📘 LESSON PACKET

Advanced Brazing Techniques: Copper, Steel & Aluminum Joints

TMM Academics – Sealed System Training

📌 Lesson Overview

This lesson builds on basic brazing skills by introducing advanced techniques for joining different materials used in refrigeration systems. Students will learn how to properly control heat, prepare tubing, use filler materials correctly, and avoid common mistakes that lead to leaks or system contamination.

🔹 Section 1: Work Area Setup and Safety

Before brazing, the work area must be properly set up.

- Keep hoses untangled
- Position the tank away from the work area
- Ensure nothing can be pulled or knocked over

A poorly positioned tank or tangled hose can create dangerous situations during a repair.

Key Point:
Safe setup prevents accidents before the torch is even lit.

🔹 Section 2: Proper Torch Handling

When brazing:

- Hold the torch in your weaker hand
- Use your dominant hand to control the solder

This allows better precision when applying filler material and controlling the joint.

Section 3: Brazing Technique Fundamentals

The correct brazing method is:

- Heat the pipe, not the solder
- Watch for the pipe to reach proper temperature
- Touch the solder to the pipe
- Allow it to flow naturally around the joint

The solder should melt from the heat of the pipe, not from direct flame contact.

Section 4: Copper to Copper Brazing

Copper-to-copper is the most common type of joint.

Steps include:

- Clean tubing to bright metal
- Apply heat evenly
- Allow solder to flow completely around the joint

A properly brazed joint will appear smooth and fully sealed with no visible gaps.

Section 5: Using Brazing Rings

Brazing rings can be used instead of a rod in tight spaces.

- Slide ring over the joint
- Apply heat below the joint
- Allow heat to draw solder upward

This method is useful when access is limited.

Section 6: Heat Application Technique

Proper heat placement is critical:

- Apply heat below the joint
- Allow heat to rise
- Avoid direct flame on solder

If heat is applied directly to the solder, it will melt and fall off instead of bonding.

🔹 Section 7: Oxidation and Contamination

During brazing, oxidation forms inside the tubing.

This black residue can:

- Travel through the system
- Mix with oil
- Cause restrictions in capillary tubes

Minimizing heat exposure reduces contamination.

Key Point:
The longer you apply heat, the more contamination you create.

🔹 Section 8: Copper to Steel Brazing

Copper-to-steel joints require additional preparation:

- Remove paint from steel tubing
- Clean both surfaces
- Apply flux

Steel requires more heat than copper, and flux helps improve bonding.

🔹 Section 9: Using 15% vs 45% Silver Rod

- 15% silver → standard applications
- 45% silver → easier flow, less heat required

Higher silver content is better for dissimilar metals such as copper to steel.

🔹 Section 10: Controlling Heat to Prevent Damage

Excessive heat can:

- Burn through tubing
- Melt aluminum instantly
- Cause solder to run inside the pipe

Instead of removing the flame completely, pull it back to reduce heat while maintaining control.

🔹 Section 11: Aluminum Brazing

Aluminum requires special handling:

- Use low heat
- Use aluminum brazing rod (with built-in flux)
- Heat slowly and carefully

Too much heat will quickly melt the tubing.

🔹 Section 12: Copper to Aluminum Brazing

When joining copper to aluminum:

- Heat the copper first
- Use low flame
- Allow material to flow onto aluminum

This prevents overheating and ensures proper bonding.

🔹 Section 13: Managing Different Tube Sizes

When tubing sizes do not match:

- Use swaging to expand tubing
- Use pinch-off technique to reduce gap

Large gaps can cause excessive solder use and create restrictions.

🔹 Section 14: Removing Brazed Joints

To remove a brazed joint:

- Heat the joint evenly
- Wait until solder fully liquefies
- Pull apart carefully

Removing too early can leave material inside the tubing.

🔹 Section 15: Repairing Leaks

If a joint leaks:

- Attempt repair once
- If unsuccessful, cut out and redo

Repeated attempts can contaminate the system and create restrictions.

🔹 Section 16: Safety Practices

Always follow safety procedures:

- Wear safety glasses
- Be aware of surroundings
- Avoid pointing flame toward people or components
- Be cautious of refrigerant and oil discharge

Improper handling can cause injury or damage.

🔹 Section 17: Final Understanding

Brazing is a skill that improves with practice.

Proper technique results in:

- Strong joints
- No leaks
- Clean system operation

Poor technique results in repeat failures and system contamination.

📝 Review Questions

Multiple Choice

1. Why should heat be applied below the joint?
   A. To cool the pipe
   B. Heat rises and draws solder into the joint
   C. To melt solder faster
   D. To reduce pressure

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2. What is a major risk of excessive heat during brazing?
   A. Stronger joint
   B. Increased airflow
   C. Contamination and oxidation
   D. Faster cooling

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3. Why is flux used when brazing copper to steel?
   A. Increase pressure
   B. Improve solder flow and bonding
   C. Reduce temperature
   D. Clean refrigerant

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4. What is the purpose of swaging?
   A. Reduce pressure

B. Expand tubing to fit another tube
C. Increase heat
D. Clean tubing

Short Answer

5. Why should you avoid applying heat directly to the solder?
6. What problem can oxidation inside tubing cause?

Scenario-Based

7. A technician continues applying heat for several minutes trying to complete a joint. What problem is likely to occur inside the system and why?

✅ Answer Key

1. B – Heat rises and draws solder into the joint
2. C – Contamination and oxidation
3. B – Improve solder flow and bonding
4. B – Expand tubing to fit another tube
5. Because solder must melt from the heat of the pipe, not the flame
6. It can create restrictions and contaminate the system
7. Excess oxidation buildup, which can clog the system and cause failures