PIPES & FITTINGS

As used in Instrumentation

TTE TRAINING LIMITED

INSTRUMENT COURSE

SECTION 2

PIPES AND FITTINGS

SECTION	*CONTENT*
2.1	Introduction to Instrument pipework- Uses materials
2.2	Screwed fittings- Taper threads Parallel threads
2.3	Compression fittings
2.4	Variety of fittings
2.5	Pipework installations
2.6	Testing methods
2.7	Summary

2.1 Introduction to instrument pipework.

In instrument systems, pipework is normally used for 1 of 3 purposes.

* The first being a means of connecting instruments to the process pipeline or vessel, these are often referred to as *impulse lines*. It is these pipelines that come into direct contact with the process fluid.

* The second application is the pneumatic instrument *air supply*, normally this is only compressed air however in some applications it may be Nitrogen. Neither of these substances can you smell or see so care is of vital importance when working on supply lines, also the pressure at which the supply is at.
Never tamper with, or fool around with instrument supplies.

* The third common use for pipework is instrument *signals* or *outputs*, this is the information in pneumatic form, given out from pneumatic transmission equipment, although the air is clean and at relatively low pressure these pipelines should still be treated with respect.

On one particular site it was found that almost 70% of all pipe fittings leaked.

The table below details some of the considerations to be made when selecting pipework for instrument systems:-

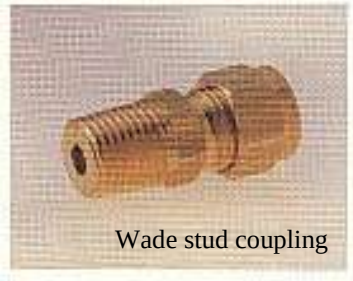
Duty	Medium	Suitable Material	Safe/ operating pressure (app)	Size (in / mm)
Impulse lines.	acids alkali's liquids gases water steam non/ toxic non/ corrosives	stainless steel alloys - ie. monel cast steel- but not for corrosives	Determined by size, thickness and material, also the measurement device.	1/4 to1 6mm to 25mm
Supplies	Compressed air Nitrogen	Copper Mild steel	Up to 100psi dependant on instrument	1/4 to 1/2 6mm to 13mm
Signals	Compressed air	Copper Nylon/ plastic	Up to 20psi	1/4 6mm

Due to the physical properties of copper pipe, it is common to see small bore pipe with a pvc outer coating, this provides protection against external corrosion. Another benefit of pvc coated copper is that it is easy to manipulate into shape, however care should be taken to *avoid overbending or kinking the pipe* as this would render it unsuitable. Any bends should be smooth and neat.

Should replacement of pipelines be required they should be done so like for like. There may be occasions when lengths of pipe may need joining together, or where pipe needs to be joined to the instrument to which it is connecting. There are a number of methods that can be employed to do this. The most common methods are either via a screw thread or compression joint, both of these methods usually involving the use of some form of interconnection known commonly as a *fitting.* The use of such fittings allows jointing of:-

copper to copper pipe – eg Wade equal ended coupling

copper pipe to mild steel pipe – eg Wade stud coupling



copper pipe into a screw fitting – eg Wade stud coupling

mild steel to mild steel – mild steel pipe sockets

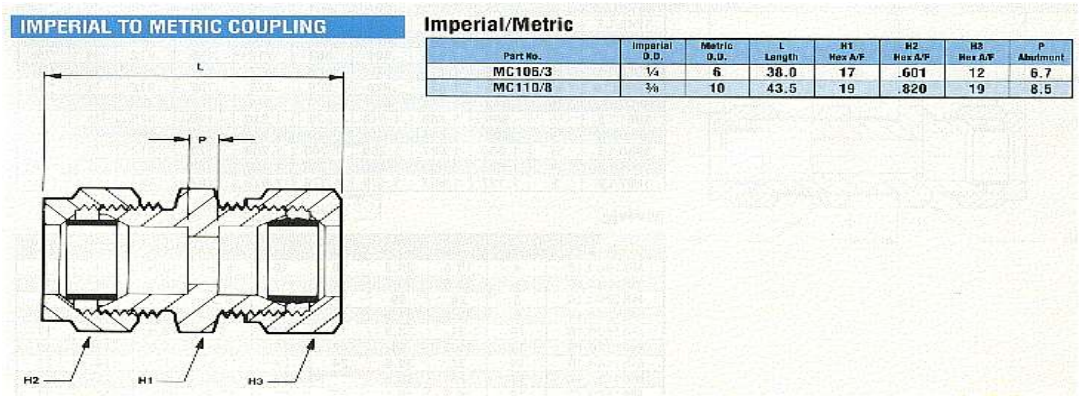
copper to nylon – eg equal ended coupling
large bore to small bore pipe – eg reducers and bushes etc

2.2 Screwed fittings

Screw threads may be categorised in 1 of 4 ways:-

Tapered or Parallel, and
Male or female (external/ internal)

In addition to this screw threads are identified by the style of thread, ie: - number of teeth and their pitch. Common forms in use are the metric thread and some imperial threads namely BSP (British Standard Pipe) are still in use, although most new installations use metric. Common sizes used are 6mm or 1/4" BSP, 1/8", 3/8" and 1/2" others larger ones are used depending on the specific application.



Imperial/Metric

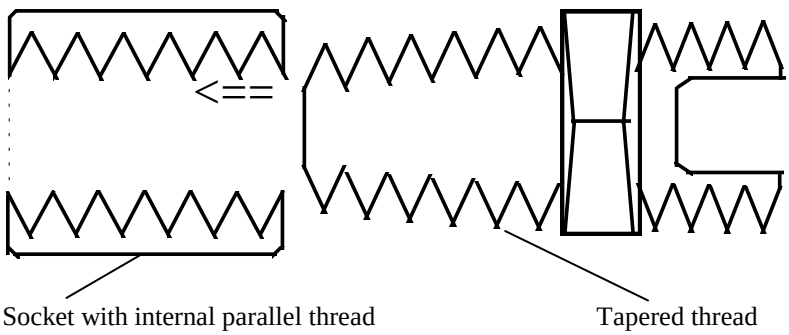
Part No.	Imperial O.D.	Metric O.D.	L Length	H1 Hex A/F	H2 Hex A/F	H3 Hex A/F	P Aburment
MC106/3	¼	6	38.0	17	.601	12	6.7
MC110/8	⅜	10	43.5	19	.820	19	8.5

The application would therefore determine the type of thread required.

1. Taper threads:

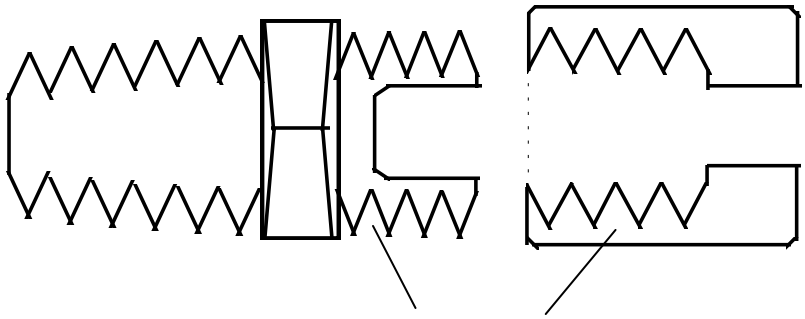
This is an external thread, and as the name suggests this type of thread is tapered along its length, with the narrowest part of the taper being at the end of the pipe (or fitting), therefore allowing it to be screwed into a female threaded socket whose thread is normally parallel. As the narrower male thread is screwed into the socket, the threads tighten and lock together creating a seal. PTFE tape or a leakproof sealant is normally used on the male thread to assist in making this seal leak/ pressure tight. One of the problems with sealing occurs when the threads are overtighten'd together thus resulting in spreading of the female joint (socket), were possible this must be guarded against.

(see diagram to follow)



2. *Parallel Threads:*

These are either internal or external threads. It is the internal form which is used most commonly in a socket, whereas the external form of this thread is normally used in conjunction with a compression fitting. The internal form when used with a taper thread would normally require a suitable sealant. As an external thread this one is not suitable for creating pressure tight seal alone and would normally require some form of sealing ring between itself and the socket it would be inserted into.

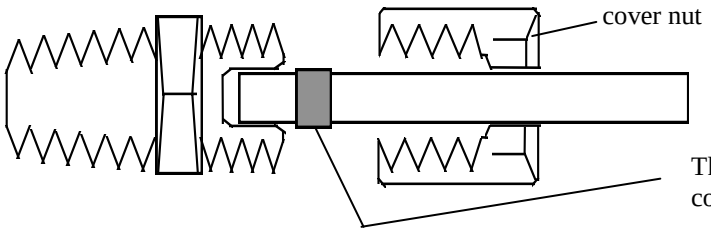


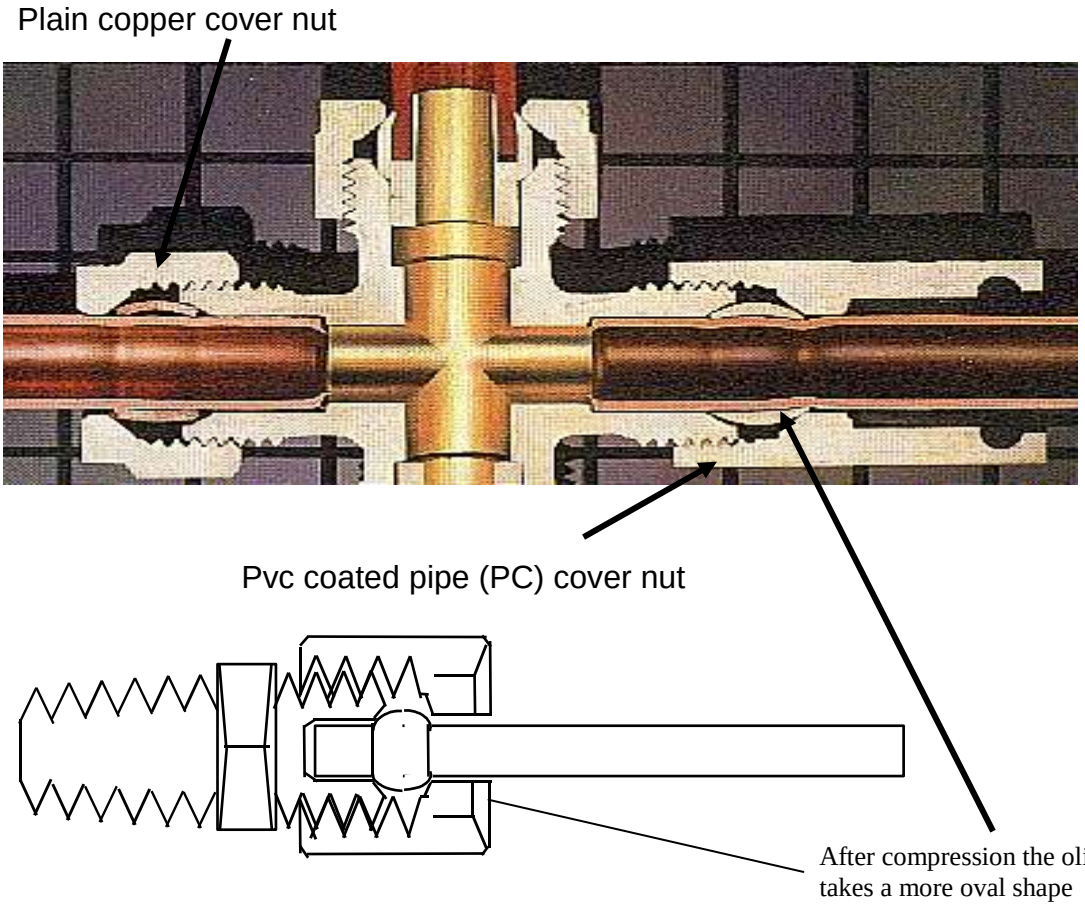
Common uses of these threads may be found in the following table:

Thread type	Common Applications	Sealing medium	Common faults
Taper	Sealing	PTFE, Sealing-paste	Cross threading Spreading Overtightening
Parallel	Compression fittings/ cover nuts - Sockets - Pressure gauge connections/ connectors -	Olive Ptfe/ sealing ring Fibre washer/ sealing ring	Overtightening Crushing Over-use Cross thread

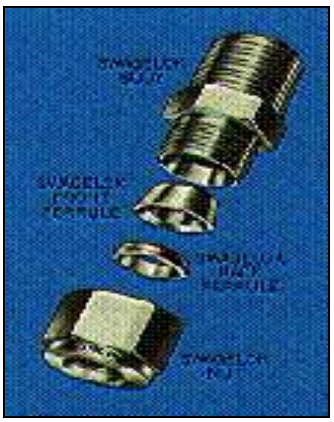
2.3 Compression fittings.

These joints are created by the compression of a sealing ring commonly known as an *olive* onto the pipe between a machine faced socket and compression or *cover* nut. The type of pipe being used, ie: plain or coated will determine the type of cover nut required. When compressed, the outer edges of the ring dig into the wall of the pipe to create the seal thus distorting the ring from its original shape. The cheapest and most commonly used form involves a single copper olive.





A more complex double version is available and these tend to be made from stainless steel. Some manufacturers claim that correct use of these fittings will create a seal that will be stronger than the burst pressure of the pipe. A typical example is the *swageloc/ Gyroloc* fitting as shown below:-



The following table gives a comparison between 3 different, commonly used pipe materials:-

Material/ Size	Usage	Sealing method	Safe Working Pressure (approx maximum)
stainless steel/ 6mm	Acids Corrosives Clean substances	Double olive	13000 psi
Plain or PVC coated Copper/ 6mm	Clean Substances	Single Olive	2500 psi
Nylon/ 6mm	Compressed air	Single nylon Olive	50 psi

If fitted correctly pipe fittings may be re-used several times, however overtightening will distort the olive causing leakage and thus rendering the joint un-usable.

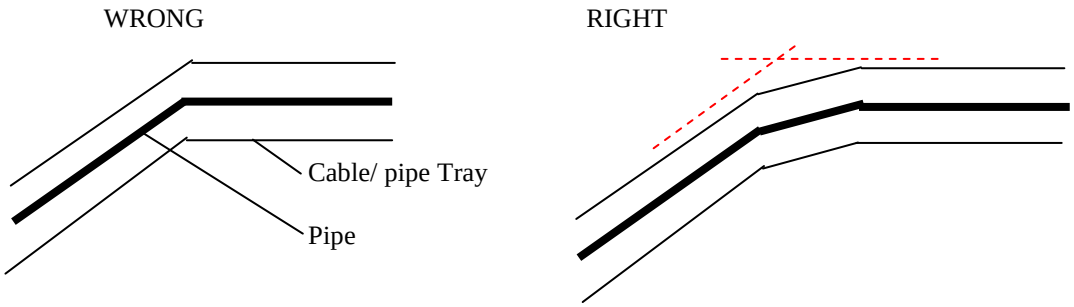
2.4 The Variety of fittings.

There is an enormous variety of fittings available, the following diagram represents just a few:-

2.5 Pipework installations

In all cases pipework installations should be neat and tidy, with the correct choice of fittings and pipework, and importantly of the right material.

When carrying out installation work, care and attention should be given to location of pipelines and avoid pipe-runs that use unnecessary amounts of fittings, as more fittings mean potentially more leaks. Also avoid putting pipes where they are likely to be damaged, and where possible use cable tray etc to support nylon or copper pipes, and as previously mentioned be careful not to kink or overtighten bends. The diagrams below give an idea of the right and wrong approach to putting pipelines on traywork, remembering to ensure that all bends are smooth.



In some case both mild steel and copper pipes can be seen suspended in thin air between tray and for example a control valve, where this is unavoidable try to ensure that these distances are a short as possible, it is a guarantee that someone will bend and damage hanging or trailing pipes.

There are commercially available pipe benders available, although small bore copper pipe can be bent into shape using fingers

2.6 Testing Methods

The most common form of test is a pressure test. This would normally involve sealing/ blocking of one section of pipe to be tested and connecting a suitable testing medium to the other end. Suitable test mediums can be compressed air, water or nitrogen. Nitrogen would be used if the pipeline was for oxygen duty.

Once connected the supply is slowly opened up, where possible a pressure gauge would be used to indicate the pressure in the tested object. The pressure may then be isolated and the pressure in the pipeline should be maintained. A suitable leak detector may then be used on the outer surfaces of the joints to detect minute leaks, helping to identify the source should they appear. If the pressure reduces immediately it may be necessary to keep the supply on so that the source of leak may be more easily identified. There are commercially available leak detection sprays but soapy water is a commonly used alternative.

These test methods can be applied to any of the joints/ fitting types mentioned in this section

The test pressure used would be determined by the normal operating pressure. It is common to test using pressures of upto 100psi. Care must therefore be taken when carrying out pressure tests, paying particular attention to the possibility of leaks and so the use of eye protection is strongly recommended. When high test pressures are required specially equipped test bays and equipment may be required.

2.7 Summary

In summary the careful selection, installation and maintenance of pipes and fittings will help reduce the number of leaks, thus improving reliability/ safety and keeping costs to a minimum.