins parts 1C and 1D to 1E.
12. Weld joins parts 1C and 1E to 1A.

ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				GMAW-S, GTAW Carbon Steel		
				DATE:	**SCALE:**	**DWG #:** AWS EDU-3
				DR BY:	**Tolerances:** (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16” Angles: +10°, -5°	
				APP BY:		

WPS WELDING PROCEDURE SPECIFICATION
(WPS): AWS1.4 -GMAW-Spray
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

GMAW (Gas Metal Arc Welding –Spray)

Welding Process: GMAW-Spray	**Method:** Semi Automatic	**Supporting SWPS No:** AWS B2.1-1-235

BASE METAL		
Material:	**Product Form:**	**Thickness:**
ASTM A36	Plate	3/8”

FILLER METALS				
Electrode F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**	**Transfer Mode:**
F6	ANSI/AWS A5.18	Per Drawing AWS EDU-2	ER70S-3	Spray

JOINT DESIGN			
Joint Design:	**Backing:**	**Back Gouging:**	**Welding Positions/Progression:**
See Drawing AWS EDU-2	None	None	1G, 2F / NA

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50ºF minimum	N/A	As Welded Condition

ELECTRICAL CHARACTERISTICS							
Electrode		**Current**					
Classification	**Diameter**	**Volts**	**Amperage**	**Polarity**	**WFS (IPM)**	**Travel Speed**	**CTWD**
ER70S-3	.035	24 – 28	180 – 280	DCEP	330 – 500	N/A	½ - 1”

SHIELDING GAS		
Composition	**Flow Rate**	**Nozzle Size**
98% Ar/2% O_2	30-40 CFH	1/2” ID Minimum

WELD TECHNIQUE				
Weave or Stringer	**Initial Cleaning**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Either	Chemical or Mechanical; joint shall be dry prior to welding	Mechanical Only	Per Drawing AWS EDU-2	Not Permitted

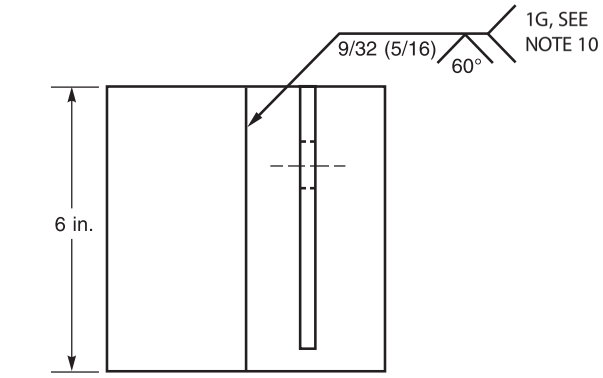
SUPPORTING PQR(S) AWS-EDU-PQ3

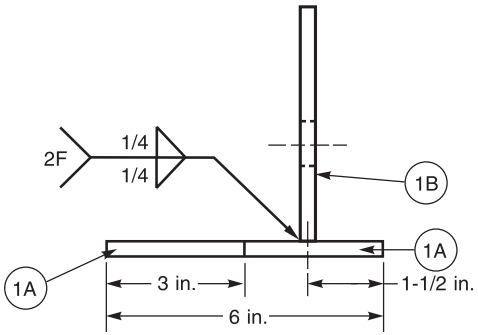
SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

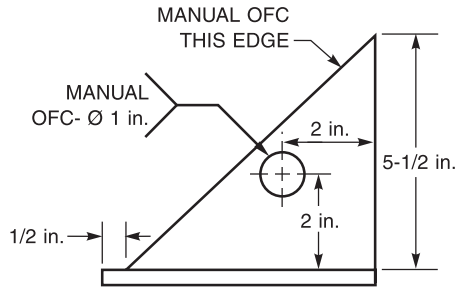
Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: September 2018 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor
Date: _____ Approved By: _____ Title: _____

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.
Notes: 1. Base Metal Groupings (M Numbers) per AWS B2.1

Repair: Defects in welds shall be removed by mechanical or thermal methods. The repair cavity may differ in contour and dimension from a normal joint preparation and may present different restrain conditions. Repair of base metal defects shall be in accordance with the requirements of the fabrication document(s).







NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 3/8 in. thickness carbon steel.
3. The welder shall prepare a bill of materials in U.S. Customary Units of measure prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine OFC unless specified manual OFC.
6. All welds GMAW Spray Transfer.
7. Fit and tack entire assembly on bench before welding.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.

ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				GMAW Spray Transfer, Carbon Steel		
				DATE:	**SCALE:**	**DWG #:** AWS EDU-2
				DR BY:	**Tolerances:** (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16" Angles: +10°, -5°	
				APP BY:		

WPS WELDING PROCEDURE SPECIFICATION (WPS): AWS1.3-FCAW-S
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

FCAW-S (Flux Core Arc Welding – Self Shielded)

Welding Process: FCAW-S	**Method:** Semi Automatic	**Supporting SWPS No:** AWS B2.1-1-027 AWS B2.1-1-018

BASE METAL		
Material:	**Product Form:**	**Thickness:**
ASTM A36	Plate	3/8 inch

FILLER METALS				
Electrode F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**	**Transfer Mode:**
F6	AWS 5.20	Per Drawing AWS EDU-1	E71T-11	Globular or Spray

JOINT DESIGN			
Joint Design:	**Backing:**	**Back Gouging:**	**Welding Positions/Progression:**
Per QC10 & QC11 Drawings	None	None	Multiple / Uphill

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50°F minimum	500 °F Maximum	As Welded Condition

ELECTRICAL CHARACTERISTICS							
Electrode (COREX or NR-211-MP)		**Current**					
Classification	**Diameter**[1]	**Volts**	**Amperage**	**Polarity**	**WFS (IPM)**	**Travel Speed**	**CTWD**
E71T-11	.045	16-19	140-170	DCEN	90-130	NA	1/2”-1”
E71T-8 (NR-233)	1/16”	15-19	150-220	DCEN	90-150	NA	1/2”-1”

SHIELDING GAS		
Composition	**Flow Rate**	**Nozzle Size**
NA	NA	NA

WELD TECHNIQUE				
Weave or Stringer	**Initial Cleaning:**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Either	Chemical or Mechanical, Joint shall be dry prior to welding	Mechanical Only	Per Drawing AWS EDU-1	NotRequired

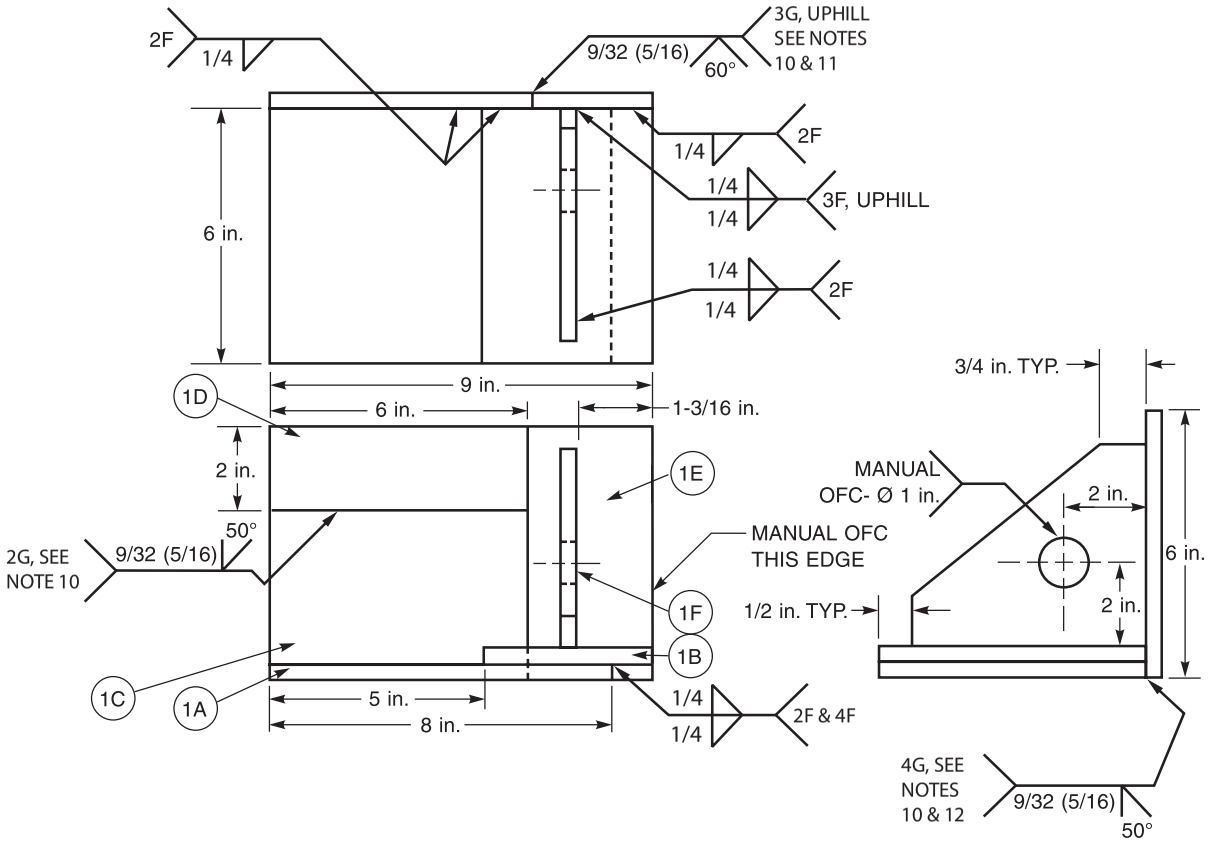
SUPPORTING PQR(S) AWS-EDU-PQ2

SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: September 2018 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor
Date: _____ Approved By: _____ Title: _____

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.

Notes: 1. Electrode Size – Welder’s Choice



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 3/8 in. thickness carbon steel.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine OFC unless specified manual OFC.
6. All welds FCAW-G/GM or FCAW-S as applicable.
7. Fit and tack entire assembly on bench before attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Weld joins parts 1C and 1D to 1E.
12. Weld joins parts 1C and 1E to 1A.

ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				FCAW-G/GM, FCAW-S Carbon Steel		
				DATE:	**SCALE:**	**DWG #:** AWS EDU-1
				DR BY:	**Tolerances:** (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16" Angles: +10°, -5°	
				APP BY:		

WPS WELDING PROCEDURE SPECIFICATION (WPS): AWS1.2B-FCAW-G
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

FCAW-G (Flux Core Arc Welding – Gas Shielded)

Welding Process: FCAW-G	**Method:** SemiAutomatic	**Supporting SWPS No:** AWS B2.1-1-020

BASE METAL		
Grade/Type:	**Product Form:**	**Thickness:**
ASTM A36	Plate	3/8 inch

FILLER METALS				
Electrode F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**	**Transfer Mode:**
F6	ANSI/AWS 5.20	Per Drawing AWS EDU-1	E71T-1M	Globular or Spray

JOINT DESIGN			
Joint Design:	**Backing:**	**Back Gouging:**	**Welding Positions/Progression:**
Per QC10 & QC11 Drawings	As Required	None	Multiple / Uphill

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Max Interpass Temp:**	**Postheat Heat treatment**
50°F Minimum	500 °F Maximum	As Welded Condition

ELECTRICAL CHARACTERISTICS							
Electrode (ULTRACORE 71A85)		**Current**					
Classification	**Diameter**	**Volts**	**Amperage**	**Polarity**	**WFS (IPM)**	**Travel Speed**	**CTWD**
E71T-1M	.045	22-31	150-280	DCEP	250~600	NA	.75 – 1.25”

SHIELDING GAS		
Composition	**Flow Rate**	**Nozzle Size**
75-85% Ar/Balance CO2,	40-50 CFH	½” Minimum

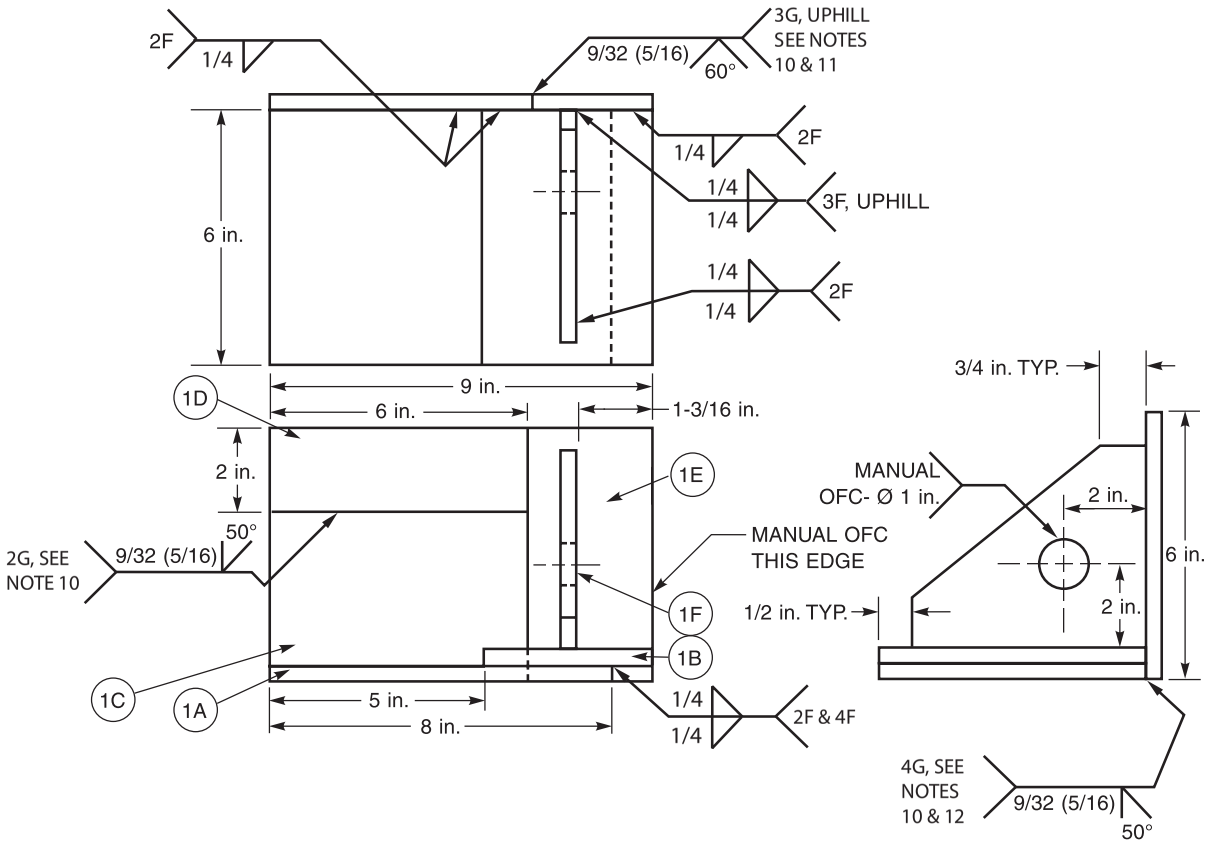
WELD TECHNIQUE				
Weave or Stringer	**Initial Cleaning:**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Either	Chemical or Mechanical, Joint shall be dry prior to welding	Mechanical Only	Per Drawing AWS EDU-1	NotRequired

SUPPORTING PQR(S) AWS-EDU-PQ2

SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: Septemer 2018 Amended By: Stephen Hasselbach Title: CWI/CWE - Instructor
Date: _____ Approved By: _____ Title: _____

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 3/8 in. thickness carbon steel.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine OFC unless specified manual OFC.
6. All welds FCAW-G/GM or FCAW-S as applicable.
7. Fit and tack entire assembly on bench before attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Weld joins parts 1C and 1D to 1E.
12. Weld joins parts 1C and 1E to 1A.

ID	QTY	SIZE	METRIC CONVERSION

American Welding Society

Entry Welder Performance Qualification

FCAW-G/GM, FCAW-S Carbon Steel

DATE:	SCALE:	DWG #: AWS EDU-1
DR BY:	Tolerances: (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16" Angles: +10°, -5°	
APP BY:		

WPS WELDING PROCEDURE SPECIFICATION (WPS) AWS-EDU-GTAW-01
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

GTAW-CS (Gas Tungsten Arc Welding – Carbon Steel)

Welding Process: GTAW	**Method:** Manual	**Supporting SWPS No:** AWS B2.1-1-008

BASE METAL		
Grade/Type:	**Product Form:**	**Thickness**:
ASTM A569 (or equivalent M-1 steel)[1]	Sheet Steel	10 Gage to 14 Gage

FILLER METALS			
Filler Metal F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**
F6	ANSI/AWS 5.18	1/16" – 3/32"	ER70S-X

JOINT DESIGN			
Joint Design:	**Backing:**	**Position:**	**Progression:**
See Drawing AWS EDU-3	None	Multiple	Uphill

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50°F minimum, 120 °F Maximum	No Maximum	As Welded Condition

ELECTRICAL CHARACTERISTICS						
Tungsten Electrode		**Filler Metal**		**Current**		
Classification	**Size (in)[2]**	**Classification**	**Diameter**	**Grooves**	**Fillets**	**Polarity**
EWCE-2 or E3 (purple)	3/32 or 1/8	ER70S-2 or 3	3/32"	57-100	86-130	DCEN

SHIELDING GAS			
Composition	**Flow Rate**	**Backing Gas**	**Nozzle Size**
100% Argon	15-25 CFH	NA	1/4"-5/8"

WELD TECHNIQUE				
Beads:	**Initial Cleaning**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Stringer or Weave	Mechanical or Chemical, joint shall be dry prior to welding	Mechanical Only	Per Drawing	No

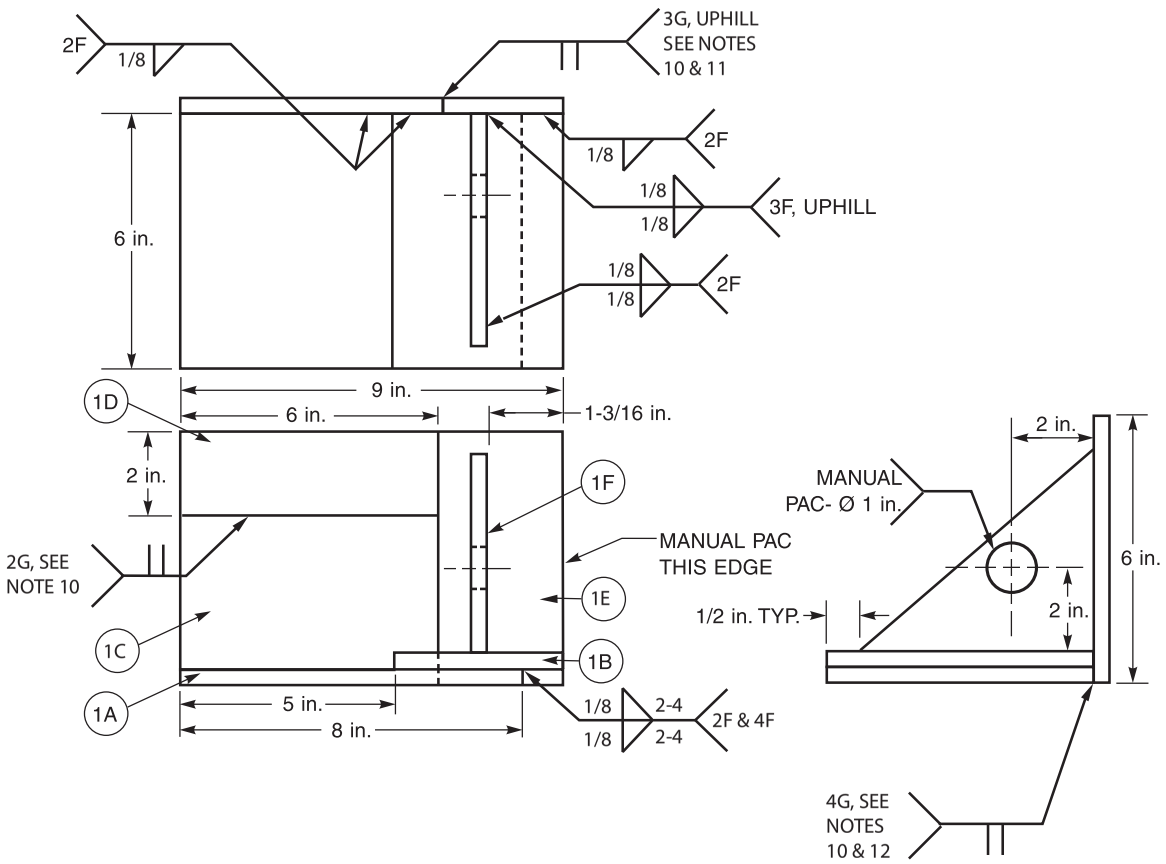
SUPPORTING PQR(S) AWS-EDU-PQ6

NOTES:
1. Base Metal Groupings (M Numbers) per AWS B2.1
2. Tungsten Electrode size - Welder's choice

SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: September 2018 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 10 ga.-14 ga. thickness carbon steel. Optional choice of thickness within range specified.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
6. All welds GMAW-S (Short Circuiting Transfer) or GTAW as applicable.
7. Fit and tack entire assembly on bench befoRe attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Weld joins parts 1C and 1D to 1E.
12. Weld joins parts 1C and 1E to 1A.

ID	QTY	SIZE	METRIC CONVERSION

American Welding Society

Entry Welder Performance Qualification

GMAW-S, GTAW Carbon Steel

DATE:	**SCALE:**	**DWG #:** AWS EDU-3
DR BY:	**Tolerances:** (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16” Angles: +10°, -5°	
APP BY:		

WPS WELDING PROCEDURE SPECIFICATION (WPS) AWS-EDU-GTAW-02
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

GTAW-SS (Gas Tungsten Arc Welding – Stainless Steel)

Welding Process: GTAW	**Method:** Manual	**Supporting SWPS No:** AWS B2.1-8-009

BASE METAL		
Grade/Type:	**Product Form:**	**Thickness**:
ASTM A240 (or equivalent M-8 steel)[1]	Sheet Steel	10 Gage to 14 Gage

FILLER METALS				
Filler Metal F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**	**Diameter:**
F6	ANSI/AWS 5.9	Per Drawing AWS EDU-4	ER308, ER308L	3/32”

JOINT DESIGN			
Joint Design:	**Backing:**	**Position:**	**Progression:**
See Drawing AWS EDU-4	Not Permitted	Multiple	Uphill

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50°F minimum, 120 °F Maximum	No Maximum	As Welded Condition

ELECTRICAL CHARACTERISTICS					
Tungsten Electrode		**Current - Amperage**			
Classification	**Size (in)[2]**	**Grooves**	**Fillets**	**Polarity**	**Pulsing Current**
EWCE-2 or E3 (purple)	3/32 or 1/8 Sharpened to a point	51 – 95	86 – 130	DCEN	Not Permitted

SHIELDING GAS			
Composition	**Flow Rate**	**Root Shielding Flow Rate**	**Nozzle Size**
100% Argon	15-25 ft^3/hr	5 – 15 ft^3/hr	1/4”-5/8”

WELD TECHNIQUE				
Bead Width:	**Initial Cleaning**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Stringer	Wire Brush, Grind as Required	Wire Brush, Grind as Required	Per Drawing	No

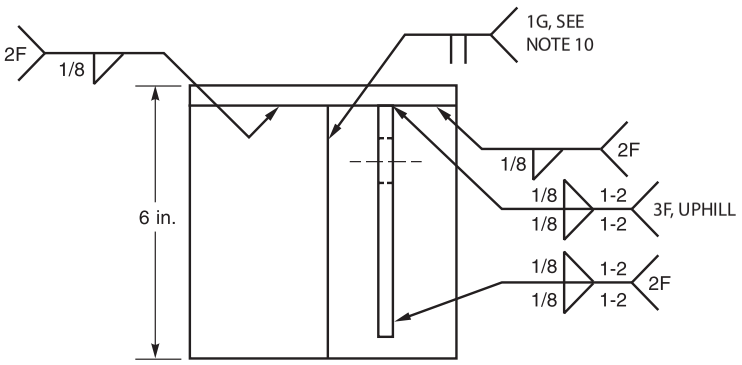
SUPPORTING PQR(S) AWS-EDU-PQ4

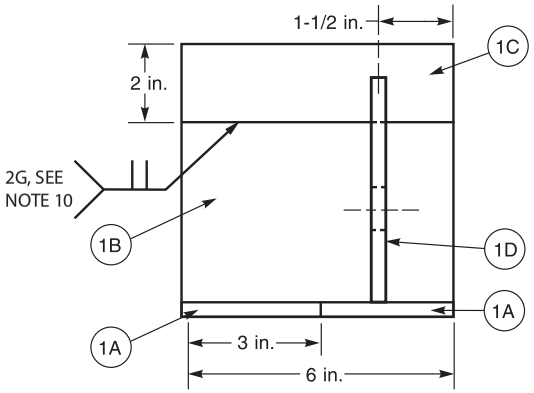
NOTES:
1. Base Metal Groupings (M Numbers) per AWS B2.1
2. Tungsten Electrode size - Welder's choice

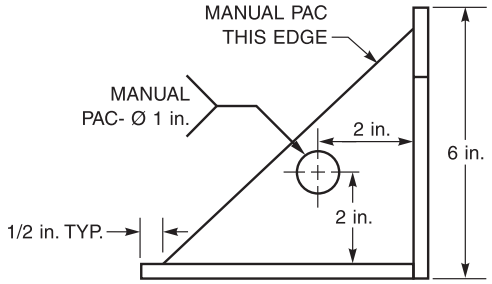
SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: September 2018 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.







NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 10 ga.-14 ga. thickness austenitic stainless steel. Optional choice of thickness within range specified.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
6. All welds GTAW.
7. Fit and tack entire assembly on bench before attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.

ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				GTAW Austenitic Stainless Steel		
				DATE:	**SCALE:**	**DWG #:** AWS EDU-4
				DR BY:	**Tolerances:** (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16" Angles: +10°, -5°	
				APP BY:		

WPS WELDING PROCEDURE SPECIFICATION (WPS) AWS-EDU-GTAW-03
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

GTAW-AL (Gas Tungsten Arc Welding – Aluminum)

Welding Process: GTAW	**Method:** Manual	**Supporting SWPS No:** AWS B2.1-22-015

BASE METAL		
Grade/Type:	**Product Form:**	**Thickness**:
M/P-22 Aluminum Sheet[1]	Aluminum Sheet	10 Gage

FILLER METALS				
Filler Metal F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**	**Diameter:**
AWS/ASME F23	ASME/AWS 5.10	Per Drawing AWS EDU-5	ER4043	1/8”

JOINT DESIGN			
Joint Design:	**Backing:**	**Position:**	**Progression:**
See Drawing AWS EDU-5	Not Permitted	Multiple	Uphill

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50ºF minimum, 120ºF Maximum	250ºF Maximum	As Welded Condition

ELECTRICAL CHARACTERISTICS						
Tungsten Electrode			**Current - Amperage**			
Classification	**Specification**	**Size (in)[2]**	**Grooves**	**Fillets**	**Polarity**	**Pulsing Current**
EWCE-2 or E3 (purple)	AWS A5.12, ASME SFA 5.12	3/32 or 1/8 with a balled end	110 – 125	15 – 125	AC	Not Permitted

SHIELDING GAS			
Composition	**Flow Rate**	**Root Shielding Flow Rate**	**Nozzle Size**
100% Argon	20 – 40 ft^3/hr	Not Required	1/4”-5/8” I.D.

WELD TECHNIQUE				
Stringer or Weave:	**Initial Cleaning**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Either	Mechanical or Chemical, joint shall be dry prior to welding	Mechanical only	Per Drawing EDU – 5	Not Permitted

SUPPORTING PQR(S) AWS-EDU-PQ5

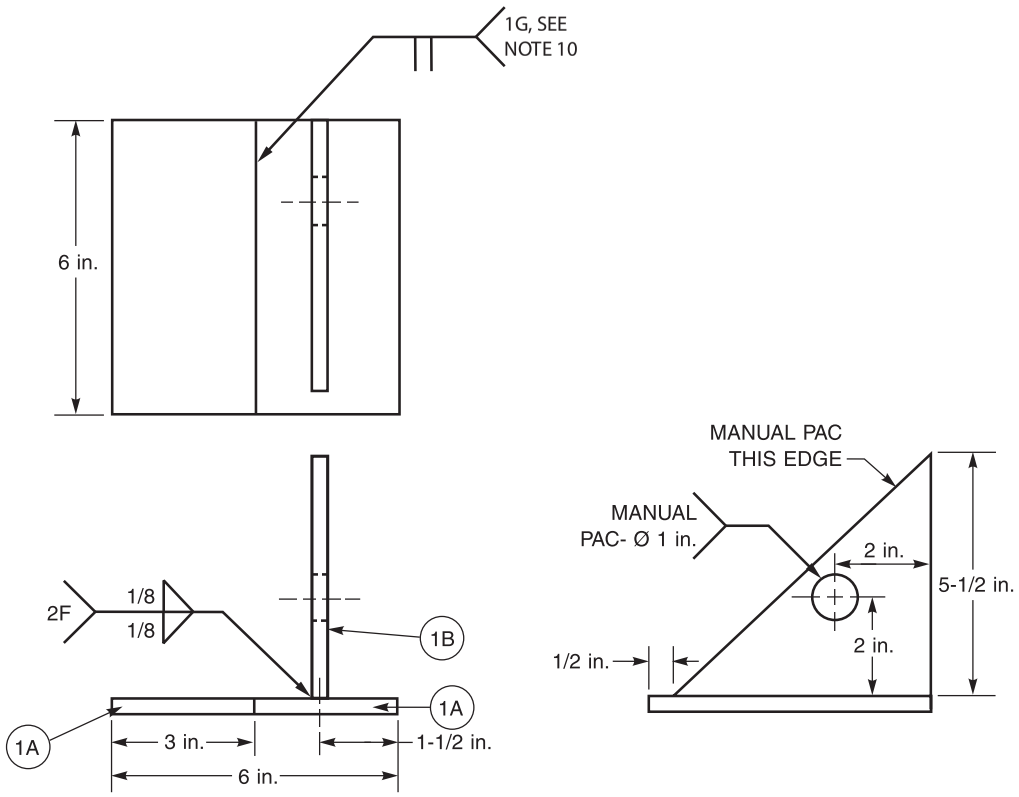
Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1 – Entry Welder*
Acceptance Criteria: Visual Inspection per: AWS QC-10, Table 3.

NOTES: 1. Base Metal Groupings (M Numbers) per AWS B2.1
2. Tungsten Electrode size - Welder's choice

SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: April 17, 2017 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor

Repair: Defects in welds shall be removed by mechanical or thermal methods. The repair cavity may differ in contour and dimension from a normal joint preparation and may present different restraint conditions.



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 10 ga.-14 ga. thickness aluminum. Optional choice of thickness within range specified.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
6. All welds GTAW.
7. Fit and tack entire assembly on bench before attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.

ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				GTAW Aluminum		
				DATE:	**SCALE:**	**DWG #:** AWS EDU-5
				DR BY:	**Tolerances:** (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16” Angles: +10°, -5°	
				APP BY:		

WPS WELDING PROCEDURE SPECIFICATION (WPS) AWS-EDU-SMAW-01/02
THIS WPS IS FOR EDUCATIONAL PURPOSES ONLY

SMAW (Shielded Metal Arc Welding)

Welding Process: SMAW	**Method:** Manual	**Supporting SWPS No:** AWS B2.1-1-016

BASE METAL			
Grade/Type:	**Thickness:**	**Product Form:**	**Coupon:**
ASTM A36 M1, P1, or S1, GROUP 1 or 2	3/8”	Plate	3/8” x 3” min. x 7” min., 2 pieces required

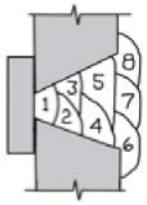
FILLER METALS			
Filler Metal F#:	**Specifications:**	**Deposit Thickness:**	**Classification:**
F4	ANSI/AWS 5.1	3/8” (plus reinforcement)	E7018

JOINT DESIGN			
Joint Design:	**Backing:**	**Back Gouging:**	**Welding Positions:**
45º – see attached Figures for complete details for 2G/3G	Carbon Steel Backing Strip[1]	None	2G & 3G

PREHEAT, INTERPASS AND POSTHEAT TEMPERATURES		
Preheat:	**Interpass Temp:**	**Postheat Heat treatment**
50ºF minimum	50ºF min - 500ºF max	As Welded Condition

ELECTRICAL CHARACTERISTICS			
Electrode[3]		**Current**	
Classification	**Diameter[2]**	**Amperage**	**Polarity**
E7018	3/32”	70 – 110	DCEP
E7018	1/8”	90 – 150	DCEP

Weld Progression



WELD TECHNIQUE					
Weave or Stringer	**Single or Multipass**	**Initial Cleaning**	**Interpass Cleaning**	**Maximum Bead Thickness**	**Peening**
Either	Either	Chemical or Mechanical; Joint shall be dry prior to welding	Mechanical Only	1/4”	No

SUPPORTING PQR(S) AWS-EDU-PQ1

Qualification Standard: AWS QC-10 *Specification for Qualification and Certification of Level 1- Entry Welder*

Acceptance Criteria: **1.** Visual Inspection per: AWS QC-10, Table 3
2. One Face Bend and One Root Bend for each position per: AWS QC-10 Table 4

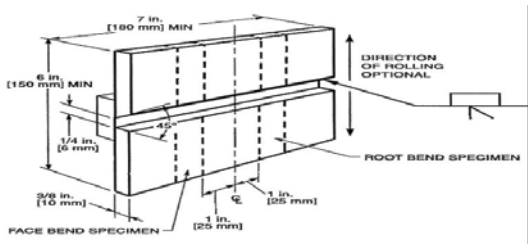
Notes: **1.** The backing thickness shall be ¼” min. to $^{3}/_{8}$” max; backing width shall be one inch minimum.
2. Electrode Size – Welder’s Choice
3. The care and storage of electrodes shall be as recommended by the electrode manufacturer.

SCHOOL NAME: Monroe County Community College
In the name of the school above, the following personnel are responsible for the acceptance and application of this welding procedure in the school curriculum and corresponding documents.

Date: June 21, 2012 Implemented By: Edward L. Baltrip Title: Senior Welding Instructor
Date: September 2018 Amended By: Stephen Hasselbach Title: CWI/CWE – Instructor
Date: _____ Approved By: _____ Title: _____

	SENSE PROGRAM WELDER PERFORMANCE QUALIFICATION TECHNIQUE SHEET	**SENSE TEST No:** Level I - Entry Welder, Test 8
		REVISION No: 1 / **DATE:** 5/15/2015
		SUPPORTING SWPS No: AWS B2.1-1-016

MATERIAL: ASTM A36	**Joint Details:**
PRODUCT FORM: Plate	
DIAMETER: NA / **THICKNESS:** 3/8 in.	
POSITION: 2G / **PROGRESSION:** NA	
MIN. PREHEAT / MAX INTERPASS TEMP: 50°F /NA	
CLEANING: Wire Brush, Grind as Required	
BACKING: Carbon Steel Backing Strip[1]	
BACKGOUGING: None	
COUPON: 3/8" x 3" min. x 7" min., 2 pieces required	



VARIABLE	Root and Balance (3/32" Electrode)	Root and Balance (1/8" Electrode)	Root and Balance (5/32" Electrode)
Process	SMAW	SMAW	SMAW
Process Type	Manual	Manual	Manual
Electrode/Filler Classification	E7018	E7018	E7018
Electrode/Filler Size (in.)[2]	3/32	1/8	5/32
Consumable Insert	NA	NA	NA
Tungsten Electrode Classification	NA	NA	NA
Penetration Enhancing Flux	NA	NA	NA
Current/Polarity	DCEP	DCEP	DCEP
Current Range (Amps)	70 - 110	90 - 150	120 - 190
Transfer Mode (GMAW & FCAW)	NA	NA	NA
Voltage Range	NA	NA	NA
Wire Feed Speed (ipm)	NA	NA	NA
Contact Tube to Work (in.)	NA	NA	NA
Bead Width (Stringer or Weave)	Either	Either	Either
Travel Speed (IPM)	NA	NA	NA
Torch Shielding Gas Composition	NA	NA	NA
Torch Shielding Gas Flow Rate (cfh)	NA	NA	NA
Shielding Gas Cup Size	NA	NA	NA
Root Shielding Gas Composition	NA	NA	NA
Root Shielding Gas Flow Rate (cfh)	NA	NA	NA
Deposit Thickness (in.)	3/8 (plus reinforcement)	3/8 (plus reinforcement)	3/8 (plus reinforcement)
Qualification Standard	AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders*		

Acceptance Criteria:	Visual Inspection per: AWS QC-10, Table 8.1	One Face Bend and One Root Bend for each position per: AWS QC-10 Table 8.2

NOTES:

1. The backing thickness shall be ¼″ min. to 3/8″ max; backing width shall be one inch minimum.
2. Electrode Size - Welder's choice

	SENSE PROGRAM WELDER PERFORMANCE QUALIFICATION TECHNIQUE SHEET	**SENSE TEST No:** Level I - Entry Welder, Test 9
		REVISION No: 1 / **DATE:** 5/15/2015
		SUPPORTING SWPS No: AWS B2.1-1-016

MATERIAL: ASTM A36

PRODUCT FORM: Plate

DIAMETER: NA **THICKNESS:** 3/8 in.

POSITION: 3G **PROGRESSION:** Uphill

MIN. PREHEAT / MAX INTERPASS TEMP: 50°F /NA

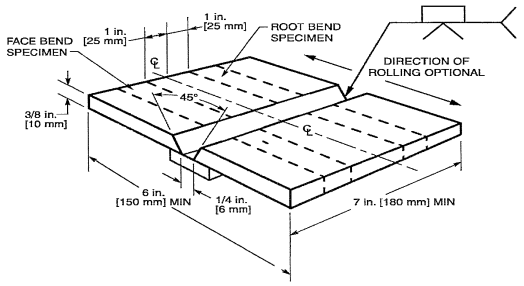
CLEANING: Wire Brush, Grind as Required

BACKING: Carbon Steel Backing Strip[1]

BACKGOUGING: None

COUPON: 3/8" x 3" min. x 7" min., 2 pieces required

Joint Details:



VARIABLE	Root and Balance (3/32" Electrode)	Root and Balance (1/8" Electrode)	Root and Balance (5/32" Electrode)
Process	SMAW	SMAW	SMAW
Process Type	Manual	Manual	Manual
Electrode/Filler Classification	E7018	E7018	E7018
Electrode/Filler Size (in.)[2]	3/32	1/8	5/32
Consumable Insert	NA	NA	NA
Tungsten Electrode Classification	NA	NA	NA
Penetration Enhancing Flux	NA	NA	NA
Current/Polarity	DCEP	DCEP	DCEP
Current Range (Amps)	70 - 110	90 - 150	120 - 190
Transfer Mode (GMAW & FCAW)	NA	NA	NA
Voltage Range	NA	NA	NA
Wire Feed Speed (ipm)	NA	NA	NA
Contact Tube to Work (in.)	NA	NA	NA
Bead Width (Stringer or Weave)	Either	Either	Either
Travel Speed (IPM)	NA	NA	NA
Torch Shielding Gas Composition	NA	NA	NA
Torch Shielding Gas Flow Rate (cfh)	NA	NA	NA
Shielding Gas Cup Size	NA	NA	NA
Root Shielding Gas Composition	NA	NA	NA
Root Shielding Gas Flow Rate (cfh)	NA	NA	NA
Deposit Thickness (in.)	3/8 (plus reinforcement)	3/8 (plus reinforcement)	3/8 (plus reinforcement)
Qualification Standard	AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders*		

Acceptance Criteria:	Visual Inspection per: AWS QC-10, Table 8.1	One Face Bend and One Root Bend for each position per: AWS QC-10 Table 8.2

NOTES:

1. The backing thickness shall be ¼″ min. to 3/8″ max; backing width shall be one inch minimum.
2. Electrode Size - Welder's choice

Thermal Cutting & CAC Reference & OAC/OFC Evaluation Rubrics

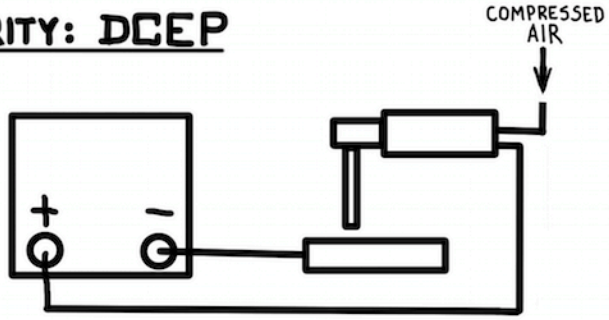
TITLE:

CAC-A

CARBON ARC CUTTING, SCARFING AND GOUGING

SCARFING: REMOVAL OF WELD METAL FROM BASE METAL
GOUGING: REMOVAL OF BASE METAL

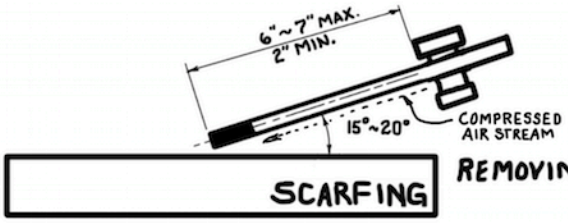
POLARITY: DCEP



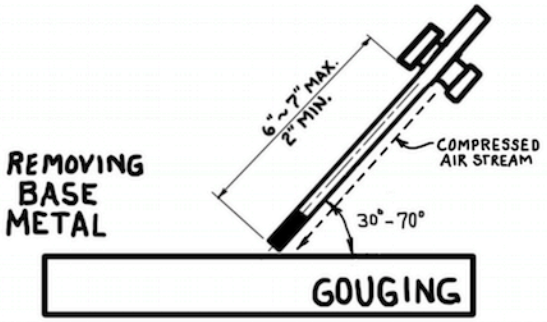
SCARFING	15°~20°
GOUGING	30°~70°
CUTTING	80°~90°

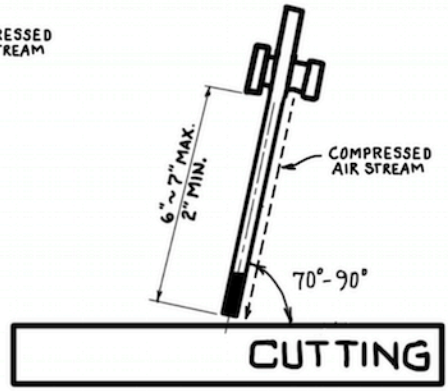
ELECTRODE	AMPERAGE
3/16"	200~250
1/4"	300~400

DIG @ 100%



REMOVING SURFACE METAL





E.BALTRIP'S WELDER'S JOURNAL | FILE: CAC-A | E.L.BALTRIP © 10 JUNE 1996

STUDENTS NAME: _____ **DATE:** _____

Course: WELD 100 Learning Objective:: Thermal Cutting Rubric

Learning Outcome: Uses the OFC/OAC process to cut (4) four 1" circles, (4) four 1" notches and (1) one 6" straight cut on 1/4"-3/8" Carbon Steel plate. (Read Weld 100 manual pg. 78-91)

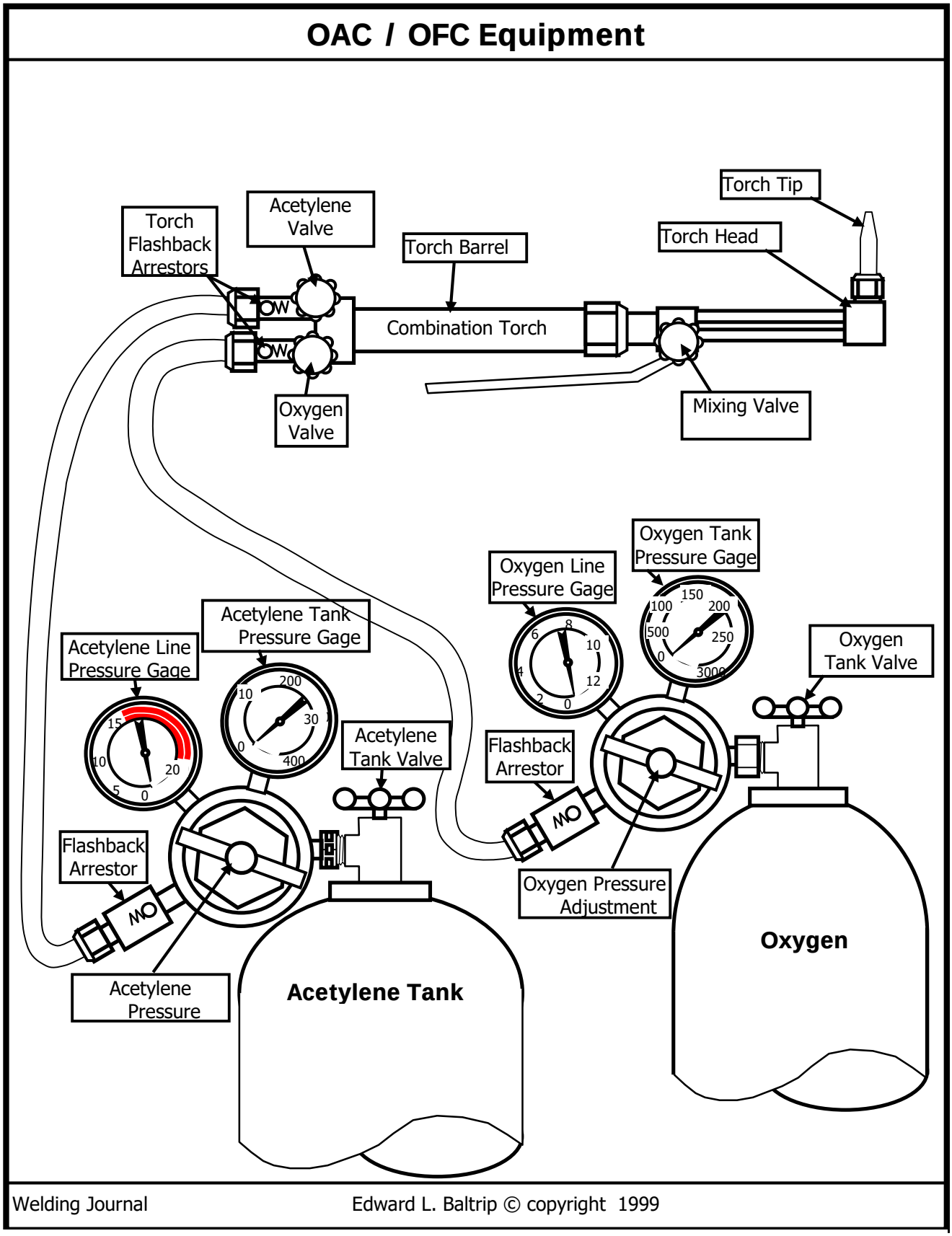
NOTES: CW = clockwise, CCW = counter clockwise.

	Learning Objective	Mastery 4 points	Accomplished 3 points	Developing 2 points	Underdeveloped 1 point	Undeveloped 0 points
1	Marks CS plate to cut 1" circles, 1" notches and 6" straight cut.	Consistently marks CS plate cut 1" circles, 1" notches and 6" straight cut.	Usually marks CS plate to cut 1" circles, 1" notches and 6" straight cut.	Inconsistently marks CS plate to cut 1" circles, 1" notches and 6" straight cut.	Rarely marks CS plate to cut 1" circles, 1" notches and 6" straight cut.	Does not CS plate to cut 1" circles, 1" notches and 6" straight cut.
2	Cracks open each tank valve to clear dust from nozzle and check if empty or full.	Consistently cracks open each tank valve to clear dust from nozzle and check if empty or full.	Usually cracks open each tank valve to clear dust from nozzle and check if empty or full.	Inconsistently cracks open each tank valve to clear dust from nozzle and check if empty or full.	Rarely cracks open each tank valve to clear dust from nozzle and check if empty or full.	Does not crack open each tank valve to clear dust from nozzle and check if empty or full.
3	Installs regulators on oxygen and acetylene cylinders and tightens fittings properly.	Consistently installs regulators on oxygen and acetylene cylinders and tightens fittings properly.	Usually installs regulators on oxygen and acetylene cylinders and tightens fittings properly.	Inconsistently installs regulators on oxygen and acetylene cylinders and tightens fittings properly.	Rarely installs regulators on oxygen and acetylene cylinders and tightens fittings properly.	Does not installs regulators on oxygen and acetylene cylinders and tightens fittings properly.
4	Disassembles and cleans OFC torch tip properly.	Consistently disassembles and cleans OFC torch tip.	Usually disassembles and cleans OFC torch tip.	Inconsistently disassembles and cleans OFC torch tip.	Rarely disassembles and cleans OFC torch tip.	Does not disassembles and cleans OFC torch tip.
5	Disassembles and cleans OAC torch tip properly.	Consistently disassembles and cleans OAC torch tip.	Usually disassembles and cleans OAC torch tip.	Inconsistently disassembles and cleans OAC torch tip.	Rarely disassembles and cleans OAC torch tip.	Does not disassemble and cleans OAC torch tip.
6	Opens oxygen cylinder valve slowly then opens fully CCW to a back-seated position.	Consistently opens oxygen cylinder valve slowly then opens fully CCW to a back-seated position.	Usually opens oxygen cylinder valve slowly then opens fully CCW to a back-seated position.	Inconsistently opens oxygen cylinder valve slowly then opens fully CCW to a back-seated position.	Rarely opens oxygen cylinder valve slowly then opens fully CCW to a back-seated position.	Does not open oxygen cylinder valve slowly then opens fully CCW to a back-seated position.
7	Opens acetylene cylinder valve slowly the continues opening to 1/2 turn CCW.	Consistently opens acetylene cylinder valve slowly then continues opening to 1/2 turn.	Usually opens acetylene cylinder valve slowly then continues opening to 1/2 turn.	Inconsistently opens acetylene cylinder valve slowly then continues opening to 1/2 turn.	Rarely opens acetylene cylinder valve slowly then continues opening to 1/2 turn.	Does not open acetylene cylinder valve slowly then continues opening to 1/2 turn.
8	Adjusts regulators to appropriate pressures for cutting CS plate. (O_2@40psi, Acety@5psi)	Consistently adjusts regulators to appropriate pressures for cutting CS plate.	Usually adjusts regulators to appropriate pressures for cutting CS plate.	Inconsistently adjusts regulators to appropriate pressures for cutting CS plate.	Rarely adjusts regulators to appropriate pressures for cutting CS plate.	Does not adjust regulators to appropriate pressures for cutting CS plate.
9	Lights combination torch correctly. Open and light fuel gas first. Then adjust oxygen to a neutral cutting flame.	Consistently lights combination torch correctly.	Usually lights combination torch correctly.	Inconsistently lights combination torch correctly.	Rarely lights combination torch correctly.	Does not light combination torch correctly.
10	Lights single purpose torch correctly. Open and light fuel gas first. Then adjust oxygen to a neutral cutting flame.	Consistently lights single purpose torch correctly.	Usually lights single purpose torch correctly.	Inconsistently lights single purpose torch correctly.	Rarely lights single purpose torch correctly.	Does not light single purpose torch correctly.
11	Practices proper bracing techniques and practices making the cut to preheat metal.	Consistently practices proper bracing techniques and practices making the cut to preheat metal.	Usually practices proper bracing techniques and practices making the cut to preheat metal.	Inconsistently practices proper bracing techniques and practices making the cut to preheat metal.	Rarely practices proper bracing techniques and practices making the cut to preheat metal.	Does not practice proper bracing techniques and practices making the cut to preheat metal.
12	Cuts 1" circles from CS plate within a 1/16" tolerance.	Consistently cuts 1" circles.	Usually cuts 1" circles.	Inconsistently cuts 1" circles.	Rarely cuts 1" circles.	Does not cut 1" circles within tolerance.
13	Cuts 1" notches from CS plate within a 1/16" tolerance.	Consistently cuts 1" notches within tolerance.	Usually cuts 1" notches within tolerance.	Inconsistently cuts 1" notches within tolerance.	Rarely cuts 1" notches within tolerance.	Does not cut 1" notches within tolerance.
14	Cuts 6" straight line from CS plate without stopping within a 1/16" tolerance.	Consistently cuts 6" straight line within tolerance.	Usually cuts 6" straight line within tolerance.	Inconsistently cuts 6" straight line within tolerance.	Rarely cuts 6" straight line within tolerance.	Does not cut 6" straight line within tolerance.
15	Shuts down torch safely.	Consistently shuts down torch safely.	Usually shuts down torch safely.	Inconsistently shuts down torch safely.	Rarely shuts down torch safely.	Does not shut down torch safely.
16	Shuts off Oxygen and acetylene cylinder tank valve correctly.	Consistently shuts off Oxygen and acetylene cylinder tank valve.	Usually shuts off Oxygen and acetylene cylinder tank valve.	Inconsistently shuts off Oxygen and acetylene cylinder tank valve.	Rarely shuts off Oxygen and acetylene cylinder tank valve.	Does not shut off Oxygen & acetylene cyl. tank valve correctly.
17	Bleeds off (vents) torch and regulators safely and correctly.	Consistently bleeds off (vents) torch and regulators safely.	Usually bleeds off (vents) torch and regulators safely.	Inconsistently bleeds off (vents) torch and regulators safely.	Rarely bleeds off (vents) torch and regulators safely.	Does not bleed off (vents) torch and regulators safely.
18	Removes regulators from both oxygen and acetylene cylinders.	Consistently removes regulators from both oxygen and acetylene cylinders.	Usually removes regulators from both oxygen and acetylene cylinders.	Inconsistently removes regulators from both oxygen and acetylene cylinders.	Rarely removes regulators from both oxygen and acetylene cylinders.	Does not remove regulators from both oxygen and acetylene cylinders.
		Max. 72 points	Max. 54 points	Max. 36 points	Max. 14 points	**TOTAL** (max 72pts)

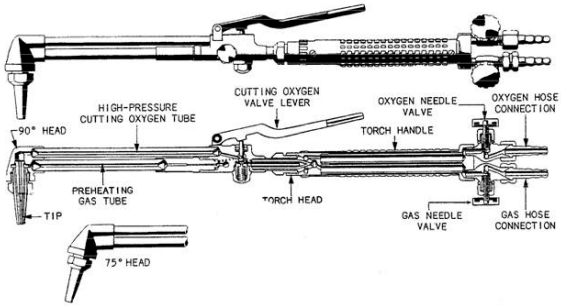
Students will be evaluated by:

1. Preparations for operating the OFC/OAC torch.
2. Disassembling, cleaning or replacing the torch cutting tip.

3. Setting up OFC/OAC equipment.
4. Adjusting the torch flame for cutting.
5. Performing the 3 cutting processes.
6. Shutting down the torch and bleeding residual pressures.
7. Disassembling the equipment.



Combination Torches have 3 valves and can use various brazing and rose bud tip adapters.



Single Purpose Torches have only 2 valves

Sequence of OAC/OFC Operations

Connect portable tanks, torch, hose and regulators safely prior to completing the steps below.

1. **Use soap stone to mark metal for pieces to be cut.**
2. **Assure cylinders are placed together and secured on a torch cart or against the wall so that they don't fall over.**
3. **Remove the protective caps covering the cylinder tank valves and keep them close by.**
   You'll have to put them back on when the cylinders are empty.
4. **Crack open and quickly close both oxygen then the fuel cylinder valves.**
   That's called *cracking* the cylinders, and you need to do it to blow any dirt, dust or other debris out of the valves. Make sure you are in a well-ventilated area when cracking open the valves.
5. **Attach oxygen regulator to oxygen cylinder tank valve with a crescent wrench or an open-end wrench; tighten nut firmly.**
6. **Turn oxygen regulator's adjusting screw CCW (counterclockwise) until loose and has no resistance.**
7. **Open the oxygen cylinder valve very slowly; when you reach full pressure (about 2,000 psi on tank gage), then open the valve all the way CCW or fully back seated.**
   Never stand directly in front of a regulator bonnet. During a malfunction the bonnet can blow off the front of the regulator with force enough to harm or kill anyone in its path.
8. **Connect the acetylene regulator (left hand threads). Tighten (CCW) the nut firmly into nozzle of tank valve.**
9. **Unscrew the acetylene regulator's "T" handle adjusting screw CCW (counterclockwise) until loose and has no resistance.**
10. **Slowly open the acetylene tank valve no more than 1/2 turn CCW.**
11. **Adjust acetylene regulator to exactly 5 psi by turning regulator "T" handle CW until desired pressure is reached.**
12. **Adjust oxygen regulator to 40 psi by turning regulator "T" handle CW until desired pressure is reached.**
13. **Open the acetylene torch valve ½ turn and adjust the acetylene regulator until the gauge pressure reads exactly 5 psi, then close the acetylene torch valve.**
14. **Open oxygen torch valve ½ turn and adjust the oxygen regulator until the gauge pressure reads 40 psi then close the oxygen torch valve.**

15. **If you think there are leaks, check the fittings by spritzing them with soapy water; if you see bubbles, tighten the fittings.**

Lighting the Torch:

16. **Open torch fuel valve 1/2 turn CCW. Use a striker to light torch.**
17. **Adjust the torch fuel valve until the flame comes back and touches the tip.**
18. **Open torch oxygen valve 2 full turns CCW.**
19. **Slightly crack open torch mixing valve until neutral flame is produced.**
20. **Actuate cutting lever valve to observe clean clear line shooting through center of flame.**
21. **Complete cutting processes.**

Shutting down the Torch:

22. **Shut off torch mixing valve by turning valve CW, then the torch oxygen valve by turning CW, then finally the torch fuel gas valve by turning CW.**
23. **Shut off both tank valves fully CW.**
24. **Open fuel torch valve and observe fuel gas regulator line pressure gage decrease to zero psi.**
25. **Open oxygen torch valve and observe oxygen regulator line pressure gage decrease to zero psi.**
26. **Unscrew both acetylene and oxygen regulator "T" handle adjustment screws until loose.**
27. **Remove both regulators and secure. Install both tank valve protect caps.**
28. **OFC/OAC is now safe.**

Prepare to answer the following Questions:

1. Can OFC tips be used in OAC torches and vice versa?
2. Why are two pressure gages mounted on each regulator?
3. What is the difference between the combination torch and the single purpose torch?
4. How should compressed gas cylinders be stored?
5. If an acetylene cylinder is stored on its side, how long should it be turned upright before it is used?
6. What are the different types of fuel gases used in the OFC/OAC processes?
7. What is the purpose of cracking open the tank valve before connecting the regulator?
8. What do the acronyms: OFC and OAC mean?
9. What type of tip is used to preheat a large heavy part?
10. What are flashback arrestors and why are they important to be used?
11. What color is the fuel gas hose?
12. What color is the oxygen gas hose?

WELDING MACHINE SETUPS

GMAW / FCAW WELD SETTINGS

Example: 21/400 means Volts/WFS inches (21 Volts/400 inches per minute WFS)

Selecting Wire, Gas and Control Settings

Material	Suggested Wire Types	Suggested Shielding Gases And Flow Rate	Wire Sizes (Diameters)	1/2" (12.7 mm)	3/8" (9.5 mm)	1/4" (6.4 mm)	3/16" (4.8 mm)	1/8" (3.2 mm)	14 ga. (2.0 mm)	18 ga. (1.2 mm)	22 ga. (0.8 mm)
STEEL	Solid (or hard) ER70s-6	75% Ar/25% CO_2, 25 cfh (Ar/CO_2 produces less spatter–better overall appearance)	0.023" (0.6mm)	—	—	—	20.0/480	18.3/350	18.0/240	17.0/190	15.8/125
			0.030" (0.8mm)	—	24.3/500	21.0/400	19.0/290	18.0/250	17.3/200	16.3/115	15.9/95
			0.035" (0.9mm)	29.5/515	26.0/475	21.0/375	18.4/265	17.4/230	16.5/190	15.8/120	15.0/88
			0.045" (1.1mm)	29.5/315	28.0/300	20.0/225	17.5/195	17.2/190	16.5/165	15.5/95	—
	Solid (or hard) ER70s-6	100% CO_2, 25 cfh	0.023" (0.6mm)	—	—	—	—	21.5/330	20.0/235	19.0/180	18.7/140
			0.030" (0.8mm)	—	23.8/325	22.4/290	20.8/245	20.1/190	19.4/145	18.6/100	18.2/85
			0.035" (0.9mm)	—	23.6/325	22.2/290	20.6/245	19.9/190	19.2/145	18.5/100	18.0/88
			0.045" (1.1mm)	—	—	—	—	—	—	—	—

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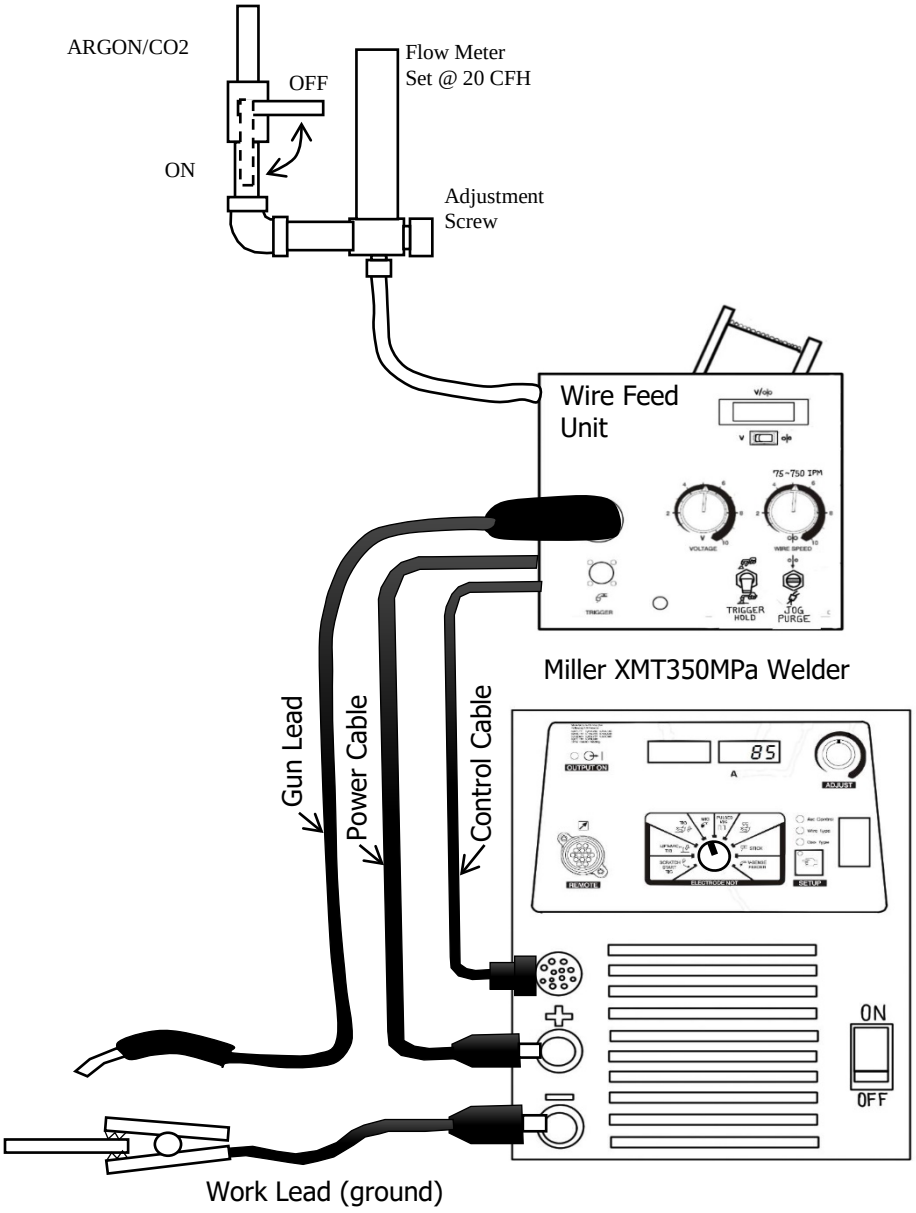
	Suggested Wire Types	Suggested Shielding Gases And Flow Rate	Wire Sizes (Diameters)	1/2" (12.7 mm)	3/8" (9.5 mm)	1/4" (6.4 mm)	3/16" (4.8 mm)	1/8" (3.2 mm)	14 ga. (2.0 mm)	18 ga. (1.2 mm)	22 ga. (0.8 mm)
STEEL	Flux core E71T-1	100% CO_2, 25 cfh	0.035" (0.9mm)	—	26.0/500	24.0/380	23.0/325	21.5/270	20.0/235	—	—
		75% Ar/25% CO_2, 25 cfh	0.045" (1.1mm)	24.3/380	23.8/350	23.5/300	23.0/275	21.5/210	21.0/200	—	—
STAINLESS STEEL	Stainless Steel ER 308, ER 308L ER 308LSi	Tri-Mix, 35 cfh (90% He/7.5% Ar/2.5% CO_2)	0.023" (0.6mm)	—	—	—	—	21.2/500	20.1/350	19.0/210	—
			0.030" (0.8mm)	—	—	23.9/450	20.7/375	19.2/275	18.2/190	17.7/120	—
			0.035" (0.9mm)	—	24.5/500	21.5/425	20.0/350	19.3/250	18.9/163	—	—
			0.045" (1.1mm)	—	24.0/325	22.0/300	20.0/250	19.0/200	—	—	—
Aluminum with Optional Spoolmatic® spoolgun.	Aluminum 4043 ER	100% Ar, 25 cfh	0.030" (0.8mm)	—	—	24.5/620	22.5/540	20.8/480	19.7/460	—	—
			0.035" (0.9mm)	—	26.5/630	24.5/530	23.0/460	20.0/350	18.5/380	—	—
			0.047" (1.2mm)	—	25.0/455	23.5/390	21.7/320	19.5/270	—	—	—

GMAW-S, GMAW SPRAY and FCAW-G
WELDING MACHINE SETUP

WELDING MACHINE SETUP

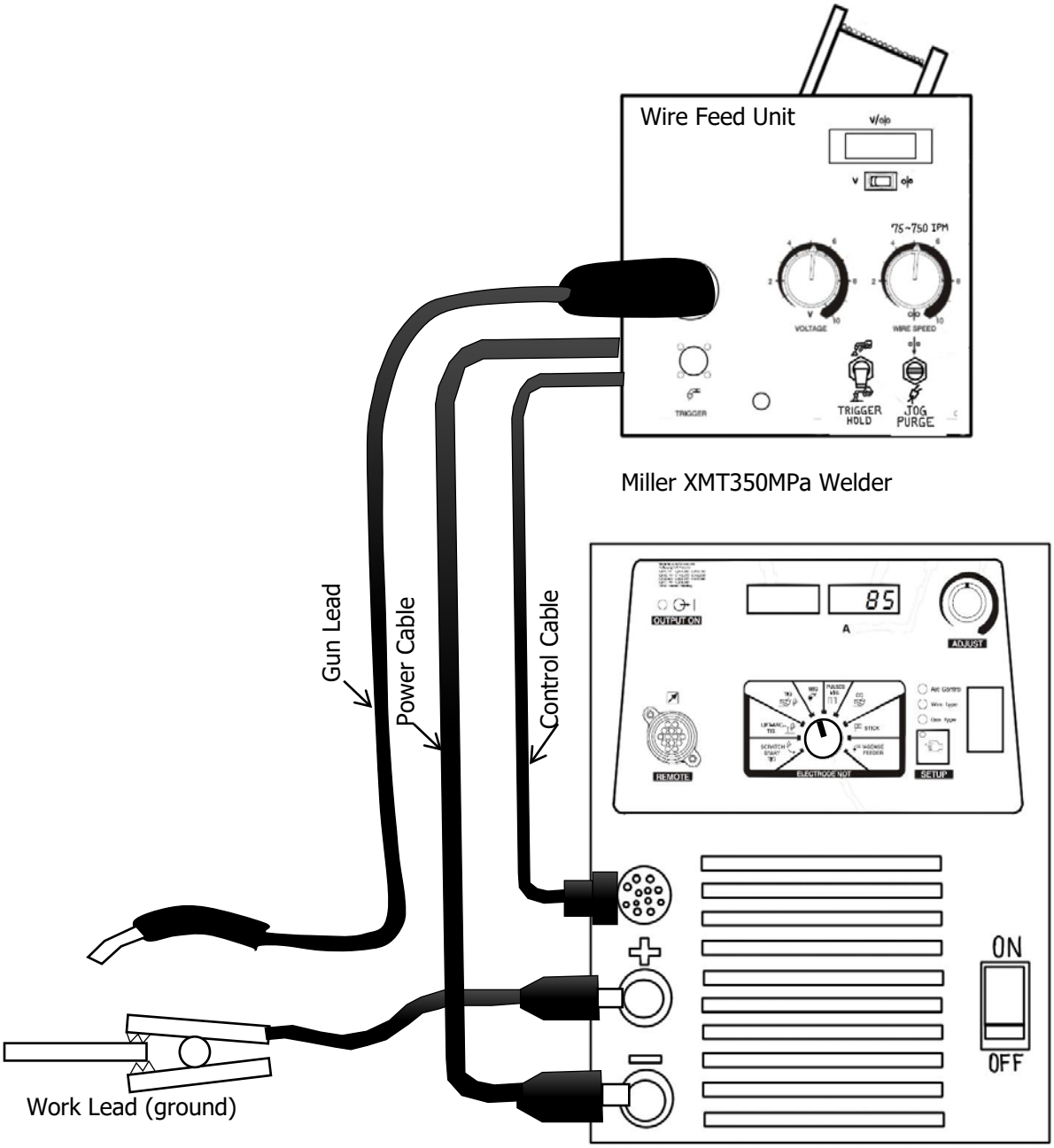
1. Install appropriate type and size of MIG wire into wire feed unit. (For GMAW use SUREARC, for FCAW-G use ULTRACORE)
2. Assure that feed rollers and contact tip matches the wire size.
3. Connect the "control cable" from wire feeder to welding machine.
4. Connect "work lead" (ground lead) to the "negative terminal" of the welding machine and connect ground clamp to workpiece.
5. Connect wire feeder power cable to "positive" terminal of welding machine.
6. Open the Argon-CO2 valve 1/4 turn until the handle is in the vertical position.
7. Turn "ON" both welding machine and wire feed unit.
8. On the wire feeder, press the "Jog/purge" switch downward to start the purge gas flowing from the gun nozzle and adjust gas flow rate at the flow meter by turning the flow meter adjustment knob until red ball is at 20 CFH.
9.



FCAW-S
WELDING MACHINE SETUP

WELDING MACHINE SETUP

1. Install appropriate type and size of Flux Core (.045 COREX) wire into wire feed unit.
2. Assure that feed rollers and contact tip matches the wire size.
3. Connect the "control cable" from wire feeder to welding machine.
4. Connect "work lead" (ground lead) to the "positive terminal" of the welding machine and connect ground clamp to workpiece.
5. Connect wire feeder power cable to "negative" terminal of welding machine.
6. Shielding gas is NOT required for FCAW-S welding process.
7. Turn "ON" both welding machine and wire feed unit.



DYNASTY 350XMT GTAW
WELDING MACHINE SETUP

WELDING MACHINE SETUP

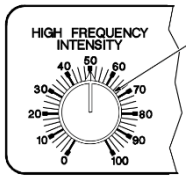
Connect welding machine to leads in rear of HF unit.

Work Lead (ground) connects to HF unit's front bottom plug. Welding lead connects to HF unit's front top plug.

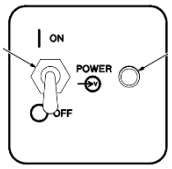
Set Argon @ 15-20 CFH

Set Miller Selector to "TIG position, set amperage to 1 AMP per .001 thickness of material to be welded. (1/8"=125A)

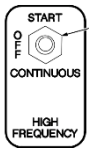
Set HF Unit controls as follows: Power Swt: ON, HF Swt: Continuous, HF Selector: Remote 14, HF Freq: mid range.



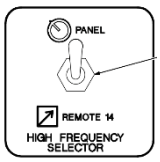
High Frequency Intensity Control
Use to change amount of HF to start and maintain arc. Set as low as practical to prevent electronic interference.



Power Switch
Use switch to turn unit ON and OFF



High Frequency Switch
Start: Provides HF for arc starting only.
Off: Provides no HF, use OFF for SMAW welding.
Continuous: Provides HF continuously.



High Frequency Selector
Panel: provides HF without need for remote switch.
Remote 14: provides HF when remote switch is connected to control receptacle.

Student _____

Instructor_____

Semester_____

MONROE COUNTY COMMUNITY COLLEGE

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Welding Technology

AWS QC10
Entry Level Welding
WELD 115

Performance Objectives. Upon completion, the objective must be signed by instructor for validity.	**Approval 0 - 3**
Oxy-Fuel Cutting (OFC)	
1. Setting up, Lighting, Adjusting, & Shutting Down oxy-fuel cutting equipment	
2. Make a straight cut on 3/8" Carbon Steel, flat position	
3. Make a straight cut on 3/8" Carbon Steel, horizontal position	
4. Make a bevel cut on 3/8" Carbon Steel 22.5-50°, flat position	
5. Make a bevel cut on 3/8" Carbon Steel 22.5-50°, horizontal position	
6. Make a circle cut to fit 1" Pipe/Tube on 3/8" Carbon Steel, flat position	
7. Make a circle cut to fit 1" Pipe/Tube on 3/8" Carbon Steel, horizontal position	
8. Perform scarfing & gouging to remove base & weld metal, flat & horizontal positions on CS	
9. Set up, Operate, & Properly Shut Down OFC Track Burner	
10. Make a straight cut on 3/8" Carbon Steel using the line burner	
11. Make a bevel cut on 3/8" Carbon Steel 22.5-50° Line Burner	
Plasma Arc Cutting (PAC)	
12. Set up, Operate, Shut Down PAC Equipment Properly	
13. Make a straight cut on 1/8" Aluminum, flat position	
14. Make a straight cut on 1/8" Aluminum, horizontal position	
15. Make a straight cut on 10ga Carbon Steel, flat position	
16. Make a straight cut on 10ga Carbon Steel, horizontal position	
17. Make a straight cut on 10ga Stainless Steel, flat position	
18. Make a straight cut on 10ga Stainless Steel, horizontal position	
19. Make circle cut to fit 1" Pipe/Tube on 1/8" Aluminum	
20. Make circle cut to fit 1" Pipe/Tube on 10ga Carbon Steel	

21. Make circle cut to fit 1” Pipe/Tube on 10ga Stainless Steel
Air Carbon Arc Cutting (CAC-A)
22. Set up, Operate, Shut Down CAC-A Equipment Properly
23. Performs scarfing & gouging operations to remove base and weld metal, flat position, on carbon steel
24. Performs scarfing & gouging operations to remove base and weld metal, horizontal position, on carbon steel
Gas Metal Arc Welding – Short Circuit (GMAW-S)
25. Set up, Operate, Shut Down Gas Metal Arc Welding (GMAW-s) equipment
26. Square Groove weld, flat position (1G) on 10ga carbon steel
27. Lap weld, horizontal position (2F) on 10ga carbon steel
28. Tee weld, horizontal position (2F) on 10ga carbon steel
29. Square Groove weld, horizontal position (2G) on 10ga carbon steel
30. Lap weld, vertical position (3F) on 10ga carbon steel
31. Tee weld, vertical position (3F) on 10ga carbon steel
32. Square Groove weld, vertical position (3G) on 10ga carbon steel
33. Lap weld, overhead position (4F) on 10ga carbon steel
34. Tee weld, overhead position (4F) on 10ga carbon steel
35. Square Groove weld, overhead position (4G) on 10ga carbon steel
Gas Metal Arc Welding – Spray (GMAW-Spray)
36. Set up, Operate, Shut Down Gas Metal Arc Welding (GMAW-Spray) equipment
37. V - Groove weld, flat position (1G) on 3/8” carbon steel
38. Lap weld, flat position (1F) on 3/8” carbon steel
39. Tee weld, flat position (1F) on 3/8” carbon steel
40. Lap weld, horizontal position (2F) on 3/8” carbon steel
41. Tee weld, horizontal position (2F) on 3/8” carbon steel

Flux Cored Arc Welding – Gas Shielded (FCAW-G)	
42. Set up, Operate, Shut Down Flux Cored Arc Welding (FCAW-G) equipment	
43. V - Groove weld, flat position (1G) on 3/8” carbon steel	
44. Lap weld, horizontal position (2F) on 3/8” carbon steel	
45. Tee weld, horizontal position (2F) on 3/8” carbon steel	
46. Single Bevel Groove weld, horizontal position (2G) on 3/8” carbon steel	
47. Lap weld, vertical position (3F) on 3/8” carbon steel	
48. Tee weld, vertical position (3F) on 3/8” carbon steel	
49. V - Groove weld, vertical position (3G) on 3/8” carbon steel	
50. Lap weld, overhead position (4F) on 3/8” carbon steel	
51. Tee weld, overhead position (4F) on 3/8” carbon steel	
52. Single Bevel Groove weld, overhead position (4G) on 3/8” carbon steel	
Flux Cored Arc Welding – Self Shielded (FCAW-S)	
53. Set up, Operate, Shut Down Flux Cored Arc Welding (FCAW-S) equipment	
54. V - Groove weld, flat position (1G) on 3/8” carbon steel	
55. Lap weld, horizontal position (2F) on 3/8” carbon steel	
56. Tee weld, horizontal position (2F) on 3/8” carbon steel	
57. Single Bevel Groove weld, horizontal position (2G) on 3/8” carbon steel	
58. Lap weld, vertical position (3F) on 3/8” carbon steel	
59. Tee weld, vertical position (3F) on 3/8” carbon steel	
60. V - Groove weld, vertical position (3G) on 3/8” carbon steel	
61. Lap weld, overhead position (4F) on 3/8” carbon steel	
62. Tee weld, overhead position (4F) on 3/8” carbon steel	

63. Single Bevel Groove weld, overhead position (4G) on 3/8” carbon steel	
Gas Tungsten Arc Welding (GTAW)	
64. Set up, Operate, Shut Down Gas Tungsten Arc Welding (GTAW) equipment	
65. Square Groove weld, flat position (1G) on 1/8” Aluminum	
66. Lap weld, flat position (1F) on 1/8” Aluminum	
67. Tee weld, flat position (1F) on 1/8” Aluminum	
68. Lap weld, horizontal position (2F) on 1/8” Aluminum	
69. Tee weld, horizontal position (2F) on 1/8” Aluminum	
70. Square Groove weld, flat position (1G) on 10ga carbon steel	
71. Lap weld, horizontal position (2F) on 10ga carbon steel	
72. Tee weld, horizontal position (2F) on 10ga carbon steel	
73. Square Groove weld, horizontal position (2G) on 10ga carbon steel	
74. Lap Weld, vertical position (3F) on 10ga carbon steel	
75. Tee Weld, vertical position (3F) on 10ga carbon steel	
76. Square Groove Weld, Vertical Position (3G) on 10ga carbon steel	
77. Lap weld, overhead position (4F) on 10ga carbon steel	
78. Tee weld, overhead position (4F) on 10ga carbon steel	
79. Square Groove weld, overhead position (4G) on 10ga carbon steel	
80. Square Groove Weld, flat position (1G) on 10ga stainless steel	
81. Lap Weld, horizontal position (2F) on 10ga stainless steel	
82. Tee Weld, horizontal position (2F) on 10ga stainless steel	
83. Square Groove Weld, horizontal position (2G) on 10ga stainless steel	
84. Lap Weld, vertical position (3F) on 10ga stainless steel	

85. Tee Weld, vertical position (3F) on 10ga stainless steel	
Shielded Metal Arc Welding (SMAW)	
86. Set up, Operate, & Shut Down SMAW Equipment	
87. Deposit Stringer Beads flat position on ¼" carbon steel – E7018	
88. Deposit Weave Beads flat position on ¼" carbon steel – E7018	
89. V - Groove weld w/backer, flat position (1G) – 3/8" carbon steel – E7018	
90. Lap weld, flat position (1F) on ¼" carbon steel – E7018	
91. Tee weld, flat position (1F) on ¼" carbon steel – E7018	
92. V - Groove weld w/backer, horizontal position (2G) – 3/8" carbon steel – E7018	
93. Lap weld, horizontal position (2F) on ¼" carbon steel – E7018	
94. Tee weld, horizontal position (2F) on ¼" carbon steel – E7018	
95. V - Groove weld w/backer, vertical position (3G) – 3/8" carbon steel – E7018	
96. Lap weld, vertical position (3F) on ¼" carbon steel – E7018	
97. Tee weld, vertical position (3F) on ¼" carbon steel – E7018	
98. V - Groove weld w/backer, overhead position (4G) – 3/8" carbon steel – E7018	
99. Lap weld, overhead position (4F) on ¼" carbon steel – E7018	
100. Tee weld, overhead position (4F) on ¼" carbon steel – E7018	

Total Points Earned _____

Each objective is worth 3 points. Objective must be initialed by instructor to be valid.
Count number of incomplete objectives and multiply by 3, then subtract from 300.
All visual inspection criteria for AWS QC-10 Entry Welder applies to receive weld approval.
This document satisfies the required Training Achievement Record (TAR) for AWS QC-10.

Notes