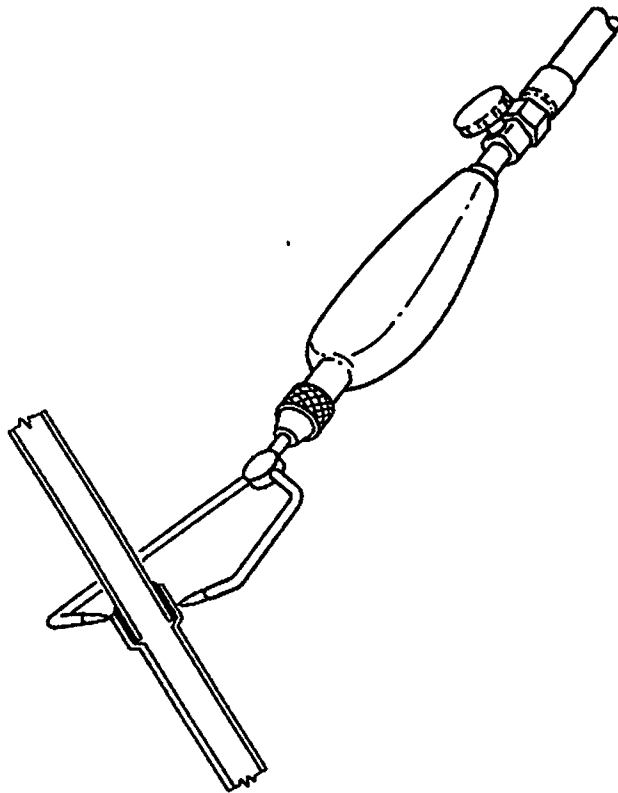


REFRIGERATION

STUDY COURSE

UNDERSTANDING:

- TECHNIQUES OF BRAZING



MODULE 3

LIT4814333

A properly brazed joint on copper tubing will show an alloy fillet completely around the rim of the joint. When copper tubing is brazed to steel tubing, there will not be a noticeable fillet.

But remember, it is the alloy (fig. 23) that flowed down inside the joint, not the visible fillet, that makes the joint strong and leak-tight.

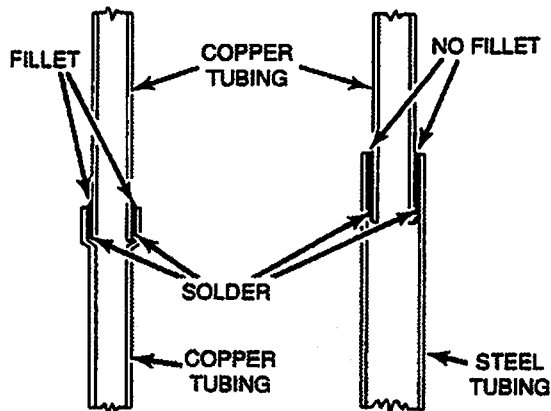


FIGURE 23

Remember, good brazing is absolutely essential to the proper repair of sealed systems.

REMEMBER TO PRACTICE PRACTICE PRACTICE

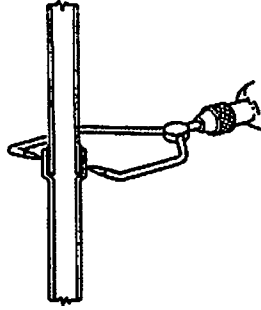


FIGURE 20

Since the silver solder will melt very quickly, it is a good idea to bend (fig. 21) over a short "L" at the end of the alloy. One-half inch of alloy is sufficient to braze most joints, Don't forget to flux the alloy.



FIGURE 21

Heat the joint at the edge of the overlapping tubing. You will notice the flux

- First start to bubble
- Then dry and turn white
- Lastly turn clear and waterlike

The joint is now hot enough to apply the alloy. Hold the short end of the "L" shape at the edge of the joint. As the alloy starts to melt move the flames of the torch down (fig. 22) the length of the joint. This heating action will draw the alloy, by capillary action, down inside of the overlapping portion of the joint.

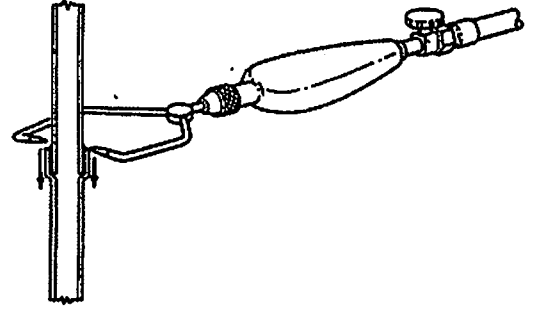


FIGURE 22

When the short end of the "L" shape is gone, remove the alloy.

When the torch flames have been moved to the bottom of the overlapping portion of the joint, remove the torch.

Avoid overheating the copper tubing. When copper tubing is heated so hot that it glows, a scale forms on the inside of the tubing. This scale may eventually break off and affect the sealed system's performance.

Cool down the newly brazed joint with a wet towel. Then scrape off any residue flux with a pair of pliers and/or sanding cloth.

The joint should then be carefully inspected using the inspection mirror. Flaws in a brazed joint will usually appear as small black specks (pinholes) in the alloy fillet.

If the joint must be brazed again, reclean the outside of the joint with refrigeration sanding cloth and then reflux before reheating.

INTRODUCTION

The material presented in this module is intended to provide you with an understanding of the fundamentals of refrigeration servicing.

Major appliances have become more sophisticated, taking them out of the screwdriver and pliers category. Their electrical circuits include several different types of automatic controls, switches, heaters, valves, etc.. Semiconductors, solid-state controls, and other components usually associated with radio and television electronic circuits, are being engineered into automatic washers, dryers, dishwashers and refrigerators.

The appliance technician is emerging into a professional status of his own. He must prepare himself now to be able to perform his duties today as well as to retain his professionalism in the future.

No longer is on-the-job training sufficient to prepare technicians for the complicated procedures required for today's sophisticated appliances. This training can best be obtained through organized classroom study and application. However, much of the knowledge necessary to service today's appliances can be obtained through study courses. Completion of this and other courses will provide you with sufficient understanding of appliances and their operation to enable you to do minor service. It will also serve as a valuable stepping stone to more advanced study and on-the-job training to improve your servicing skills.

Information contained in this module is used on WHIRLPOOL® appliances.

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***TEST** See Test Book LIT4314335

***NOTE:** *We recommend taking the TEST for MODULE 3, right after studying it.*

CHAPTER 1

BRAZING

TECHNIQUES OF BRAZING

Any repair of a refrigeration system that requires you to enter the sealed system will also require you to braze. You will have to braze on at least one permanent access valve to purge the sealed system of refrigerant, to sweep charge the system, and to provide a final charge for the system after the repair has been completed. You may also have to braze replacement components such as compressors and driers into the sealed system. You may even have to braze in a section of new tubing.

Therefore, it is very important you learn how to braze properly. Only by understanding the correct techniques of good brazing, and by *practice*, can you produce the leak-free joints that are required in sealed system service.

TECHNIQUES FOR SUCCESSFUL BRAZING

- CLEAN-CLEAN-CLEAN
- Use proper equipment
- Use recommended materials
- Observe all safety precautions
- Follow correct brazing procedures

Cleanliness

The single most important factor affecting your brazed joint is *cleanliness*. A clean working environment, clean tools and clean joints are all absolutely essential to proper brazing.

Equipment

Good brazing requires the use of proper equipment that is kept in good working condition.

- You will need a pair of safety glasses (fig. 1).

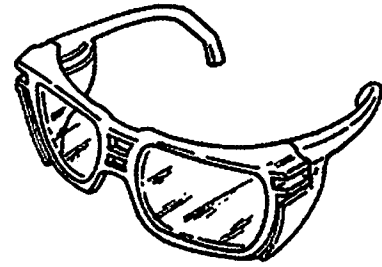


FIGURE 1

- You should have a swaging tool set (fig. 2) with drive tubes to fit 3/16, 1/4, 5/16, 3/8 and 1/2-inch tubing. You should never use multi-size swaging tools. You should never use a flaring tool as your swaging tool can be used to open or round out a tubing end.

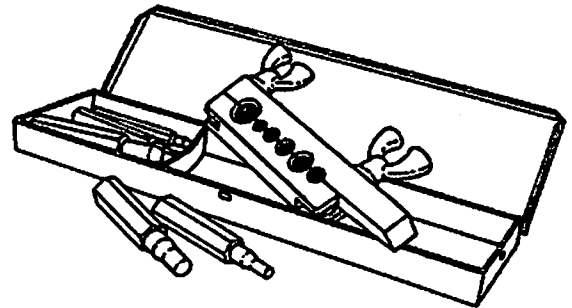


FIGURE 2

•You should have a standard tubing cutter and mini-cutter (or "imp" cutter) (fig. 3) that will be very useful for cutting tubing in tight places where a standard cutter will not turn.

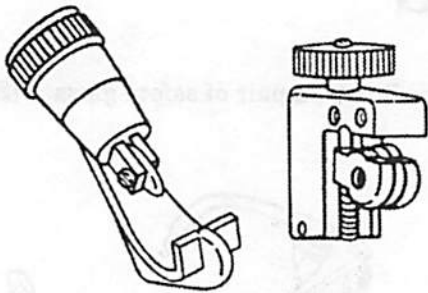


FIGURE 3

•You should have a tubing bender (fig. 4).

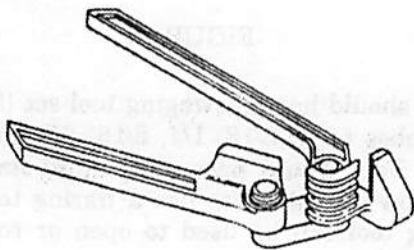


FIGURE 4

•You should have an assortment of wire brushes (fig. 5) to be used to clean the joints that are to be brazed.

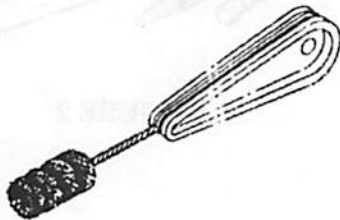


FIGURE 5

•You should have refrigeration sanding cloth (fig. 6) to clean the joints that are to be brazed. *Never* use emery cloth, steel wool or acid to clean the metal at a joint. Emery cloth contains oil which will

prevent a good brazed seal. Small filaments may break off of steel wool and enter the refrigeration system and clog the strainer. And even the smallest amount of acid accidentally introduced into the system will contaminate the refrigeration system.



FIGURE 6

•You will need a small CO_2 fire extinguisher (fig. 7).

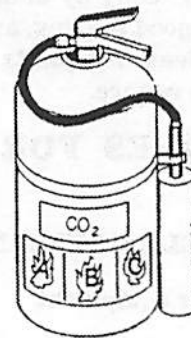


FIGURE 7

•You should have a single fuel tank (fig. 8) of acetylene gas for your torch. An acetylene torch will produce just the right amount of heat to make a tightly sealed joint.

A two tank system (oxygen and acetylene) will produce too hot of a flame and will scorch the inside of the tubing. During cooling, the burnt scale will break off and contaminate the system.

A pressure regulator with a gauge that shows how much acetylene is left in the tank.

A double-tip torch because of its ability to heat both sides of the joint at once. This provides quicker brazing and less scorching.

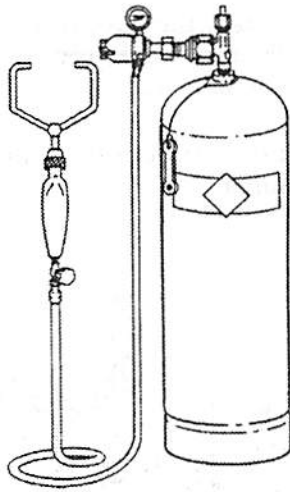


FIGURE 8

•You will need a standard striker (fig. 9) that catches a small pocket of gas to ignite the torch.

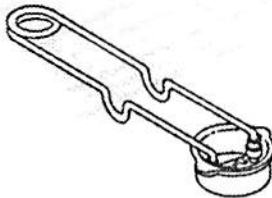


FIGURE 9

•You will need a bubble solution for checking leaks at the brazed joints or an electronic leak detector (fig. 10) that detects the presence of refrigerant vapor. These can also be used to check for gas leaks on your torch.

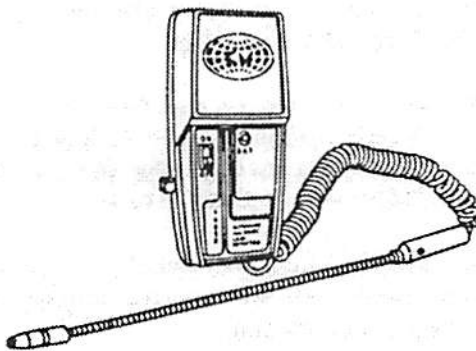


FIGURE 10

•You will need an inspection mirror (fig. 11) small enough to inspect all around a joint even in tight places.

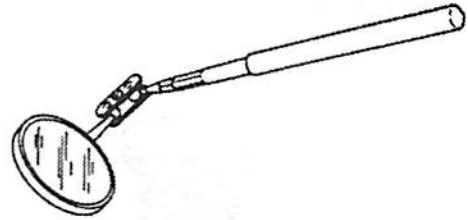


FIGURE 11

Materials

In addition to your brazing tools, you will need a supply of expendable materials. There are many brazing materials available on the market, so it is very important to carefully check and make sure the materials you use meet the required specifications.

•A brazing alloy (commonly called silver solder) (fig. 12) which can be used in all sealed system brazing. The alloy must contain a minimum of 45% silver and be cadmium-free.



FIGURE 12

•A flux (fig. 13) that is compatible with silver solder brazing and suitable for brazing copper-to-copper and copper-to-steel. Liquid flux is available but most service technicians prefer a paste flux applied with a brush.



FIGURE 13

•A commercially available heat sink or heat trap material (fig. 14).



FIGURE 14

Safety Precautions

Rule # 1: Wear eye protection at all times.

Although the acetylene torch flame does not generate rays that are harmful to your eyes, you should use safety glasses or goggles to protect your eyes in case of an accident. The safety glasses should have a lens shade of at least three or four.

It is a good habit to wear your safety glasses or goggles from the time you pull out the unit to begin repairs until you pack up your equipment.

Safety eyewear will not only protect your eyes during brazing but will also provide protection from an accidental discharge of refrigerant gas.

Rule # 2: Protect the customer's floor or other surface under the area where you are brazing with an approved fireproof mat.

Rule # 3: Transport your torch tank (fig. 15) in an approved manner.

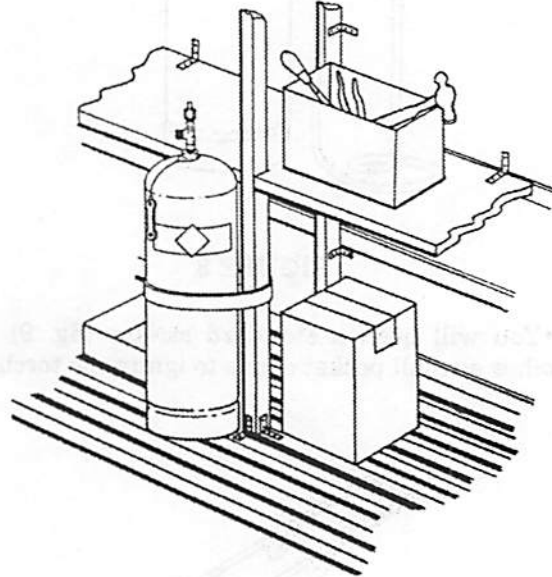


FIGURE 15

Your torch fuel tank is a very dangerous piece of equipment if not handled properly.

Always secure the tank in a vertical position when transporting it in the service van. Remember also to secure other items in the service van that might roll and bump into the fuel tank.

Never store or transport the fuel tank with the pressure regulator attached.

A fuel tank must be handled with care and respect. A tank that is dropped, falls over or rolls into a solid object can damage the stem at the head of the cylinder with explosive results.

In addition, the safety relief valve that is part of all fuel tanks will not operate properly if the fuel tank is lying on its side.

Rule # 4: Always check your torch assembly for leaks.

Acetylene at high concentrations is an asphyxiant, irritant and anesthetic. Depending on the concentration and exposure time, symptoms such as irritation to the mucous membranes of the eyes, nose, throat and respiratory tract; shortness of breath with rapid respiration; fatigue, dizziness, diminished mental alertness, and muscular inco-ordination, nausea, vomiting, loss of consciousness, convulsions and, finally, coma and death may occur.

Rule # 5: Always use an approved pressure regulator (fig. 16) on your tank.

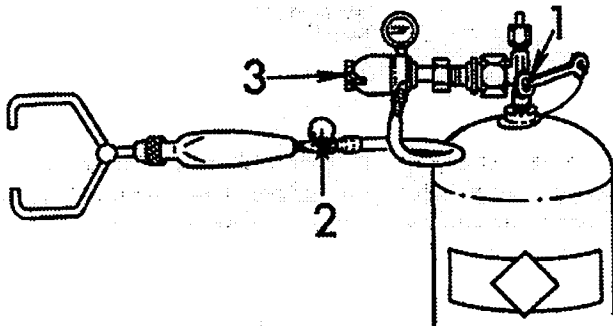


FIGURE 16

When ready to ignite your torch, open the valve (1) on the fuel tank 1/4 turn with the wrench. Always leave the wrench in place while the valve is open. This allows you to quickly shut off the gas supply in an emergency.

Now open the valve (2) on the torch handle completely, and ignite the torch.

The valve (3) on the pressure regulator is used to adjust the flame size.

When shutting off the torch, first close the valve (2) on the torch handle. Then, using the cylinder wrench, close the valve (1) on the fuel tank. You should always purge the torch assembly of any remaining gas by briefly opening the valve (2) on the torch handle.

If you are finished using your torch, remove the pressure regulator.

Rule # 6: Always secure your tank.

If the fuel tank (fig. 17) should fall over while you are brazing, the pressure regulator may be damaged and you could end up with an unwanted, unguided lethal missile flying through the work area.

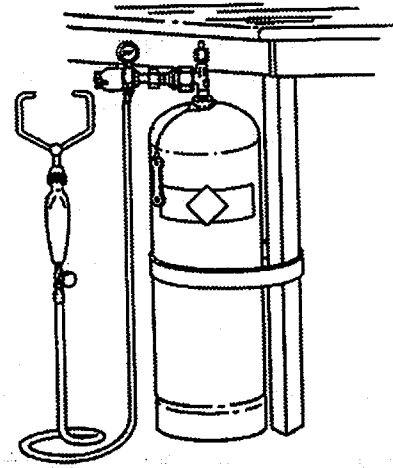


FIGURE 17

Rule # 7: Always work in a well-ventilated area.

Most fluxes contain fluorides. Fumes and gases can be dangerous to your health.

Avoid contact of flux with eyes and skin. If contact with eyes, flush immediately with clean water for at least 15 minutes.

Rule # 8: Handle tubing ends and brazed joints carefully.

Newly cut tubing can be very sharp on the edges.

Any recently brazed joints are very hot until you cool them down with a wet towel. Copper is a very good conductor of heat. You may find that tubing far away from the brazed joint is too hot to touch.

Correct brazing procedures

KEYS TO GOOD JOINTS

- Good fit and clearance
- Clean metal
- Self-supporting
- Good use of flux
- Right amount of heat
- Cleaned and inspected

In sealed systems, tubing of one size will normally slip into the next larger size of tubing. For example, 1/4-inch tubing will slip into 5/16-inch tubing. The joint should overlap one diameter of the larger tubing-in this case 5/16 of an inch.

Copper tubing of the same size can be expanded to make a slip joint of the proper clearance-an overlap of one diameter-by using a swaging tool.

Steel tubing, such as compressor stubs, should never be swaged. Steel is a much harder metal than copper and will split if you attempt to expand it.

Always support the swaging tool (fig. 18) with your hand. Don't expect the tubing to absorb the force of the hammer blows. The tubing would probably bend or collapse.

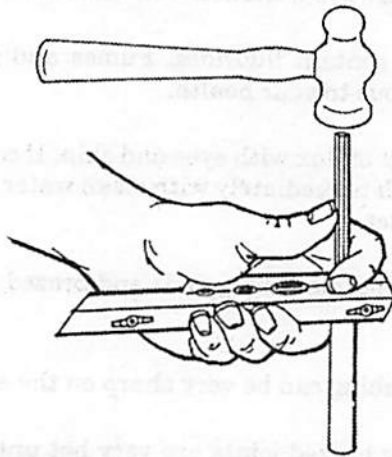


FIGURE 18

Tubing with a large difference in size can be joined by making a pinched joint.

If joining a capillary tube (fig. 19) in a pinched joint, always "contaminate" the end of the cap tube with a drop of body oil (run your finger along the side of your nose). This will keep the solder from closing over the end during brazing. Then insert the small cap tube into the larger tubing. Using pliers, pinch the larger tubing together to surround the small cap tube. The joint can now be brazed as normal.

The brazing alloy will not bond to dirty metal. The metal surfaces that are to be joined should be cleaned thoroughly with refrigeration sanding

cloth. If the tubing is painted, such as compressor stubs, the paint must be cleaned off with a wire brush and then with refrigeration sanding cloth.

It is often a good idea to clean the tubing before cutting it. When cleaning open tubing be careful to keep dirt and grit from getting inside the tubing.

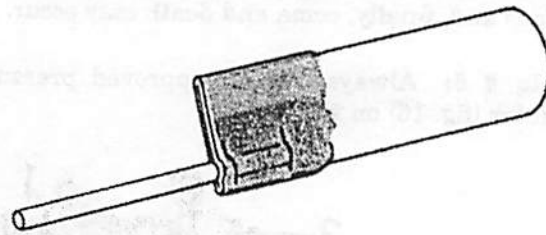


FIGURE 19

When the joint is assembled it should be self-supporting, holding itself together even before it is brazed. If you have several joints to braze it's a good idea to assemble them all and then braze them.

It is very important to first properly flux the joint. If you have to reheat the joint additional flux should be applied.

Flux:

- Prevents the metal from oxidizing while being heated.
- Provides additional cleaning of the metal by absorbing and dissolving surface residue.
- Assists the flow of the alloy by wetting the surfaces to be bonded.
- Acts as a temperature indicator.

If you will be brazing a joint near an aluminum weld joint, apply a generous coating of heat sink or heat trap material to assure that the aluminum does not burn through. Also apply heat sink or heat trap material to any access valves that are in the vicinity of the joint to be brazed. This will prevent damage to the Teflon O-ring in the valve.

When your torch is lit (fig. 20) adjust the torch tips so that the hottest part of the flame-the light blue tip-just grazes either side of the joint.