**Instructor Guide**

Piping

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Overview and Goals

Pipes, because of age, obstructions, or new installations may need to be joined. This is a task that must be managed correctly to ensure that natural gas does not leak and cause harm to the personnel, environment or persons in the area.

Not only does the installer need to follow federal regulations, but it is also very important that he or she must strictly adhere to the manufacturer’s instructions, company policies, and best practices associated with the task to create strong, gas-tight joints.

Keep in mind, when pipes are joined correctly, the pipe joint becomes as strong, or stronger, than the pipe itself.

In this unit of work the instructor will:

* Highlight the concepts introduced in the online course.
* Demonstrate how to use the relevant tools and reference guides, applicable to the content and activities.
* Guide the participants through hands-on activities to work safely with natural gas, as a qualified operator would on the job

Upon completion of this unit of work, participants will be able to:

* Join pipes
* Make a stab fitting
* Conduct the following processes and procedures:
* Butt-heat fusion: manual
* Hydraulic butt heat process
* Sidewall heat fusion
* Electrofusion process

Preparation – Facilitation Guidelines

Ensure the participants have completed:

* ASME–0681 Joining of Plastic Pipe, including the pre-test and 10 question course assessment.
* ASME–0711 Joining of Pipe – Compression Couplings, including the pre-test and 15 question course assessment.
* ASME–0751 Joining of Plastic Pipe – Butt-Heat Fusion: Manual, including the pre-test and 20 question course assessment.
* ASME–0761 Joining of Plastic Pipe – Butt-Heat Hydraulic, including the pre-test and 20 question course assessment.
* ASME–0771 Joining of Plastic Pipe – Sidewall Heat Fusion, including the pre-test and 20 question course assessment.
* ASME–0781 Joining of Plastic Pipe – Electrofusion, including the pre-test and 20 question course assessment.

Conduct this training in a classroom setting, with a simulated lab and/or field site allowing the participants to work independently or in groups (dependent on number of participants) and then present findings to the workshop for further discussion.

Use a flipchart to capture key lessons learned from the group discussions, or to identify questions that will be answered in upcoming units of work or that require further research and discussion.

Reinforce the importance of damage prevention programs and the best practices and guidelines of the Compressed Gas Association (CGA), the Occupational Safety and Health Administration (OSHA), and the Federal Government.

Ensure the participants have a copy of the Common Ground Alliances (CGA) Best Practices guide: <http://www.commongroundalliance.com>

Review the following regulations as tasks are introduced, demonstrated, and practiced.

* §192.59 Plastic pipe.
* §192.121 Design of plastic pipe.
* §192.123 Design limitations for plastic pipe.
* §192.143 General requirements
* §192.151 Tapping.
* §192.159 Flexibility.
* §192.273 General.
* §192.281 Plastic piping joining.
* §192.283 Plastic pipe: procedures.
* §192.285 Plastic pipe: Qualifying persons to make joints.
* §192.287 Plastic pipe: Inspection of joints
* §192.307 Inspection of materials.
* §192.311 Repair of plastic pipe
* §192.321 Installation of plastic pipe.
* §192.513 Test requirements for plastic pipelines.
* §192.627 Tapping pipelines under pressure.
* §1926.651 Specific excavation requirements.
* §1926.652 Requirements for protective systems.

Materials

Provide the following to each participant:

* A copy of the Activity Worksheets and Appendix 2 Performance Checklists.
* Access to the Internet, as needed, for OSHA, federal, and industry resources/references supporting course related discussions, demonstrations, and hands-on activities.
* Access to manufacturers’ instructions as needed.

Provide the following materials and tools used locally for the lab demonstrations and hands-on practice:

* Bolted compression couplings
* Hydraulic compression couplings
* Insulated couplings
* Non-insulated couplings
* Heating iron
* Plastic pipes
* Cleaning equipment and supplies
* Plastic pipe shears
* Teflon coated butt fusion heater face
* Butt fusion machine
* Facing tools
* Compatibility insulator(required for fusing pipes of different materials)
* Tempilstik and/or pyrometer)
* Carpenter’s saw
* Wheel plastic pipe cutter
* Clamping tool
* Personal Protective Equipment (PPE)

***Note****:**These items, and any other materials used for demonstrations and participant activities, will be determined by the materials and tools used at the training facility.*

Schedule

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| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **30 minutes** | **Introduction**  Emphasize that this course work focuses on the characteristics and uses of plastic pipe.  Review key vocabulary terms and acronyms, e.g.: IPS, SDR, FIU, EGD, SDR   * Review features and characteristics of stab-type fittings. * Typically used with small diameter pipe (used for service installations). * Use no exterior nuts or bolts, "stab" principle, means when the pipe is inserted into the fitting to the correct depth, an internal seal activates grips mechanisms to seal the joint and prevent pullout. * Fast and easy, requires only one person, minimal equipment. * Review installation requirements. * Pipeline operators must be qualified (§ 192.285). * OSHA requires employees are trained in the use of PPE. * Code of Federal Regulations requires that any person making a joint follow a written procedure (§ 192.273) that must be proven. * The fitting must match the pipe size and Standard Dimension Ratio (SDR), which is the ratio of pipe diameter to wall thickness.   ***Note****: The tools, PPE and materials used in the demonstrations will be determined by the materials and tools used at the training facility.* |
| **30 minutes** | **Stab Fittings**  **Demonstration**  Demonstrate how to install a stab fitting by selecting and preparing a joint according to project and manufacturer requirements.   * Cut pipe ends square and remove any burrs. * Chamfer the edges. * Thoroughly clean the pipe surface. * Mark the stab depth on the pipe. * Stab pipe completely into fitting until the mark on the pipe is flush or less from the fitting entrance.   + Emphasize the importance to visually inspect the fitting and adjoining pipe for any damage and/or improper installation. |
| **60 minutes** | **Check for Leaks**  **Demonstration**  Demonstrate how to check for leaks, using the soap bubble test.   * Address through the demonstration how to watch for and manage any potential problems and/or AOCs * Reinforce the importance that maintenance records and repairs must be maintained throughout the life of the pipeline   Instruct participants to complete **Activity Worksheet #1.** |
| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **30 minutes** | **Joining Pipe-Compression Couplings**  **Discussion**  Explain that these activities will focus on compression couplings.   * Mechanical couplings are commonly used to join pipe when making pipeline repairs and tie-in connections. * Transition couplings connect pipe of different materials.   Show examples of the following while explaining typical usage:   * Bolted compression couplings (typical use: pipes over 2’ diameter) * Hydraulic compression couplings(typical use: pipes 2-4”’ diameter) * Mechanical couplings for steel-to-steel joints   + Insulated couplings   + Non-insulated couplings   Review installation requirements and federal regulations.  Reinforce the following:   * Protective measures when using steel pipe. * Installers must use an electrically insulating coupling or install a bonding device to maintain chathodic protection in steel-to-steel or dissimilar metal joints. * Importance of bridging or blocking to protect a joint from stress. |
| **45 minutes** | **Joining Pipe-Compression Couplings**  **Demonstration**   * Show examples and provide “real world” examples of how to match compression coupling according to project requirements. * Be sure to point out the pipeline characteristics: Pipe material, diameter, wall thickness, and operating pressure. * Ensure participants know the types of joint and that the coupling joining procedures depend on the pipeline characteristics and joint type. * Visually inspect, prepare and install the pipe, following the manufacturer’s instructions.   + Ensure the pipe ends are square and remove any burrs (tools used are based on pipe material).   + There should be at least ¼” gap between the ends of the two pipes.   + Keep the ends square during the installation process * Tighten the nuts and bolts (use 4-bolt or 8-bolt assembly process). * Wrap the pipe. |

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| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **60 minutes** | **Joining Pipe-Compression Couplings**  **Demonstration**  Following the manufacturer’s instructions, demonstrate how to install:   1. A bolted coupling **assembled** from the manufacturer 2. A bolted coupling that **requires reassembly** on the pipe joint  |  |  | | --- | --- | | **I**. Assembled coupling installation | **II.** Non-assembled coupling installation: | | 1. Clean the ends of the pipe. 2. Apply soapy solution. 3. Slip the coupling onto one pipe and then the other into the opposite end. 4. Tighten the bolts. 5. For insulated couplings: test to ensure there is electrical isolation. 6. Test to ensure there is continuity. | 1. Disassemble the coupling 2. Clean the ends of the pipe. 3. Measure the length and mark pipe with the measurements. 4. Place an insulated follower ring on both pipe ends 5. Apply soapy solution. 6. Position the center sleeve and slide the pipe ends together. 7. Slide gaskets and follower rings in to place. 8. Insert the coupling bolts. 9. Bond the connection to both sides of the pipe. | |
| **30 minutes** | **Create a Cathodic Protection**  **Demonstration**   * Use an electrically insulated coupling or install a bonding device to create cathodic protection. * Test for electrical continuity following installation. * Test for continuity and/or insulation of joints that join two different metals (use tools typically used at your work site) |
| **10 minutes** | **Visual Inspection**  **Demonstration**  Demonstrate how to visually inspect a joint. |
| **60 minutes** | **Test for Leaks**  **Demonstration**  Demonstrate how to test for leaks, using for example, soap bubble test or combustible gas indicator (CGI).  Emphasize   * The importance that maintenance records and repairs must be maintained throughout the life of the pipeline. * Address through the demonstration how to watch for and manage any potential problems and/or AOCs.   + If a defective or leaking joint is found during the inspection process, reassemble or replace the coupling to create a successful joint as per CFT192.703.   Instruct participants to complete **Activity Worksheet #2.** |
| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **30 minutes** | **Butt Heat Fusion: Manual**  **Discussion**  Show the participants examples of the following while explaining typical usage.   * Heat fusion-joins pipe inside a fitting such as a coupling, tee, or elbow. * Saddle (or sidewall) heat fusion joins a branching or service saddle to the side wall of another pipe at a 90-degree angle.   Emphasize   * Butt heat fusion joins pipe sections or fittings end-to-end. * Both pipe sections must reach the melt pattern at the same time. If one pipe melts more quickly than the other, they may not fuse properly. * A correctly fused connection will be stronger than the pipe itself   Review installation requirements and federal regulations (see above).  Reinforce the protective measures working with plastic pipe to prevent:   * Gaseous atmosphere   ***Caution****: Fusion power sources can become ignition sources in a gaseous atmosphere*.   * Electrical precautions   ***Caution:*** *Friction between gas and the plastic pipe can cause static electricity build-up and perhaps cause ignition.*   * Electrostatic Precautions   ***Caution:*** *Ground pipes with cloths moistened in detergent solution, and spray the pipes periodically to maintain moisture and avoid electrostatic problems*. |
| **60 minutes** | **Butt Heat Fusion: Manual**  **Demonstration**  Show participants how to inspect and use the following equipment:   * Compatibility insulator (aka fly swatter) * Pipe clamp adaptors * Clean heater faces * Facing tool * Power cord/power source * Heating iron, pointing out the temperature with templistik or pyrometer * Pipe cutting tools * Ensure the correct PPE is being used.   Show participants how to prepare the heat iron   * Preheat heating iron in a safe place. * Unplug the heater and take to the pipe being fused. * Check the temperature of the heating face with a pyrometer. |

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| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **60 minutes** | **Butt Heat Fusion: Manual**  **Demonstration**  Demonstrate the fusion process, with a pipe that has been visually inspected, and prepared, and installed according to manufacturer’s instruction:   * Clamp pipe ends. * Check alignment for facing. * Face the pipe ends. * Check for square pipe ends. * Heat pipe ends. * Use an insulator. * Remove the iron. * Join ends and cool the joint.   Demonstrate how to handle a final inspection.   * Emphasize the importance of following manufacturer’s instructions for cooling time. * Explain how to inspect: * A cooled joint * A melt bead   Instruct participants to complete **Activity Worksheet #3.** |
| **60 minutes** | **Butt Heat Fusion: Hydraulic**  **Demonstration**  Demonstrate, and explain the steps in the hydraulic fusion process:   * Preheat the iron (see steps above). * Clamp pipe ends. * Check alignment for facing. * Face the pipe ends. * Align pipe. * Check for square pipe ends. * Heat pipe ends. * Use an insulator. * Remove the iron. * Join ends. * Cool the joint. |

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| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **60 minutes** | **Butt Heat Fusion: Hydraulic**  **Demonstration, continued**  Read the hydraulic controls/determine drag:   * Carriage Pressure * This indicates the pressure at the carriage valve during the heating process at initial contact and when the pressure is lowered to drag pressure. * Facing Pressure * Pressure when two pipe ends come into contact with the rotating facer. * Caution: do not slam pipe ends into the facer. * Fusing Pressure * Drag pressure + calculated fusion pressure * Drag Pressure * Pressure required to overcome the sum of the friction and resistance of the hydraulic unit and the pipe that is being pulled into the facer and the heater.   Emphasize:   * Do not let pipe cool before bringing pipe ends together * Apply pressure to **double** the bead size. * Do not slam ends together (may cause displacement of the melt).   Instruct participants to complete **Activity Worksheet #4.** |
| **15 minutes** | **Sidewall Heat Fusion**  **Discussion**  Explain the saddle (or sidewall) butt heat fusion process joins a branching or service saddle to the side wall of a pipe at a 90-degree angle |
| **60 minutes** | **Sidewall Heat Fusion**  **Demonstration**  Demonstrate the sidewall fusion process:   * Prepare the heat iron (see steps above) * Roughen pipe and fitting surfaces * Install sidewall applicator and check alignment * Insert the heating iron * Fuse melted surfaces * Lock and cool the joint   Emphasize:   * Conditions to look for during and after the fusion process. * Offer “real-world” examples as appropriate (showing incomplete fusions, burn through, etc.). * Point out to destroy bad fittings to prevent use. * Watch/manage any potential problems. and/or AOCs   Instruct participants to complete **Activity Worksheet #5.** |

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| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **30 minutes** | **Electrofusion**  **Discussion**  Explain that electrofusion is a process of joining plastic pipe using heating coils, embedded directly into the fittings that are energized from an external power source to melt the fitting and pipe to create a fused saddle joint or socket joint, based on the fusion time needed.  Electrofusion, can be used for tie-ins and repairs in situations where conventional heat fusion equipment is not practical and mechanical couplings are not desired |
| **30 minutes** | **Electrofusion**  **Demonstration**  Show participants   * How to inspect the pipe. * How to use the following electrofusion tools:   + Electrofusion processor   + Electrofusion fittings   + Clamping tool   + Pipe cutting tool(s)   + Power source   + Pipe cutting tools   + Scraper |
| **30 minutes** | **Electrofusion**  **Demonstration**  Demonstrate how to determine stab depth for electrofusion   * Mark the pipe ends according to the manufacturer’s directions * Set/adjust and retighten fittings as needed. * Remove pipe surface oxidation up to the stab depth markings. |
| **30 minutes** | **Electrofusion**  **Demonstration**  Demonstrate how to prepare pipe for sidewall electrofusion   * Determine where fitting is to be fused * Clean pipe with a clean dry cloth (do not use emery cloth) |
| **30 minutes** | **Electrofusion**  **Demonstration**  Demonstrate (following manufacturer’s instructions and best practices) how to :   * Install a socket fitting * Install a sidewall fitting * Energize the processor:   + Tap a saddle fitting to make a 90-degree connection to the original pipe. |

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| **Time** | **Topics for Discussion, Demonstrations, and Activities** |
| **60 minutes** | Emphasize the conditions to look for during and after the fusion process/troubleshooting.   * Offer “real-world” examples as appropriate. * Pipe movement during electrofusion causes joint failure. Leave clamping device in place to secure the pipe and fitting during cooling time.   Instruct participants to complete **Activity Worksheet #6** |

Boot Camp Activities

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| Working with a partner or partners, complete the following tasks following federal guidelines, company procedures, best practices and the manufacturer’s instructions for the tools, materials and PPE you are using.   |  |  |  | | --- | --- | --- | | Activity Worksheet #1-Stab Fittings | | | | Lab | | * Use the materials provided and refer to **Appendix 2**-Performance Checklist Stab Fittings   + Perform the tasks.   + Identify the materials, tools and instructions used to complete the task(s).   + Answer any question presented. * Take notes in the sections below (as needed). * Be prepared to participate in workshop discussions. | | Tools used  PPE | |  | |  | |  | |  | | Steps -actions | |  | |  | |  | |  | | References/Guidelines including:   * Industry sources * Online course materials * CFR   Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). | |  | |  | |  | |  | |  | |  | |  | |  | |  | | Lessons learned | |  | |  | |  | |  | | | General discussion questions or notes | |  | |  | |  | |  | | Activity Worksheet #2-Compression Couplings | | | | Lab | * Use the materials provided and refer to **Appendix 2**-Performance Checklist –Compression Couplings   + Perform the tasks.   + Identify the materials, tools and instructions used to complete the task(s).   + Answer any question presented. * Take notes in the sections below (as needed). * Be prepared to participate in workshop discussions. | | | Tools used  PPE |  | | |  | | |  | | |  | | | Steps -actions |  | | |  | | |  | | |  | | | References/Guidelines including:   * Industry sources * Online course materials * CFR   Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | | Lessons learned |  | | |  | | |  | | |  | | |  | | |  | | | General discussion questions or notes |  | | |  | | |  | | |  | | |  | |  |  |  | | --- | --- | | Activity Worksheet #3-Butt Heat Fusion-Manual | | | Lab | * Use the materials provided and refer to **Appendix 2**-Performance Checklist Butt Heat Fusion Manual   + Perform the tasks.   + Identify the materials, tools and instructions used to complete the task(s).   + Answer any question presented. * Take notes in the sections below (as needed). * Be prepared to participate in workshop discussions. | | Tools used  PPE |  | |  | |  | |  | | Steps -actions |  | |  | |  | |  | | References/Guidelines including:   * Industry sources * Online course materials * CFR   Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | |  | | Lessons learned |  | |  | |  | |  | | General discussion questions or notes |  | |  | |  | |  | |  |

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| Activity Worksheet #4-Butt Heat Fusion-Hydraulic | |
| Lab | * Use the materials provided and refer to **Appendix 2**-Performance Checklist Butt Heat Fusion Hydraulic   + Perform the tasks.   + Identify the materials, tools and instructions used to complete the task(s).   + Answer any question presented. * Take notes in the sections below (as needed). * Be prepared to participate in workshop discussions. |
| Tools used  PPE |  |
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| References/Guidelines including:   * Industry sources * Online course materials * CFR   Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). |  |
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| Activity Worksheet #5-Sidewall Heat Fusion | |
| Lab | * Use the materials provided and refer to **Appendix 2**-Performance Checklist Sidewall Heat Fusion   + Perform the tasks.   + Identify the materials, tools and instructions used to complete the task(s).   + Answer any question presented. * Take notes in the sections below (as needed). * Be prepared to participate in workshop discussions. |
| Tools used  PPE |  |
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| References/Guidelines including:   * Industry sources * Online course materials * CFR   Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). |  |
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| Activity Worksheet #6-Electrofusion | |
| Lab | * Use the materials provided and refer to **Appendix 2**-Performance Checklist Electrofusion   + Perform the tasks.   + Identify the materials, tools and instructions used to complete the task(s).   + Answer any question presented. * Take notes in the sections below (as needed). * Be prepared to participate in workshop discussions. |
| Tools used  PPE |  |
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| References/Guidelines including:   * Industry sources * Online course materials * CFR   Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). |  |
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# Appendix 1

Appendix 1–Performance Checklist–Stab Fittings (Instructor)

***Note****: The tools, PPE and materials used will be determined by the materials and tools used at the training facility.*

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

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|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Install a stab fitting following project and manufacturer requirements. | List the steps you took in the chart below to install a stab fitting according to project and manufacturer requirements, and the tools and equipment you used.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | | 1. *Cut pipe ends square and remove any burrs* |  | | 1. *Chamfer the edges.* |  | | 1. *Thoroughly clean the pipe surface.* |  | | 1. *Mark the stab depth on the pipe.* |  | | 1. *Stab pipe completely into fitting until the mark on the pipe is flush or less from the fitting entrance.* |  |   *Part A* |
| 2 | Check for leaks | 1. Indicate how you check for leaks.    * If the materials are available, run the test and present the results. 2. If the fitting fails, what actions must you take? | *Participants should run the soap test to check for leaks.* |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? | *Specific answers will depend on company guidelines and facilitator. However, the pipe should be destroyed so it is not used.* |

Appendix 1–Performance Checklist– Compression Couplings (Instructor)

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

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|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Re-assemble a bolted coupling on the pipe joint. | List the steps you took in the chart below to reassemble and install a bolted coupling.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful**  **Y/N** | | 1. *Disassemble the coupling.* |  | | 1. *Clean the ends.* |  | | 1. *Measure and mark pipe.* |  | | 1. *Place an insulator ring on both ends.* |  | | 1. *Apply soapy solution.* |  | | 1. *Position center slide and slide pipe ends together.* |  | | 1. *Slide gaskets and follower rings in place.* |  | | 1. *Insert coupling bolts.* |  | | 1. *Bond the connection to both sides of the pipe* |  | |
|  | Part B | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Check for leaks | 1. Indicate how you check for leaks.    * If the materials are available, run the test and present the results. 2. If the fitting fails, what actions must you take? | *Participants should use the combustible gas indicator (CGI) or the soap test to check for leaks.* |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? | *Specific answers will depend on company guidelines and facilitator.* |

Appendix 1–Performance Checklist– Butt Heat Fusion-Manual (Instructor)

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Prepare an iron | List the steps you took in the chart below to prepare an iron.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful**  **Y/N** | | 1. *Preheat the iron.* |  | | 1. *Unplug* |  | | 1. *Check temperature with pyrometer* |  | |
|  | Part B  Fuse pipes with butt heat fusion. | List the steps you took in the chart below to fuse pipes, with butt heat fusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful**  **Y/N** | | 1. *Clamp pipe ends* |  | | 1. *Check alignment for facing* |  | | 1. *Check for square pipe ends* |  | | 1. *Heat pipe ends* |  | | 1. *Use an insulator* |  | | 1. *Remove the iron.* |  | | 1. *Join ends* |  | | 1. *Cool the joint* |  | |
|  | Part C | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Final Inspection | Indicate how you handled a final inspection. | *Participants should address a cooled joint and a melt bead* |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? | *Specific answers will depend on company guidelines and facilitator.* |

Appendix 1–Performance Checklist– Butt Heat Fusion-Hydraulic (Instructor)

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Fuse pipes with hydraulic butt heat fusion. | List the steps you took in the chart below to fuse pipes, with hydraulic butt heat fusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | | 1. *Heat the iron* |  | | 1. *Clamp pipe ends* |  | | 1. *Check alignment for facing* |  | | 1. *Face the pipe ends* |  | | 1. *Align pipe* |  | | 1. *Check for square pipe ends* |  | | 1. *Heat pipe ends* |  | | 1. *Use an insulator* |  | | 1. *Remove the iron.* |  | | 1. *Join ends* |  | | 1. *Cool the joint* |  | | 1. *Take readings* |  | |
|  | Part B | What did the readings indicate? |  |
|  | Part C | * Why did you not cool the pipe before joining the ends? * How did you double the bead size? * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Final Inspection | Indicate how you handled a final inspection. |  |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? | *Specific answers will depend on company guidelines and facilitator.* |

Appendix 1–Performance Checklist– Sidewall Heat Fusion (Instructor)

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1. | Part A  Fuse pipes with sidewall heat fusion. | List the steps you took in the chart below to fuse pipes, with sidewall heat fusion.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | | 5. |  | | 6. |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | | 1. *Prepare the heat iron* |  | | 1. *Roughen pipe and fitting surfaces* |  | | 1. *Install sidewall applicator and check alignment* |  | | 1. *Insert heating iron* |  | | 1. *Fuse melted surfaces.* |  | | 1. *Lock and cool the joint* |  | | |
|  | Part B | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  | |
| 2 | Final Inspection | Indicate how you handled a final inspection. |  | |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? | *Specific answers will depend on company guidelines and facilitator.* | |

Appendix 1–Performance Checklist–Electrofusion (Instructor)

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Prepare the pipe for socket electrofusion. | List the steps you took in the chart below to prepare the pipe for socket electrofusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | | 1. *Square pipe ends, remove any burrs* |  | | 1. *Clean pipe ends* |  | | 1. *Scrape off contaminants and oxidation.* |  | |
|  | Part B  Determine stab depth for electrofusion. | List the steps you took in the chart below to determine stab depth for electrofusion.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | | 1. *Mark pipes per mfg. instructions.* |  | | 1. *Set fittings* |  | | 1. *Remove pipe surface oxidation up to stab depth marking.* |  | |
|  | Part C | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Prepare the pipe for sidewall electrofusion. | List the steps you took in the chart below to prepare the pipe for sidewall electrofusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | | 1. *Identify where the fitting should be fused.* |  | | 1. *Clean pipe ends\** |  | | 1. *Clean using a clean dry cloth* |  | |
| 3 | Final Inspection | Indicate how you handled a final inspection. | *Should include that pipe movement during electrofusion causes joint failure. Leave clamping device in place to secure the pipe and fitting during cooling time.* |
| 4 | Troubleshooting | Answer the following question.  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? | *Specific answers will depend on company guidelines and instructor.* |
| 5 | Install a socket fitting | List the steps you took in the chart below to install a socket fitting   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | | |  |  | | --- | --- | | **Steps** | **Successful Y/N** | |  |  | |  |  | |  |  | |  |  | |
| 6 | Install a sidewall fitting | List the steps you took in the chart below to install a sidewall fitting   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | | |  |  | | --- | --- | | **Steps** | **Successful**  **Y/N** | |  |  | |  |  | |  |  | |  |  | |
| 7 | Energize the processor | List the steps you took in the chart below to energize the processor.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | | |  |  | | --- | --- | | **Steps** | **Successful**  **Y/N** | |  |  | |  |  | |  |  | |  |  | |
|  | Tap a saddle fitting | List the steps you took in the chart below to tap a saddle fitting to make a 90-degree connection to the original pipe.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | |  |  | | --- | --- | | **Steps** | **Successful**  **Y/N** | |  |  | |  |  | |  |  | |

# Appendix 2

Appendix 2–Performance Checklist–Stab Fittings

***Note****: The tools, PPE and materials used will be determined by the materials and tools used at the training facility.*

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Install a stab fitting following project and manufacturer requirements. | List the steps you took in the chart below to install a stab fitting according to project and manufacturer requirements, and the tools and equipment you used.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |
| 2 | Check for leaks | 1. Indicate how you check for leaks.    * If the materials are available, run the test and present the results. 2. If the fitting fails, what actions must you take? |  |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? |  |

Appendix 2–Performance Checklist– Compression Couplings

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Re-assemble a bolted coupling on the pipe joint. | List the steps you took in the chart below to reassemble and install a bolted coupling.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |
|  | Part B | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Check for leaks | 1. Indicate how you check for leaks.    * If the materials are available, run the test and present the results. 2. If the fitting fails, what actions must you take? |  |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? |  |

Appendix 2–Performance Checklist– Butt Heat Fusion-Manual

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Prepare an iron | List the steps you took in the chart below to prepare an iron.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |
|  | Part B  Fuse pipes with butt heat fusion. | List the steps you took in the chart below to fuse pipes, with butt heat fusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |
|  | Part C | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Final Inspection | Indicate how you handled a final inspection. |  |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? |  |

Appendix 2–Performance Checklist– Butt Heat Fusion-Hydraulic

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Fuse pipes with hydraulic butt heat fusion. | List the steps you took in the chart below to fuse pipes, with hydraulic butt heat fusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |
|  | Part B | What did the readings indicate? |  |
|  | Part C | * Why did you not cool the pipe before joining the ends? * How did you double the bead size? * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Final Inspection | Indicate how you handled a final inspection. |  |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? |  |

Appendix 2–Performance Checklist– Sidewall Heat Fusion

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1. | Part A  Fuse pipes with sidewall heat fusion. | List the steps you took in the chart below to fuse pipes, with sidewall heat fusion.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | | 5. |  | | 6. |  | |  |
|  | Part B | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Final Inspection | Indicate how you handled a final inspection. |  |
| 3 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? |  |

Appendix 2–Performance Checklist–Electrofusion

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Part A  Prepare the pipe for socket electrofusion. | List the steps you took in the chart below to prepare the pipe for socket electrofusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |
|  | Part B  Determine stab depth for electrofusion. | List the steps you took in the chart below to determine stab depth for electrofusion   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | |  |
|  | Part C | * What type of pipe did you use? * What tools did you use? * What guidelines did you reference (Federal, company, manufacturer) as you worked through the task? |  |
| 2 | Prepare the pipe for sidewall electrofusion. | List the steps you took in the chart below to prepare the pipe for sidewall electrofusion.   |  |  | | --- | --- | | Steps | Notes | |  |  | |  |  | |  |  | |  |
| 3 | Final Inspection | Indicate how you handled a final inspection. |  |
| 4 | Troubleshooting | Answer the following question:  If a visual inspection of the fitting and adjoining pipe indicates any damage and/or improper installation, what should you do? |  |
| 5 | Install a socket fitting | List the steps you took in the chart below to install a socket fitting   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 | Install a sidewall fitting | List the steps you took in the chart below to install a sidewall fitting   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | |  |
| 7 | Energize the processor | List the steps you took in the chart below to energize the processor.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | | 4. |  | |  |
| 8 | Tap a saddle fitting | List the steps you took in the chart below to tap a saddle fitting to make a 90-degree connection to the original pipe.   |  |  | | --- | --- | | Steps | Notes | | 1. |  | | 2. |  | | 3. |  | |  |