# ATSM-2140: INDUSTRIAL I WELDING

## Cuyahoga Community College

### Viewing: ATSM-2140 : Industrial I Welding

**Board of Trustees:**

November 2020

**Academic Term:**

Fall 2021

**Subject Code**

ATSM - Applied Ind Tech- Sheetmetal

**Course Number:**

2140

**Title:**

Industrial I Welding

**Catalog Description:**

Course covers the work scope of industrial sheet metal, applied math concepts used for layout applications and fabrication and welding techniques. In addition, rigging and hoisting operations and worker safety considerations will be addressed.

**Credit Hour(s):**

3

**Lecture Hour(s):**

3

### Requisites

**Prerequisite and Corequisite**

Departmental approval: Must be enrolled in the union sheet metal apprenticeship program and/or be a member in good standing of the sheet metal workers union

### Outcomes

**Course Outcome(s):**

Describe the various types of work associated with Industrial Sheet Metal, identify the job site hazards, and describe the different materials, coatings, and linings that are used.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. List and define the terms related to Industrial Sheet Metal.
2. Describe the types of work related to Industrial Fabrication and Welding.
3. Differentiate between residential, commercial, and industrial sheet metal work.
4. Identify the safety concerns related to industrial sheet metal installations with respect to “struck by”, environmental, and fall protection.
5. Explain the importance of the roles and responsibilities for working in confined spaces.

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**Course Outcome(s):**

Examine used and apply mathematical concepts to create various geometric shapes required for transitions, collars and offsets.the sheet metal industry, identify the different metals and non-metal materials.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. List and define the terms used for materials and geometric shapes in the industrial sheet metal industry.
2. Differentiate between metal and non-metal materials and explain the application of each.
3. Identify the geometric shapes used for transitions, collars, and offsets and triangulation concepts used to establish them.
4. Establish the sheet metal circumferences using mean diameters for calculations.

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**Course Outcome(s):**

Prepare required sheet metal for fabrication by employing seam fitting set-up, alignment points and quarter markings and establishing correct bend segments and mean diameters for stretch-out cut sizes.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. Pattern draft various fittings required for plasma cutting operations.
2. List and define the terms related to industrial sheet metal layout.
3. Establish correct seam fitting fit-up required for proper weld penetration.
4. Quarter mark sheet metal patterns to achieve precise alignments.
5. Layout required bend segments using fitting degree angle of the applicable fitting.
6. Calculate correct stretch out sizes using proper mean and diameters.

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**Course Outcome(s):**

Describe the different welding applications used in industrial metal fabrication including various alloys, shielding gases, welding techniques, shop drawings, and testing procedures.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. List and explain the different types of welding and finishing procedures used in metal fabrication.
2. Identify the welding alloys used and describe the application of each.
3. Explain how TIG lengths relate to specific metal fabrication with regards to filler materials and shielding gases.
4. Explain how machine set-up and welding techniques relate to distortion and heat transfer.
5. Explain the effect of chromium loss by heat transfer during welding on stainless steel material.
6. Describe the heat affected zone during fabrication due to heat input and explain the resulting distortion on the weld.
7. Interpret different computer aided drawings (CAD) to determine welding symbols, fit-up, and inside/outside diameters and dimensions.
8. Differentiate between braze welding and TIG welding with regards to filler materials.
9. List the different forms of NDT and the respective procedures.

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**Course Outcome(s):**

Discuss rigging and hoisting operations employed by the Sheet Metal worker including communication methods, lifting procedures, and math applications to safely rig and hoist industrial sheet metal and structural components.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. List and define the terms related to rigging and hoisting operations.
2. Describe various rigging and hoisting operations performed by the Sheet Metal worker in the shop or on the jobsite.
3. List and define the different types of equipment used with respect to rigging and hoisting.
4. Review general safety rigging regulations as prescribed by the Occupational Safety and Health Administration (OSHA) to lift various loads.
5. Apply math concepts to identify lifting weights and sling capacities that determine the maximum mass force of load that rate rigging hardware and slings.

6. Identify the communication methods used to hoist loads safely in various configurations.
7. Describe specialty lifting and safety procedures applied to load placement using helicopters.

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**Methods of Evaluation:**

1. Quizzes
2. Tests
3. Class participation
4. Student must demonstrate proficiency in specified welding processes in accordance with industry standards

**Course Content Outline:**

1. Industrial Sheet Metal
    a. Terminology
        i. Industrial Sheet Metal
        ii. Modular built
        iii. Fabricate
        iv. Press brake
        v. CNC Plasma Machine
        vi. Situational awareness
    b. Types of industrial sheet metal
        i. Pharmaceutical  manufacturing
            1. Dust collection
            2. Air scrubbers
            3. Ground and polished welds
        ii. Automotive
            1. Paint booth
            2. Conveyance
            3. Clean rooms
            4. Ventilation
        iii. Food processing
            1. Dust collection
            2. Conveyor
            3. Stainless steel maintenance
            4. Packaging
        iv. Power generation
            1. Coal
                a. Chutes
                b. Hopper
            2. Insulation and lagging
            3. Stacks and boiler breechings
        v. Waste removal
            1. Fume control
            2. Air scrubber
            3. Chutes
            4. Conveyance and ventilation
    c. Residential, commercial, and industrial
        i. Residential
            1. Furnace
            2. Air conditioners
            3. Bathroom ventilators
            4. Kitchen exhaust
        ii. Commercial
            1. Heating, ventilation,  and air conditioners
            2. Roofing
            3. Curbs
        iii. Industrial
            1. Food service
            2. Power generation

3. High tech
4. Steel production

d. Safety concerns
   i. Struck by
      1. Falling objects
      2. Boom swing
   ii. Environmental
      1. Weather related
      2. Pollution
      3. Chemical
   iii. Fall protection
      1. Ladder safety
      2. Lifts
      3. Roofs
e. Confined space
   i. Locations
      1. Tank
      2. Ditches
      3. Ovens
   ii. Roles of attendant
      1. Air monitoring
      2. Communication
      3. Entry/exit
      4. Changing work conditions
   iii. Responsibilities
      1. Work permits
      2. Lock out/tag out
      3. Oxygen readings

2. Metals and Math
   a. Terminology
      i. Industrial sheet metal
      ii. Stainless steel
      iii. Mild steel
      iv. Wear plate
      v. Inconnel
      vi. Transitional collar
      vii. Obtuse
      viii. Acute
      ix. Off set
      x. Triangulation
      xi. Conical
      xii. Cylindrical
      xiii. Tapered
      xiv. Non metal
   b. Metal and nonmetal
      i. Metal
         1. Conductivity
         2. Wear plate
            a. Abrasive conditions
            b. Durable
            c. Longevity
            d. Annealed
         3. Aluminum
            a. Non magnetic
            b. Flexible
            c. Grades of hardness
         4. Stainless steel
            a. Nickle, carbon, chromium
            b. Grade

c. Clean
d. Food service facilities
5. Mild steel
a. Blow pipe application
b. Dust collection
c. Paint ability
d. Versatile
6. Inconel
a. Burners
b. Heat exchangers
c. Hard/dense
d. Custom made alloy

ii. Nonmetal
1. Fiberglass
a. Corrosive applications
b. Non metallic
c. Weld able
d. Insulating and lagging
2. Plastic
a. Ventilation
b. Dust collection
c. Flue pipe
d. Condensation purposes
3. Geometric shapes
a. Triangle
i. Pythagorean theorem
ii. Number squares
b. Rectangular
i. Diagonal measurement
ii. Area
iii. Volume
c. Conical
i. Circle division
ii. True length
d. Oval
i. Area
ii. Half circle division
e. Cylindrical
i. Area
ii. Volume

3. Industrial Sheet Metal Layout
a. Pattern draft
i. Fittings
ii. Components
iii. Shop fabrication
iv. Plasma cutting
1. Programming
2. Diameters
a. Inside
b. Outside

b. Terminology
i. Seam fitting
ii. Seam fit-up
iii. Bend segment
iv. Bend degrees
v. Alignment point
vi. Quarter markings
vii. Mean diameter
viii. Stretch out

ix. Cut size
x. Triangulation
xi. True lengths
xii. Fitting degree angle
xiii. Pattern draft
xiv. Pattern sketch

c. Seam fitting fit-up
i. Material thickness
ii. Seam allowances
iii. Degree of finished fitting divided by number of bend segments

d. Quarter mark
i. Circle division
ii. Alignment
iii. Sheet metal patterns

e. Bend segments
i. Material stroking
ii. Circumference divided by 12
iii. Smooth bending

f. Stretch out sizes
i. Actual cut size
ii. Mean diameter
iii. Material thickness

4. Industrial welding techniques
a. Welding types and finishes
i. Gas metal arc welding (GMAW)
1. Mild steel
2. Structural
ii. Tungsten inert gas (TIG)
1. Stainless
2. Aluminum
3. Silicon-bronze brazing
iii. Shielded metal arc welding (SMAW)
iv. Finishes
1. Grinding
2. Sanding
3. Buffing
4. Food grade
5. Dairy grade

b. Alloys
i. Hot rolled mild steel
1. ASTM grade xx
2. Non-pickled
ii. Cold rolled
1. ATSM xx
2. Pickled
iii. ATSM 36
iv. Stainless
1. Nickle
2. Carbon
3. Chromium
v. 300 series
vi. 400 series
vii. 4000 and 5000 aluminum

c. TIG lengths
i. 12 inches
1. Tight welding space
2. Expensive
ii. 24 inch
iii. 36 inch

1. Common use
2. Cost effective
3. Filler material

d. Machine set-up/welding technique
   i. Distortion
      1. Excessive heat input
      2. Rejection
   ii. Heat transfer
      1. Varies with material grade
      2. Material thickness
   iii. Welding technique
      1. Travel speed
      2. Distance
      3. Angle
      4. Heat

5. Rigging and hoisting
   a. Terminology
      i. Rigging
      ii. Hoisting
      iii. Shackle
      iv. Sling
      v. Wire rope
      vi. Nylon sling
      vii. Hitch
      viii. Hand signal
      ix. Sling angle
      x. Lift point
      xi. Risk management
      xii. Load configuration
      xiii. Lifting weights
      xiv. Lifting inspection
      xv. Sling capacity
      xvi. Link chain
      xvii. Chain fall
      xviii. Come along
      xix. Rotor downwash
   b. Operations
      i. Rigging
         1. Large and heavy
         2. Structural beams
         3. Pipe
         4. Stacks
         5. Load placement
      ii. Hoisting
         1. Manual
         2. Chain fall
         3. Come along
         4. Crane
            a. Boom truck
            b. Fixed
            c. Mobile
            d. Jib
         5. Helicopter
   c. Equipment
      i. Slings
         1. Wire rope
         2. Synthetic
         3. Synthetic web
         4. Chain

        a. Link
        b. Alloy
    ii. Shackle
    iii. Lifting beam
    iv. Beam grab
    v. Hooks
d. Safety
    i. Risk management
        1. Job familiarity
        2. Preparedness
        3. Correct and safe installations
        4. Housekeeping
        5. Universal responsibility
    ii. Crane safety
        1. Signaling
        2. Maneuverability
        3. Hoisting
    iii. OSHA
        1. Subpart L: Scaffolding
        2. Subpart M: Fall Protection
e. Rigging math
    i. Load limits
    ii. Center of gravity
    iii. Load calculations
    iv. Irregular shapes
        1. Rigging lifting points
        2. Height/length ratio
    v. Equipment capacities
        1. Calculations
        2. Load charts
f. Communication methods
    i. Hand signals: 100% eye contact
    ii. Radio
    iii. Critical operations
    iv. Responsibilities
        1. Eyes
        2. Ears
        3. Operator
    v. Load configurations
        1. Site layout
        2. Operator – signal person
        3. Placement locations
g. Helicopter hoisting
    i. Safety procedures
        1. OSHA 29 CFR 1910.183
        2. Daily briefing
            a. Lifting schedule
            b. Job activities
        3. Load release mechanisms
            a. Daily testing
            b. Pilot controlled
    ii. PPE / special considerations
        1. Hard hat chin strap
        2. Ear plugs
        3. Full eye protection
        4. Rubber gloves
    iii. Secure material and equipment
    iv. Pilot control duties

1. Full veto power
2. Release control

v. Assured clear distance
vi. Restricted zones
vii. Employer trained personnel
viii. Fire control/rotor downwash

## Resources

International Training Institute. *Industrial Sheet Metal and Welding* . 2007 edition. Fairfax, Virginia; International Training Institute, 2014. 2007.

American Welding Society . *Welding Inspection Technology* . Fifth edition . Miami, Florida; American Welding Society , 2008.

SMACNA. *Architectural Sheet Metal Core Curriculum*. 6th edition. Chantilly, Va.;SMACNA, 2004.

**Resources Other**

http://www.weldersuniverse.com/welding_symbols.html

ttp://www.metallicfusion.com/symbols_and_definitions.htm

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