

# INSTRUCTIONS FOR BRAZING FITTINGS TO PIPE AND TUBING

## with BRAZE, EASY-FLO and SIL-FOS

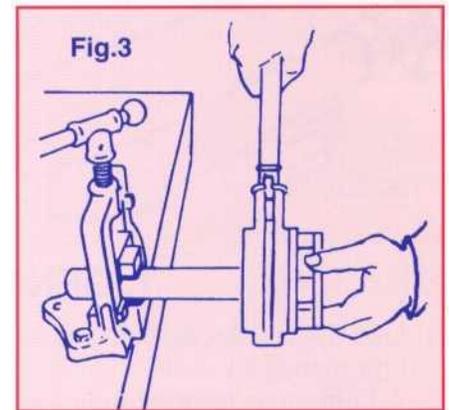
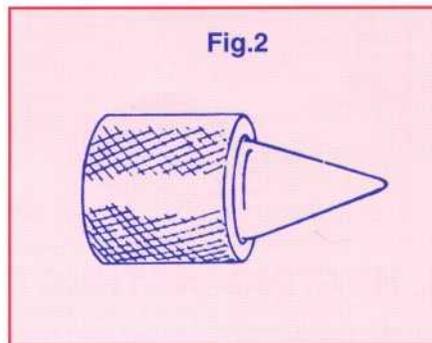
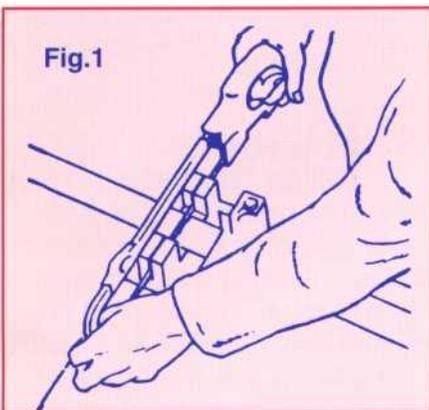
BULLETIN 17

LOW-TEMPERATURE SILVER ALLOY BRAZING with BRAZE, EASY-FLO or SIL-FOS is extensively used for joining pipe and tubing. It makes assemblies that are **strong, permanently leak-tight and maintenance-free**, and is an **extremely simple, low-cost process**. Anyone who knows how to use an oxyacetylene torch can quickly become proficient. It is merely a matter of following the correct procedure as covered by the **INSTRUCTIONS** in this bulletin. These instructions apply to the brazing of fittings to both pipe and tubing. For simplification, only the word "pipe" is used. The procedure is exactly the same when brazing with **BRAZE, EASY-FLO** or with SIL-FOS.

### PREPARATION

### 1. CUTTING AND FITTING

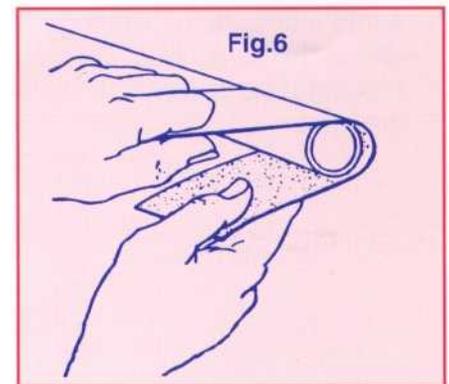
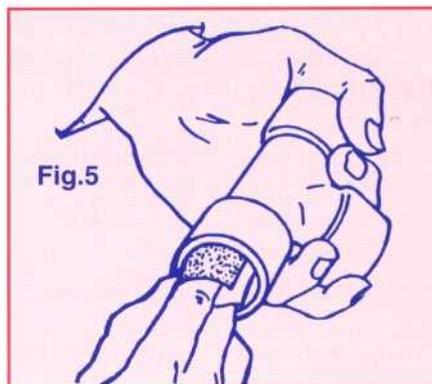
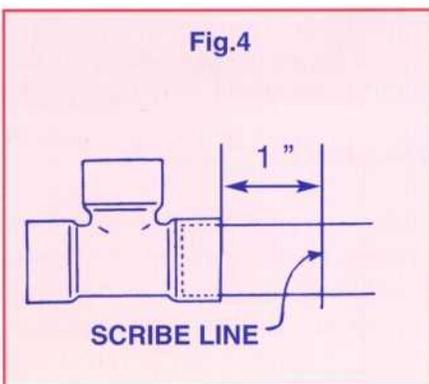
- Cut pipe to length. Make sure ends are cut square. Use of a square end sawing vise or pipe cutter is recommended, **Fig.1**.
- Remove burrs with a reamer or half-round file.
- Try pipe end in the fitting to be sure it has the proper close fit. Clearance should not be more than .005".
- Clearance should be uniform all around. Where necessary, round out pipe with a sizing tool, **Fig.2**. For sizing the outside of steel pipe use a standard Ridge, Armstrong or Beaver threading tool with cutting jaws, Fig.3.
- Scribe a line on pipe at a distance from the cut end equal to the depth of fitting socket plus 1 ". This line serves as a check to make sure pipe is inserted full depth when assembled in the fitting, **Fig.4**.



### 2. CLEANING

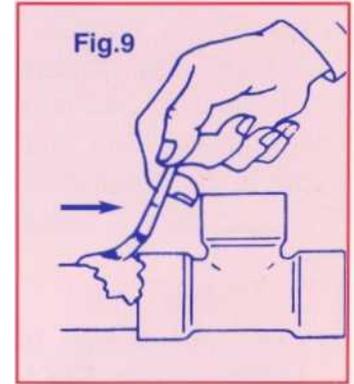
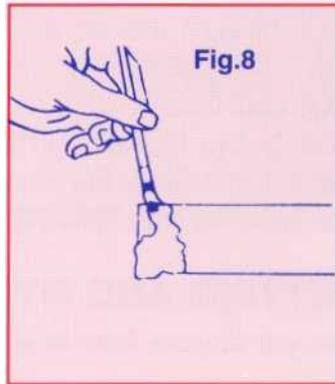
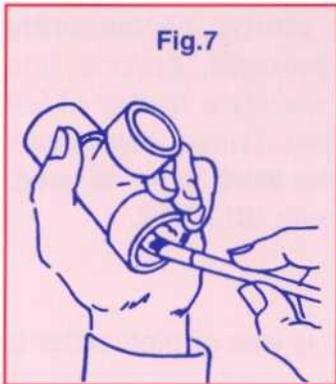
*Surfaces to be joined must be free of oil, grease, rust or oxides. Clean them as follows -*

- Practically all fittings have a coating of oil or grease. The liberal application of an effective solvent with a brush is a satisfactory method for grease removal.
- Clean socket of fitting and end of pipe thoroughly with emery cloth to remove rust and oxides, **Fig.5 and 6**.
- Do not handle surfaces after cleaning.



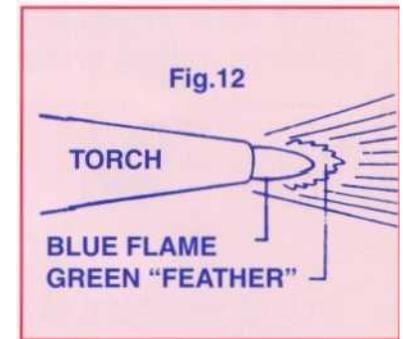
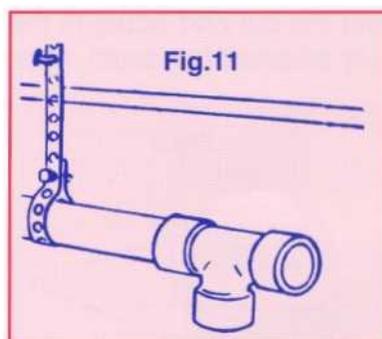
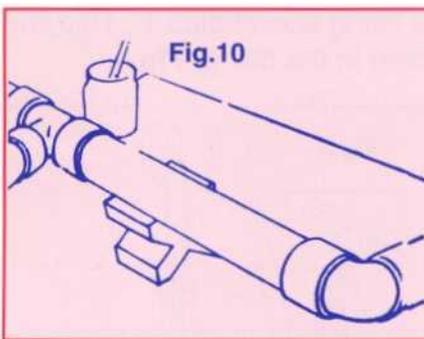
### 3. FLUXING

- Immediately after cleaning, apply Handy Flux with a brush to each joint surface. **Figs. 7&8.** Spread it evenly.
- Avoid leaving excess flux inside of pipe and fitting. No flux is permitted inside of refrigeration assemblies.
- Assemble pipe into fitting immediately after fluxing.
- Where possible, revolve fitting once or twice on pipe to spread flux uniformly.
- Make scribe line check, **Fig.4,** to see that pipe is inserted full depth in socket.
- Brush flux back over entire end of fitting all around, **Fig.9.** This prevents oxidation of the end.



### 4. SUPPORTING THE ASSEMBLY

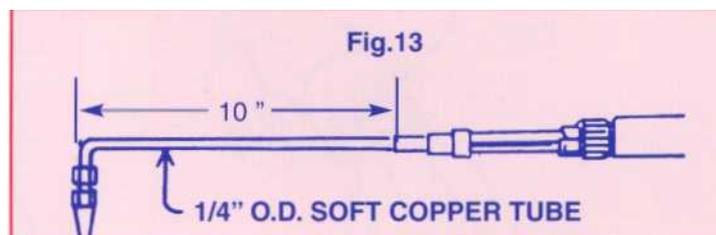
- Before brazing, assembly should be carefully aligned and adequately supported, **Figs. 10 & 11.**
- Arrange supports so that expansion and contraction will not be restricted.
- See that no strain is placed on the joints during brazing and cooling.



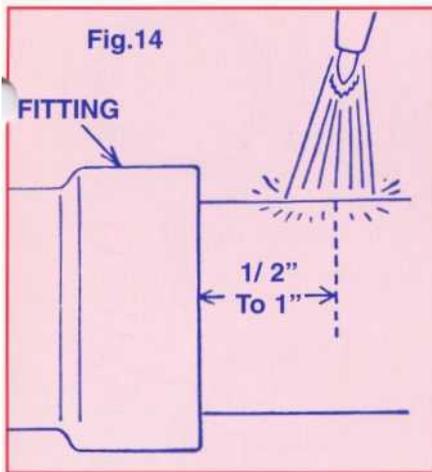
### BRAZING

#### 1. GENERAL HEATING INSTRUCTIONS

- Use a low velocity bulbous oxyacetylene tip of sufficient size to permit rapid and even heating. Multiflame tips also work well.
- Adjust torch for a slightly reducing flame, **Fig. 12.**
- If possible torch should be fitted with a soft copper extension tube about 10" long, **Fig. 13,** so tip can be bent to direct flame where desired.
- Start heating pipe about 1/2" to 1" away from end of fitting. **Fig. 14.** Heat evenly all around to get uniform expansion of pipe and to carry the heat uniformly to the end inside the fitting.
- When flux on pipe adjacent to joint has melted to a clear liquid, transfer heat to fitting, **Fig. 15.**
- Sweep flame steadily back and forth from fitting to pipe, keeping it pointed toward pipe, **Fig. 15.** The object is to bring fitting and pipe up to an equal heat together for application of the silver brazing alloy. Avoid letting flame impinge on face of fitting as this can easily cause overheating.
- When flux is a clear, fluid liquid on both fitting and pipe, pull flame back a little and apply alloy firmly against pipe at junction between pipe and fitting, **Fig. 15.** With proper heating, alloy will flow freely into the joint.

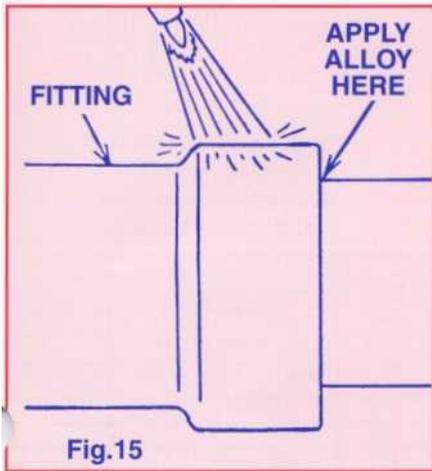


## 2. SPECIFIC INSTRUCTIONS ON HEATING AND FLOWING THE ALLOY



### MAKING VERTICAL DOWN JOINTS

- In joining fittings to 3/4" pipe or smaller, the entire joint can be brazed in one simultaneous heating operation.
- When pipe and fittings are larger than 3/4", sectional heating is necessary. This is done as follows:
  - Always start with a preliminary heating of pipe and fitting according to section d. on previous page. Bring pipe and fitting to a black heat only.
  - After preliminary heating, select a 2" segment and bring pipe and fitting to brazing temperature by wiping flame from back of bead of fitting towards pipe, **Fig. 16**. When segment is up to temperature, as indicated by clear, *very* fluid state of flux, apply silver brazing alloy and sweat it in.
  - Then do an adjacent segment and proceed around the pipe, being sure to overlap the braze from segment to segment.

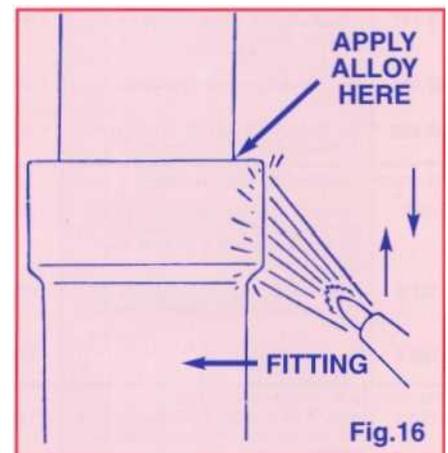


### MAKING VERTICAL UP JOINTS

- Start with preliminary heating of pipe as before. When flux is completely clear and liquid, transfer heat to fitting and sweep back and forth from fitting to pipe, **Fig. 17**. Do this all around. Be careful not to overheat pipe below fitting as this will cause alloy to run down pipe out of the joint.
- When brazing temperature is reached, as indicated by flux, touch alloy to joint with heat aimed on wall of fitting to pull alloy up into the entire joint area.

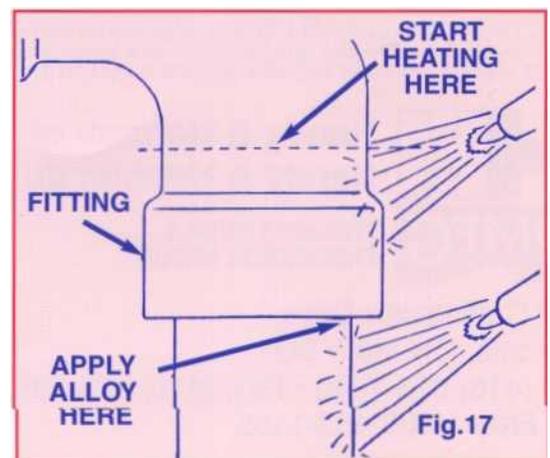
### MAKING HORIZONTAL JOINTS

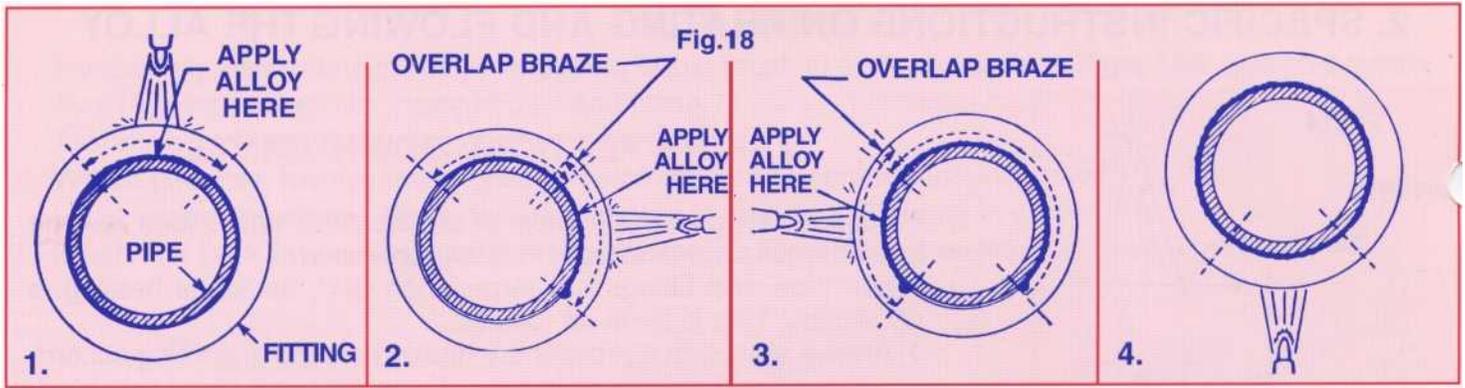
- Start by preheating pipe until it shows a black heat around its entire circumference. Duplicate this procedure on fitting.
- Now, select a segment on top of pipe and bring it up to brazing temperature by sweeping flame back and forth between fitting and pipe. Then apply alloy, **Fig. 18 (1)**, after which, remove heat and allow alloy to set.
- Then do one side, starting below centre, **Fig. 18 (2)**.
- Next do the other side, **Fig. 18 (3)**, again being sure to overlap top segment.
- When both sides are done there will be a globule of alloy on each side at the bottom of the brazed segment, **Fig. 18 (3)**. Apply heat on bottom of fitting at back of bead and with the usual back and forth motion toward pipe, draw the alloy into the bottom joint segment. Do not be fooled by a large fillet along the bottom. It may have flowed down over relatively cold metal. Always heat bottom of fitting to pull this alloy into the joint.



### 3. CLEANING AFTER BRAZING

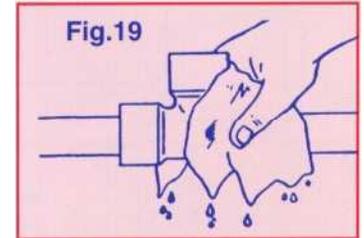
Immediately after brazing alloy has set, apply a wet brush or swab to joint, **Fig. 19**, to crack and wash off flux. Flux can be removed from inside of pipes by flushing with water. All flux must be removed for inspection and pressure testing. Use a wire brush if necessary.





#### 4. TO TAKE JOINT APART

When necessary, joint can be taken apart as follows: Reflux entire joint area. Then heat entire joint uniformly to slightly above melting point of brazing alloy. Pipe can then be easily removed from fitting. Pipe and fittings that have been taken apart can be reused by following the preparation and brazing procedures given for original brazing. Always apply additional silver brazing alloy when rebrazing.



### Brazing Filler Metals

Filler Metal Name	Typical Applications	Solidus (Melt Pt.)		Liquidus (Flow Pt.)		Max. Recom. Brazing Temp °F	Nominal Composition, %			
		°F	°C	°F	°C		Ag	Cu	Zn	Others
<b>EASY-FLO 45</b>	Very versatile alloy; can be used on most ferrous and non-ferrous metals.	1125	605	1145	620	1350	45	15	16	24Cd
<b>EASY-FLO 35</b>	Particularly adaptable where joint clearance is larger than optimum.	1125	605	1295	700	1400	35	26	21	18Cd
<b>EASY-FLO 3</b>	300 series stainless steel; brazing Al-Bronze to steel.	1170	630	1270	690	1400	50	15.5	15.5	16Cd, 3Ni
<b>BRAZE 560</b>	Good general purpose alloy where cadmium-free alloy is specified.	1145	620	1205	650	1400	56	22	17	5Sn
<b>BRAZE 505</b>	Brazing carbides and 300 series stainless steel where cadmium-free alloy is specified.	1220	660	1305	705	1500	50	20	28	2Ni
<b>BRAZE 452</b>	Cadmium-free. Good general purpose alloy.	1190	640	1260	680	1500	45	27	25	3Sn
<b>BRAZE 450</b>	Good for wide gap joints. Cadmium-free.	1225	665	1370	745	1550	45	30	25	
<b>BRAZE 380</b>	Similar to EASY-FLO 35 where cadmium-free alloy is specified.	1200	650	1330	720	1500	38	32	28	2Sn
Silver-Copper-Phosphorus Alloys (See note below)										
<b>SIL-FOS</b>	Primarily used on copper and copper alloys. <b>HANDY FLUX</b> should be used on copper base alloys such as brass and bronze.	1190	645	1475 (1300)	800 (705)	1500	15	80		5P
<b>SIL-FOS 5</b>	Same as SIL-FOS. More fluid than SIL-FOS and has less tendency to form large fillets.	1190	645	1495 (1325)	815 (720)	1500	5	89		6P
<b>SIL-FOS 2</b>	Same as SIL-FOS 5.	1190	645	1450 (1325)	785 (720)	1500	2	91		7P
Copper-Phosphorus Alloys (See note below)										
<b>FOS-FLO 7</b>	More fluid than SIL-FOS alloys at brazing temperature. No flux necessary on copper.	1310	710	1460 (1350)	795 (730)	1550		92.75		7.25P

Approximate Amounts of Silver Alloy for Brazing Different Sizes of Pipe and Tubing

Pipe & Tube Sizes	Inches of Wire per Joint		
	BRAZE or EASY-FLO Alloys for Malleable Iron or Brass I.P.S. Fittings		SIL-FOS for Copper & Brass Nominal Fittings
	1/16" WIRE	3/32" WIRE	3/32" WIRE
1/4"	3/4"		3/4"
3/8"	1"		1"
1/2"	2"	1"	1 1/4"
3/4"	3"	1 1/2"	2"
1"	4"	2"	3 1/2"
1 1/4"	5"	2 1/2"	4"
1 1/2"	6"	3 1/2"	4 1/2"
1 3/4"		5 1/2"	6"
2"		6 1/2"	8"
2 1/2"		9 1/2"	12"
3"		14 1/2"	16"
3 1/2"		17"	20"
4"		20"	24"
5"		25"	35"
6"		36"	45"
8"		46"	57"

NOTE: The SIL-FOS and FOS-FLO brazing alloys, utilized primarily on copper and copper alloys- FOR EXAMPLE: Refrigeration units, air conditioning apparatus, copper and brass pipe fittings. NEVER USE ON FERROUS METALS OR NICKEL ALLOYS.