

COURSE NAME: INDUSTRIAL PIPING SYSTEM

LECTURE II-WEEK II: MAIN COMPONENTS OF PIPING SYSTEM

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OBJECTIVES

By the end of this session the learner/student will be able to:

- ✓ Identify the components of a piping system
- ✓ Describe the role/function of the components of a piping system

II.1. Introduction

A piping system is generally considered to be composed by the interconnection of different components; including in-line components such as pipes and pipe fittings, pumps, heat exchanges, valves and tanks are also considered part of piping system. Piping systems are the arteries of our industrial processes and the contribution of piping systems are essential in an industrialized society. In this session, every single component of piping system will be highlighted but they will be deeply explained in the next session which will be about types of pipe fitting and their applications.

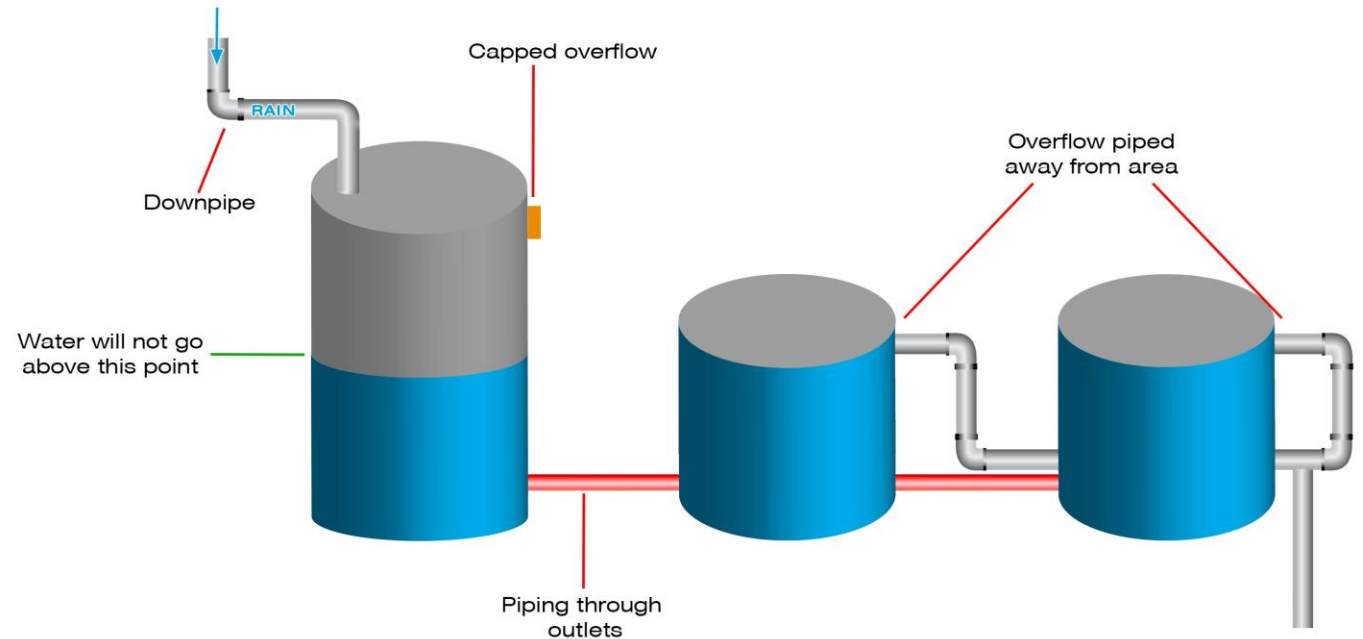
Introduction Cont'd

The components of piping systems may differ depending on the types of a piping system. However, there are some components which can't miss in a typical piping system such as: pipes and connecting components, fluid tank (reservoir), and fluid flow control components. All the mentioned components can be present in a piping system but differ depending on the types of the fluid being carried they can be different.

To be brief anything used in piping system is a piping system component.

b. Tank/reservoir

Tank is used for storing fluid such as oil, water, air,.... for future use or transit. Without the tank or reservoir, piping system will not be supplied with fluid which will affect the system's performance and may lead to long-term issues with the equipment.



Source: <https://www.pcmhandling.co.uk/what-is-the-function-of-oil-tanks-in-a-hydraulic-system/>

c. Pipe Fittings

- ✓ Pipe fittings are used for changing direction, creating branches, changing line sizes, Connect different components such as couplings and stop the flows such as Caps, etc.
- ✓ Common pipe fittings are flanges, elbows, tees, reducers, etc.

d. Valves

Valves are used to stop, divert or control fluid flow. Common valve types are gate valves, globe valves, butterfly valves, ball valves, and control valves; the selection is based on intended function and application.



Source: <https://as-schneider.blog/2022/08/10/types-of-valves-used-in-piping-and-how-to-classify-them/>

e. Strainer

Strainers are mechanical devices used to retain and remove unwanted particles from flowing liquids while also protecting equipment such as pumps and compressors from damage. Strainers are mainly classified into two (2) types: Y and basket strainers. The strainer's screen, notably its mesh size, is an important component (perforation density).



Source: <https://www.mechanical-knowledge.com/2021/02/piping-strainers-applications-types.html>

i. Y-Strainer

- ✓ A Y-strainer is a small Y-shaped tool that is used to trap undesirable particles in pipes.
- ✓ Y strainers can be placed horizontally or vertically, with the filtering element pointing towards the ground, and cause a pressure drop in the pipeline.
- ✓ This sort of pipeline strainer must be cleaned regularly to ensure that dirt does not block the device's filtering. When y-strainers require cleaning, the pipeline can be continued in service.
- ✓ Y-strainers suit high-pressure gas pipes with a low concentration of unwanted particles and dirt. Y strainers, have a lower capacity for dirt storage than T strainers of similar size.

ii. T-Strainer (Basket Strainer)

- ✓ A basket strainer is a perforated basket that is upright and collects dust and objects carried by the fluid conveyed by the pipeline.
- ✓ Because of the larger size of the filtering element, a basket strainer can store more dust and dirt than a y-strainer of the same size and is the preferred choice when pressure drops in the pipeline are unacceptable.

T-Strainer (Basket Strainer) Cont'd

- ✓ T-strainers must be positioned vertically, with the top of the strainer removed for periodic cleaning (self-cleaning t-strainers are also available on the market).
- ✓ The well-known “duplex basket strainer” is a form of T-strainer that comprises two parallel T strainers that assist in filtration element maintenance while keeping the line operational (the line is bypassed when one of the two strainers is cleaned).

iii. Y-Strainer Mesh

The mesh size of the Y strainer is a crucial consideration.

The mesh shows the number of holes per inch in the screen, which is the strainer's filtration element.

The screen mesh size can be specified in millimeters, inches, microns, or by a mesh number.

Y-Strainer Mesh Cont'd

The following factors should be considered while determining the appropriate mesh size:

- ✓ The largest particle size that downstream equipment (such as a pump or compressor) can handle safely.
- ✓ The pipe system's working temperature and pressure
- ✓ The max permissible pressure decrease
- ✓ The type of the transmitted fluid.

Y-Strainer Mesh

If the mesh is too small, some undesirable particles may pass through and damage downstream equipment, and extra amounts of dirt may accumulate in the strainer cage, causing pressure decreases in the pipe system and higher-than-necessary maintenance costs.

II.6 Materials used for making different parts of strainers

a. Body Materials

- ✓ Cast iron, bronze, carbon steel, stainless steel, and plastic are the most prevalent materials used for the bodies of Y strainers and basket strainers.
- ✓ Essentially, Y-strainers have bodies constructed of the same cast and forged materials as other commercial valves.

1. Cast Iron

- ✓ Cast iron is the most popular strainer body material due to its minimal initial cost. It is used in systems where the water pressure and temperature are not excessive, and the system is not subjected to a lot of thermal or mechanical shock.
- ✓ Cast iron is primarily used for larger potable water lines and various non-potable water systems, as well as a range of other products and process applications.

2. Bronze

- ✓ For brackish, saline, and marine service, a bronze body is ideal.
- ✓ It is frequently used to provide potable water services.
- ✓ It costs twice as much like cast iron.

3. Chrome Molybdenum Alloy

- ✓ High pressures and temperatures above 1000 °F are typically specified for chrome-moly steel bodies.

4. Carbon Steel

- ✓ Carbon steel bodies are utilized in high temperature and pressure applications, as well as when thermal and mechanical stress resistance is required.
- ✓ Carbon steel is also used in settings where there is a risk of fire.

5. Stainless Steel

- ✓ Because of its corrosion and contamination resistance and convenience of cleaning, stainless steel is the ideal body, basket, and screen material in the pharmaceutical, food processing, and chemical industries. Stainless steel is around four times the price of cast iron.
- ✓ Cast steel (bore size greater than 2 inches) and forged steel are the most commonly used material grades for strainer bodies (bore size below 2 inches).

II.7 Pipe insulation

- ✓ **Pipe Insulations** are materials or combinations of materials wrapped around the pipe which retard the flow of heat energy.
- ✓ Pipe insulation reduces energy losses to a great extent and thereby reduce energy cost. Piping shall be insulated as per the insulation class, operating temperature, and insulation thickness stated in the process and instrumentation diagram (P&ID).

II.8 Functions of Pipe Insulation

A piping insulation system serves three principal purposes:

- ✓ The significant reduction in heat transfer of thermal energy to and from the surface of the piping system (Heat Conservation). So, piping insulation conserves energy.
- ✓ The prevention of moisture formation and collection on the surface of the piping system due to condensation on cold surfaces (Cold Insulation).
- ✓ The prevention of potentially injurious personnel contact with the surface of the exposed piping system (Personal Protection).

Functions of Pipe Insulation Cont'd

However, there are various other benefits of piping insulation as listed below:

- ✓ Piping insulation facilitates temperature control of the process
- ✓ Prevent vapour flow and water condensation on cold surfaces
- ✓ Increase the operating efficiency of heating/cooling, power, and process systems.
- ✓ Reduce major damages in the piping during fire or accidents.
- ✓ Prevent pollutant emissions to the atmosphere to a great extent.

II.9 Pipe Insulation Types

Piping insulation can be classified based on various parameters like:

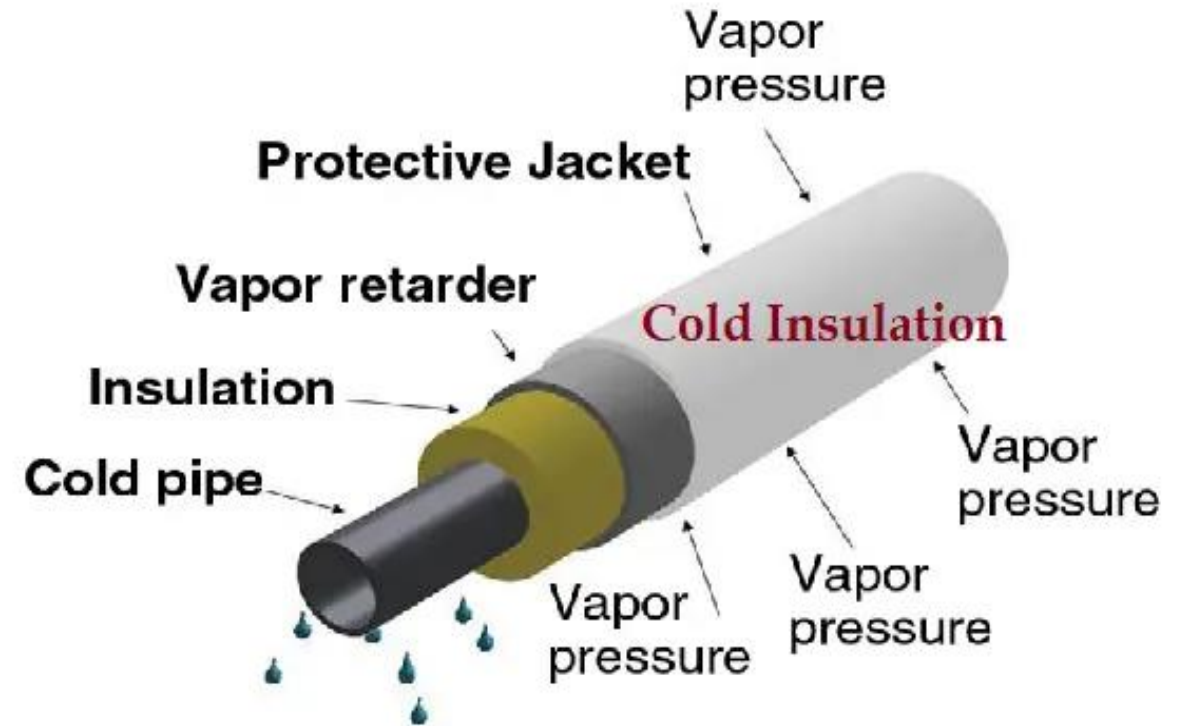
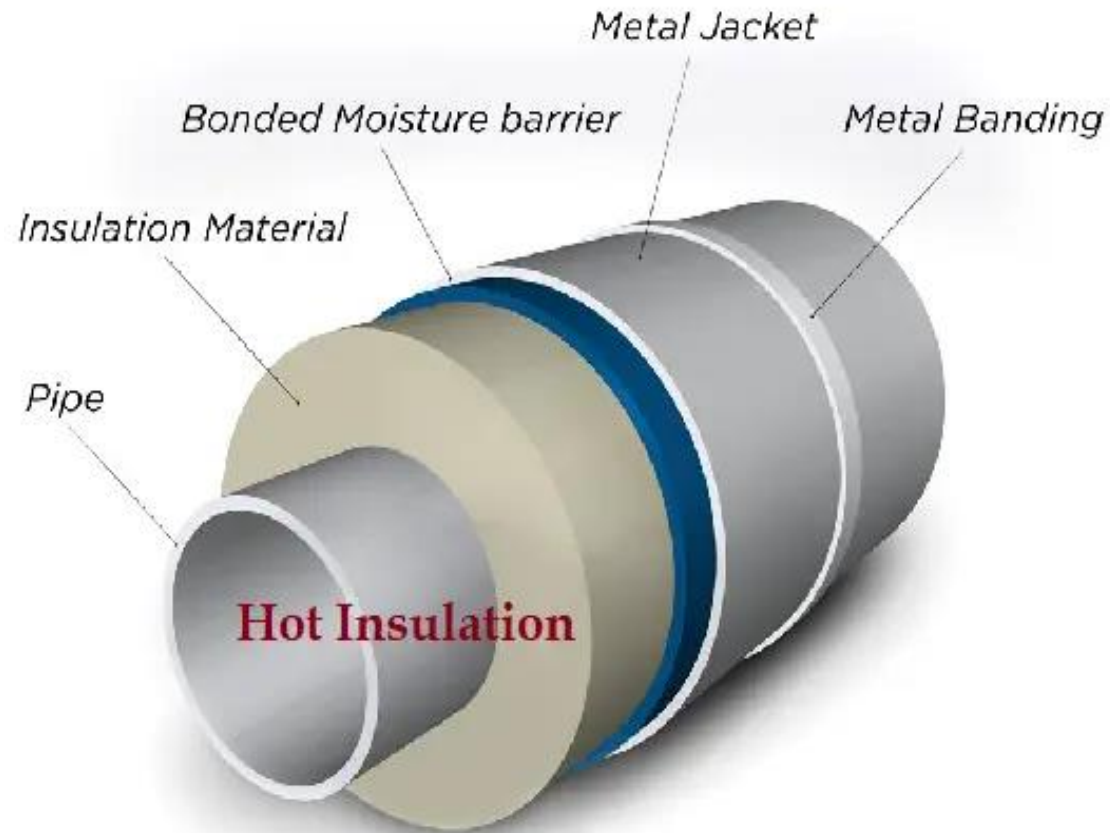
a. Based on the Pipe Insulation function

- ✓ Hot Insulation
- ✓ Cold Insulation
- ✓ Personal Protection Insulation
- ✓ Acoustic Insulation

b. Based on Insulation Material Types

- ✓ Fibrous Insulation
- ✓ Cellular Insulation
- ✓ Granular Insulation

Hot and Cold Pipe Insulation



Source: <https://whatispiping.com/wp-content/uploads/2020/08/Hot-and-Cold-Pipe-Insulation.png?ezimgfmt=ng:webp/ngcb2>

1. Hot Insulation

- ✓ Hot insulation is applied on the hot surfaces of the piping system to prevent the energy flow from flowing fluid. So, the main aim of hot piping insulation is heat conservation.
- ✓ Examples of hot piping insulations are: Mineral Wool, Glass Wool, Calcium Silicate, etc are normally used as Hot insulating material.

2. Cold Insulation

- ✓ Cold Insulation is the insulation used on cold surfaces of the piping system to avoid heat gain from outside (Cold Conservation) or to avoid Condensation.
- ✓ Examples of cold piping insulations are: Polyurethane Foam, Expanded Perlite Foam, Expanded Polystyrene Foam, etc are the widely used cold insulating materials.

3. Personal Protection Insulation

- ✓ Personal Protection insulation is provided to avoid personal heat injury. All exposed piping surfaces that exceed 65 deg.C are provided with personal protection insulation. The areas that are not accessible by construction or operating personnel can be left exposed. An open mesh metal guard, mineral wool, etc are used as personal protection insulation material.
- ✓ The criteria for personal protection is that the exposed surfaces located within 600 mm horizontally or 2100 mm vertically of a normal access, walkway, or work area are to be insulated.

4. Acoustic insulation

Acoustic Insulation is provided for all piping that is considered a potential sound source. The main purpose is to reduce the noise (vibration) to an acceptable limit. The minimum thickness for acoustic insulation is normally 75 mm. Acoustic Foam, fiberglass, polyester/polyurethane foams, rock wool, Mass Loaded Vinyl, etc are used as Acoustic Insulating material.

5. Fibrous Insulation

Fibrous insulation consists of small diameter fibers which finely divide the air space. The fibers may be perpendicular or parallel to the surface being insulated, and they may or may not be bonded together. Common fibers used in piping insulation are Silica, slag wool, rock wool, and alumina-silica. Among these, Glass fiber and Mineral Wool are the two most widely used piping insulations of this type. Their fibers are normally bonded with organic binders for structural integrity.

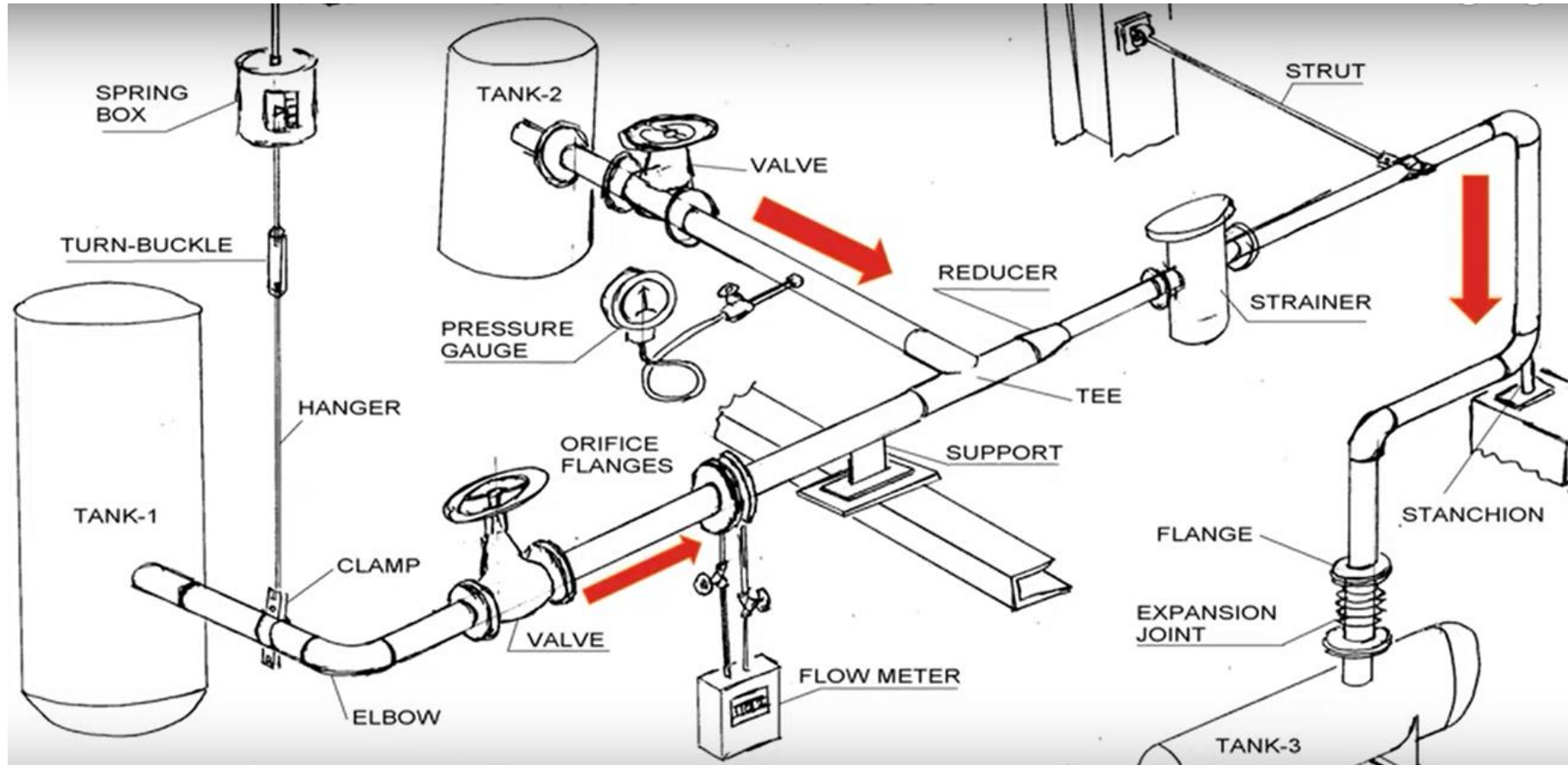
6. Cellular Insulation

Cellular pipe insulation material comprises small individual cells separated from each other. Common cellular material used as pipe insulation is glass or foamed plastics such as cellular glass, phenolic foam, or nitrile rubber.

7. Granular Insulation

Small nodules containing voids or hollow spaces constitute granular insulation. As gas can be transferred between the individual spaces, It is not considered a true cellular material. This type is manufactured as loose or pourable material or combined with a binder and fibers. Sometimes they undergo a chemical reaction to form rigid insulation. Calcium silicate and vermiculite are examples of these types of insulations.

The figure below shows some components of a dummy piping system in operation of a designed dummy pipeline plant as an example:



Source: <https://www.youtube.com/watch?v=XpCehaJMN1w>

The assembly of piping components is used to perform the following tasks:

- ✓ Convey
- ✓ Distribute
- ✓ Mix
- ✓ Separate
- ✓ Discharge
- ✓ Meter
- ✓ Control and Stop fluid.

In case one component is not available or not working properly the system could not be efficient. There is a need of installing it professionally and keep following up in order to make sure that each component is performing its function to the maximum.

THANK YOU!!!!!!!!!!!!

QUESTIONS AND ANSWERS

References

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