ATGL-2815: SPECIAL TOPICS: GLAZIER WELDING: 3G

Cuyahoga Community College

Viewing: ATGL-2815 : Special Topics: Glazier Welding: 3G

Academic Term:

Spring 2021

Subject Code

ATGL - Appld Indus Tech - Glazing

Course Number:

2815

Title:

Special Topics: Glazier Welding: 3G

Catalog Description:

Comprehensive course covering welding processes used in the glazing industry. Course includes processes, applications and welding safety. Welding processes include horizontal, vertical and overhead applications. The student will perform related welding tasks related to the glazing trade and in compliance with current industry standards.

Credit Hour(s):

4

Lecture Hour(s):

4

Requisites

Prerequisite and Corequisite

Departmental approval and a member in good standing with the International Union of Painters and Allied Trades.

Outcomes

Course Outcome(s):

Discuss various welding processes, applications and techniques used in the glazing industry, recognize welder safety and protection, conditions encountered during welding operations and preventative measures taken and interpret common welding symbols applied in accordance with the American Welding Society.

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 terms related to welding operations.**
2. **Explain the definition of “welding” and describe the process of joining metal with a common bond.**
3. **Describe the two grouped processes in terms of “mode of energy transfer” and “influence of capillary attraction with respect to filler metal distribution.**
4. **List and describe the common welding processes.**
5. **Identify the different welding industries and state the major functions of each. List and describe common welding conditions and safety hazards.**
6. **Identify various safety precautions required for worker safety.**
7. **Describe the five basic types of weld joints commonly used in glazing applications.**
8. **List and describe the respective welding positions.**
9. **Identify standardized welding symbols used to locate, indicate joint type and weld size and deposited weld metal.**
10. **List the proper personal protective equipment PPE required for protection against respective risk hazards.**

Course Outcome(s):

II. Discuss the applications and safety procedures, electrode types, classifications and polarity, weld defects and the processes of welding for the glazing industry

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 the uses and applications of welding for glaziers. Discuss the nature of the arc and identify the safety procedures for equipment set up and use.**
2. **Identify the different types of filler material used in welding and explain the parts of the electrode and the respective function of each.**
3. **List the five essentials of good welding and explain each**
4. **Identify the common welding defects and discuss the causes and corrections.**
5. **Explain the methods used to start an arc in welding processes and discuss the aspects of peening, crater control, undercutting and overlap.**
6. **Demonstrate the ability to properly set up the welding equipment, select applicable electrodes and apply basic weld beads to plate steel.**

Course Outcome(s):

III. Discuss the welding processes in the horizontal position, including techniques used, electrode movement, and demonstrate the ability to perform welding operations for various butt joints welded in the horizontal position.

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. **Explain the welding process in the horizontal position, including groove and fillet welds and identify the respective axis of the weld.**
2. **Describe the movement of the electrode use for welds made in the horizontal position including the respective work and travel angles.**
3. **Explain the function of narrow weaving motion technique for heat distribution and sag control.**
4. **List the different types of butt joints used for horizontal welding.**
5. **Demonstrate the ability to weld in the horizontal position in accordance with industry standards.**

Course Outcome(s):

IV. Discuss the application of vertical welding including the difference between upward and downward motion, various techniques used including those specific to the use of the E-7018 electrode welds on T-Joints using stringer and weave bead techniques.

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 the applications of vertical position welding.**
2. **Differentiate between vertical up and vertical down welding.**
3. **Discuss the advantages of vertical up welding with upward progression.**
4. **Discuss the techniques used to weld vertical up including rod selection and movement.**
5. **Demonstrate the ability to perform welding processes on T-Joints using stringer and weave bead techniques.**

Course Outcome(s):

V. Identify the respective processes used for overhead welding including positioning and techniques, special PPE, welding machine settings, and electrode movement, butt and t-joint welds and demonstrate correct procedures used in overhead welding.

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. **Describe the difficulties encountered in overhead welding including gravity forces, awkward stance, and cable weight and body fatigue.**
2. **Discuss the importance of following strict guidelines for PPE while performing overhead welding operations and identify specific PPE.**
3. **State the importance of arc length and amperage setting and explain consequences of long arc length.**
4. **Describe the proper procedure used for overhead weld butt joints and discuss the preference of bead welds over weave welds.**
5. **Explain the consequences of using electrodes that are too large.**
6. **Describe the preferred methods used in making t-joint welds in the overhead position.**
7. **Demonstrate the ability to perform welding processes in the overhead position following procedures adopted by the AWS including correct travel angle electrode selection and positioning, specific personal welding positions, and correct arc length and appropriate welding motion.**

Course Outcome(s):

VI. Discuss the respective arc welding techniques and flame cutting procedures, including safety procedures, and identify the components of the torch and oxyacetylene consumables.

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):

A. List and discuss the safety procedures as prescribed by the Occupational Safety and Health Administration (OSHA) relative to the welding industry
B. Recognize the safety hazards with respect to welding including arc flash, electrical shock and burns.
C. Discuss the importance of the hot work permit and explain the procedures that are to be followed.
D. List and define the terms related to basic metal cutting and welding
E. Identify the components of the oxyacetylene torch and describe the function of each.
F. List the consumables in the torch cutting process and discuss proper handling and storage practices.

Methods of Evaluation:

1. **quizzes, tests, class participation;**
2. student will demonstrate the ability to perform welding process in horizontal, vertical and overhead positions in accordance with current industry standards;

Course Content Outline:

Course Outline

1. **Glazier welding**
    a. **Terminology**
        i. **Welding**
        ii. **Electrode**
        iii. **Muscle Memory**
        iv. **Position**
        v. **Stinger**
        vi. **Duty Cycle**
        vii. **Amperage**
        viii. **Slag**
        ix. **Base Metal**
        x. **Filler Metal**
        xi. **Root Pass**
        xii. **Intermediate Pas**
        xiii. **Cover Pass**
        xiv. **Slag Inclusion**
        xv. **Undercuts**
        xvi. **Welding Position**
        xvii. **Grounding**
        xviii. **Polarity**
        xix. **Flat**

xx. **Fillet**
xxi. **Groove**
xxii. **Weld Pool**
xxiii. **Consumable**
xxiv. **Arc**
xxv. **Flux Covering**
xxvi. **Heat Fatigue**
xxvii. **Electrode Core**
xxviii. **Crater**
xxix. **Bead**

1. **Welding defined, purpose and filler material**
   a. **Defined**
      i. **Processes**
      ii. **Modes of joining**
   b. **Purpose**
      i. **Strength**
      ii. **Points of attachment**
      iii. **Temporary attachments**
   c. **Filler metal**
      i. **Sacrificial metals**
      ii. **Bond metal**
      iii. **Varies with application**
2. **Grouped processes**
   a. **Mode of energy transfer**
      i. **Alternating current**
         1. **Positive**
         2. **Negative**
      ii. **Direct current**
         1. **Positive**
         2. **Negative**
      iii. **Decorative**
      iv. **Explosive**
      v. **Penetration depth**
   b. **Influence of capillary attraction**
      i. **Metal bonding**
      ii. **Filler metal inclusion**
3. **Welding processes**
   a. **SMAW**
   b. **Flux core SCAW**
   c. **Gas metal arc GMAW**
   d. **Plasma arc PAW**
   e. **Carbon arc CAW**
   f. **Gas tungsten arc GTAW**
   g. **Stud arc SW**
   h. **Submerged arc SAW**

1. **Brazing**
   a. **Diffusion**
   b. **Dip**
   c. **Furnace**
   d. **Induction**
   e. **Infrared**
   f. **Resistance**
   g. **Torch**
2. **Oxy-fuel gas and resistance**
   a. **Oxy-acetylene**
   b. **Oxy-hydrogen**
   c. **Pressure gas**
   d. **Flash**

    e. **High frequency**
    f. **Percussion**
    g. **Protection**
    h. **Resistance seam**
    i. **Resistance spot**
    j. **Upset**
3. **Solid state**
4. **Soldering**
5. **Miscellaneous**
    a. **Laser beam**
    b. **Induction**
6. **Welding industries**
    a. **Ship building**
    b. **Automotive**
        i. **Manufacturing**
        ii. **Repair**
    c. **Aerospace**
    d. **Construction**
    e. **Buildings**
    f. **Bridges**
    g. **Pipelines**
    h. **Power plants**
    i. **Refineries**
    j. **Function**
        i. **Fabrication**
        ii. **Maintenance**
        iii. **Repair**

1. **Conditions/hazards**
    a. **Fire**
    b. **Wet/moist**
    c. **Electrical**
    d. **Electrical/wet**
2. **Safety standards/precautions**
    a. **1926.350`**
        i. **Compressed gas cylinders-storage**
        ii. **Handling**
        iii. **Transportation**
        iv. **Assembly/disassembly**
    b. **1926.351**
        i. **Welding**
            1. **Grounding**
            2. **Shielding**
            3. **Cables and connectors**
        ii. **General**
    c. **1926.352 Fire Prevention**
        i. **Restrictions**
            1. **Fire in closed spaces**
            2. **Hazard removal**
        ii. **Heating transfer**
            1. **Drums**
            2. **Hollowed structures**
    d. **1926.353**
3. **Basic weld joints**
    a. **Butt**
    b. **Tee**
    c. **Lap**
    d. **Edge**
    e. **Corner**
4. **Welding positions**

a. **Flat**
b. **Horizontal**
c. **Fillet**
d. **Groove**
e. **Overhead**
f. **Pipe**

1. **Standardized symbols**
   a. **Universal language**
   b. **Application**
      i. **Weld size**
      ii. **Location of the weld**
      iii. **Type**
      iv. **Weld metal deposited**
2. **PPE**
   a. **Eye protection**
      i. **Lens setting**
      ii. **Safety glasses**
   b. **Hearing**
   c. **Respiratory**
   d. **Jackets**
      i. **Flame retardant**
      ii. **Leather**
      iii. **Free of external openings**
   e. **Leather gloves**
   f. **Hood**
   g. **Beanie**
   h. **Shoes/boots**

1. **Welding: electrodes, essentials and defects**
   a. **Applications for glazing**
      i. **Anchor clips**
         1. **Wind load**
         2. **Dead load**
      ii. **Temporary anchors**
         1. **Material positioning**
         2. **Safety**
         3. **Staging platform**
      iii. **Fabrication**
   b. **Filler material**
      i. **Sacrificial metals**
         1. **Backing plate**
         2. **Strap**
      ii. **Electrode**
         1. **E-7018**
         2. **E-6010**

1. **Electrode parts**
   a. **Sacrificial metal**
   b. **Flux**
2. **Welding essentials**
   a. **Copper rod**
   b. **Safety**
   c. **Ventilation**
   d. **Properly maintained equipment**
   e. **PPE**
3. **Welding defects**
   a. **Slag intrusion**
   b. **Porosity**
   c. **Undercut**
   d. **Heat fatigue**
   e. **Heat stress**

f. **Causes**
    i. **Improper angle**
    ii. **Arc length**
    iii. **Centerline**
    iv. **Speed**
    v. **Settings**
    vi. **Welding technique**
    vii. **Cleaning**
g. **Corrections**
    i. **Training**
    ii. **Practical application**

4. **Starting an arc**
    a. **Scratch**
    b. **Tapping**
    c. **Peening**
        i. **Slag removal**
        ii. **Nicking**
    d. **Crater control**
        i. **Weld termination**
        ii. **Weld continuation**
    e. **Undercutting**
        i. **Improper angle**
        ii. **Improper centering**

1. **Overlap**
    a. **Filler termination**
    b. **Filler continuation**

2. **Application**
    a. **Equipment set-up**
        i. **Polarity**
        ii. **Amperage**
        iii. **Grounding**
    b. **Electrode selection**
        i. **Process**
        ii. **Specifications**
    c. **Application to plate**
        i. **Striking technique**
        ii. **Muscle memory**
        iii. **Weaving**
        iv. **Arc striking**
        v. **Wrist movement**
        vi. **Whipping**

1. **Horizontal: processes, techniques and electrode**
    a. **Horizontal position**
        i. **Groove**
            1. **Center electrode**
                a. **Proper fusion**
                b. **Clean joints/base metal**
            2. **Proper angles, speed, travel**
            3. **Proper machine setting**
        ii. **Fillet weld**
            1. **Whipping motion**
            2. **Clean metal between passes**
    b. **Electrode movement**
        i. **Perpendicular to joint**
        ii. **Puddle for joining/push**
        iii. **Controlled rhythmic movement**
        iv. **Steady, continuous travel**
        v. **Travel angle**

1. **0 degree to 15 degrees**
2. **Perpendicular to joint**

1. **Narrow weaving motion**
   a. **Heat distribution**
      i. **Avoid heat fatigue**
      ii. **Maintain settings**
      iii. **Controls**
         1. **Travel speed**
         2. **Equipment settings**
         3. **Material preparation**
         4. **Dry electrode**
         5. **Proper grounding**
   b. **Sag control**
      i. **Avoid overheating**
      ii. **Warping material**
      iii. **Heat stress**
2. **Horizontal welding**
   a. **Lower welding current**
   b. **Shorter arc length**
   c. **Electrode tilt**
      i. **5 degrees**
      ii. **10 degrees**
      iii. **0 to 15 degrees**
      iv. **Slant slightly away from weld**
   d. **Slight weaving motion**
   e. **Avoid pool sag, over-ups, and under cuts**
   f. **Use cover pass**

1. **Vertical welding**
   a. **Applications**
      i. **Structural clips**
         1. **Wind load**
         2. **Dead load**
      ii. **Positioning brackets**
      iii. **Support brackets**
      iv. **Backing plate**
   b. **Vertical up vs. vertical down**
      i. **Metals ¼ inch or thicker**
      ii. **Deeper penetration**
      iii. **Creates shelf for additional layer**
      iv. **Triangular wear**

1. **Vertical down**
   a. **Light gauge meter**
   b. **Slight weave**
2. **Advantages of vertical up**
   a. **Deeper penetration**
   b. **Heat distribution**
   c. **Less chance of slag inclusion**
   d. **Less chance of undercutting or porosity**
3. **Techniques**
   a. **Triangular weave**
   b. **Stringers**
   c. **Slight increase in current**
   d. **Rod selection**
      i. **E-7018**
      ii. **E- 6010**
   e. **DC current: lower amperage**
   f. **AC current : higher amperage**
4. **Application**

a. **Vertical up is more practical**
b. **Whipping electrode**
c. **Groove joints**
    i. **Deposit root pass to opening**
    ii. **Three sided contact**

1. **Overhead welding**
    a. **Welding challenges**
        i. **Gravity**
            1. **Electrode/metal droppings**
            2. **Molten slag/sparks**
            3. **Equipment weight**
            4. **Fatigue**
        ii. **Awkward stance**
            1. **Electrode positioning**
            2. **Weld observation**
            3. **Advancing the electrode**

1. **PPE/required items**
    a. **Head cap**
    b. **Hood**
    c. **Leather jacket**
    d. **Apron**
    e. **Leather sleeves**
    f. **Gloves**
    g. **Coveralls**
2. **Arc: Length, amperage and consequences**
    a. **Length**
        i. **Maintain 1/8" distance (electrode and metal)**
        ii. **Rapid movement/constant speed**
    b. **Amperage**
        i. **Match with electrode**
        ii. **Material thickness**
    c. **Long arc consequences**
        i. **Excess slag**
        ii. **Excess spatter**
        iii. **Undercutting**
        iv. **Porosity**
        v. **"Dripping" metal**
        vi. **Improper fusion**
3. **Overhead weld joints**
    a. **Butt weld (preferred)**
    b. **Backing strip included**
    c. **Maintain weld cleanliness**
    d. **Rod selection**
        i. **Avoid undercutting**
        ii. **Avoid voids**
    e. **Maintain 90° position (electrode/metal)**
    f. **Maintain proper root pass**
    g. **Weave: wider gaps**
    h. **Whip: tighter areas**
4. **Large electrode problems**
    a. **Improper amperage**
        i. **Poor fusion**
        ii. **Insufficient heat**
        iii. **Superficial welds**
    b. **Joint fit**
    c. **Voids**
    d. **Porosity**
    e. **Undercutting**
5. **T-Joint welds**

   a. **Preferred method**
      i. **Clean with wire brush**
      ii. **Remove foreign substances**
   b. **Utilize magnets for positioning**
   c. **Preliminary tack**
6. **Weld processes**
   a. **Travel angle: 10°-15°**
   b. **Knuckles up/palm down**
   c. **Side positioning with body**
   d. **Drape cord over shoulder**
   e. **Maintain short arc length**
   f. **Proper PPE**

Resources

• Andrew D. Althouse, Carl H. Turnquist, William A. Bowditch. *Modern Welding*. 11th edition. Tinley Park, Illinois; The Goodheart-Willcox Company, Inc , 2017.

The Goodheart-Willcox Company, Inc . *The Procedure Handbook of Arc Welding*. 14th edition. Cleveland, Ohio; The Goodheart-Willcox Company, Inc , 2020.

T.B. Jefferson & Gorham Woods. *Metals And How To Weld Them*. second edition. Brattleboro, VT; Echo Point Books & Media, 2015.

Resources Other

- **Air Products Oxyfuel Processes - http://www.airproducts.com/NR/exeres/788**
- **Linde Gas - http://www.linde-gas.com/international/web/lg/com/likelgcom30.nsf/docbyalias/ind_mv_10_autEA0E4-DDD Safety Glazing Article, by Douglas Hanse**
- **Glass Association of North America (GANA)**
- **http://www.glasswebsite.com/default.asp**
- **The Safety Glazing Certification Council http://www.sgcc.org/**Advocates for Safe Glass **http://www.afsgi.org/**
- **A-47C2-903D-8E089D2451B6.htm**

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