Copper

...the modern solution

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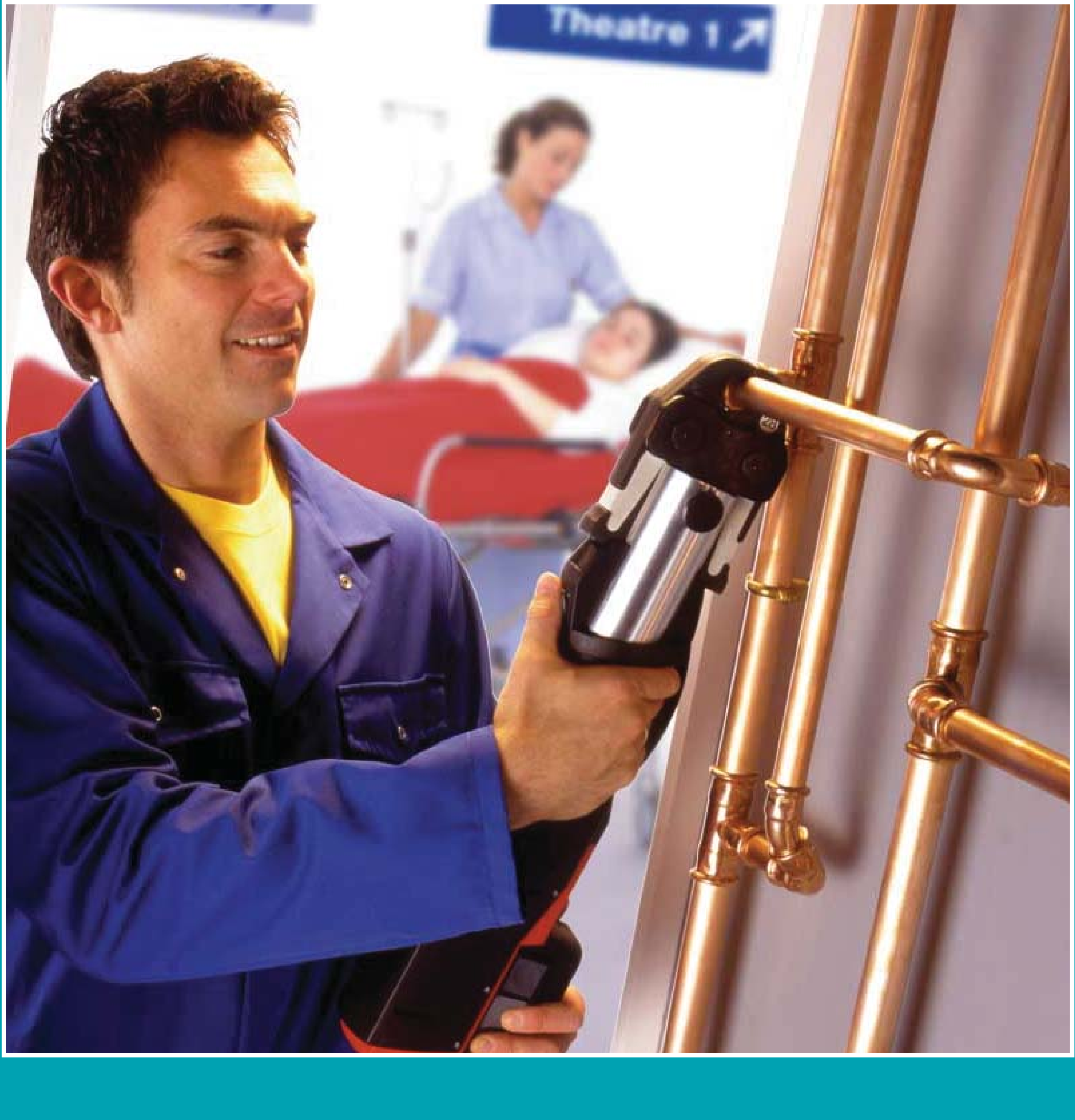

Copper ... the modern solution

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All the technical information and working practices described, and any Statutory Requirements or British or European Standards quoted are those current at the date of publication. Checks should always be made to ensure that any information used still complies with current Standards and Statutory Requirements.

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About the author

This educational module was written by Brian Curry, an experienced plumber and college lecturer at the Oldham College. He has over 35 years practical experience of plumbing and mechanical building services having worked as a member of the contracts management team of a large international building services contractor. He currently enjoys teaching the practical and theoretical aspects of plumbing work and manages a wide range of craft and professional building courses.

1. Development of modern copper plumbing systems

The earliest recorded use for copper for conveying water was at Abusir in Egypt almost 4,750 years ago and this conduit is still in a remarkable state of preservation. In the UK, copper tube has been manufactured and installed for over 100 years. During this time copper jointing systems have been developed and continuously improved:

1888 Copper tube manufacturing starts in the UK

1909 Plumbing materials are produced in Leeds, Yorkshire

1921 Introduction of mechanical compression joints

1934 Launch of integral solder ring capillary fittings

1984 Introduction of lead-free solder fittings

1996 Introduction of metal bodied copper and copper-alloy 'push-fit' fittings

1999 Launch of copper press fittings

By using press and push-fit jointing methods, today's installers have the highest quality, state-of-the-art copper jointing techniques at their disposal. It offers a modern solution to meet the challenges of changing working practices and construction techniques. These flame-free systems also meet the more stringent health and safety regulations and new water regulations. They are ideal for the installation of copper tube based building services with fast-track building systems.

2. Copper flame-free jointing techniques

Flame-free jointing has been available for decades using the still popular compression system, which only requires simple spanners. More recently, we have seen the introduction of push-fit and press fitting systems.

By specifying and jointing the first-fix piping risers and run-outs in ducts and ceiling voids using press-fittings, and making final connections to terminal fittings, heat emitters and cooling coils using copper push-fit, a completely heat-free piping installation can be achieved. This is done without the use of any potential contaminants such as flux and steel wool. Furthermore, the use of heat-free jointing removes the necessity of applying for hot-work permits and the danger of flame damage during refurbishment projects. In addition, the ease of the jointing process significantly reduces the amount of time spent on site because installation is speeded up, with only standard good plumbing practice required before the joint is ready to be made - this is a major benefit! To make a joint requires only the press fitting tool and the correct size jaws and no flux, solder or any other jointing material is necessary.

Sometimes, prefabrication of pipework can be an advantage. If the installation is in a confined or restricted space, bending, jointing and assembly of complicated piping can be done more efficiently in the ideal conditions of a workshop - press-jointed systems are ideally suited to this method of working.

3. Press fittings

Press fittings are available to suit tube sizes from 12 to 108 mm, and can be used for systems operating up to 16 bar pressure at

20°C and 6 bar pressure at 110°C. It is a fast, efficient and flame-free method of jointing of copper tube. A mechanical press-tool is used to compress the fitting onto the tube to provide positive interlocking and frictional restraint without the need for any solder, adhesives, or additional jointing materials. An EPDM 'O' ring forms the water seal.

Press fitting method

Select the correct size of tube and fitting for the job, and ensure that both are clean and in good condition and free from damage and imperfections.

1. Cut the tube square using a rotary tube cutter whenever possible. (Figure 1)

2. Use a deburring tool to ensure that the end of the tube is free from any burrs or sharp edges. If a hacksaw has to be used, take care to cut the tube square and properly deburr. (Figure 2)

3. Mark the tube insertion depth with a marker pen so that full insertion depth is ensured on assembly. (Figure 3)

4. Check that the 'O' ring is seated correctly in the fitting socket. (Figure 4)

5. Assemble the joint ensuring that the tube end meets the tube stop; this can be confirmed by checking the mark made on the tube earlier.

6. With the correct size jaws inserted into the press-tool, place them over the bead of the fitting maintaining a 90° angle between the tube and the tool. Depress the trigger to commence the compression cycle, when the jaws fully enclose the mouth of the fitting, compress the assembly and the tool will stop automatically when complete. (Figure 5)

Press fitting tools

The making of a press fitting joint relies on the use of a press-tool together with the appropriate size and profile of clamping jaws. Two types of tool are available; either mains electric or cordless, with jaws from 12 to 108 mm. Press-fit tools can complete a joint in as little as 6 seconds. An automatic mechanism ensures that the correct amount of

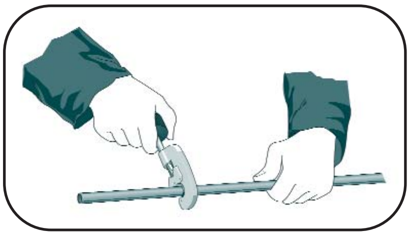

Figure 1

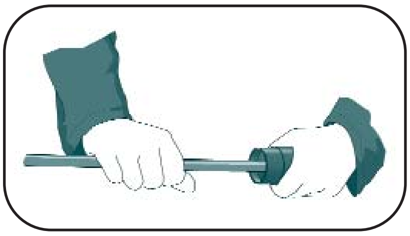

Figure 2

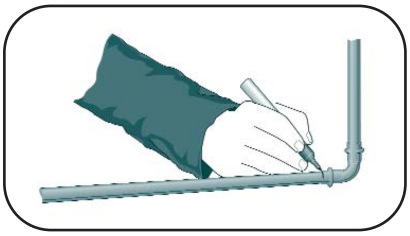

Figure 3

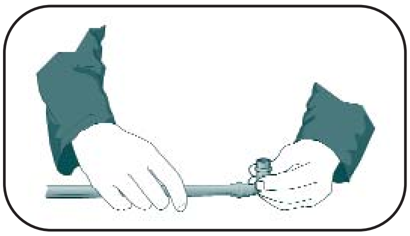

Figure 4

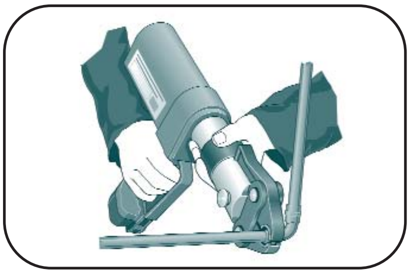

Figure 5

force is always used to create a sound joint. A safety clutch switches the machine off as soon as maximum pressing force is attained. The tool is easy to use. Some tools also have additional features, such as an automatic monitoring function to ensure consistent jointing quality.

The new press fitting tool in action. The picture demonstrates the speed and ease of installation.

Design considerations

When designing the pipework layout, allowances should be made for the clamping jaw and press fitting tool access.

Fitting spacing

A minimum gap between fittings is necessary. This is generally 10 mm for 15 to 35 mm fittings and 20 mm for 42 mm fittings and above.

Minimum projection

Where a pipe stub projects through a wall, allowance must be made for the size of the press-tool.

Thermal movement

Another consideration when designing plumbing and heating systems is thermal movement. Pipework systems expand and contract with changes in temperature and so will be subjected to stress if their movement is restricted. Therefore, particularly with central heating systems, it is always good practice to allow for the effects of thermal movement when designing or installing a system. However, note that press fittings and push-fit fittings should not be subjected to "cold-pull" on flanges when connecting to expansion couplings and anchor points.

Copper has a coefficient of linear expansion of 17 x 10-6 per °C. As an example, a 10 m length of copper tube carrying domestic hot water at 60°C will expand by almost 7 mm (just over 1/4") when heated from 20°C.

In addition, if temperature cycling of the system is 20°C, there will be a continuous cycle of expansion and contraction of 3.4 mm taking place.

Copper tube expansion (mm) for various rises in temperature										
Temperature	Tube length (m)									
change °C	3	4	5	6	7	8	9	10	12	25
10	0.5	0.7	0.9	1.0	1.2	1.4	1.5	1.7	2.0	4.3
20	1.0	1.4	1.7	2.0	2.4	2.7	3.0	3.4	4.0	8.5
30	1.5	2.0	2.6	3.1	3.6	4.1	4.6	5.1	6.1	13
40	2.0	2.7	3.4	4.1	4.8	5.4	6.1	6.8	8.2	17
50	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5	10.2	21
60	3.1	4.1	5.1	6.1	7.1	8.2	9.2	10.2	12.2	26
70	3.6	4.8	6.0	7.1	8.3	9.5	10.7	11.9	14.3	30
80	4.1	5.4	6.8	8.2	9.5	10.9	12.2	13.6	16.3	34
90	4.6	6.1	7.7	9.2	10.7	12.2	13.8	15.3	18.4	38
100	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17.0	20.4	43

The stresses imposed can be considerable if no allowance is made for thermal movement. Stress concentrations between 'fixed points' typically found at radiators, valves and other fittings should be avoided wherever possible.

Anchoring the branch of a tee, or connecting a radiator by means of too short a spur, will prevent normal thermal movement and may lead to failure. Expansion loops, cross-over tees or bellows devices should be incorporated at appropriate points within the system to accommodate thermal movement. When continual thermal cycling is encountered, a horseshoe expansion link is recommended.

Wherever pipework is to be installed under screed or plaster, it is very important to make adequate allowance for thermal movement. The preferred practice is to lay tubing in ducts surrounded by loose, non-rigid material such as vermiculite or glass wool. If further information is needed BS 6700 can be consulted.

Piping support

The maximum spacings for tube supports for copper tubes are as follows:

Maximum spacing of supports for EN1057 copper tube R250		
Tube size	Horizontal spacing	Vertical spacing
15 mm	1.2 m	1.8 m
22 mm	1.8 m	2.4 m
28 mm	1.8 m	2.4 m
35 mm	2.4 m	3.0 m
42 mm	2.4 m	3.0 m
54 mm	2.7 m	3.0 m
67 mm	3.0 m	3.6 m
76 mm	3.0 m	3.6 m
108 mm	3.0 m	3.6 m

Pipework clearance

When installing press fittings it is necessary to allow sufficient room for the jaws of the tool to operate without hindrance. The system designer should make allowance for press-tool access, fitting spacing gaps and projections; as indicated by the manufacturer. This requirement should be achieved if the designer allows for the correct insulation thickness for the tube size as specified by BS 6700. Also, when pressing fittings on complex pipework or when working in difficult locations it is important to plan the sequence to ensure tool access.

4. Push-fit jointing

Copper and copper alloy push-fit joints are ideal for making final connections to terminal fittings and heat emitters; they are available to suit tube sizes from 10 to 54 mm and can be used on hot and cold water services including direct, indirect and pressurised systems. They can also be used on heating systems and chilled water applications within permitted temperature and pressure parameters. Furthermore, push-fit quarter-turn and screwdriver operated service valves are available to enable easy installation and positive shut-off for isolation purposes.

Push joints rely on a mechanical mechanism to join tube and fittings. There are a number of designs that use similar principles. Generally, when a length of tube is pushed into the joint it passes through a release collar and then through a stainless steel grip ring. This has a series of teeth that open out and grip onto the tube securing it so that it can only be released using some form of disconnecting tool.

Push-fit fittings are ideal for making final connections as demonstrated in above and opposite pictures.

Pushing the tube further into the joint ensures that it passes through a support sleeve, which helps to align the tube and compresses a pre-lubricated EPDM 'O' ring between the wall of the fitting and the tube, see figure. Only when the tube has passed through the 'O' ring and reached the tube stop is a secure joint created.

Working temperatures and pressures

Copper and copper alloy push-fit fittings and service valves used to join copper tube are generally suitable for the following working temperatures and pressures:

Push-jointing service temperature and pressure range

Temperature not exceeding	Maximum working pressure
30°C	16 bar
65°C	10 bar
90°C	6 bar

Easy jointing

Neither spanners nor naked flames are needed to install copper and copper-alloy push-fit fittings. Furthermore, the ability to rotate the fitting once it has been pushed onto the tube means that installation in confined spaces is facilitated; this versatility is also useful when carrying out alterations to pipe-work, repairs and maintenance.

Push-fit jointing method

1. Ensure the fitting is the right size for the tube.
2. Cut tube using a rotary tube cutter, ensuring the tube end is round & free from damage.
3. Use a deburring tool to ensure that the end of the tube is free from any burrs or sharp edges. It is essential that all burrs are removed and the outside of the tube is chamfered around the full circumference to remove any sharp edges.
4. Mark the socket insertion depth to provide visual evidence that the tube has been fully inserted.
5. Keeping the fitting and tube in line, insert the tube through the release collar to rest against the grip ring.
6. Push the tube firmly with a slight twisting action until it reaches the tube stop with a positive 'click'. Note that excessive force should not be necessary to assemble tube and fitting and, if required may indicate damage to the tube end.
7. Pull on the tube to check that the fitting is secure and the grip ring is engaged.

Other points to note

- Copper and copper-alloy push-fit joints are pre-lubricated with silicone; it is not necessary to add further lubricant.
- Do not use push-fit joints directly with capillary fittings as the heating may damage the non-metallic components.
- Correct tube support should be used to secure finished pipework and prevent movement and vibration.
- Avoid contact with mineral oils as these may affect the 'O' rings.
- Copper and copper-alloy push-fit joints do not need flux or heat to achieve a joint
- Where parallel threaded connectors are used, a good quality fibre jointing-washer should be used to form the seal.

Disconnecting Push-fit joints

Place the disconnecting tool on the fitting assembly. Squeeze the tool with one hand to compress the release collar and twist out the tube with the other. Before remaking the joint check the tube end and fitting for damage. Note that a space is needed between fittings to insert a disconnecting tool.

5. Conclusion

The correct specification and installation of press and push-fit jointing methods will enable professional installers to offer their customers all the peace-of-mind, proven benefits of copper in a fit-and-forget, resilient, maintenance free piping system with excellent protection against contaminants that threaten the water supply.

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