Pipe Freezing

Pipe freezing can be a fast, clean and efficient method of carrying out plumbing repairs and piping alterations without having to isolate or drain an entire water piping system.

Pipe freezing can be carried out on copper tube and other metallic and plastics piping systems to facilitate extensions to pipework; installing tees to feed additions to systems, such as plumbing in washing machines and dishwashers; central heating repairs and maintenance; exchanging faulty stop-valves and re-washering taps and float valves.

Pipe freezing can be carried out on both small and large tube sizes by means of either a refrigeration machine, **see Figure 1**, or an aerosol spray kit, **see Figure 2**. Once formed, the internal ice plug can withstand the water pressure enabling a union or compression fitting to be dismantled or the tube to be cut through to fit a tee or service valve without having to search for or turn off a valve or cause a flood.

How does it work?

Pipe freezing uses the evaporation of a volatile fluid to remove heat from the pipe and its contents to form an ice plug inside the pipe. Evaporation is the escape of molecules of gas from a liquid and it is this process that requires heat energy creating the cooling effect needed to freeze the water inside the tube.

When using an aerosol spray to form the ice plug, the evaporation occurs from the volatile fluid direct into the atmosphere inside an insulated jacket, which is placed around the pipe. This means that, as the process is carried out, the volatile fluid is lost and so the aerosol can has to be replaced or refilled when it is empty.

A refrigeration machine, on the other hand, retains the volatile fluid within a closed circuit so that it is not lost during the freezing process. An electric motor drives a pump that compresses the gaseous fluid and a heat exchanger cools this into its liquid state, a valve in the machine controls the liquid flow to the freezer head, which is clamped on to the pipe. When the pipe-freezing machine is operated the valve is opened and the liquid flows through a small diameter capillary tube to the freezer head where the volume is increased. This increase in volume allows the liquid pressure to drop and consequently the liquid rapidly evaporates cooling the freezer head, which in turn cools the pipe to freeze the water and form the ice plug. The vapour then flows back to the pump at a lower pressure via a larger diameter return pipe.

Preparations for freezing – points to note

1. Switch off circulation pump if freezing heating system pipes.
2. Ensure water in pipes is not flowing, and preferably cold.
3. Freeze horizontal pipes where possible - freezing a vertical pipe can cause water movement due to natural convection.
4. Anti-freeze or corrosion inhibitors used in some heating systems can affect freezing times and more aerosol spray will be required.
5. In warm ambient conditions (+25°C) more aerosol spray will be required.
6. A flame-free joint is an advantage, particularly if space is limited, so use compression, push-fit or press-fit fittings where possible. Capillary solder joints can also be used, but take care to leave a space of at least 200mm from the fitting to the freeze jacket or freeze head to prevent heat affecting the ice plug.

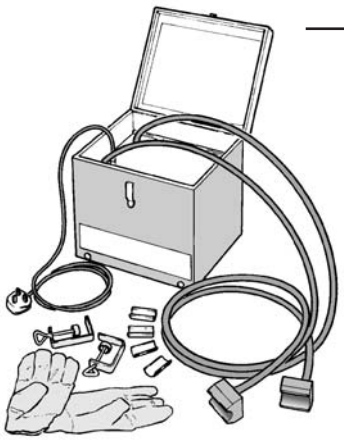
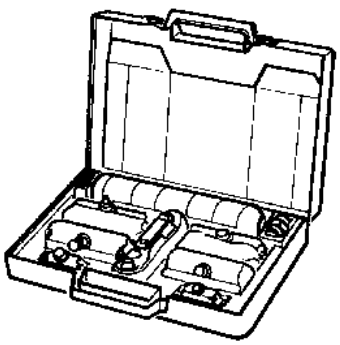


Figure 1 Typical pipe-freezing machine.

Figure 2 Typical professional aerosol freezer kit.



7. When using an aerosol spray in a confined space, it is important to remember that gas is given off during the process and so good ventilation is needed, especially in trenches, cupboards and under floorboards.

8. The use of flames, heat or smoking close to the aerosol spray or freezing jacket can result in noxious fumes being formed.

9. Avoid contact with skin or eyes; use gloves/goggles, as the spray will freeze skin.

10. Remember to fit a temporary electrical earth bond across the work area if cutting through a metal pipe to fit a tee.

Freezing method using aerosol spray

1. Place the freeze jacket(s) around the pipe at least 200mm from the work area and tie each end of the jacket tightly with cable ties or string, **see Figure 3**. Connect the extension tube to the aerosol spray can and freeze jacket following the manufacturer's instructions carefully.

2. Ventilate the work area and inject the freezing dose into the jacket, again following the manufacturer's instructions as to the amount to be used and time taken but note that, if liquid escapes from the ends of the jacket whilst freezing, stop for a short time to allow the liquid to evaporate inside the jacket, then resume injecting.

3. Wait for the correct pause period before starting work on the pipe.

4. **LEAVE** the freezer jacket(s) in place until all work has been completed and checked!

5. Once work is complete, remove freezer jacket(s). The pipe will then thaw in a few minutes.

Typical aerosol spray freezing times

Piping material	Tube size (mm)	Pause time (mins)	Ice plug life (mins)
Copper & stainless steel	15	5	30
	22	5	30
	28	10	30
Lead & low carbon steel	15	5	30
	22	10	30
	28	15	30
Polythene	15	15	45
	22	20	45

Freezing method using pipe freezing machine

1. If necessary, select and fit the appropriate adapters for the pipe material and diameter to the freeze head(s).

2. Clamp the freeze head(s) to the pipe, **see Figure 4**.

3. Connect the machine to the electrical supply and switch on.

4. Wait for the correct pause period before starting work on the pipe.

5. **LEAVE** the machine running and the freeze head(s) in place until all work has been completed and checked!

6. Once work is complete switch off the machine, the pipe will then thaw in a few minutes and the freeze head(s) can be removed.

How to check that an ice plug has been formed

A problem when freezing a water pipe is that the water could be moving. If the freeze times specified by the freezer makers are to be achieved, the water must be cold and stationary.

One way to check when using a pipe-freezing machine is to use a digital temperature probe to measure the temperature of the pipe close to either end of the freeze head. If the water is moving during the freezing process it will be cooled and this will show as a lower temperature on the down-stream probe, giving an indication of any flow and its direction. In humid atmospheres a coating of 'frost' will also form on the freeze head and pipe after a period of time once the ice plug has formed.

When using an aerosol spray a small quantity of aerosol can be sprayed on to the pipe immediately next to the freeze jacket to determine if an ice plug has formed. If the pipe is sufficiently cold to have formed the plug, then the spray will condense as a white 'frost' on the surface of the pipe whist the spray is applied.

Which method is best?

Both methods are effective. The aerosol spray method usually forms the ice plug faster, and copper's good heat conducting properties mean that the ice plug will form more quickly in a copper tube compared to other materials, but the aerosol spray method has a relatively high cost per freeze (because the volatile fluid is lost). Also, once the aerosol is empty one is working against time, as the ice plug will melt in about 30 minutes unless more fluid can be injected into the freezer jacket.

The pipe-freezing machine on the other hand has a higher initial purchase cost but low running costs and, provided the electricity supply to the machine is not interrupted, the ice plug can be maintained more or less indefinitely. The pipe-freezing machine is also more 'ozone-friendly' as no greenhouse gases are released into the atmosphere when it is used.

Another factor to consider is accessibility: with the aerosol freezer it is necessary to be able to fit the insulation jacket all round the pipe, and this can sometimes be difficult where the pipe is installed tight against a wall surface or in a corner; however, the freezer heads used with a pipe freezing machine are specially shaped to fit on to one side of the pipe and can be used even when the pipe is tight against the wall.

So, to try to answer the question 'which freezing method is best?': if freezing is often needed due to, for example, ineffective or missing servicing valves, then a pipe-freezing machine would probably be an economical option; if pipe freezing is only rarely required then an aerosol kit will probably be adequate.

Brian Curry, December 2004.

Figure 3 Disposable freezer kit

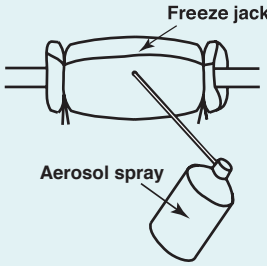


Figure 4 Freezer head clamped to pipe