

Syllabus: Aluminum Welding, WELD 2010

Part 1: Course Information

Description

Preparation for aluminum welders utilizing both GTAW (TIG) and GMAW (MIG). This course will offer safe and proper machine set-up, demonstrate the welding characteristics of aluminum and explain the use of special equipment associated with aluminum welding.

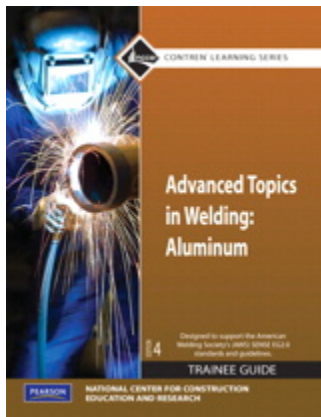
This course is designed to meet over a period of 14 weeks, 1 meetings per week, and 3 hours per meeting in a combined lecture-lab meeting.

Prerequisites

Prior to attending, each individual should be familiar with and has demonstrated their ability to weld carbon and or stainless steel with the GTAW (TIG) process. GMAW (Mig) experience is a desirable.

Required Materials

- Aluminum Welding, Second Edition by N.R. Mandal - \$171.00 (cost to students)
- Advanced Topics in Welding: Aluminum Trainee Guide, Paperback, 4th Edition
By NCCER
Pub. Date: Apr 29, 2010 by Prentice Hall.
ISBN-10: 0-13-213722-4
ISBN-13: 978-0-13-213722-5



Recommended Reference Materials

Tools to be used

Aligned Industry Certifications

WS D1.2, Structural Welding Code - Aluminum - Tech Street \$227.00

http://www.techstreet.com/products/1880360?product_id=1880360&sid=goog&clid=CJ D1ya6gz8kCFYEdHwodiAwD_A

Part 2: Course Learning Outcomes (CLOs)

The course learning outcomes are to have students:

GTAW (TIG) Portion of Course:

1. Comply With Industry Standard Safety Requirements
2. Set-up of Machine to Proper Polarity
3. Adjust Proper Cover Gas Flows
4. Prepare Base Metals, (i.e. Clean and Bevel)
5. Recognize and Choose The Right Filler Metals
6. Perform Fillet Welds On T Joints and Lap Joints
7. Perform Butt Welds On Plate With and Without Bevels
8. Perform Butt Welds On Pipe
9. Learn Different Purging Techniques On Both Plate and Pipe
10. Learn How To Prepare And Setup Test Coupon
11. Throughout The Course Students Will Learn To Recognize Discontinuities and Be Able To Offer Solutions To Correct The Problem

GMAW (MIG) Portion of Course:

12. Comply With Industry Standard Safety Requirements
13. Adjust Voltage and Wire Speed
14. Perform Filet Welds
15. Perform Butt Welds on Plate
16. Recognize Discontinuities and Offer Solutions To Correct The Problem

Part 3: Course Topics and Roadmap

Roadmap

The following roadmap is recommended for instructors

Week	• Lecture Topics • CLOs	Main Concepts, Terms, and Equations	• Lab Projects
1	• 1, 2	Introduction and Safety Class	• stringer beads
2	• 3-5	Discuss different Welding Processes and Equipment	• corner joints

3	• 5-10	Types, Properties and Uses of Aluminum	• Squareness
4	• 5-10	Issues related to Aluminum	• T-joint fillet
5	• 2	Aluminum in Industry	• T-joint fillet, • GTAW AC and DCEN
6	• 5-10	Heat treatment	• V-Groove
7	• 5-10	Intro to NDT	• V-Groove Open Root
8	• 5-10	Review and Quiz	• V-Groove Vertical and Overhead
9	• 5-10	NCCER Modules	• Double V- Groove
10	• 5-10	NCCER Modules	• Pipe Welds
11	• 5-10	NCCER Modules	• Pipe Welds 5g position
12	• 5-10	NCCER Modules	• Pipe Welds 6g position
13	• 12-16	NCCER Modules	• MIG welding
14	•	Review and Quiz	• Wrap-up

Part 4: Grading and Assessment

Graded Assignments

Students will complete weekly safety messages, will perform welding projects under the direction of the welding instructor, and will complete written assignments.

Proposed Grading Schedule

Attendance –	10%
Quizzes – 4 x 2.5% -	10%
Homework –	10%
Lab –	20%
Mini Lab Projects –	10%
Midterm Exam –	20%
Final Exam –	20%
	= 100%

Part 5: Notes to Program Administrators

Resources

See Appendix

Instructor Qualification

Instructor Qualifications Lecture

- Bachelor's or higher degree in a qualifying field or
- Bachelor's or higher degree in any discipline and certifying credentials:
 - 30 undergraduate hours or 18 graduate hours of coursework in a qualifying field, or
- Bachelor's or higher degree with relevant supplemental experiential experience:
 - Two years professional employment or
 - Research or publications, or
- A.A.S. in a qualifying discipline and four years of relevant professional employment

Qualifying fields:

Metallurgical Engineering

Mechanical Engineering

Construction Technology

Quality Assurance/Quality Control Technology

Instructor Qualifications Lab

1. Certified Welding Instructor
2. Relevant professional certification(s) for Aluminum Welding

Prepared by

Keith Barding and Spencer Peterson

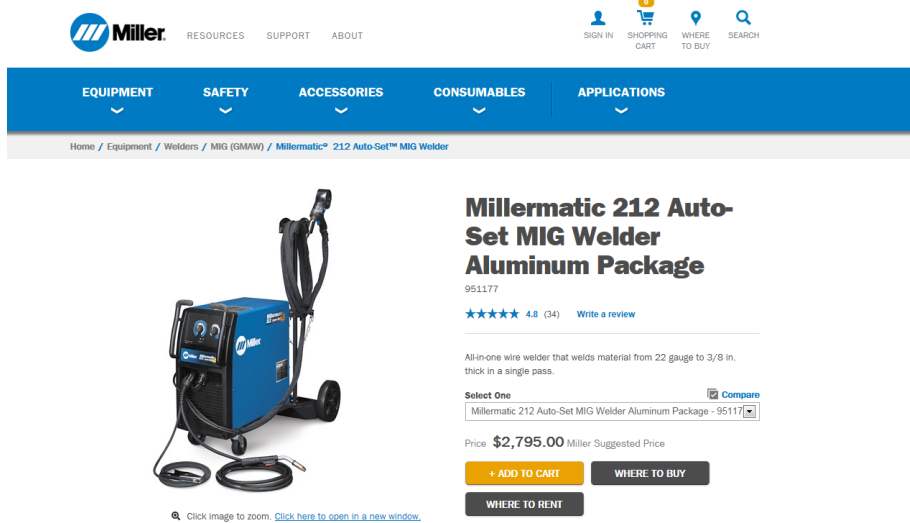
Appendix A

List of Material and Equipment

Required Materials-Equipment

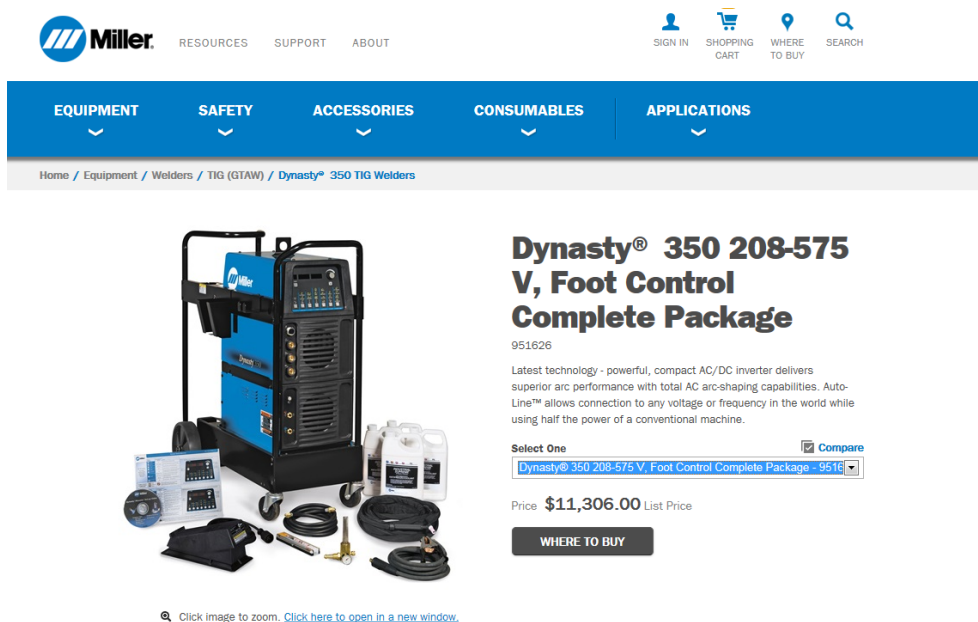
1. Laptop Computer
2. Projector and Screen, for Power Point Presentation and The Use of a Conference Room
3. Welding Machines:

One of the following:



The screenshot shows the Miller website's product page for the Millermatic 212 Auto-Set MIG Welder Aluminum Package. The page features a blue header with the Miller logo and navigation links for Resources, Support, and About. A secondary navigation bar includes Equipment, Safety, Accessories, Consumables, and Applications. The breadcrumb trail reads: Home / Equipment / Welders / MIG (GMAW) / Millermatic® 212 Auto-Set™ MIG Welder. The product image shows a blue Millermatic 212 MIG welder with its accessories. The product title is "Millermatic 212 Auto-Set MIG Welder Aluminum Package" with ID 951177. It has a 4.8 star rating from 34 reviews. The description states it is an all-in-one wire welder that welds material from 22 gauge to 3/8 in. thick in a single pass. The price is \$2,795.00, labeled as the Miller Suggested Price. There are buttons for "ADD TO CART", "WHERE TO BUY", and "WHERE TO RENT".

Six of the following:



The screenshot shows the Miller website's product page for the Dynasty 350 208-575 V, Foot Control Complete Package. The page features a blue header with the Miller logo and navigation links for Resources, Support, and About. A secondary navigation bar includes Equipment, Safety, Accessories, Consumables, and Applications. The breadcrumb trail reads: Home / Equipment / Welders / TIG (GTAW) / Dynasty® 350 TIG Welders. The product image shows the Dynasty 350 TIG welder on a cart with its accessories, including a foot pedal and various cables. The product title is "Dynasty® 350 208-575 V, Foot Control Complete Package" with ID 951626. The description highlights its latest technology, powerful AC/DC inverter, and superior arc performance. The price is \$11,306.00, labeled as the List Price. There is a "WHERE TO BUY" button.

4. Argon (Cover Gas and purge Supply)
5. Power Supply to Satisfy Welding Machines Will Self-adjust to Voltage. Single Phase 240V is adequate. Roane State to get quotes.
6. Six Booths with Steel Tables, Welding Curtains and 110 Power.
7. Jig/Vise To Hold Coupons (Vise \$50 each, Jigs custom built \$200 each)
8. Regulators and Hoses For Purging Applications (\$100 each) 6 of each. Welding machines will come with regulator and applicable hoses.
9. Stools Inside Welding Booths (\$100 each)
10. Building Ventilation (Exhaust Hoods) Roane State to get quotes.
11. One Belt Sander (\$180)
12. 4" Side Grinders (Five Total; One per Booth and a Spare) (\$100 each)
13. Face Shields (With Extra Clear Shields) (\$15 Head Gear, \$10 Lenses/Covers)
14. Extension Cords For Hand Tools UL Approved (\$30 each)

Required Materials-Consumables (enough to supply 6 booths, 12 welders)

NOTE: Money must be available to purchase consumables if numbers change.

1. TIG wire (4043 aluminum):
 - 10 lbs. of 1/16 (\$5 per lbs.)
 - 30 lbs. of 1/32 (\$5 per lbs.)
 - 30 lbs. of 1/8 (\$45 per lbs.)
2. Tungsten (pure)
 - 20 sticks of 3/32 for class duration (\$3 per stick)
 - 20 sticks of 1/8 for call duration (\$3 per stick)
3. 4 Dozen TIG Rig Cups (nozzles) Various Sizes (\$2.50 each)
4. Minimum of 24 Gas Lenses for TIG Rigs (\$4.00 each)
5. 20 Each Collets and Collet Bodies (\$1.00 each)
6. 8 Inch Grinding Discs (\$5.00 each)
7. 4 x 36 Inch Grinding Belts (\$15.00 each)
8. 24 Flapper-Style Grinding Discs for Aluminum (\$8.00 each)
9. Various Sizes C-clamps, One Set Per Welding Booth (\$15.00 each)
10. Spool Wire For MIG Application (One Size That Is Decided Upon) (Hobart 4043 .035 x 1 pound \$10.00)

NOTE: Students will supply his or her own welding hood, safety glasses (must be worn), files, gloves, special magnification lenses and any other Personal Protective Equipment needed (e.g. flame-resistant clothing and gear).

ATTACHMENT A
Sample Quote

HARRIMAN OFFICE

1981 S. Roane St.
Harriman, TN 37748
(865) 882-3251
FAX (865) 882-1750
www.holstongases.com



THIS QUOTE ISSUED BY:
HOLSTON GASES-HARRIMAN
1981 S. Roane St
PO Box 1425
Harriman, TN 37748-1425
1-865-882-3251

PRICE QUOTATION

S E T L O L HARRIMAN VISA ACCOUNT
1981 S ROANE ST
HARRIMAN TN 37748-1425
S H I P KEITH BARDING

CUST#	QUOTE#	GIVEN BY	ON DATE	LOC	TERMS	CUSTOMER PO#
VIS18	665033	JAMES	12/10/15	18	NET 30 DAYS	
ITEM NUMBER	DESCRIPTION	QUANTITY	U/M	PRICE	EXTENSION	
951468	DYNASTY 280DX PACKAGE		EA	6,251.0000		
951469	PKG,DYNASTY 280 DX WIRELE		EA	6,669.0000		
951626	PKG,DYNASTY 350 COMPLETE			8,140.0000		
951627	PKG, DYNASTY 350 COMPLETE		EA	8,558.0000		
THESE PRICES INCLUDE THE AVAILABLE EDUCATIONAL DISCOUNT. THERE ARE NO EXTRA DISCOUNTS FOR MULTIPLE QUANTITIES.						
					TAX:	\$.00
					QUOTE TOTAL:	\$.00

QUOTE EXPIRES MIDNIGHT
ON 1/31/16

Appendix B: Detailed Weekly Schedule

Breakdown of Classes/Labs to Be Held:

Week 1

- Class Time: Introduction and Safety Class
- Material:
 - Total per student: 12 each 6"x 6" x 1/8" plates (flat bar)
 - Total per class: 6' of 6"x 1/8" Flat Bar
- Activity: Perform padding exercise by laminating plates with stringer beads. Student will weld both sides of plate. Once plate is full student will continue padding over existing beads for the remainder of class.
- Process: GTAW with 100% argon.

Week 2

- Class Time: Discuss different Welding Processes and Equipment used
- Material:
 - Total per student: 8 each 4"x6"x1/8" flat bar and 4 each 4"x4"x1/8 flat bar
 - Total per class: 64' of 4"x1/8" flat bar
- Activity: Students will build a box utilizing the corner joint configuration. The box will be 6"x 4". Students will have material available to build 2 boxes each. One box maybe rolled and welded any position. The second box should welded horizontal and vertical.
- Process: GTAW AC 100% argon

Week 3

- Class Time: Discuss different types of aluminum, aluminum's properties, and why and where they are used in industry.
- Material:
 - Total per student: 10' of 1"x1"x1/8" wall square tube
 - Total for class: 120' of 1"x1"x1/8" square tube
- Activity: Students will build a 10"x10" square frame, ensuring the widget dimensions are equal and square. The top and bottom will be 45 degrees at the corners and a post will be installed to separate top from bottom.
- Process: GTAW AC with 100% argon

Week 4

- Class Time: Discussion on Issues related with Aluminum
- Material:
 - Per student: 1 each 6"x6"x1/4" plate and 6 each 1"x1/4" flat bars
 - 6' of 6"x1/4" flat bar and 36' of 1"x1/4" flat bar

- Activity: Using 1/4" material, students will perform T-joint fillet welds. Students will tack weld 3 each of the 1" flat bar equally spaced on each side of 6" plate. Fillet welds will be applied to each side of the 1" flat bar producing 12 total 6" long fillets per widget; one side flat one side vertical. If time allows students will apply 2 addition beads on top of original single bead fillet producing larger fillet. Students should maintaining proper bead separation.
- Process: GTAW AC current 100% argon.

Week 5

- Class Time: Why and Where Aluminum is used in industry.
- Material:
 - Per student: 1 each 6"x6"x1/4" plate and 6 each 6" x 1"x 1/4" flat bars
 - Per class: 12' of 6"x1/4" and 36' of 1"x1/4" flat bar
- Activity: Using 1/4" material performs T-joints fillet welds using Fillet welds are to be performed in flat and vertical positions. If time allows, students can continue welding on widget producing larger fillet welds maintaining proper bead separation.
- Process: GTAW AC and DCEN (straight polarity). AC mode will require a small amount of helium mixed with argon. Gas regulators will require a Y assembly to mix the gases from 2 cylinders and DCEN (straight polarity) using 100% helium.

Week 6

- Class Time: Discuss Different heat treatments and non-heat treatments associated with Aluminum
- Material:
 - Total per student: 4 each 2"x6"x1/4" flat bar and 2 each 1"x6"x1/8" flat bar
 - Total per class: 24' of 2"x1/4" flat bar and 12' of 1"x1/8" flat bar
- Activity: Perform v-groove (beveled on one side of each plate) welds with 1/8" thick backing plate. Root opening 1/8"-1/4". Each coupon will consist of 2 each 2"x6"x1/4" plate/flat bar and 1 each 1"x6"x1/8" flat bar. 2 coupons per student, one welded flat and one vertical.
- Process: GTAW AC 100% argon

Week 7

- Class Time: Discuss the Importance of Non-Destructive Examination
- Material:
 - Total per student: 2' of 2"x 1/4" flat bar
 - Total per class: 24' of 2"x1/4" flat bar
- Activity: Using 1/4" material and performing v-groove open root (root opening 3/32"-1/8") weld. No purging, students will back grind and back weld. Weld

positions will be flat and horizontal. If time allows one end of each completed coupon can be beveled and welded in position of choice. Bevel 2-2"x6" plates .2 total coupons per student.

- Process: GTAW AC 100% argon

Week 8

- Class Time: Review and Quiz from Weeks 1 through 7
- Material:
 - Total per student: 2 total coupons per student. 2' of 2"x1/4" flat bar.
 - Total per class: 24' of 2"x1/4" flat bar
- Activity: Using 1/4" material and performing v-groove open root (root opening 3/32"-1/8") weld. No purging, students will back grind and back weld. Weld positions will be vertical and overhead. If time allows one end of each completed coupon can be beveled and welded in position of choice. Bevel 2-2"x6" plates.
- Process: GTAW AC 100% argon

Week 9

- Class Time: NCCER Module
- Material:
 - Discarded outboard lower units (supplied by Keith Barding and Bunch marine)
- Activity: Students will be asked to repair specific sections of the unit. 6061 material will be used to replace missing pieces on the unit. This will require cutting to shape, welding and grinding. Unit should be ready for paint upon completion. Weld joint would consist of a double v-groove (both sides) to obtain a 100% penetration weld. Weld, straightness and overall appearance will be critiqued.
- Process: GTAW AC (argon and helium mix if needed)

Week 10

- Class Time: NCCER Module
- Material:
 - Total per student: 3 each 4" long producing 3 welds. 1 foot of material per student.
 - Total per class: 12' of 3" sch 40
- Activity: Using 3" sch 40 pipe prepared 4" long, beveled on both ends. Students will be asked to perform complete penetration welds with v-groove open root set up (root opening 3/32"-1/8"). Internal argon purge will be required. Students will be permitted to roll pipe. After welding, coupons will be cut and opposing ends welded together using same method.

- Process: GTAW AC 100% argon

Week 11

- Class Time: NCCER Module
- Material:
 - Total per student: 3 each 4" long per student producing 3 welds
 - Total per class: 12' of 3" sch 40 pipe
- Activity: Using 3" sch 40 pipe prepared 4" long, beveled on both ends. Students will be asked to perform complete penetration welds with a v-groove open root set up (root opening 3/32"-1/8"). Internal purge will be required. Students will weld one joint 2g (weld horizontal/pipe vertical) and one weld 5g (weld vertical uphill pipe horizontal). After welding, coupons will be cut and opposing ends welded together using the same method.
- Process: GTAW AC 100% argon

Week 12

- Class Time: NCCER Module
- Material:
 - Total per student: 3 each 4" long per student producing 3 welds
 - Total per class: 12' of 3" sch 40 pipe
- Activity: Activity: Using 3" sch 40 pipe prepared 4" long, beveled on both ends. Students will be asked to perform complete penetration welds with a v-groove open root set up (root opening 3/32"-1/8"). Internal purge will be required. Students will weld all joints in 6g position (weld horizontal/pipe vertical). If time permits, coupons will be cut and opposing ends welded together using the same method.
- Process: GTAW AC 100% argon.

Week 13

- Class Time: NCCER Module
- Material:
 - Total per class: 40' of 2"x1/4" flat bar
- Activities: Classes 14 will be based on how many GMAW (MIG) machines are available. Material will be available for padding, lap joints, tee joints, 3" pipe to plate making circular fillet welds and groove welds, as time allows students will weld various set ups and positions.
- Process: GMAW, gas to be determined

Week 14

- Class Time: Semester Review, Final Quiz, and Finish Final Project
- Lab Time: Free Time in Lab, Practice Techniques, use different Processes.

