

MECHANICAL

PIPING

In this course you will learn

- ▶ Introduction to piping
- ▶ General constitution of the piping
- ▶ Tube design
- ▶ Tube manufacturing
- ▶ Pipe sizing
- ▶ Copper piping
- ▶ Steel piping
- ▶ Pipe protection
- ▶ Mounting the pipes
- ▶ Colour codes of the pipes

Introduction to piping

Introduction to piping

- ▶ An assembly of pipes used for the circulation of fluids.
- ▶ In the industry, piping is a pipeline system which conveys fluids or gasses from one place to another.
- ▶ A pipeline provides the flow of fluids (liquids, gas) or solids (in powder form) from one machine to another; from a machine to a reservoir during manufacturing operations, alterations or the storage of a product.



Introduction to piping

► The functions of piping

- Internal and external leak tightness
- Oxidation resistance and corrosive agent resistance
- Conveying fluids

General composition of the piping

General composition of the piping

► Piping consists of various components such as:

- The actual pipes
- The fittings: tees, elbows, reducers, etc....
- The range of connections: flanges, threaded fittings, weld fittings, etc....
- The range of seals: gaskets, etc....



General composition of the piping

► The fluid circulation devices:

- Pumps
- Compressors
- Ejectors



Pump and valve

► Flow control components:

- Valves
- Slave valves
- Check valves
- Etc....



General composition of the piping

► Safety and protection devices:

- Safety valves
- Rupture discs
- Flame arrestor
- Filters
- Etc....



Valve and thermometer

► The devices for measuring, checking and controlling:

- Pressure gauges
- Flowmeters
- Thermometers
- PH meters
- Fiscal Meters



Tube design

Tube design

- ▶ The tubes must be resistant to burst stress, crushing stress and tensile stress.
- ▶ Moreover, they must also be resistant to buckling.
- ▶ Without this complex network the industry would not be able to operate.



Tube manufacturing

Tube manufacturing

► Welded tubes

- They are obtained with heat or cold.
- The weld may be longitudinal (butt seam/welded tube) or helical (spiral-wound tube).

► Centrifuged tubes

- Obtained by pouring metal into a rotating cylindrical mould.

► Seamless tubes:

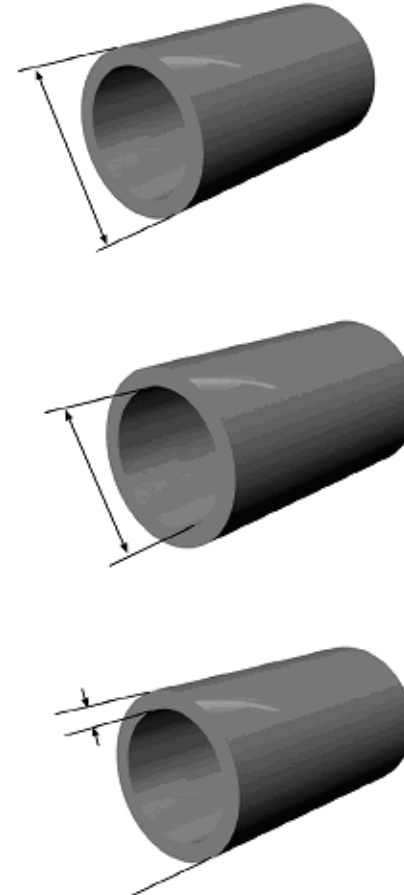
- These are used most in the oil and petrochemical industry.

Pipe sizing

Pipe sizing

► A tube is defined by:

- Its diameter
- The thickness of the envelope.
- The steel grade it is composed of.



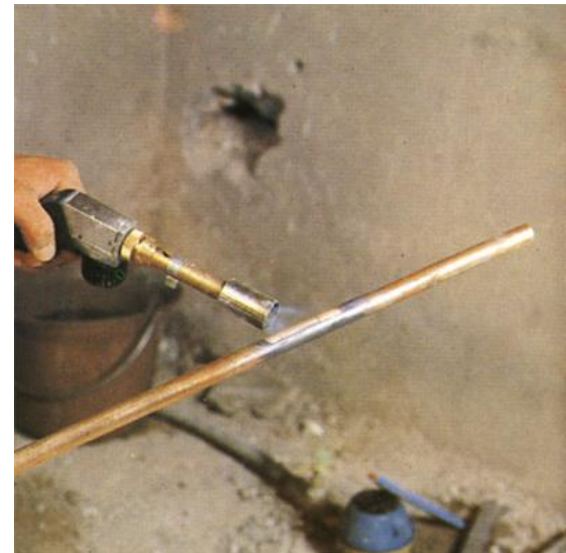
Tube diameters

Copper piping

Copper piping

- ▶ Copper tubes are best adapted for cold/hot water and gas pipes.
- ▶ It is sometimes necessary to anneal a tube to improve its malleability.
 - Use a blowtorch to heat the tube to redness on the part which is to be annealed.
 - This work can be done with a blowtorch (oxy-acetylene)

Annealing



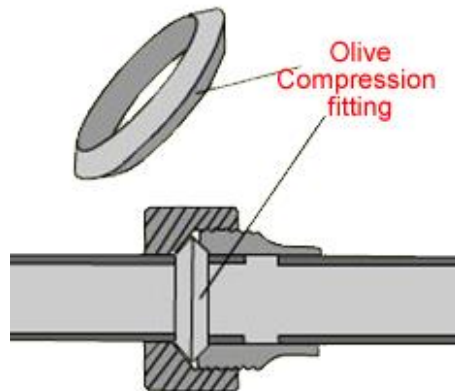
Copper piping

► Olive compression fittings:

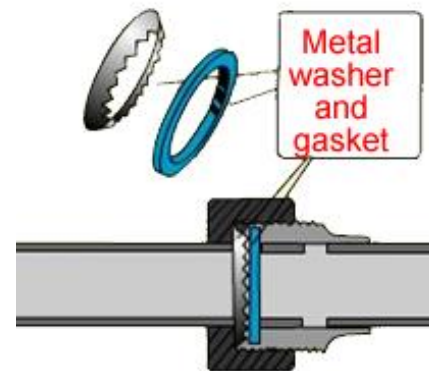
- These olive compression fittings simplify the installation, but they cannot withstand several disassemblies.

► Grip fitting:

- For a beginner this principle is the easiest and has the advantage of being indefinitely detachable.



Olive compression fitting

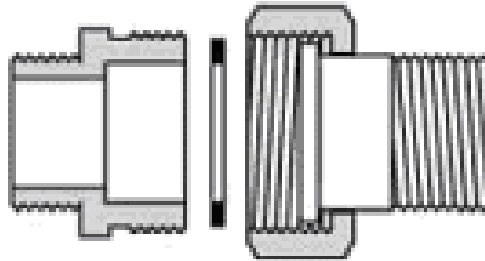


Grip fitting

Copper piping

► Flare fitting:

- It consists of a female nut and a male union fitting.
- This fitting requires the installation of a fibre or rubber gasket for the sealing.



► **ALL THESE FITTINGS ARE PROHIBITED FOR GAS.**

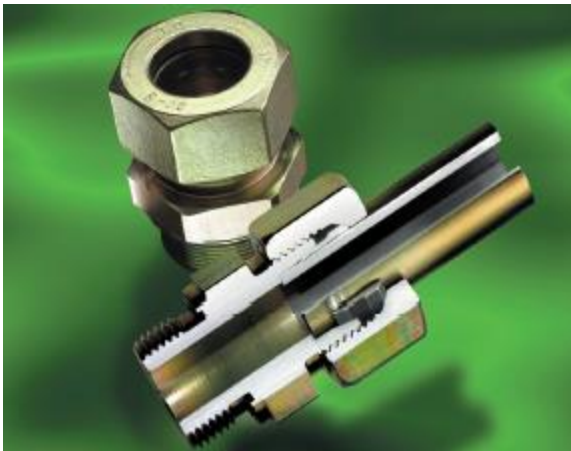
Copper piping

► Progressive ring fittings (Ermeto):

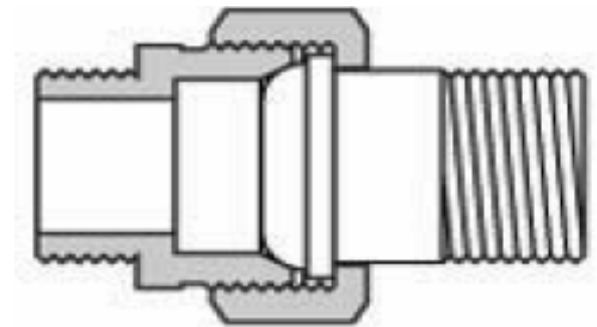
- The Ermeto fitting is very popular thanks to its easy assembly which only needs two flat wrenches.

► Spherical seat union:

- The tightening of the nut locally crushes the metal thus procuring a tight seal.



Ermeto



Spherical seat

Copper piping

► Weld fittings:

- There are several kinds of copper weld fittings.

- With copper piping, the term “welding” is not used; we speak of soldering or brazing.
- Soldering and brazing consist of a lapped joint assembly of two pieces of metal by capillarity, using a welding rod.

Brazing



Copper piping

► The difference between soldering and brazing:

- Soldering (melting point less than 450°C)
- Brazing (melting temperature higher than 450°C)



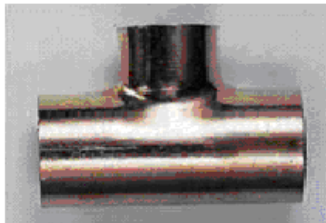
Soldering



Brazing

Copper piping

- ▶ **Two things should be noted when speaking of soldering or brazing:**
 - This is a capillary phenomenon (where a liquid spreads between the cracks of two parts in contact and which slowly progresses whatever the position of the parts)
 - Wetting (when the bond between the soldering or brazing and the workpiece is free of apparent defects and the coating of the soldering or brazing appears even)
- ▶ **The damages which the structure of the metal can withstand depend on the temperature, but also on the time during which this temperature is maintained.**
- ▶ **Consequently, brazing operations, especially those made involving melting points in the range of 700°C, must be performed as quickly as possible.**
- ▶ **Coupling sleeves are used to connect two tubes without welding.**



Welding sleeves:



Steel piping

Steel piping

- ▶ The steel pipes are much larger than those made of copper but steel pipes can also be found in small sizes.
- ▶ Most fittings that are adaptable on copper pipes can be used on steel pipes
- ▶ Steel is divided into three categories:
 - Non-alloy steels
 - Alloy steels
 - Stainless steels
- ▶ The choice of steel for the piping depends on the nature, temperature and pressure of the fluid transported.
- ▶ To connect steel pipes the same process is used as for copper pipes.

Steel piping

► Coupling:

Used for possible (non-frequent) disassembly.



coupling

► Reducers

Used for possible (non-frequent) disassembly.



reducer

► Nipple

Used for possible (non-frequent) disassembly.



nipple

Steel piping

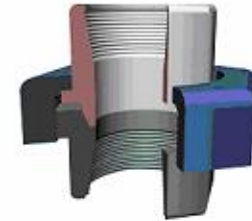
► Elbow

- Used for possible (non-frequent) disassembly.



► Union fitting

- Used for regular disassembly.



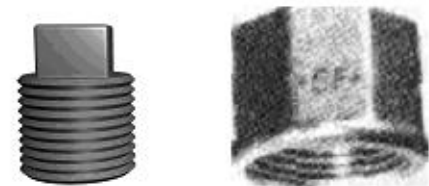
► Tee and cross

- The tee connects three tubes of the same diameter
- The cross connects four tubes of the same diameter



► Caps

- Used to isolate a section of piping.



Steel piping

■ Weld fittings

- Weld fittings for pipes are more or less identical to those for copper pipes, but for one or two exceptions.

■ Flanges

- When the tube diameters are larger than the diameters of the largest fittings, steel tubes are joined by flanges.
- The steel tubes with a small diameter can also be fit with flanges depending on the nature and pressure of the transported fluid.



Weld fittings



Flanges

Pipe protection

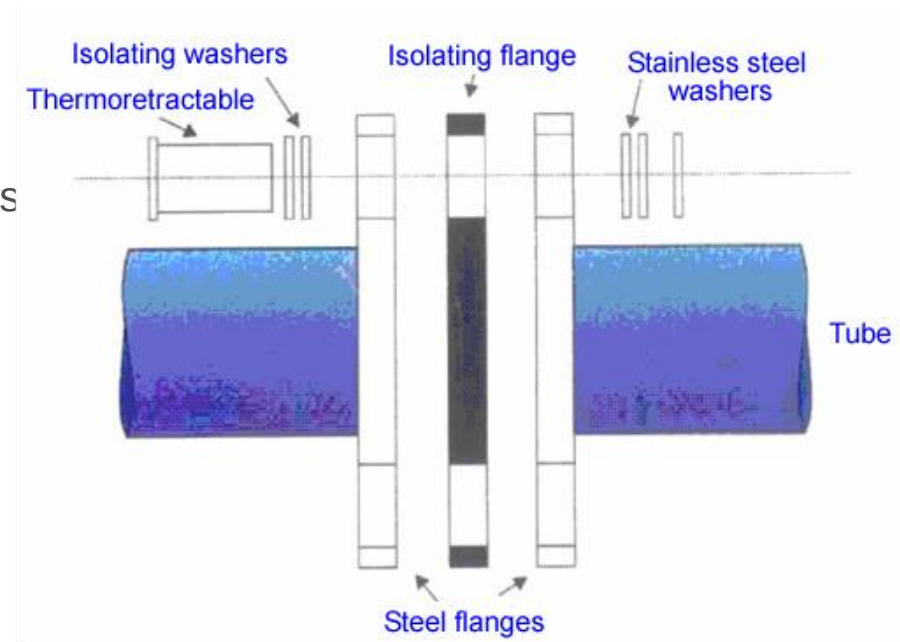
Pipe protection

- ▶ Corrosion protection is very important for many professional groups.
- ▶ Contact corrosion occurs when pipes made of different materials are connected.
- ▶ Metals which corrode easily are known as the common metals (- potential) and those which corrode with difficulty as the precious metals (+ potential).
 - Metals when they have a high potential are known as precious metals.
 - Metals with low potential are known as common metals.

Pipe protection

► Risks and safety measures

- Flow rule
- Combining materials in the installations
- Steam condensate
- Preventing contact corrosion of the screws
- Separating the voltages
- Interrupting the voltages



Pipe protection

► Various types of protection:

- Corrosion inhibitors
- Surface treatments
- Organic coatings



Poor adherence of the paint



Oxidised thread

Pipe mounting

Mounting the clamps

- ▶ The various pipes tend to vibrate when in service.
- ▶ In all cases, these vibrations expose the pipes to rupture.
- ▶ To limit these incidents it is necessary to:
 - Counter the vibrations
 - Ensure fixation (for maximum immobility)
- ▶ Several other factors must also be taken into consideration when the pipes are installed.
 - The dilatation and the contraction of the pipes (thermal shocks)
 - The vibrations transmitted to the pipes
 - The flow rate changes in the pipes

Mounting the clamps

► Supports are divided into two categories

- Pipe supports which support the pipes from underneath
- The piping suspension loops (or U-bolts) (used to mount the pipes on the ceiling)

► It is vital to ensure the integrity of the fittings, and improve them where necessary, but with caution.

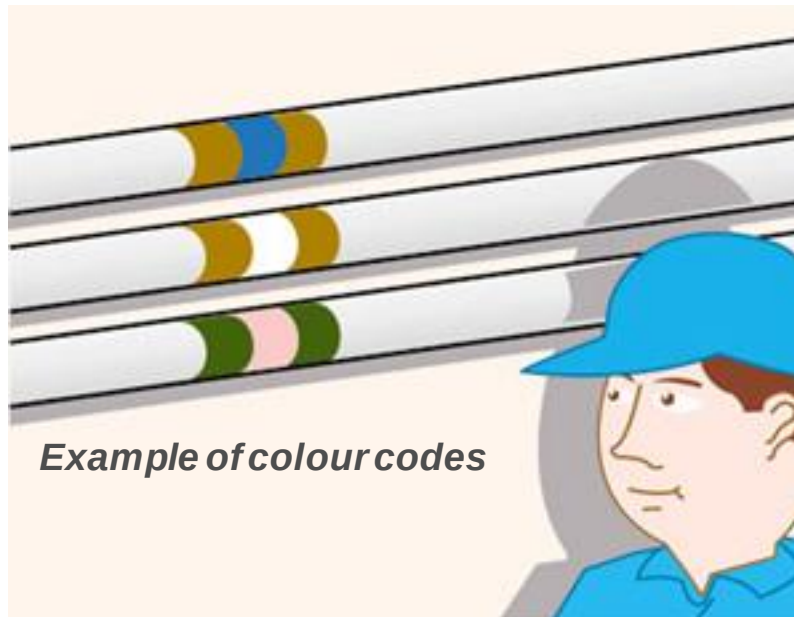


Supports and U-bolts

Colour coding of rigid pipes

Colour coding of rigid pipes

- ▶ Colour coding is used to indicate potential hazards associated with the contents of a rigid pipe.
- ▶ The goal of such marking is to make the task easier for the technicians, to facilitate intervention by safety crews in event of damage and to thus prevent any confusion.



Colour coding of rigid pipes

- ▶ **The fluids in the pipes are identified using three series of colours**

- The main identification colour (background)
- The secondary identification colour
- The status identification colour

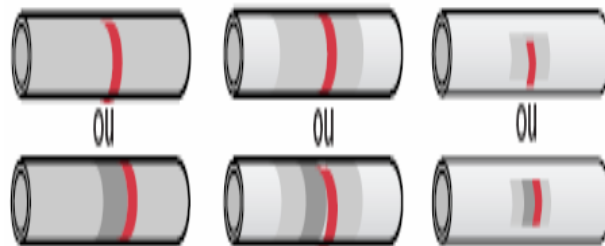
- ▶ **Each family of fluids has its own specific main identification (background) colour.**

- Along the whole length of the piping
- Or on part of the piping

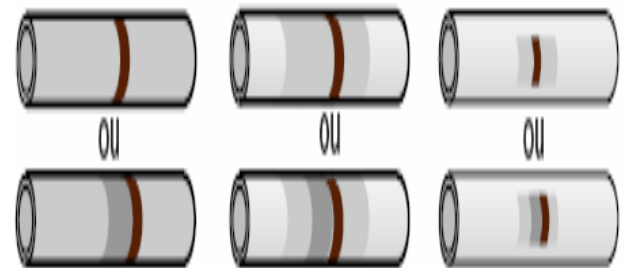
Colour coding of rigid pipes

- Some fluids have a specific colour called the secondary identification colour.
- This colour is placed in several places, along the whole length of the main identification colour.
- This colour specifies some of the fluid's properties:

- Pressure
- Temperature
- Purity



Red-bright orange>> Under pressure



Common brown>>Polluted or fouled

Colour coding of rigid pipes

- ▶ Indicating the direction of the flow can prove very useful to quickly locate the block valves in case of an emergency.
- ▶ A white or black arrow (so as to ensure a better contrast with the background colour) is placed in the direction of the flow.
- ▶ For two-way flows, a double arrow is used.



Direction of the flow

Colour coding of rigid pipes

- It is often recommended to explicitly attract the personnel's attention to the hazardous nature of certain fluids.
- Therefore labels, plates, writings or icons are attached to the piping close to the main background colour.

General warning



Explosive materials



Substances under pressure



Examples of pictograms

Conclusion

Conclusion

► What you have learned in this course

- General composition of the piping
- Tube design
- Tube manufacturing
- Pipe dimensioning
- Copper piping
- Steel piping
- Pipe protection
- Mounting the clamps
- Colour codes of the pipes.