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INDUSTRIAL PLANTS

Chapter twenty-four:

Piping - Generality

DOUBLE DEGREE MASTER IN

“PRODUCTION ENGINEERING AND MANAGEMENT”

SEAT OF PORDENONE

UNIVERSITY OF TRIESTE

Generality

The industrial plants need of fluid of service (water, compressed air, electricity, steam etc.), which are secured to the productive cycle of **general plants**.

The design of the various general plants must be the result of a study of economic optimization.

While the investment costs of the plants for the production and distribution of fluids of service can reach 30% of the total cost of the plant (excluding the machines), it is shall also seek to the design such systems in order to reduce the costs of exercise.

Generality

When designing this type of general plants should be taken into consideration the foreseeable future needs, evaluated with sufficient width, to avoid having to redo or twice a plant shortly after its completion.

The distribution of the various fluids of service must be visible and easy to inspect (color indications on the table UNI 5634-97 P: Identification systems for pipes and ducts conveying of the fluids.

Generality

Among the **distinctive colors of the base**, which identify the pipes conveying fluids of which is sufficient to identify the nature, we have:

- green ………………………………… water;
- silver gray …….…………………… steam and superheated water;
- brown ……………………………….. mineral oil, liquid fuels;
- yellow ocher ……………………… gases (excluding air);
- violet ………………………………. acids and alkalis;
- light blue …………………………. air;
- black ..…………………………….. other liquids.

Generality

The **indications of code** are the colors of security and the data indicating the nature of the fluid, which are apply in the vicinity of fittings, valves, equipment, piping adduce fluids of information must be accurate. Is apply the following colors:

- **red**, for the piping for sprinkler installations;
- **blue**, **together with the green base color**, for distinguish the pipes that convey sweet water (drinking or not).

The data indicating the nature of the fluid can be reported in any of the following ways:

- full name (ad example demineralized water);
- abbreviation (ad example AD);
- chemical formula (H_2O).

Generality

The basic colors are applied across the pipe or on bands, with a length depending on the diameter of the pipe and the distance from which should be visible.

The safety colors are applied on the base color with bands of width equal to ¼ of the width of the band of base color.

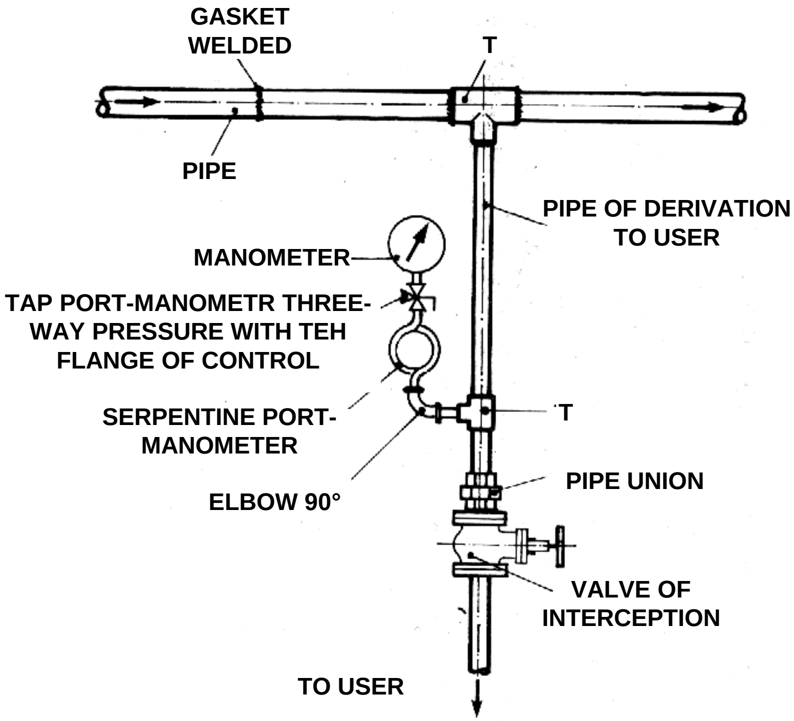
The data indicating the nature of the fluid are white or black to contrast with the base color. They are applied directly on the tube or on labels attached on the pipe.

The piping, valves and various components of the distribution of the fluids of service must be installed so as not to obstruct the passage, not being damaged by vehicles, conveyances etc. not occupy the spaces of work and not a barrier to light natural

Generality

The principal elements of the **distribution networks of fluids** are:

- pipes;
- joints, fittings and seals;
- organs of interception and adjustment;
- accessories (pressure gauges, flow meters, filters, dilators, steam traps etc.).



Generality

The graphical representation of the distribution networks of fluids almost always requires the adoption of a special symbol generally unified or conventionally adopted

Nominal diameter (DN)

It is an indication conventional to identify the different elements that can be coupled to a pipe (pipes, valves, fittings, etc.) for the conveyance of fluids, it represents approximately the size in mm of the inner effective diameter of the pipe.

The UNI 1282-67 provides the following series of nominal diameters: 1 – 1,5 – 2 – 2,5 – 3 – 4 – 5 – 6 – 8 – 10 – 15 – 20 – 25 – 32 – 40 – 50 – 65 – 80 – 100 – 125 – 150 – 175 – 200 – 250 – 300 – 350 – 400 – 450 – 500 – 600 – 700 – 800 – 900 – 1000 – 1200 – 1400 – 1600 – 1800 – 2000.

Generality

The graphical representation of the distribution networks of fluids almost always requires the adoption of a special symbol generally unified or conventionally adopted

Nominal pressure (PN)

Indicates a conventional pressure expressed in bar, that characterizing the possibilities of resistance of the elements constituting the pipe.

The UNI 1283-67 provides the following set of nominal pressures: 1 – 2,5 – 6 – 10 – 16 – 25 – 40 – 64 – 100 – 160 – 250 – 320 – 400 – 640 – 1000 – 1600 – 2500.

Generality

For each value of the **nominal pressure** correspond 3 values of the **operating pressure**, depending on the degree of security required (depending on the nature of the fluid, its temperature etc.).

To determine the **maximum pressure** to which a pipe can be subjected, are considered 3 operating conditions:

I - is made to coincide the operating pressure with the nominal pressure (for non-hazardous fluids from a chemical point of view and with temperatures below to 120°C);

II - the pressure is about 80% of the nominal pressure (for chemically hazardous fluids at temperatures above 120°C, or non-hazardous fluids at temperatures between 120 and 300°C);

III - the pressure is about 64% of the nominal pressure (fluid very dangerous or not dangerous, but with temperatures above 300°C).

Generality

PN	Pressures of operating				Pressures of hydraulic test
	I	II	III		
	Pipes to flanges	Pipes to flanges	Pipes	Flanges	
1	1	1	-	-	2
2,5	2,5	2	-	-	4
6	6	5	-	-	10
10	10	8	-	-	16
16	16	13	10	-	25
25	25	20	16	20	40
40	40	32	25	32	60
64	64	50	40	40	96
100	100	80	64	64	150

The pressure required for the test of the hydraulic pipes is that which is carried out after the laying and before entry into service

Generality

The type of pipe suitable for the transport of a particular fluid is chosen based on:

- **material** (steel, plastic, cast iron and lead)
  This choice is made taking into account the chemical-physical characteristics of the fluid to be transported (aggressiveness, temperature and pressure) and the environmental conditions in which the pipes will be located at (temperature, pressure, aggression etc.);
- **construction type of the pipes** (with or without welding, smooth or threaded, with or without protective covering etc.)
  This choice is based on the nature of the fluid, flow, pressure, mode of install (basement, aerial to the inside or outside of buildings etc.)

Chosen the tube, it determines the diameter and thickness.

Generality

The minimum thickness of metal pipes subjected to internal pressure is detectable by the relation (UNI 1285):

$$s_o = \left(\frac{p \cdot d_e}{200 \cdot \sigma_{am} + p} + c \right) \cdot \frac{100}{100 - a}$$

where:

s_o = thickness of calculation of the tube (mm);

p = maximum pressure difference between internal and external operating (kg/cm^2);

d_e = outer diameter of the tube (mm);

σ_{am} = maximum unitary allowable stress (kg/mm^2);

c = over-thickness related to the material, manufacturing process and the corrosion conditions in the operating phase (mm): is assumes: 0-1 mm for carbon steels, 0 mm for stainless steel, nonferrous metals and plastics;

a = manufacturing tolerance on the thickness of the tube (%).

Generality

If, however, is expected a hydrostatic test or other of substitution pressure, the minimum thickness is:

$$s_o = \left(\frac{p \cdot d_e}{200 \cdot \frac{R_t}{K} \cdot z + p_p} \right) \cdot \frac{100}{100 - a}$$

where:

s_o = thickness of calculation of the tube (mm);

p = difference between maximum pressure internal and external operating pressure (kg/cm^2);

d_e = outer diameter of the tube (mm);

R_t = unit load at the limit of permanent deformation of 0.2% at the temperaturet (kg/mm^2);

z = welding efficiency (0.5 for welded steel pipes Fe00, 0.8 for pipes of quality material and 1 for seamless pipes and welded material quality and submitted to nondestructive testing on the whole development of welding);

K = safety factor of R_t ($\geq$1,1);

p_p = hydraulic test pressure (kg/cm^2);

a = manufacturing tolerance on the thickness of the tube (%).

Generality

The thickness of manufacture of the tube is assumed not less than the greater of the two values obtained with the previous two formulas, which already take account of manufacturing tolerances.

More simply, the thickness of the tubes can be calculated by the following relation:

$$s = \frac{PN \cdot d_e}{200 \cdot \sigma_{amm} + PN} + c$$

where:

s = thickness of calculation of the tube (mm);

PN = nominal pressure (kg/cm^2);

d_e = outer diameter of the tube (mm);

σ_{am} = maximum unitary allowable stress (kg/mm^2);

c = over-thickness related to the material, manufacturing process and the corrosion conditions in the operating phase (mm): is assumes: 0-1 mm for carbon steels, 0 mm for stainless steel, nonferrous metals and plastics;

Generality

a) Steel Pipes

Are the most used in the industrial field; can be manufactured with or without welding, depending on the production process.

These pipes are divided into 4 categories:

- **Commercial pipes**

  Are tubes of current production (steel Fe00), without any special characteristics, submitted to low pressures, and easily machinable unless the tubes per well.

  They are divided into threaded pipes (or gas pipes - threaded diameter measured in inches and not more than 4"- galvanized or non-normal series of UNI 3824, UNI 4148 medium, heavy pipes UNI 4149 and UNI 1288 from a well light and heavy UNI 1289) and smooth tubes (UNI 4991 - used for conveying fluids having temperatures up to 225°C and nominal pressures up to 25 kg/cm^2 for water, compressed air etc. and which can reach up to DN 500 or DN 600

Generality

a) Steel Pipes

Are the most used in the industrial field; can be manufactured with or without welding, depending on the production process.

These pipes are divided into 4 categories:

- **Pipes normal class**

  They are steel tubes with certain features and are subjected to mechanical tests and technological and high pressure test. Are employed for the realization of ducts destined to fluids having temperatures up to 400°C and pressures nominal greater than 25 kg/cm^2

Generality

a) Steel Pipes

- **Pipes of the upper class**

  Are tubes that must match the requirements of the class than normal, also for technological evidence of enlargement, edging and crushing.

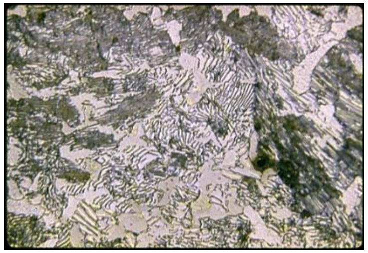
  They are suitable for applications characterized by solicitations very challenging when they have to be mandrel for use in steam generators, heat exchangers etc.

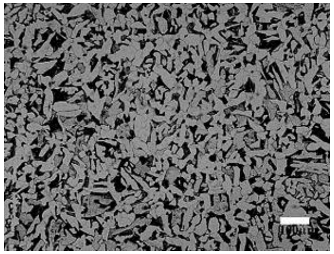
a) Steel Pipes

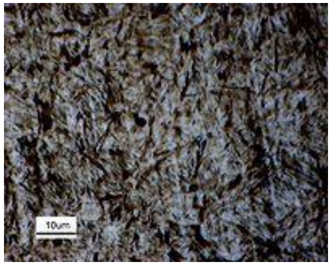
- Special pipes

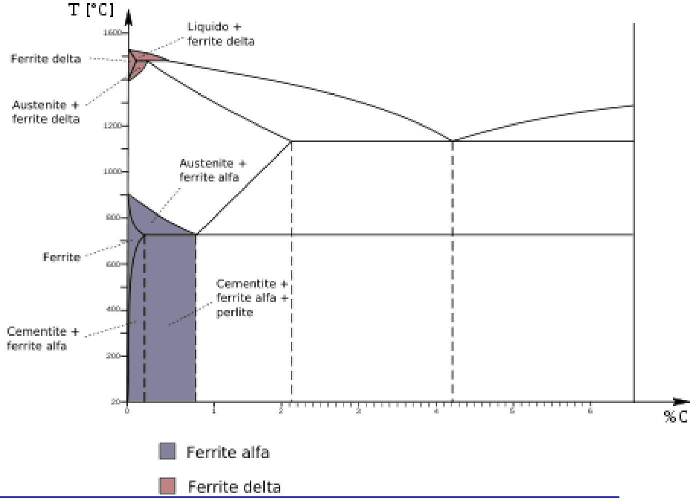
They are suitable for severe conditions of operation (corrosion, temperature etc.) and are constructed without welding (lengths between 3 and 10 m) with alloy steel, in running at hot and cold, high-Cr steels (steels with an austenitic matrix, ferritic and martensitic.

Are employed in the field of high temperatures (industries of the nitrogen and their derivatives, pharmaceutical, canning etc.), with high values of the mechanical characteristics of sliding to hot and stability to oxidation and corrosion.









Generality

a) Steel Pipes

The main design requirements are:

- **surfaces**: internal and external smooth, even if they are allowed increases and decreases in thickness, grooves or longitudinal striations, surface related to the process (thickness, however, within the limits of tolerance);
- **form**: circular within the tolerance limits prescribed and appeared rights in sight. The ends should be cut normal to the axis of the tube and not present of the smearing;
- **lengths**: commercial (4 to 8 m) or manufacturing (minimum 1.5 m);
- **annealing**: the procedure that is executed on the ends of the tubes of a fixed length when they are intended to be mandrel or on the whole tube in the case of cold-drawn tubes after the last step to the die to eliminate the work hardening;

Generality

a) Steel Pipes

The main design requirements are:

- **material**: carbon steel pipes and tubes business class and above normal.

b) Plastic Pipes

Used for the conveyance of liquids and gases because they have a good resistance to corrosion by chemical agents, are lightweight, with consequent savings in installation and support structures, and have good dielectric properties.

They are used in conveying by gravity and pressure of polluted waste water, but are not suitable for operating pressures in excess of 16 kg/cm^2 and are difficult to seal in the junctions for hot fluid (> 50-60°C) or to frequent variations in temperature.

These pipes are submitted to an aging-sensitive, which makes them fragile, if not subjected to the action of light, to thermal shock and vibration.

b) Plastic Pipes

Are made of PVC (polyvinyl chloride), polypropylene, polyethylene, PVC coated on the outside of polyester reinforced with glass fibers, with lengths from 3 to 6 m. The dimensional and physical-mechanical properties are shown in the tables UNI 7441, 7443 and 7447.

c) Cast iron pipe

Obtained by centrifugal casting, are produced in bars with a length of 2-5 m depending on the diameter.

The shorter length is due to the fragility of the material. They are normally covered with tar to protect them from corrosion.

The use of cast iron pipes is very limited in the industry because they are not suitable for PN > 10.

The cast iron pipes have the advantage of good resist corrosion.

Before use, must be subjected to acceptance tests as required by the rules.

Generality

d) Lead pipes

Have always lower use in industry due to the increased cost and difficulties related to their laying.

They can easily bend (cold to small diameters and hot to large diameters previously filled with sand).

Must be installed in a protected position to avoid crushing and deformation.

The lead pipes are corroded by cement, lime etc.. whereby must be coated with insulating paints or tarring.

d) Lead pipes

The unions between the tubes are made by welding with alloy formed from 2/3 of lead and 1/3 from the pond.

If horizontal or nearly so, the pipes should be laid on a laying surface continuously while for vertical sections are fixed with bracelets of sheet galvanized.

Generality

Joints

Allow to connect "head to head" the various truncated pipes.

They adopted the following types:

Solder joints

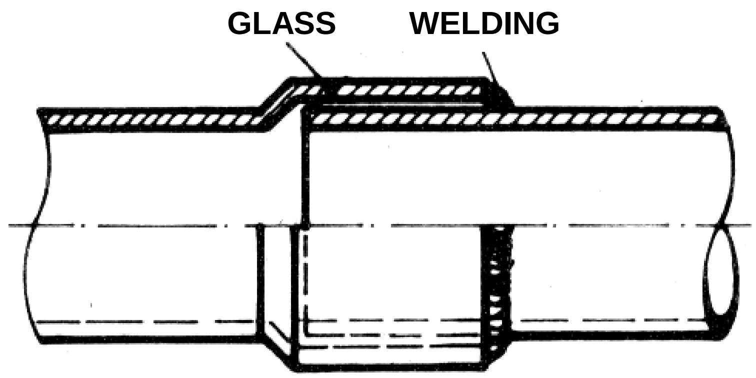
Is the most common system for steel pipes with a diameter of medium and large, and for small diameter pipes. The welding (oxyacetylene or electrical with filler material) is made of the head, after chamfering to V of the ends of the tubes, so as to allow the penetration of the weld bead.

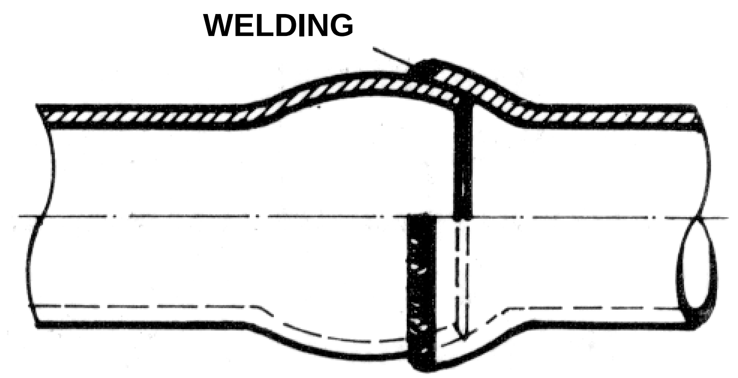
Joints

Joints at glass welded

Take their name from the form of one of the ends of the tubes, adapted to receive the end of the other, without having the need to bevel the ends of the same.

Used for underground pipes, are distinguished: cylindrical glass (require precise alignment) and spherical glass (allowing slight deviations of the tubes). The elements are welded while rotating around its axis on special supports or keeping fixed.



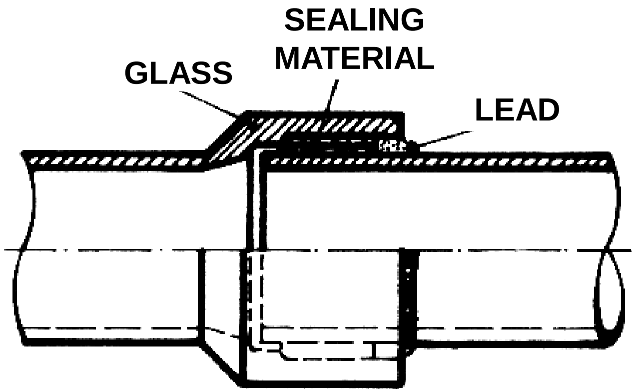


Joints

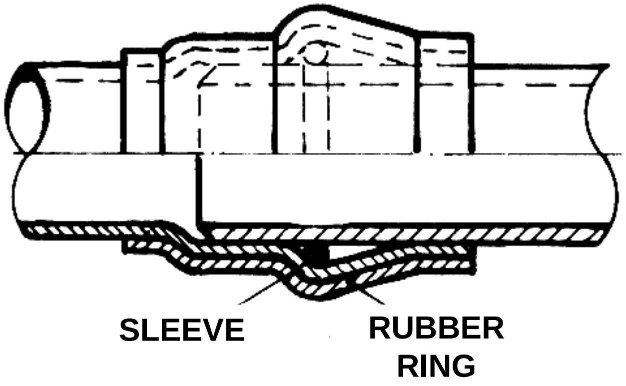
Joints at glass not welded

Used for the piping joints in cast iron and plastics, which allow a slight misalignment between the tubes.

The seal is assured by molten lead, superimposed on tarred rope that prevents the entry of the same inside the pipe.



for cast iron pipes

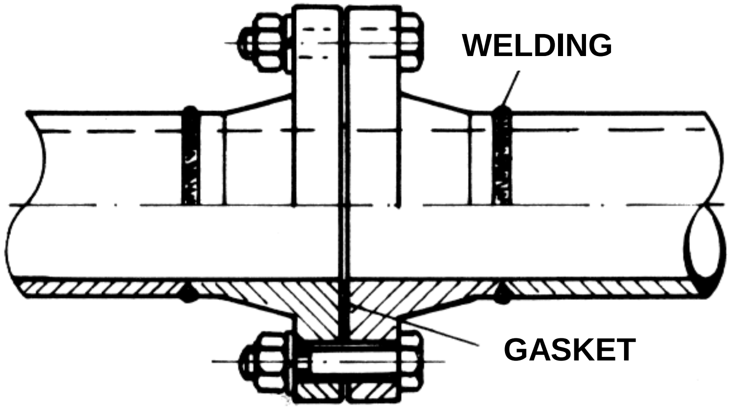


for plastic pipes

Joints

Flanged joints

Are used for the piping joints of steel, plastic and cast iron, in correspondence of the attacks of the tubes to the plant, equipment etc., for the mounting of shut-off and in cases where it is expected to disassemble the pipes.

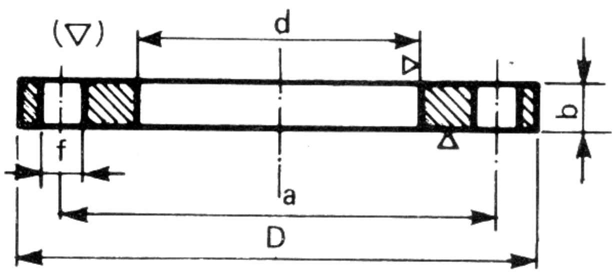


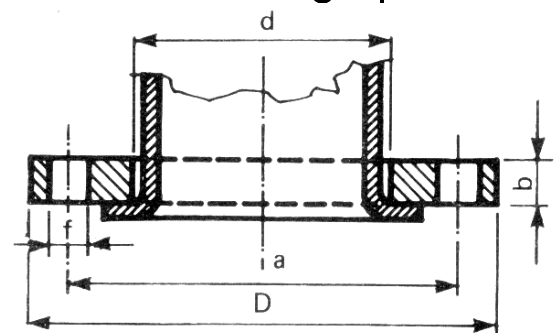
Joints

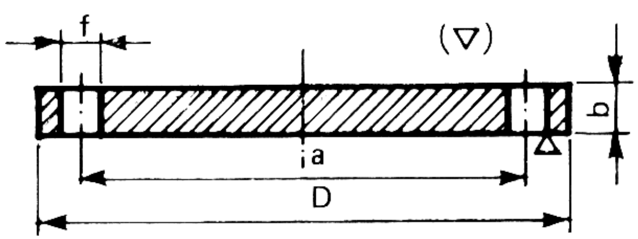
Flanged joints

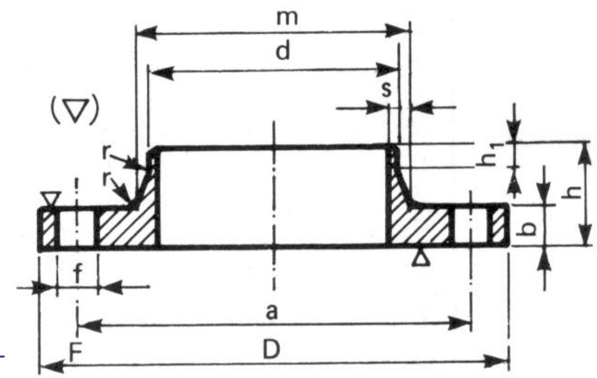
We have:

- *flat flange*, when the fluids transported are at low and medium pressure;
- *sliding*, for the distribution networks of hot fluids at low pressure;
- *blind*, for the closure of the ends of a pipe;
- *to collar*, for networks conveying fluids at medium and high pressure.



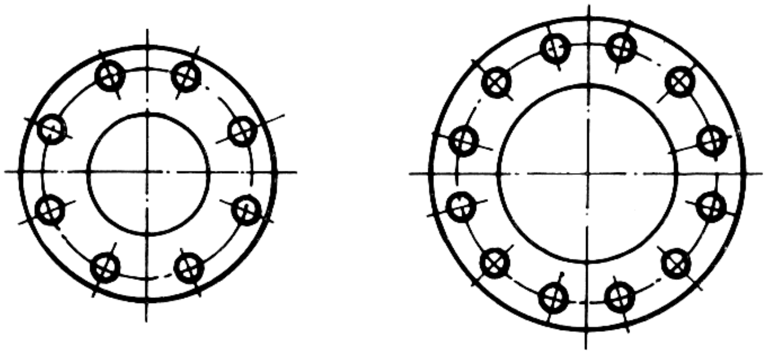






Joints

All types of flanges are then connected together by bolts inserted into holes formed on a circumference close to the outer edge. Their number varies 4 by 4 depending on the diameter and the nominal pressure, to which are also linked to the size of the flange itself.

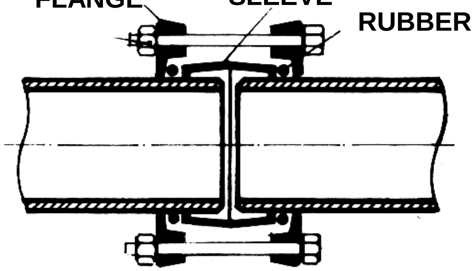


The seal between the flanged joints of the pipes is obtained by means of gaskets, made of flexible material and waterproof, which are arranged between the opposing flat surfaces of the two flanges or in suitable seats. The contact faces of the flat flanges often present some concentric ridges (ridges), that promote the contact with the gasket and thus improve the seal.

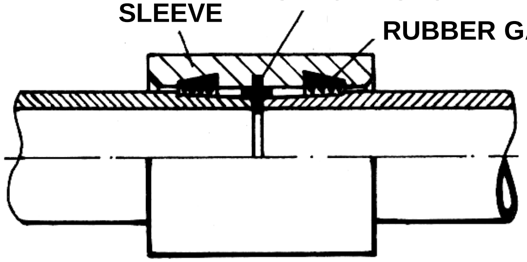
Joints

Special joints

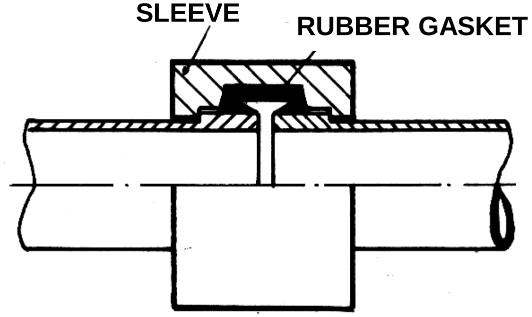
Are of junctions without welding, that allow slight misalignments to the trunks of the tubes and can be disassembled. They are used for steel pipes.



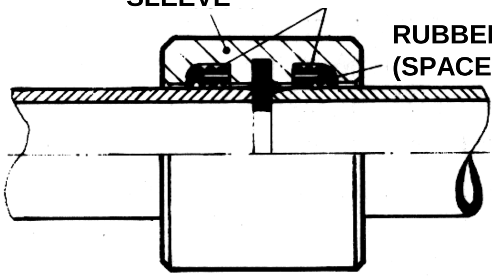
Joint Gilbault



Joint Supersimplex



Joint Victaulic



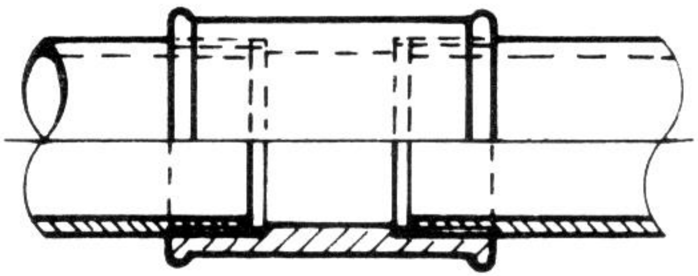
Joint Eterliss

Joints

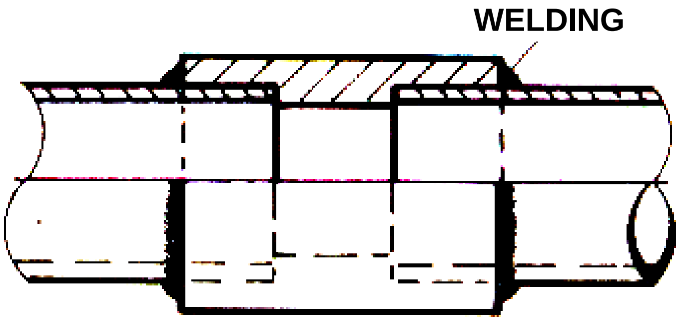
Sleeve joints

They are used for steel and plastic pipes.

For the steel pipe, the sleeve is internally threaded (the ends of the tubes must be threaded) or is smooth (the sleeve is fixed to the tubes by welding). For plastic pipes are used smooth sleeves which are glued along the contact surfaces.



Threaded joint sleeve



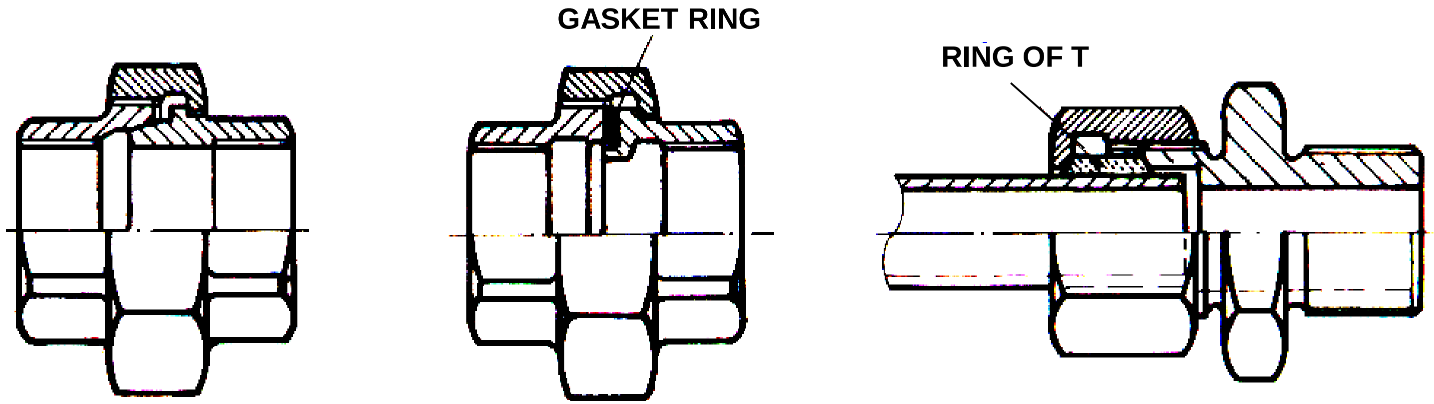
Joint to pocket be welded

Joints

Joint to pipe union

They are used for steel tubes and plastic threaded (up to DN 60).

They consist of from 3 threaded parts, two of which are bolted to the ends of the tubes, while the third holds together the two. The unions are malleable iron with interposed sealing ring (hemp, teflon etc.).

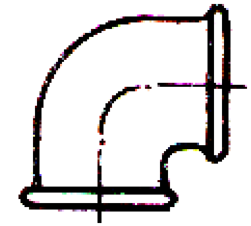


Joint to pipe union with conical seat, and with flat clamping ring

Fittings

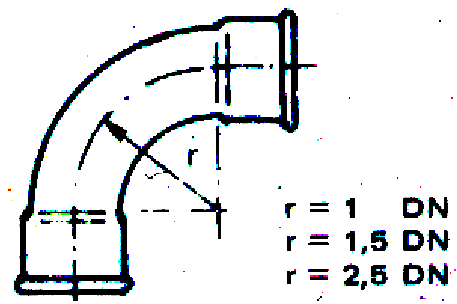
They adopted the following types:

Fitting at 45° or at 90°



They can be with both entrances smooth or threaded male or female or a male and a female

Bends at 45° or at 90°

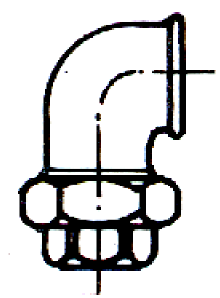


They can be with the entrances chamfered (butt welding) or with both the entrances threaded male or female, or a male and a female

Double curves at 180°

They can be with entrances bevelled or threaded female

Bends with pipe unions



They can be the elbows or curves, which terminate at one end with a nozzle (male or female thread)

Generality

Fittings

They adopted the following types:

T

Can be derived with the same diameter or different diameters with beveled inlets or threaded male or female (diameter < 4")

T curves

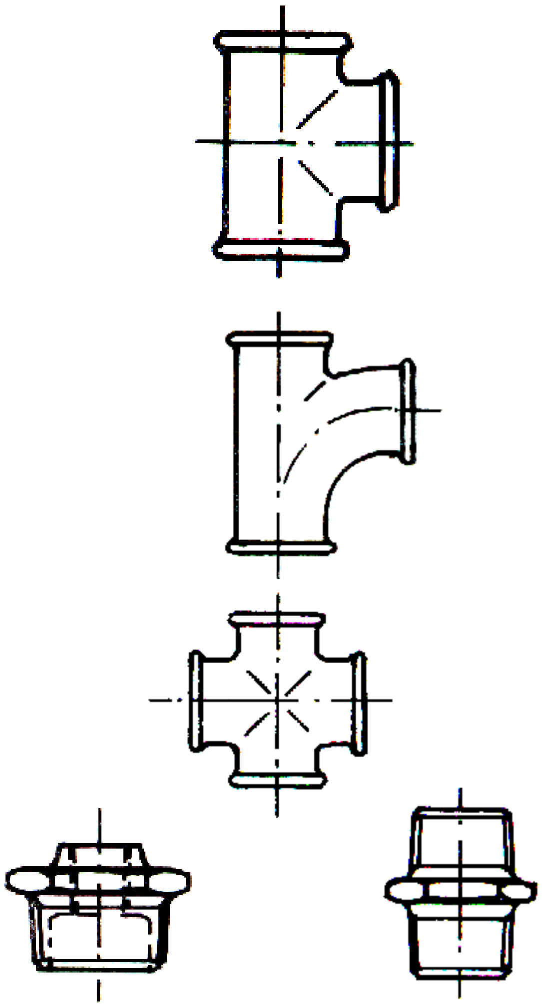
May be one or two corners with threaded hubs generally

Crosses

They can be with 2 entrances, possibly of reduced diameter and with female thread

Reductions and nipples

It is of fittings that serve to join two pipes of different diameter or having a different thread



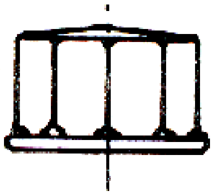
Generality

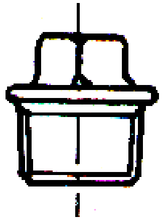
Fittings

They adopted the following types:

Caps and plugs

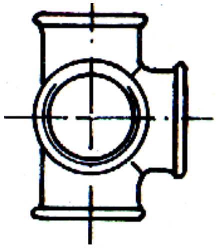
Serve to close the threaded end of a tube (cap with female thread) or a fitting (cap with male thread





Distributions

Are fittings that serve to join, 3, 4 or 5 tubes converging (the thread is always female)



The fittings are usually smooth entrances with steel hot-drawn or welding molded parts.
The fittings with threaded hubs is malleable iron, except for the sleeves (in steel).
For special applications are used stainless steel fittings.

Seals

Serve to ensure the seal between the two flanges.

The materials are chosen according to the characteristics of the fluid that runs through the pipe. Those most used are the following:

Flat non-metallic

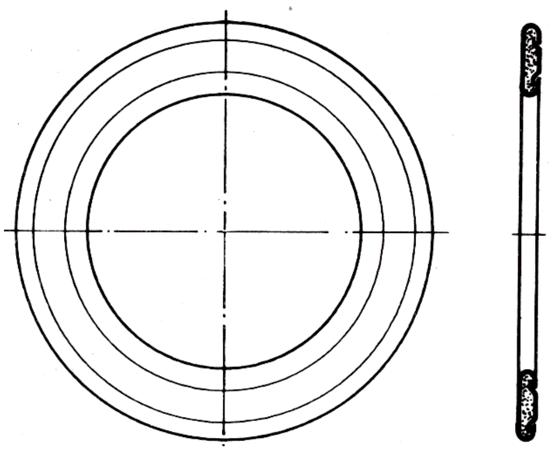
Usually made of rubber, suitable for low temperature, medium pressure and for fluids such as water, air, gas, steam etc.

Apply when there is the relationship:

$$p \cdot t < 8500$$

with p (bar) pressure of the fluid and t (°C) temperature of the fluid.

If you have not checked the report, using the metal gaskets.



Seals

Those most used are the following:

Flat metal

They are made in soft iron, copper, lead or aluminum.

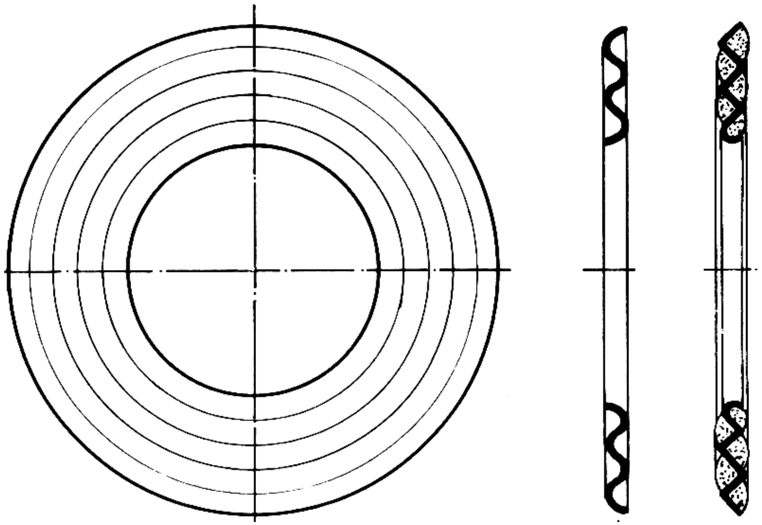
They are suitable for corrosive fluid (acids, ammonia, bases, etc.), high temperatures and pressures.

Corrugated metal or metal-plastics

They are made of corrugated sheet metal, sometimes covered based compound materials no "asbestos free".

They are suitable for low pressure.

Ensure the estate of lids and organs of interception.

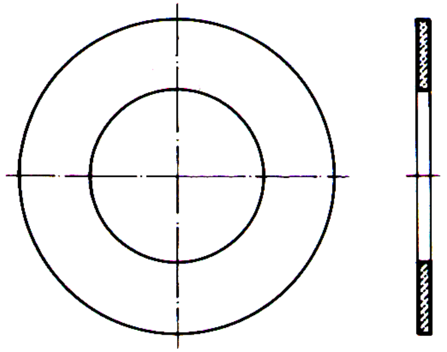


Seals

Those most used are the following:

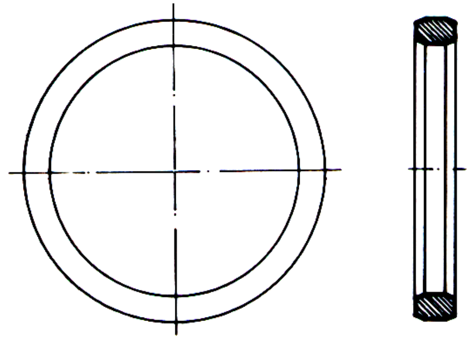
Metal-plastic jacketed or to envelope

They consist of a foil, smooth or wavy, which encloses a core of a material resistant to the temperatures (600°C) and with good resistance



At ring

Are at oval or octagonal cross-section, consisting of soft iron or steel (including stainless steel) having a hardness lower than that of the flanges. They are suitable for high temperatures and pressures.



The tightness of the seal depends on the profile of the opposing faces.

The faces must be parallel and clean. After an initial manual tightening of the bolts, the tightening is done with a torque wrench with opposites bolts.

Generality

Organs of interception and of adjustment

Allow the adjustment or interruption of the flow of fluids in pipes.

These organs for maneuver, referred to as **valves**, are installed at appropriate locations.

Are realized in various forms, although the principle of operation is the same. The organ of interception is constituted by:

- a body or casing (bronze, brass, cast iron, steel, plastics etc.);
- a cover or hat (gate valves) or stand (valves). They are threaded, welded or flanged;
- a sealing seat consists of interchangeable rings;
- a shutter with tree and gasket (puddening), in martensitic steels, bronze and brass, cast iron valves, or alloys of nickel and copper, for valves mounted on pipes with flowing steam or corrosive fluids;
- a device of maneuver (flyer), which controls the tree or the stem.

Generality

Organs of interception and of adjustment

They fall into three main categories:

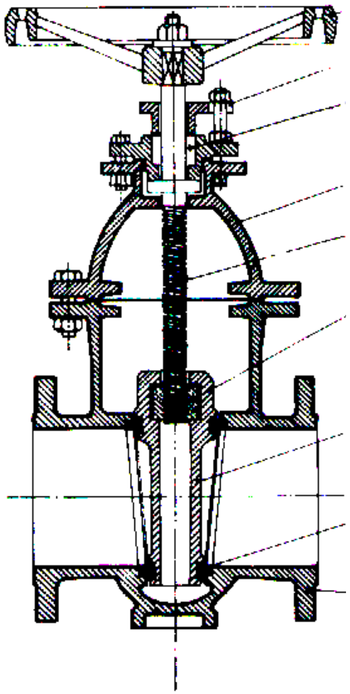
- **gate valves**
- **valves**
- **taps.**

Generality

Organs of interception and of adjustment

Gate valves

The organ of interception is constituted by a shutter in parallel or wedge faces, which makes a motion perpendicular to the axis of the tube, on which the same are mounted, and to the direction of the fluid. It runs until it comes into contact with the appropriate locations.



They are suitable for large flows and to control the flow of fluid moves with "completely open" or "closed", but are less suitable for intermediate regulations. They have a small footprint according to the axis of the tube, while vertically is remarkable. Cast iron flat bodies are used for pressures of 4 bar and up to DN 300, otherwise using a steel or oval body. There is no additional pressure drop when the valve is fully open.

Organs of interception and of adjustment

Valves

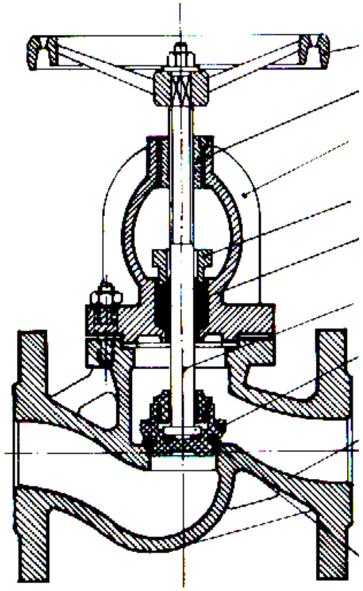
Are mainly used to adjust the flow of fluids in the distribution networks, which is obtained by changing the load losses in the network.

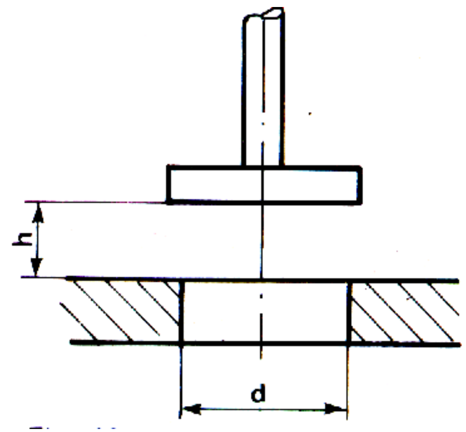
The axis of the shutter coincides with the axis of the seal seat and the closure is assured by the contact between the shutter and the seat of a circular shape. In started flow valve there are two subsequent deflections of 90°, with a consequent loss of load also to open the shutter. To ensure the passage of the entire fluid flow through the valve should be that it is:

$$\pi \cdot d2 / 4 = \pi \cdot d \cdot h$$

for which the shutter stroke must be equal to

$$h = d/4$$





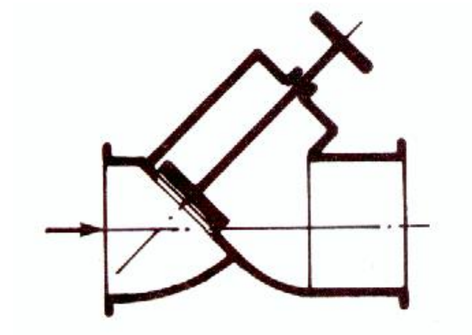
Organs of interception and of adjustment

Valves

The pressure drop through the valves is:

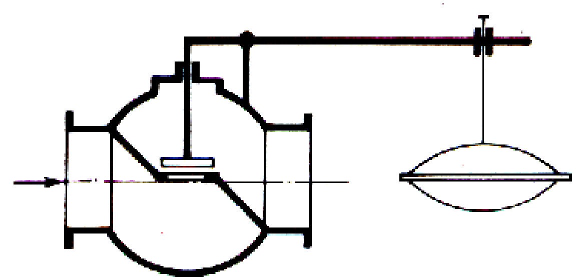
$$h' = j \cdot \gamma \cdot v^2 / (2 \cdot g)$$

where j = loss factor of the load, γ = specific gravity of the fluid and v = velocity of the fluid.



Load losses minors are found in the **free-flow valve**, since the variation of direction imposed on the fluid is less.

The started flow valves belong to the **float valves**, the shutter of which is actuated by a lever, by a float which controls the closure when the level of fluid contained in a certain container reaches a predetermined height.



Organs of interception and of adjustment

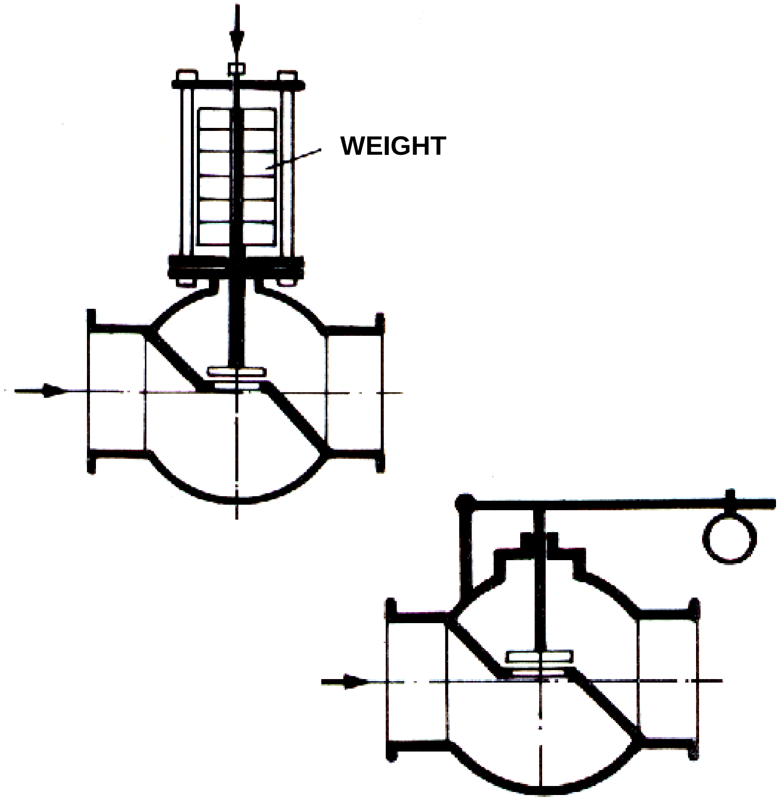
Valves

The **needle valves** are characterized by a shutter more pointed at one end than that of the normal flow valves started (the case of small diameters and small flow rates).

The **safety valves** are provided for automatic intervention of emergency, when the pressure of the fluid in a pipe or in a container, exceeds a certain value.

They are divided into safety valves:

- ***to weight direct***, as this is applied directly to the stem shutter;
- ***to lever with counterweight direct***, in which the weight is obtained by moving the adjustment of the operating pressure;



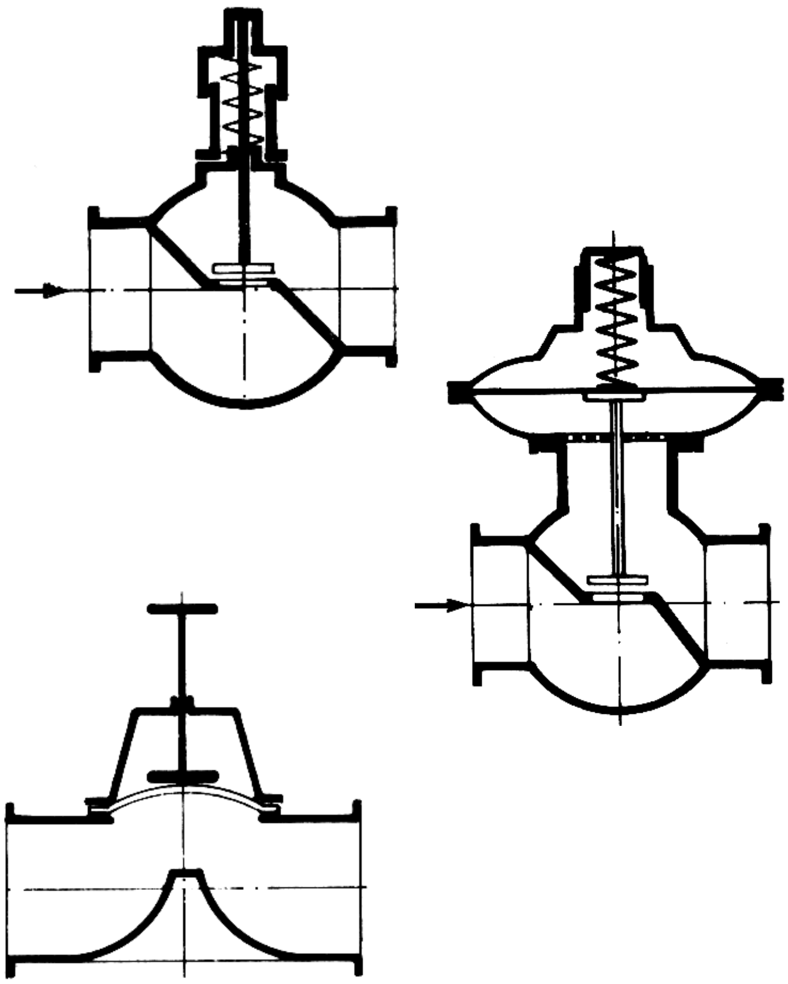
Organs of interception and of adjustment

Valves

They are divided into safety valves:

- ***to spring***, with calibration of the spring setting by compressing;
- ***to membrane***, for networks of low-pressure gas (acetylene, methane etc.).

Between the valves conveyed flow, we include the **diaphragm valves**, in which the shutter is constituted by a diaphragm (of rubber or plastics), which closes under the pressure of the stem. Are suitable for corrosive fluids or toxic, provided it is compatible with the material of which consists of the diaphragm.



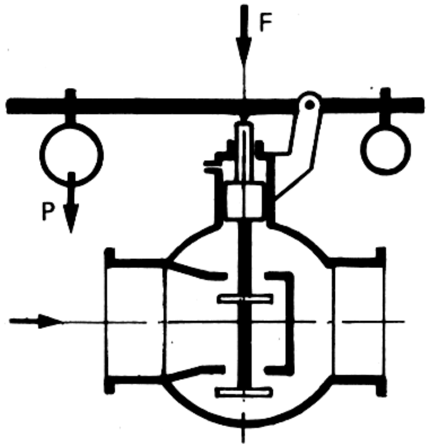
Organs of interception and of adjustment

Valves

To adjust continuously the flow rate or pressure, we use the ***flow and/or pressure control valves***.

Among them are remembered:

- ***pressure-regulating valve to counterweight***: the shutter is applied a force F generated by a lever on which can slide a weight P (there will be a variation of F by positioning the weight P in different positions). When the pressure exceeds the predetermined value, the fluid exerts a force greater than F, causing the opening

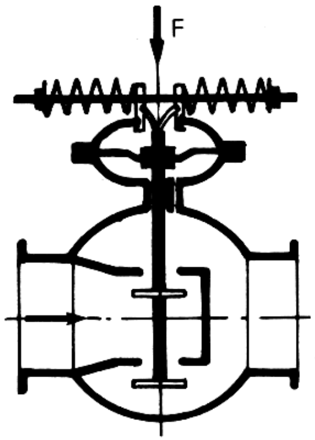


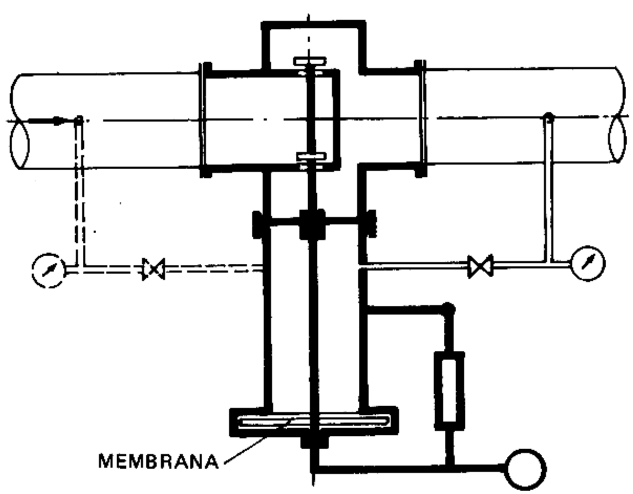
Organs of interception and of adjustment

Valves

Flow and/or pressure control valves:

- ***regulator valve of pressure to spring***: the force F is applied to the shutter by a spring, rather than by a counterweight;
- ***regulator valve of pressure power-operated***: the adjustment of the pressure is obtained, downstream and upstream of the valve, through a derivation of the main pipe, commanding the opening/closing the shutter



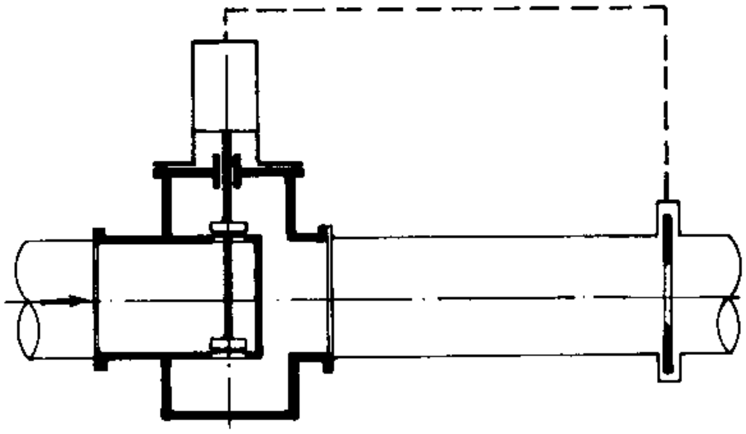


Organs of interception and of adjustment

Valves

Flow and/or pressure control valves:

- ***regulator valve of flow power-operated***: a flange Venturi, is installed downstream of the same organ, but at a safe distance, controls the opening of the shutter, letting the predetermined fluid flow rate.



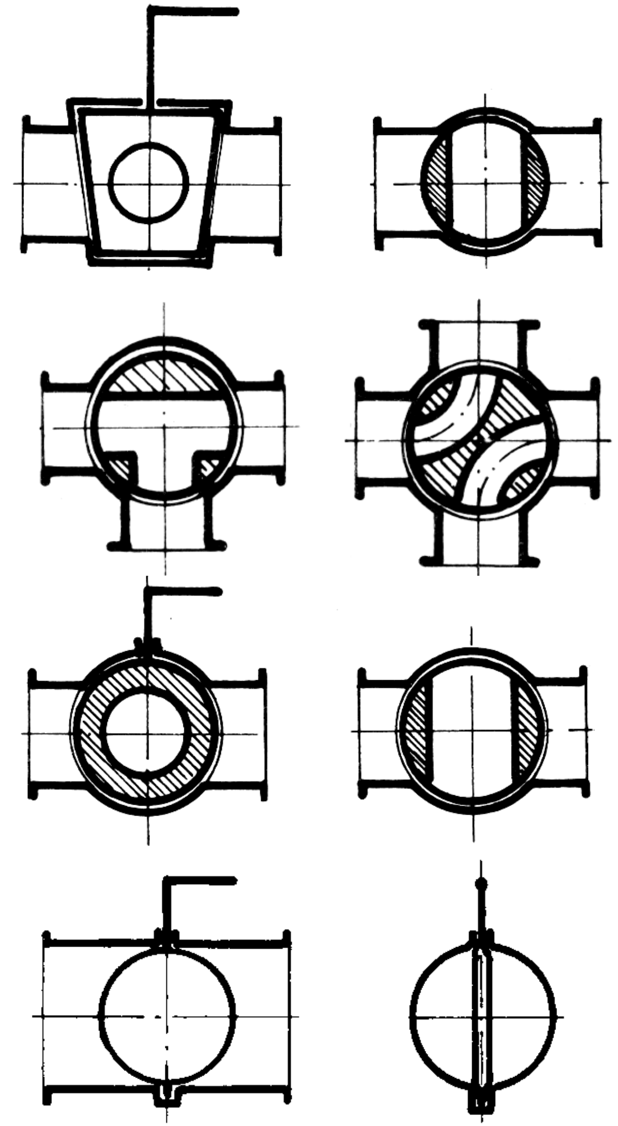
Organs of interception and of adjustment

Taps

The organs of interception suitable for small diameters and flow adjustments for the type "fully closed" or "fully open".

The ***taps to male to 2, 3 or 4 ways*** have an organ of closing a truncated cone, with a hole with a circular section through which, in the open position, the fluid passes. The closure is ensured by a simple rotation of 90°.

The ***ball valves*** are of the taps in which the shutter is in spherical form, while the butterfly valves have the control member of only 90° and rotating the shutter is disc shaped.



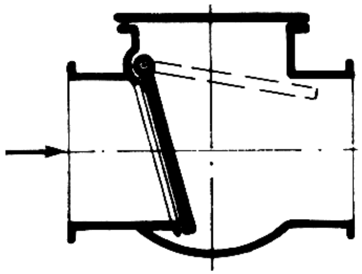
Generality

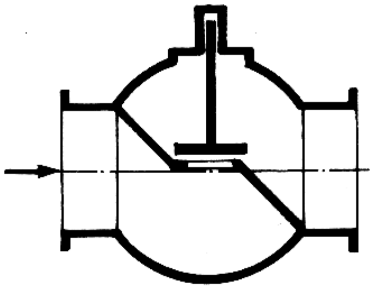
Organs of interception and of adjustment

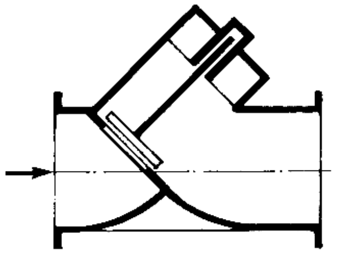
Check valves

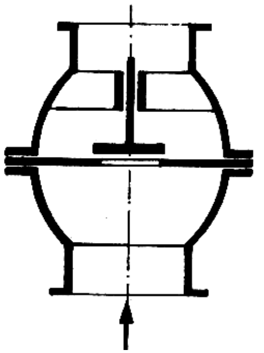
Are shut-off valves, which prevent the return of the fluid in the opposite direction, allowing the passage of the fluid in one direction only and closing in the opposite direction. The main types are:

- ***to clapper***, suited to be installed on a horizontal pipe, vertical or oblique. When the fluid moves in the direction allowed, the door is kept open by the fluid itself, whereas when there is an opposite direction, the door closes again under the effect of the fluid itself;
- ***to free flow***;
- ***to started flow***;
- ***for vertical pipes***.









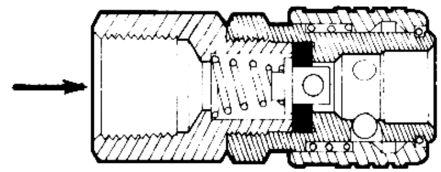
Organs of interception and of adjustment

Quick coupling valves

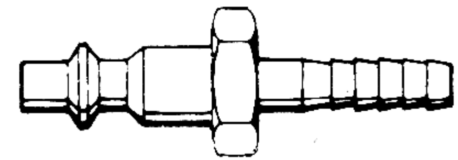
Serves for connection to the rigid and flexible.

The inclusion of a separate shank opens the shutter of the valve, normally closed by a spring.

The inclusion of a separate shank opens the shutter of the valve, normally closed by a spring. This type of valve is used for the leads to the users of compressed air by means of flexible pipes made of plastic material with a diameter ≤ ½”.



VALVE



SHANK OF GRAFT