The GRIT Foundation

Soldering, Brazing & Aluminum Repair Quick Start Guide

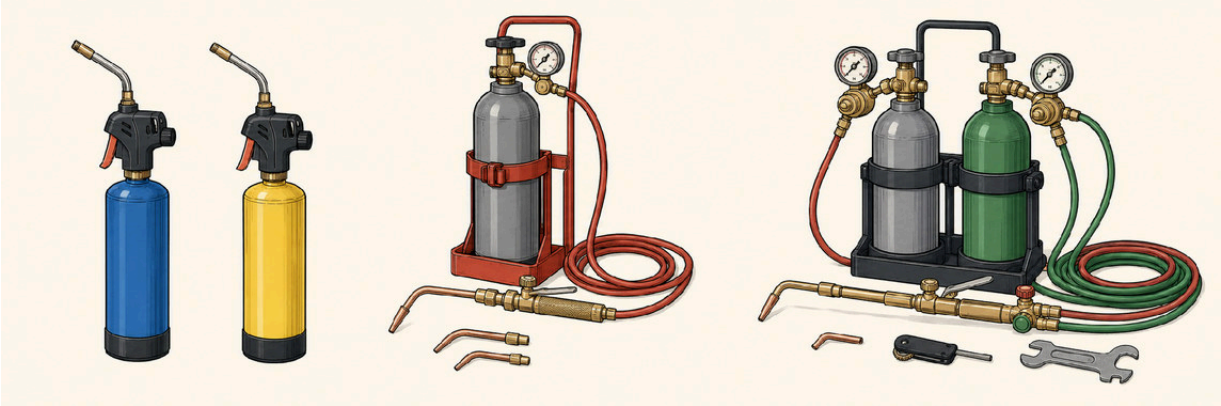
Last Revised: September 17th, 2026

Host Goal #1: Choose ONE complete copper joining system before purchasing.

Host Goal #2: Provide one complete Station and one competent Mentor for every lit torch.

Mentor & Student Goal: Complete, clean, and inspect the copper work before installing the box backer.

Use this guide to select, purchase, set up, and operate the torch stations used for the GRIT pipe assembly. It supplements the general Host and Mentor Quick Start Guides.



- ☐ **Copper joining system selected:** _____
- ☐ **Education Lead:** _____
- ☐ **Aluminum repair module offered:** Yes / No
- ☐ **Student pairs:** _____ **Complete torch kits:** _____

Host Decisions

Choose ONE complete copper joining system. The equipment, filler, flux, ignition method, and Mentor competency must stay matched to that system.

Copper Joining System

- ☐ **Propane or MAP-Pro** — soft solder
- ☐ **Air-acetylene/swirl-tip, usually TurboTorch** — soft solder or copper braze
- ☐ **Oxy-acetylene** — copper braze only

Aluminum Repair Product

- ☐ **Flux-cored aluminum repair rod** — preferred
- ☐ **Aluminum rod with external powder flux** — second choice
- ☐ **Very-low-temperature aluminum solder with liquid flux** — alternate

On the next page, you will see a table of each torch system's capabilities and ignition method.

System	Copper work	Aluminum repair	Ignition/valve tool
Propane / MAP-Pro	**Soft solder only**	**Yes, with selected product**	• **Built-in trigger; no striker** • **Hand-tight cylinder; no wrench**
Air-acetylene / swirl-tip (usually TurboTorch)	**Soft solder or copper braze**	**Yes**	• **Push-button preferred; striker if manual** • **Acetylene wrench always**
Oxy-acetylene	**Copper braze only**	**NO — never use for aluminum**	• **Flint striker** • **Acetylene wrench always**

DO NOT MIX torch parts, tips, fillers, fluxes, or procedures between systems.

Important: Air-acetylene/swirl-tip is the only single torch system that can soft solder, copper braze, and perform the aluminum repair module. Oxy-acetylene is copper-braze only and is never used for aluminum repair.

Buy ALL Components for ONE Complete Torch System

Count complete matched stations—not loose torches, cylinders, tips, or supplies stored elsewhere.

Buy aluminum supplies only if that optional activity is selected. The Host and Education Lead choose the activities in advance and may adapt on the day when materials and competent supervision are available.

Propane or MAP-Pro

- ☐ **Trigger torch and compatible cylinder**
- ☐ **Plain lead-free plumbing wire solder**
- ☐ **Matching plumbing flux**
- ☐ **Plumbing flux brush**
- ☐ **Selected aluminum repair product**, if offering aluminum repair

This system can soft-solder the copper joint and perform the aluminum portion. It **cannot** be used for brazing.

Air-Acetylene / Swirl-Tip

- ☐ **Complete matched air-acetylene/swirl-tip kit**, usually TurboTorch
- ☐ **Matched A-8 tip** for the copper joint
- ☐ **Matched A-3 tip** for aluminum repair
- ☐ **Push-button ignition** or the proper striker if manually lit

- ☐ **Properly rated shade 3 or darker eye protection for brazing operators and exposed observers; use any higher shade required by the manufacturer or site**
- ☐ **Acetylene tank wrench**
- ☐ **Sil-Fos / phos-copper (BCuP)** for copper brazing
    - 0%, 5%, and 15% phos-copper rods
- ☐ **Selected aluminum repair product**

Tip numbers apply only to the matching torch system. Do not assume that tip numbers transfer between brands.

Oxy-Acetylene

- ☐ **Complete matched two-gas kit** with regulators, twin hose, handle, and torch
- ☐ **Small manufacturer-approved tip** for the ⅞" copper joint
- ☐ **Flint striker**
- ☐ **Acetylene tank wrench**
- ☐ **Sil-Fos / phos-copper (BCuP)**

Copper braze only. If the Host also offers aluminum repair, provide a separate propane/MAP-Pro or air-acetylene setup for aluminum.
Provide properly rated shade 3 or darker eye protection for brazing operators and exposed observers; use any higher shade required by the manufacturer or site. Clear safety glasses alone are not sufficient for brazing.

Determine Station Capacity

Plan for two Students per active torch station.

- **One lit torch** per active pair
- **One competent Mentor** per lit torch
- **At least one additional floater Mentor, preferably experienced, for breaks, setup, materials, and support. The floater does not require an extra torch kit. The Education Lead is a separate role.**

Students	Active pairs	Complete torch kits	Torch Mentors + floater
8	4	4	4 + 1
12	6	6	6 + 1
16	8	8	8 + 1

Set Up Each Active Station

- ☐ **One complete selected torch kit**, tied down or otherwise secured to prevent tipping
- ☐ **Correct tip** for the work being performed
- ☐ **Acetylene wrench** whenever an acetylene cylinder is present
- ☐ **Tongs/pliers and rags**
- ☐ **One water bucket per Station, half-filled**
- ☐ **Stable work table and clamp or fixture**
- ☐ **Four firebricks**
- ☐ **Clearly defined hot and cooling area**

A supply table in the Staging Area is not an active work table. Every active Student pair needs a Station where they can work.

Some items may be kept at a supply table or staging area, if not at a table:

- **Correct ignition device**
- **Slim red pencil reamer**
- **Tube abrasive and fitting brush**
- **Correct filler and its exact matching flux system**
- **Plumbing flux brush** when soft soldering
- **Copper tubing cutter** appropriate for ⅞” OD copper

Follow the Assembly Sequence

Complete the fitting and joining work before installing the back piece of the box.

1. **Fit the copper assembly using the Host’s selected end treatment: a plain cap joined during camp, an explicitly identified prepared subassembly, or the approved swaged-end option. Purchase only the chosen branch and its matching supplies/tools.**
2. **Soft-solder or braze** the copper joint using the selected complete system.
3. **For this non-service GRIT practice assembly, leave the copper joint supported and undisturbed for approximately 30 seconds after removing the flame, and until the filler has solidified. The Mentor may then supervise wet-rag cooling or water quenching, keeping hands clear of steam and hot water. Keep the work in the marked cooling area and confirm it is cool before handling.**
4. **Clean and inspect** the entire joint.
5. **Install the box backer** only after the joining work is complete.

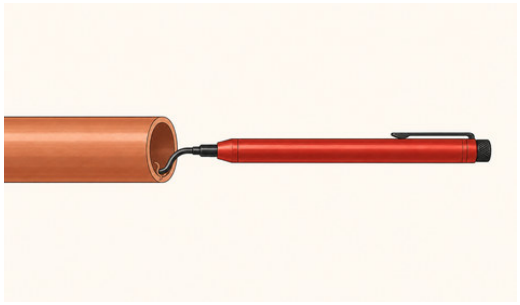
Before lighting any torch, confirm the following. An experienced Mentor lights, adjusts, and shuts down oxy-acetylene; a Student may handle the lit torch only under that Mentor’s direct supervision. Other ignition methods remain under direct Mentor supervision. Make sure you have:

- [ ] **The torch kit**
- [ ] **Correct tip**
- [ ] **Ignition device**
- [ ] **Acetylene wrench**, when applicable
- [ ] **Filler and flux**
- [ ] **Clamp and firebrick**
- [ ] **Hot zone and cooling area**
- [ ] **Shutdown procedure**
    - Consult torch manuals for the manufacturer's procedures
    - Oxy-acetylene: Harris Product Group's Guide

Prepare the Exact Copper Joint

The required connection is ⅞” OD ACR copper fully seated in the straight sweat cup of the ¾” sweat-by-male-NPT adapter.

1. **Cut** the tubing square with an appropriate copper tubing cutter.
2. **Ream** the full inside diameter with a slim reaming pen.



3. **Clean** the tube exterior and fitting cup until both are bright.
4. **Confirm** a fully seated, snug fit.
5. **Select EITHER the soft-solder procedure (page 7) or the brazing procedure (page 8).**

Soft-Solder the Copper Joint

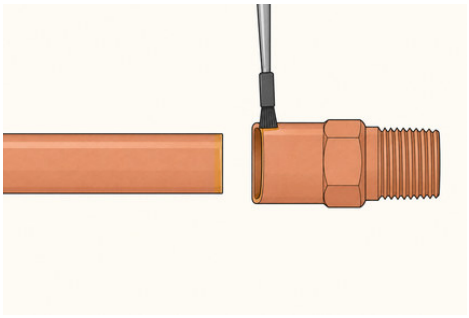
Use propane/MAP-Pro or the air-acetylene system set up for soft soldering.

Buy

- ☐ **Preferred solder:** silver-bearing lead-free plumbing solder, such as Safe-Flo; approximately 420–460°F
  - ☐ **Alternative:** 95/5 tin-antimony plumbing solder; approximately 450–464°F
  - ☐ **Alternative:** 97/3 tin-copper plumbing solder; approximately 440–572°F
- ☐ **GRIT preferred flux:** Oatey No. 95 tinning flux or an appropriate matching plumbing flux

Do not use rosin-core electrical solder, acid-core or general-repair wire, or leaded solder.

Procedure



1. **Brush** a very thin coat of flux on the cleaned tube exterior and inside the straight fitting cup.
2. **Seat** the tube fully and wipe away excess flux.
3. **Clamp** the assembly over firebrick.
4. **Light** the torch with the proper mechanism.

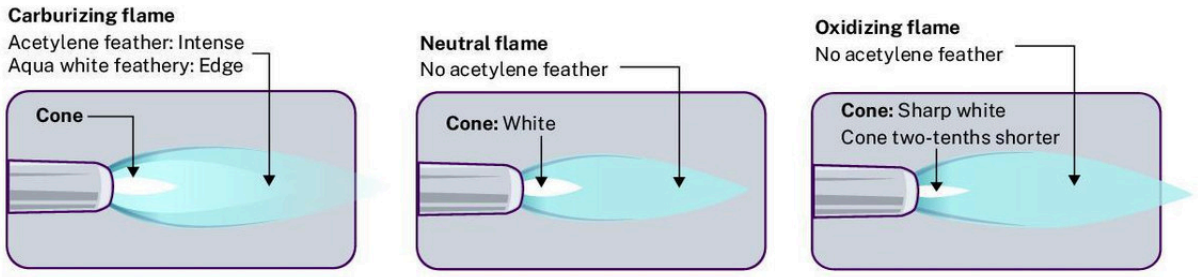
5. **Heat** the tube and fitting around the depth of the socket. Keep the flame moving.
6. **Touch** the solder to the joint opposite the flame.
7. **Let the work melt the solder.** The hot base metal should draw it into the joint. If the filler metal beads up, stop, let it cool, and retry.
8. **Stop** when a continuous solder ring forms.
9. **For this non-service GRIT practice assembly, leave the copper joint supported and undisturbed for approximately 30 seconds after removing the flame, and until the filler has solidified. The Mentor may then supervise wet-rag cooling or water quenching, keeping hands clear of steam and hot water. Keep the work in the marked cooling area and confirm it is cool before handling.**
10. **Wipe** off flux residue.
11. **Inspect** the entire joint through 360 degrees.

Braze the Copper Joint

Use **air-acetylene or oxy-acetylene** with Sil-Fos / phos-copper (BCuP; 0%, 5%, or 15% is fine). No external flux is needed on a clean copper-to-copper joint.

Air-acetylene: use the matched A-8 copper tip in the selected swirl-tip system, usually TurboTorch. **Oxy-acetylene:** use a small manufacturer-approved tip for this ⅞" copper joint only.

1. **Dry-fit** the tube fully seated and snug.
2. **Clamp** the assembly over firebrick.
3. **Light the selected torch using its proper ignition method. For oxy-acetylene, the experienced Mentor uses a flint striker and controls ignition and adjustment.**
    a. **For oxy-acetylene, the experienced Mentor sets a neutral or slightly reducing/carburizing flame in accordance with the equipment instructions.**



4. **Heat** both pieces of base metal evenly.
5. **Touch** the Sil-Fos / phos-copper to the joint AWAY from the flame.
6. **Let the work melt the filler.** Judge flow rather than color alone. If the filler metal beads up, stop, let it cool, and retry.
7. **Stop** when the joint is filled.
8. **For this non-service GRIT practice assembly, leave the copper joint supported and undisturbed for approximately 30 seconds after removing the flame, and until the filler has solidified. The Mentor may then supervise wet-rag cooling or water quenching, keeping hands clear of steam and hot water. Keep the work in the marked cooling area and confirm it is cool before handling.**
9. **Wipe** away surface oxide after the joint sets.
10. **Inspect** the entire joint through 360 degrees.

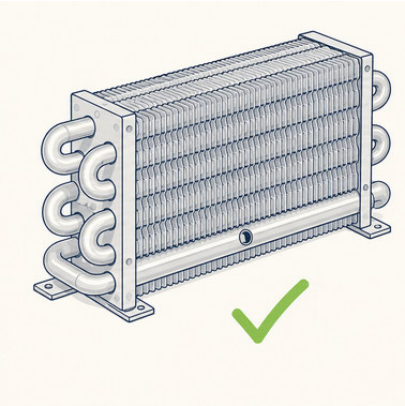
Common Copper Mistakes

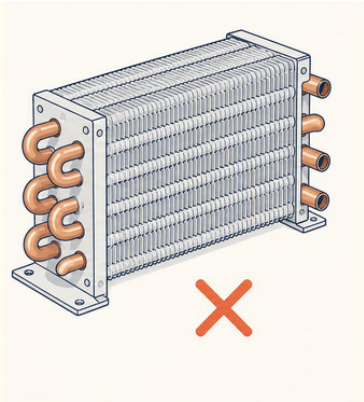
- **Burr left inside the tubing**
- **Dirty or loose fit**
- **Tube not fully seated**
- **Too much plumbing flux or burned flux**
- **Flame melts the filler instead of letting the hot base metal melt it**
- **Joint moved or quenched before it sets**

If filler beads up instead of wetting, STOP. Allow the work to cool, clean it again, and remake the joint. Adding more filler will not correct poor preparation or heat control.

Optional: Prepare for Aluminum Repair

The aluminum module includes a repair on an all-aluminum coil and a repair on an aluminum can. These holes can be made with a **drill with a ⅛" bit** or a **sharp awl.**





Before Offering the Module

- **Confirm that the practice coil is all aluminum**
  - Copper U-bends will not work
- **Stage 30 clean aluminum cans total for the camp's can-repair exercise, including practice and spare cans.**
- **Make holes in the aluminum cans or coils**
- **Degrease the repair area**
- **Clean with a dedicated stainless-steel brush**
- **Use propane/MAP-Pro or a matched air-acetylene A-3 setup**
  - Never use oxy-acetylene for aluminum repair
- **Keep the selected rod, flux, heating method, and cleanup instructions together**

Choose One Aluminum Product System

- **Preferred — flux-cored rod:** Lucas-Milhaupt AL 822 or Harris ALUXCOR ZnAl 78/22; approximately 800–900°F; no external flux.
- **Second choice — external powder flux:** SolderWeld Alloy-Sol; powder flux is applied separately and heated on the work.
- **Alternate — very-low-temperature liquid flux:** Uniweld UNI-4300; approximately 500°F; indirect or side heat. Generally less capable for patching, and the liquid flux is easier to burn.

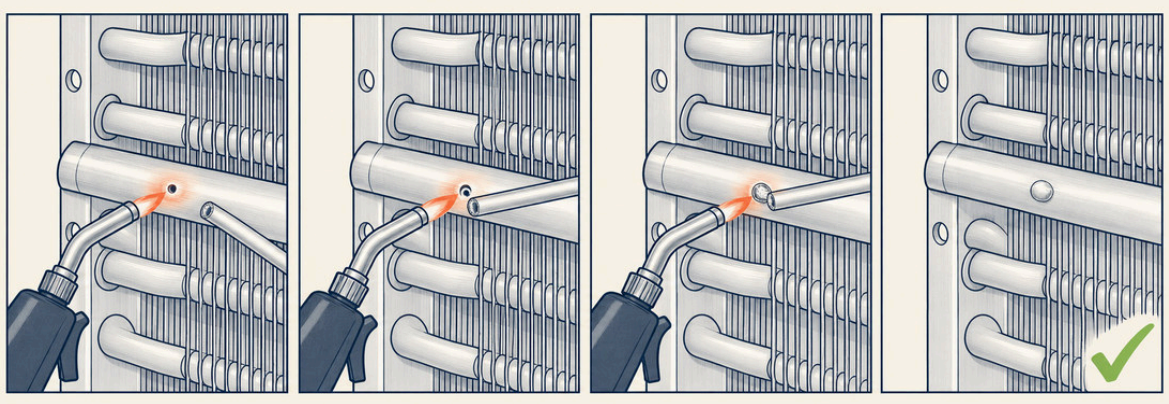
Do not mix systems. Use the exact rod, flux, heat pattern, and cleanup instructions for the selected product category.

Aluminum Option 1: Flux-Cored Rod — Preferred

This category places the flux inside the rod. Do not add external flux.

- **Lucas-Milhaupt AL 822**
- **Harris ALUXCOR ZnAl 78/22** — example MPN ZN78CW09420POP
- **Working range:** approximately 800–900°F
- **Heat source:** controlled propane/MAP-Pro or the matched A-3 air-acetylene tip

Procedure



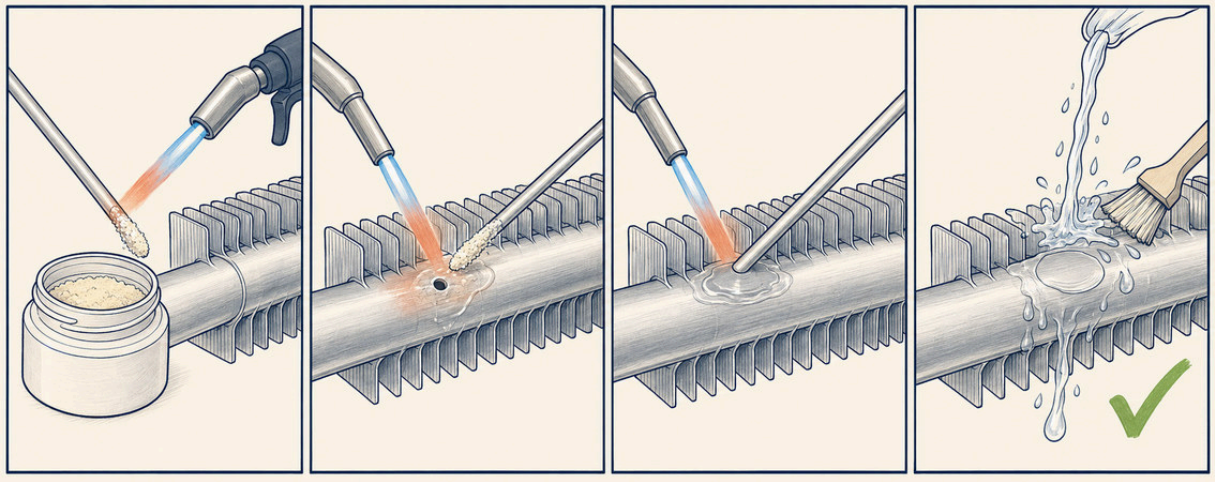
1. **Clean** and degrease the repair area with a dedicated stainless-steel brush.
2. **Heat** the base metal around the hole with controlled propane/MAP-Pro or matched A-3 air-acetylene heat.
3. **Touch** the cut face of the rod to the hole so the internal flux reaches the work first.
4. **Let the hot base metal melt and draw the alloy** into the repair.
5. **Remove the rod and heat immediately** when the opening fills.
6. **Do not continue heating**; excess heat may enlarge the hole.
7. **Follow the product label for residue**. Lucas identifies AL 822 residue as noncorrosive.

Common Mistakes

- **Adding external flux to a flux-cored rod**
- **Heating the rod instead of the base metal**
- **Feeding an uncut or oxidized rod end first**
- **Continuing to heat after the repair fills**

Aluminum Option 2: External Powder Flux

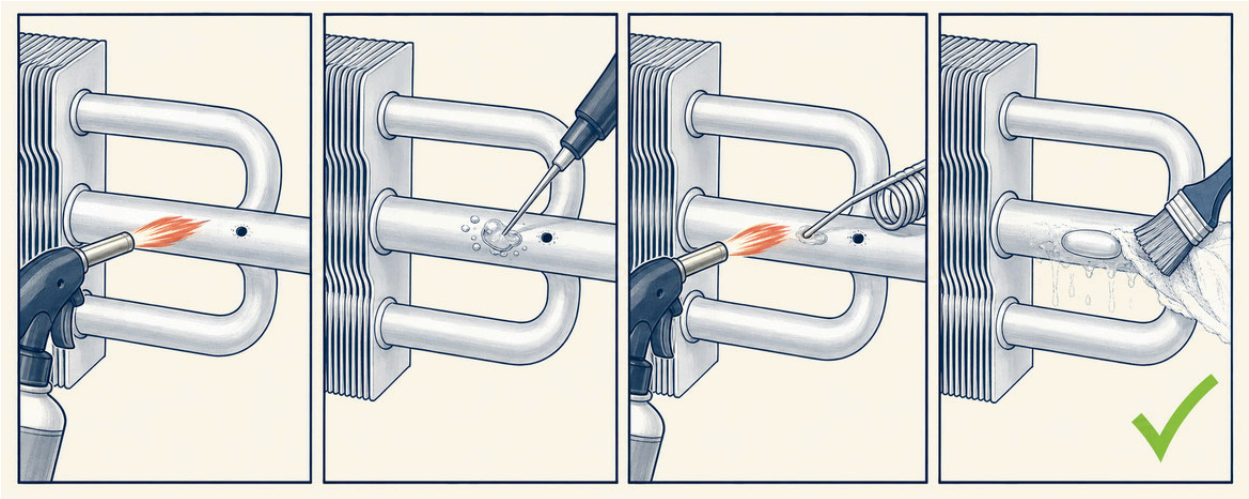
Reference product: SolderWeld Alloy-Sol. The powder flux is separate from the repair rod.



1. **Warm** the end of the rod.
2. **Dip** the warmed rod tip into the named external powder flux.
3. **Preheat** the base metal around the hole.
4. **Melt** the flux onto the repair area until it becomes clear.
5. **Feed** the alloy while continuing to heat the base metal.
6. **Stop** as soon as the alloy flattens and wets the repair.
7. **Cool naturally** without moving the repair.
8. **Wash** away flux residue according to the manufacturer's instructions.

Aluminum Option 3: Very-Low-Temperature Liquid Flux

Reference product: Uniweld UNI-4300; approximately 500°F. This is an alternate, not a main choice, because it is generally less capable for patching, and its liquid flux is easier to burn.



1. **Gently preheat** the sides of the repair.
2. **Apply the matching liquid flux, then feather indirect or side heat** along the repair area.
3. **Watch the flux** bubble and then become quiet; it may show a green flash.
4. **Do not continue heating** after the flux reaches working temperature.
5. **Touch the filler to the hot base metal** and let the work—not the flame—melt it.
6. **Cool naturally** without moving the repair.
7. **Remove all residual liquid flux** according to the manufacturer's instructions.

Common Confusions and Mistakes

Use this page as a quick Mentor troubleshooting check.

Torch System Mistakes

- ☐ **Loose components are counted as a complete station**
- ☐ **A manual-light torch is used without the proper striker**
- ☐ **An acetylene cylinder is present without the correct wrench**
- ☐ **Tips are mixed between manufacturers or torch systems**
- ☐ **Oxy-acetylene is used for aluminum repair**
- ☐ **Propane/MAP-Pro is expected to perform the copper-brazing option**

Copper Mistakes

- ☐ **Tube is not reamed through the full inside diameter**
- ☐ **Tube or fitting cup is dirty**
- ☐ **Fit is loose or not fully seated**
- ☐ **Too much flux is applied, or the flux is burned (soft soldering)**
- ☐ **Filler is melted directly with the flame**
- ☐ **Joint is moved or quenched before it sets**

Aluminum Mistakes

- ☐ **Copper-tube/aluminum-fin coil is used instead of an all-aluminum coil**
- ☐ **Not enough clean cans are prepared**
- ☐ **Flux-cored, powder-flux, and liquid-flux procedures are mixed**
- ☐ **Wrong cleanup procedure is used**
- ☐ **Rod is heated instead of the base metal**
- ☐ **Heat continues after the repair fills**
- ☐ **Liquid flux is burned**

When the filler will not wet, stop. Cool the work, identify the preparation or heat-control problem, clean again, and remake the repair with the selected matched system.

Shared Camp Support

Stock enough compatible support equipment to keep every selected Station complete.

- ☐ **Spare compatible cylinders and tips**
- ☐ **Spare strikers or igniters**
- ☐ **Spare acetylene wrenches**
- ☐ **Enough filler, flux, and brushes** for every Station
- ☐ **Enough tables and clamps** for every active pair
- ☐ **Compatible hoses, handles, and replacement components**
- ☐ **Exact aluminum repair kit and product-specific cleanup supplies**
- ☐ **Dedicated stainless-steel brush, all-aluminum coil, and 30 clean cans total per camp, if offering aluminum repair**

Final Mentor Check

Mentors must complete this check before the box backer is installed and before the station is released.

- ☐ **Copper assembly is fully seated**
- ☐ **Copper joint held undisturbed for approximately 30 seconds and until the filler solidified, then cooled under Mentor supervision; safe handling confirmed**
- ☐ **Flux or oxide was cleaned as required**
- ☐ **Joint was inspected through 360 degrees**
- ☐ **Aluminum repair used one selected matched product system**, if offered
- ☐ **Torch and cylinder were shut down using the equipment manufacturer’s procedure**
- ☐ **Hot tools and workpieces remain in the defined cooling area**
- ☐ **Backing board was installed only after all fitting and joining work was complete**

Completion Sign-Off

Education Lead: _____ Date: _____

Host: _____ Station count: _____

The goal is a complete, repeatable station setup that lets each Student pair prepare, join, clean, and inspect the exact GRIT pipe assembly with a competent Mentor.