

# ANSI/ASME

## ASME B31.3



Chemical & Oil  
Refineries

## ASME B31.1



Power Plant

# ANSI/ASME B31.1 power piping

The ASME B31.1, Piping for *industrial plants* and *marine* applications.

The ASME B31.1 **Power** piping specification regulates the proper installation, inspection, and maintenance of power piping systems, dictating the proper design, materials, fabrication, erection, and testing of piping.

## Piping elements

Piping components specifically covered by the ASME B31.1 specification include

- 1.) Pipe
- 2.) Flanges
- 3.) Bolting
- 4.) Gaskets
- 5.) Valves
- 6.) Relief devices
- 7.) Fittings
- 8.) Pressure bearing components.

Additional piping components used to prevent undue structural stress upon installed piping, including supports and hangers are also covered.

# ANSI/ASME B31.1 power piping

## **External piping**

External piping such as external boiler piping is governed by the ASME B31.1 specification. This code regulates all high temperature, high pressure boilers where steam pressure exceeds 15 psig, water pressure exceeds 160 psig, or temperature exceeds 250 Fahrenheit. Typical external piping applications include the transportation of steam, water, oil, gas, or oxygen.

## **Identification**

External boiler piping is generally considered to be piping attached directly to the boiler, where the first circumferential joint begins, the first bolted flange connector begins, or the first threaded connector joint begins. External boiler piping may be identified by the verification of proper inspection and stamping codes located on the piping, which is set in accordance with the ASME Boiler and pressure vessel specification.

# ANSI/ASME B31.1 power piping

## **Code exclusions**

Certain types of piping are excluded from the regulatory code established by the ASME B31.1 Power Piping specification. Excluded piping elements include building heating and distribution steam and condensate piping designed for 15 (psig) or less, hot water heating systems designed for 30 (psig) or less, piping for hydraulic or pneumatic tools, and piping for marine or other installations currently under Federal control. Structural non-piping building elements, such as towers, building frames, tanks, mechanical equipment, instruments, and foundations are also excluded from the ASME B31.1 power piping specification.

# ANSI/ASME B31.3 chemical piping

## **B31.3 - 2002 - Process Piping**

Design of *chemical* and *petroleum plants* and *refineries processing chemicals and hydrocarbons, water and steam*.

This Code contains rules for piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals.

This Code prescribes requirements for materials and components, design, fabrication, assembly, erection, examination, inspection, and testing of piping.

# ANSI/ASME B31.3 chemical piping

This Code applies to piping for all fluids including:

- (1) Raw, intermediate, and finished chemicals;
- (2) Petroleum products;
- (3) Gas, steam, air and water;
- (4) Fluidized solids;
- (5) Refrigerants; and
- (6) Cryogenic fluids.

Also included is piping which interconnects pieces or stages within a packaged equipment assembly.

# Comparison ASME B31

| ASME B31.1 (2008)                                                                                                                                                                                                                                                                                                                                                   | ASME B31.3 (2008)                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ASME B31.8 (2007)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power piping:</b> typically found in electric power generating stations, in heating and cooling systems                                                                                                                                                                                                                                                          | <b>Process piping:</b> typically found in petroleum refineries, chemical, pharmaceutical, textile and paper plants                                                                                                                                                                                                                                                                                                                                                                | <b>Gas transportation and distribution systems:</b> piping transporting products, predominantly gas                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Applicable:</b> boiler external piping from first joint up to and including first block valve for boilers where:</p> <ul style="list-style-type: none"> <li>• steam or vapor is generated over 100 kPa</li> <li>• high temperature water over 1103 kPa and/or temperatures of 120 Celsius</li> </ul> <p><b>Excluding:</b> fatigue due to pressure cycling</p> | <p><b>Exclusions:</b></p> <ul style="list-style-type: none"> <li>• piping systems pressure above 0 and less 105 kPa nonflammable, nontoxic and not damaging to human tissues</li> <li>• power boilers covered in BPV code and external piping covered in B31.1</li> <li>• tubes, tube headers, crossovers and manifolds of fired heaters</li> <li>• pressure vessels, heat exchangers, pumps</li> </ul> <p><b>Including:</b> fatigue due pressure cycling and thermal cycling</p> | <p><b>Exclusions:</b></p> <ul style="list-style-type: none"> <li>• pressure vessels, heat exchangers, pumps</li> <li>• metal temperatures below -28.88 Celsius (-20 F) or over 232.22 Celsius (450 F)</li> <li>• piping beyond customer's meter set assembly</li> <li>• piping in refineries, natural gasoline extraction, gas treating plants</li> <li>• vent piping to substantially atmospheric pressures</li> <li>• wellhead assemblies</li> <li>• proprietary items such as equipment</li> <li>• liquid petroleum transportation systems, slurry transportation, carbon dioxide and liquefied natural gas piping systems</li> </ul> |

# Comparison ASME B31

|                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Allowable stress:</b> <ul style="list-style-type: none"> <li>• as per tables in Appendix A</li> <li>• shear to remain below 80%, bearing to remain below 160% of allowable stress</li> <li>• basis are same as ASME section II Part D Appendix 1 except for cast iron and ductile iron</li> </ul> | <b>Allowable stress:</b> <ul style="list-style-type: none"> <li>• as per Table A-1 and A-2</li> <li>• shear to remain below 80%, bearing to remain below 160% of allowable stress</li> <li>• basis for bolting, cast iron, other material</li> <li>• flanges due to leakage below 75%</li> <li>• allowable stress of unlisted material (not conforming 323.1.2) can not be used</li> </ul> | <b>Allowable stress:</b> <ul style="list-style-type: none"> <li>• as per table Appendix D times temperature derating factor in table 841.116A</li> </ul> |
| <b>Materials:</b> material of unknown specification shall not be used for pressure containing components                                                                                                                                                                                             | <b>Materials:</b> material of unknown specification shall not be used for pressure containing components                                                                                                                                                                                                                                                                                   | <b>Materials:</b> material only as per Appendix A                                                                                                        |

NOTE:

Appendix A of ASME B31.1 is for material strength/stress.

# Organization of the Codes

- I Scope and Definitions
- II Design
- III Materials
- IV Dimensional Requirements
- V Fabrication, Assembly, and Erection
- VI Inspection, Examination and Testing

# Bases for Design Stresses

## **B31.1** – The lowest of

- the specified minimum tensile strength divided by 3.5
- tensile strength at temperature divided by 3.5
- 2/3 of specified minimum yield strength
- 2/3 of yield strength at temperature; except for austenitic stainless steels, 90% of yield strength at temperature
- Creep strength criteria

## **B31.3** – The lowest of

- the specified minimum tensile strength divided by 3
- tensile strength at temperature divided by 3
- 2/3 of specified minimum yield strength
- 2/3 of yield strength at temperature; except for austenitic stainless steels, 90% of yield strength at temperature
- Creep strength criteria

# Pressure Design

The rules for pressure design are essentially the same in B31.1 and B31.3, but they are not identical.

# Pressure class

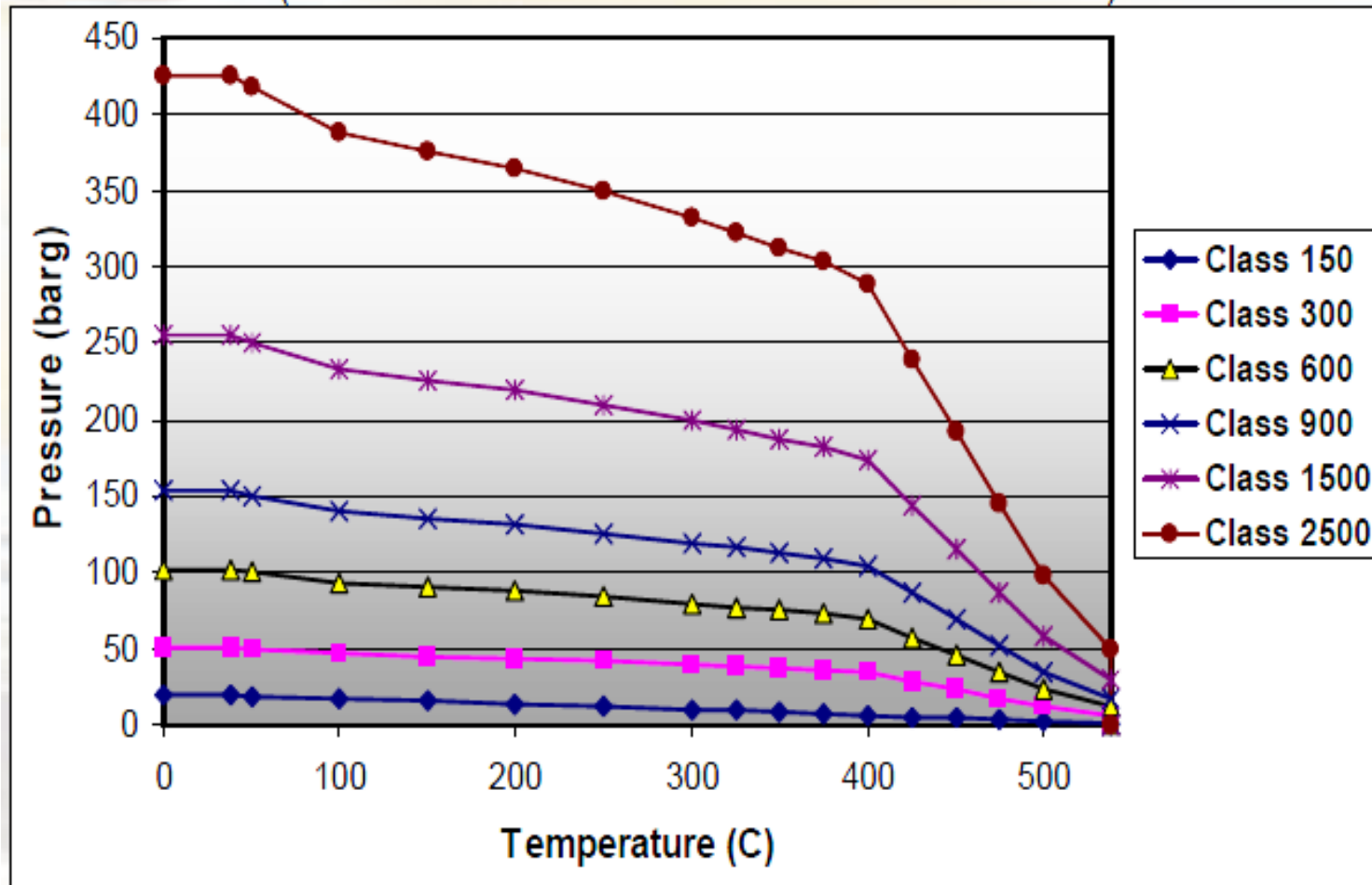
Ratings for above ground metallic systems are generally **Governed by their joints.**

Frequently these are **Flange joints manufactured in accordance with ASME B16.5** (metallic flanges)

Ratings for flanges (and some other piping components such as valves) are designated by pressure class

# Flange P-T Ratings – Carbon Steel (bar)

(Class Rated in accordance with ASME B16.5)



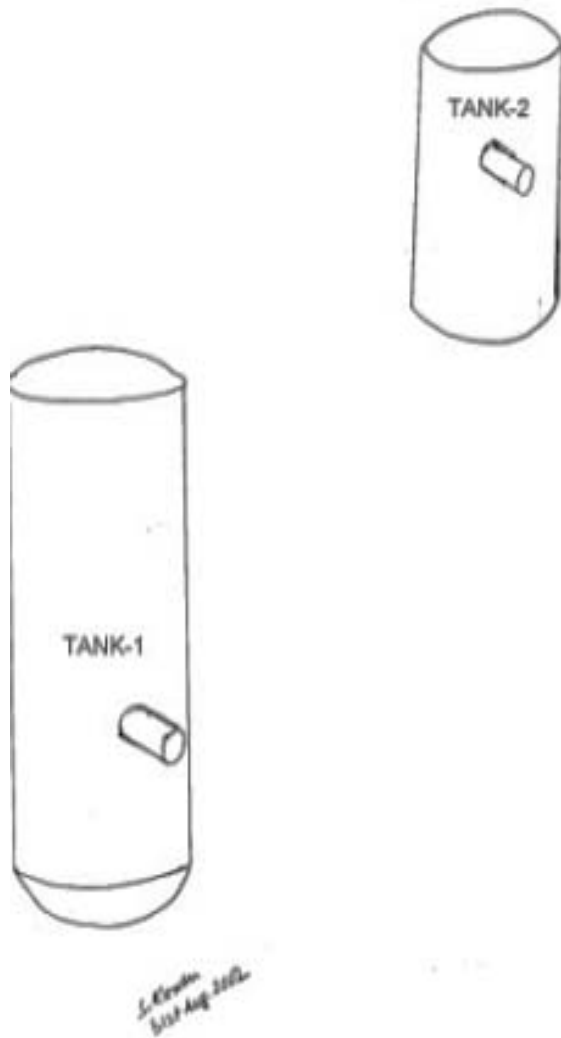
# Some ASME listed components

|                      |                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------|
| ASME B 1.1 – 2003    | Unified Inch Screw Threads, (UN and UNR Thread Form)                                           |
| ASME B 1.2 – 1983    | Gages and Gaging for Unified Inch Screw Threads                                                |
| ASME B 1.20.1 – 1983 | Pipe Threads, General Purpose, Inch                                                            |
| ASME B 16.5 – 2009   | Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard                   |
| ASME B 16.9 – 2007   | Factory-Made Wrought Buttwelding Fittings                                                      |
| ASME B 16.10 – 2009  | Face-to-Face and End-to-End Dimensions of Valves                                               |
| ASME B 16.11 – 2009  | Forged Fittings, Socket-Welding and Threaded                                                   |
| ASME B 16.20 – 2007  | Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed                      |
| ASME B 16.21 – 2005  | Nonmetallic Flat Gaskets for Pipe Flanges                                                      |
| ASME B 16.24 – 2006  | Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500 |
| ASME B 16.34 – 2009  | Valves Flanged, Threaded and Welding End                                                       |
| ASME B 16.36 – 2009  | Orifice Flanges                                                                                |
| ASME B 16.48 – 2005  | Line Blanks                                                                                    |
| ASME B 18.2.1 – 1996 | Square and Hex Bolts and Screws, Inch Series                                                   |
| ASME B 18.2.2 – 1987 | Square and Hex Nuts                                                                            |
| ASME B 36.10M – 2004 | Welded and Seamless Wrought Steel Pipe                                                         |
| ASME B 36.19M – 2004 | Stainless Steel Pipe                                                                           |
| ASME B 46.1 – 2002   | Surface Texture, Surface Roughness, Waviness and Lay                                           |

# Piping Components

- Pipe
- Fittings
- Branch Connections
- Flanges
- Gaskets
- Bolting
- Flanged Joints
- Valves

# PIPE



In any plant various fluids flow through pipes from one end to other.

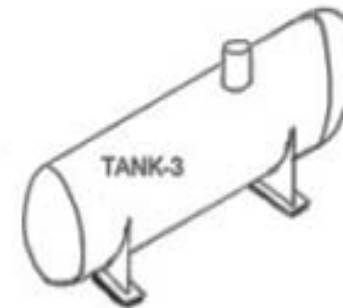
Now let us start with a plant where we see three tanks.

Tank-1, Tank-2 and Tank-3

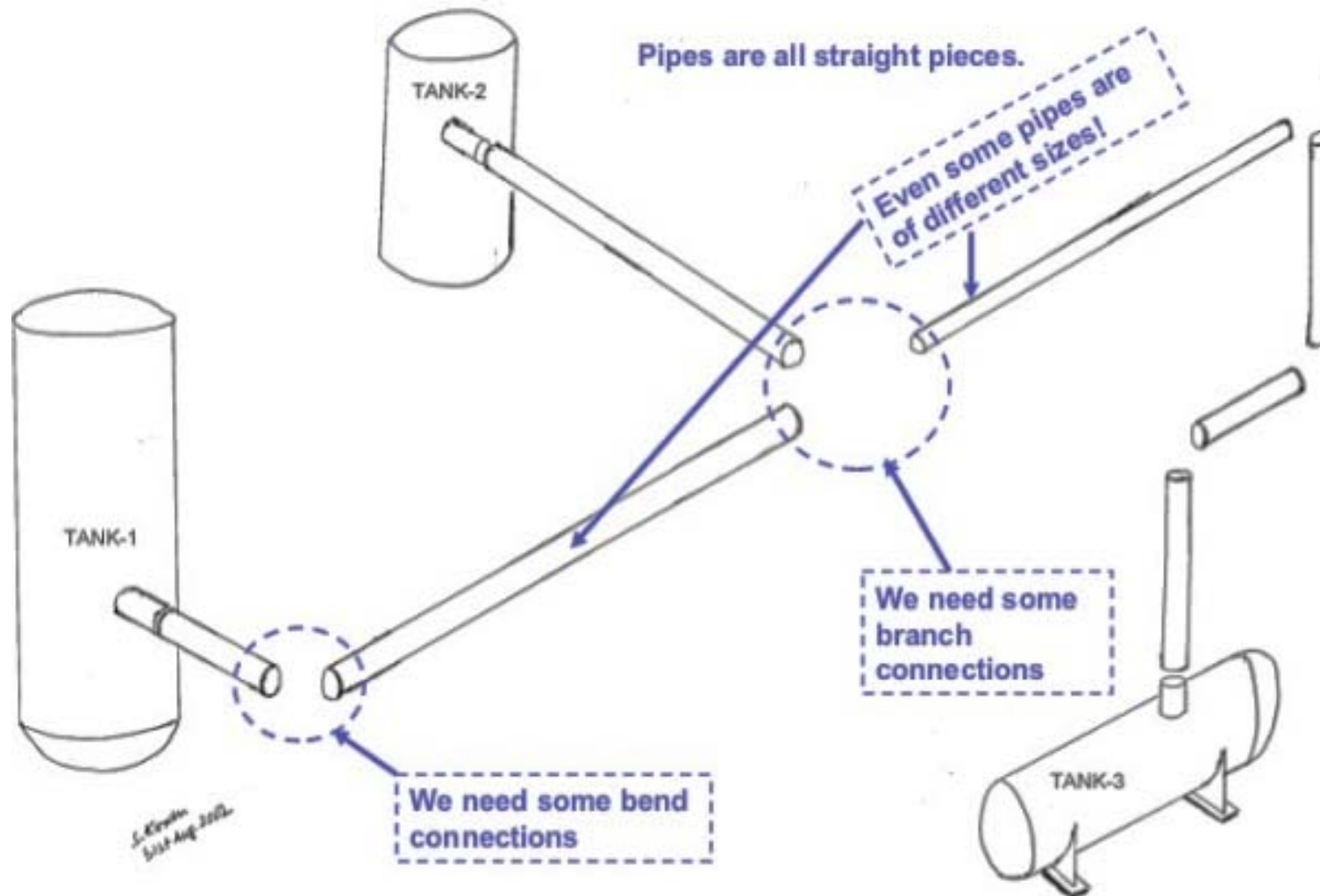
We have to transfer the content of Tank no. 1 to the other two tanks.

We will need to connect pipes to transfer the fluids from Tank-1 to Tank-2 and Tank-3

**LET US BRING THE PIPES.**



# PIPE



# ASME piping components

| Reference   | Title                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------|
| ASME V      | Boiler and Pressure Vessel Code - Section V - Non Destructive Examination                                           |
| ASME VIII   | Boiler and Pressure Vessel Code - Section VIII Div. 1 and Div. 2 - Rules for Construction of Pressure Vessels       |
| ASME IX     | Boiler and Pressure Vessel Code - Section IX - Welding Qualifications                                               |
| ASME B1.1   | Unified Inch Screw Threads (UN and UNR Thread Form)                                                                 |
| ASME B1.2   | Gauges and Gauging for Unified Screw Threads                                                                        |
| ASME B16.5  | Pipe Flanges and Flanged Fittings                                                                                   |
| ASME B16.9  | Factory-Made Wrought Steel Butt Welding Fittings                                                                    |
| ASME B16.10 | Face to Face and End to End Dimensions of Valves                                                                    |
| ASME B16.11 | Forged Fittings, Socket Welding and Threaded                                                                        |
| ASME B16.20 | Metallic Gaskets for Pipe Flanges - Ring Joint, Spiral Wound and Jacketed                                           |
| ASME B16.21 | Non Metallic Flat Gaskets for Pipe Flanges                                                                          |
| ASME B16.24 | Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500 and 2500 and Flanged Fittings Class 150 and 300 |

# ASME piping components

| Reference    | Title                                                                     |
|--------------|---------------------------------------------------------------------------|
| ASME B16.25  | Butt Welding Ends                                                         |
| ASME B16.28  | Wrought Steel Butt Welding Short Radius Elbows and Returns                |
| ASME B16.34  | Valves - Flanged, Threaded and Welding End                                |
| ASME B16.36  | Steel Orifice Flanges, Class 300, 600, 900, 1500 and 2500                 |
| ASME B16.47  | Large Diameter Steel Flanges NPS 26" through NPS 60"                      |
| ASME B18.2.2 | Square and Hex Nuts (Inch series)                                         |
| ASME B31.3   | Process Piping                                                            |
| ASME B31.4   | Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids |
| ASME B31.8   | Gas Transmission and Distribution Piping Systems                          |
| ASME B36.10  | Welded and Seamless Wrought Steel Pipe                                    |
| ASME B36.19  | Stainless Steel Pipe                                                      |
| ASME B46.1   | Surface Texture                                                           |

# ASTM piping components

| Reference | Title                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------------|
| ASTM A53  | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless                                          |
| ASTM A105 | Carbon Steel Forgings for Piping Applications                                                                |
| ASTM A106 | Seamless Carbon Steel Pipe for High Temperature Service                                                      |
| ASTM A153 | Standard Specification for Zinc Coating (Hot dip) on Iron and Steel Hardware                                 |
| ASTM A671 | Electric-fusion Welded Steel Pipe for Atmospheric and Lower Temperatures                                     |
| ASTM A182 | Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service |
| ASTM A192 | Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service                               |
| ASTM A194 | Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service                         |
| ASTM A216 | Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service                            |

# ASTM piping components

| Reference | Title                                                                                                                          |
|-----------|--------------------------------------------------------------------------------------------------------------------------------|
| ASTM A234 | Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature service                              |
| ASTM A240 | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Application           |
| ASTM A262 | Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels                                                |
| ASTM A269 | Seamless and Welded Austenitic Stainless Steel Tubing for General Service                                                      |
| ASTM A312 | Seamless ,Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes                                                      |
| ASTM A320 | Alloy Steel and Stainless Steel Bolting Materials for Low Temperature Service                                                  |
| ASTM A333 | Seamless and Welded Steel Pipe for Low Temperature Service                                                                     |
| ASTM A350 | Carbon and Low Alloy Steel Forgings Requiring Notch Toughness Testing for Piping Components                                    |
| ASTM A358 | Electric Fusion -Welded Austenitic Chromium - Nickel Stainless Steel Pipe for High-Temperature Service and General application |
| ASTM A370 | Test Methods and Definitions for Mechanical Testing of Steel Products                                                          |
| ASTM A403 | Wrought Austenitic Stainless Steel Piping Fittings                                                                             |
| ASTM A420 | Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service                                              |

# ASTM piping components

| Reference  | Title                                                                                                               |
|------------|---------------------------------------------------------------------------------------------------------------------|
| ASTM A435  | Straight-Beam Ultrasonic Examination of Steel Plates                                                                |
| ASTM A450  | General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes                                   |
| ASTM A519  | Seamless Carbon and Alloy Steel Mechanical Tubing                                                                   |
| ASTM A530  | General Requirements for Specialized Carbon and Alloy Steel Pipe                                                    |
| ASTM A672  | Electric-Fusion- Welded Steel Pipe for High Pressure Service at Moderate Temperatures                               |
| ASTM A694  | Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Service |
| ASTM A700  | Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment                                    |
| ASTM A790  | Seamless and Welded Ferritic / Austenitic Stainless Steel Pipe                                                      |
| ASTM A815  | Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings                              |
| ASTM A860  | Wrought High-Strength Low Alloy Steel Butt Welding Fittings                                                         |
| ASTM B466  | Seamless Copper-Nickel Pipe and Tube                                                                                |
| ASTM B608  | Welded Copper Alloy Pipe                                                                                            |
| ASTM B633  | Electrodeposited Coatings of Zinc on Iron and Steel                                                                 |
| ASTM D1418 | Practice for Rubber and Rubber Lattices- Nomenclature                                                               |

# ASTM piping components

| Reference  | Title                                                                                                                              |
|------------|------------------------------------------------------------------------------------------------------------------------------------|
| ASTM D2310 | Machine-Made “Fibreglass” (Glass-Fibre-Reinforced Thermosetting-Resin) Pipe                                                        |
| ASTM D2996 | Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe                                                      |
| ASTM E165  | Test Methods for Liquid Penetrant Inspection                                                                                       |
| ASTM G48   | Test Methods for Pitting and Cervice Corrosion Resistance of Stainless Steel and Related alloys by Use of Ferric Chloride Solution |

# API piping components

| Reference  | Title                                                                  |
|------------|------------------------------------------------------------------------|
| API 5 L    | Line Pipe                                                              |
| API 6A     | Valves and Well Head Equipment                                         |
| API 6D     | Pipeline Valves                                                        |
| API 6FA    | Fire Test for Valves (Trunnion Ball Valves)                            |
| API 6FB    | Fire Test for End Connections                                          |
| API 15LR   | Low Pressure Fibreglass Line Pipe                                      |
| API 590    | Steel Line Blanks                                                      |
| API 594    | Wafer Type Check Valves                                                |
| API 598    | Valve Inspection and Test                                              |
| API 599    | Metal Plug Valves- Flanged, Threaded and Welding Ends                  |
| API 600    | Steel Gate Valves, Flanged or Buttweld Ends                            |
| API 602    | Compact Steel Gate Valves                                              |
| API 607    | Fire Test of Soft Seated Quarter Turn Valves                           |
| API 608    | Metal Ball Valves - Flanged, Threaded and Welding Ends                 |
| API 609    | Lug and Wafer -Type Butterfly Valves                                   |
| API RP 14E | Design and Installation of Offshore Production Platform Piping Systems |

# PIPE FITTING

To solve these problems we need the pipe components, which are called

**PIPE FITTINGS**

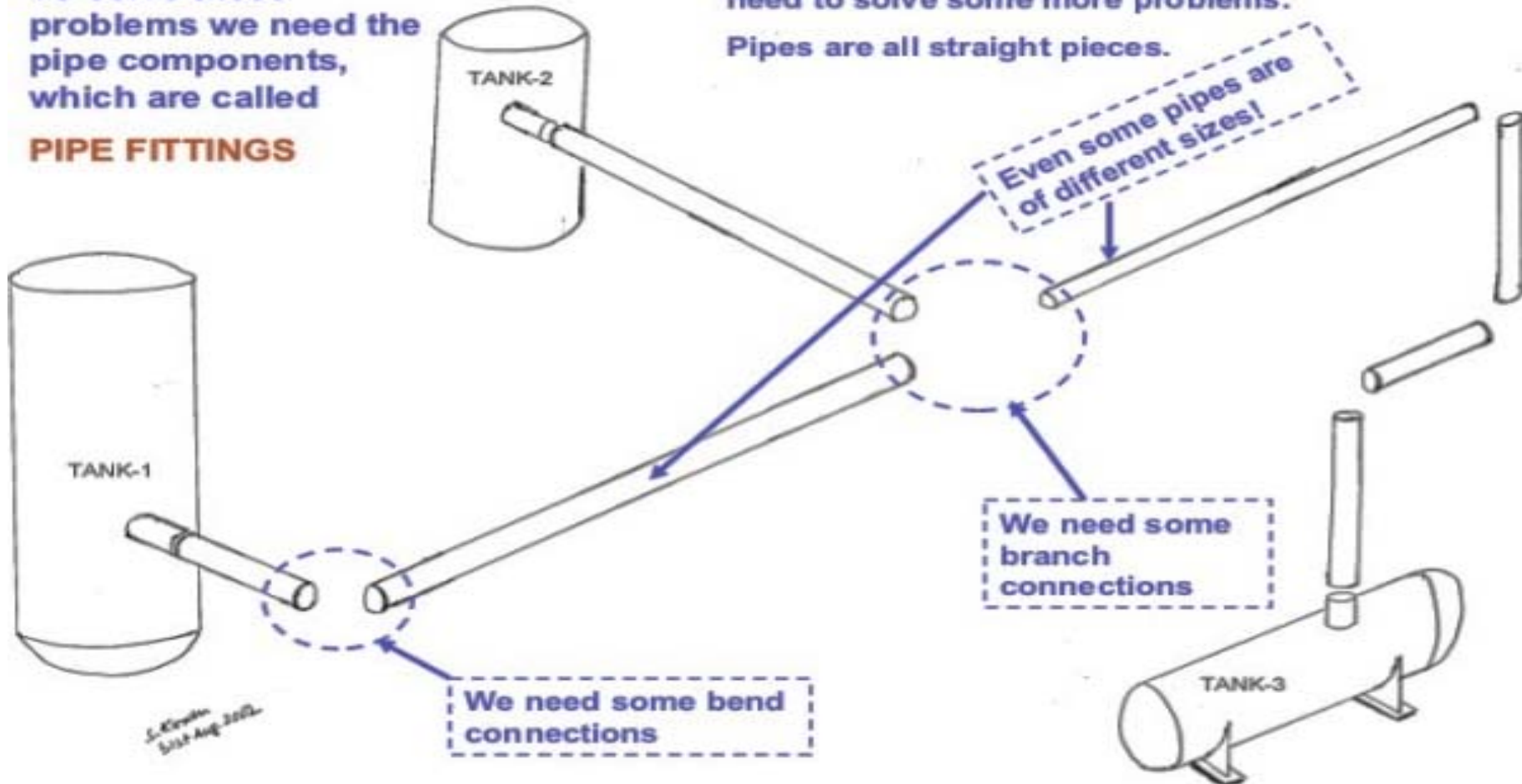
We have just brought the pipes, now we need to solve some more problems.

Pipes are all straight pieces.

Even some pipes are of different sizes!

We need some branch connections

We need some bend connections

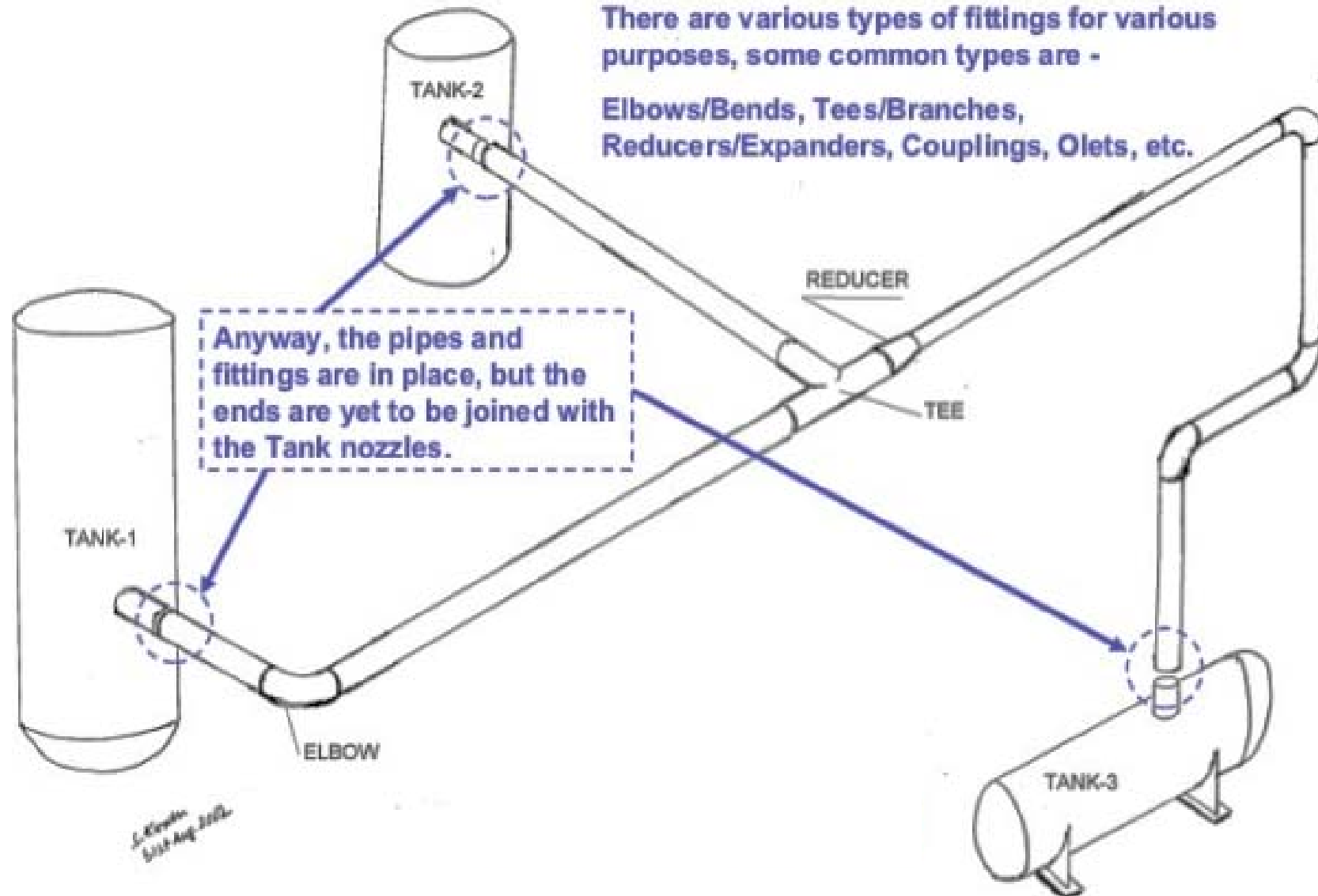


# PIPE FITTING

These are the pipe fittings,

There are various types of fittings for various purposes, some common types are -

Elbows/Bends, Tees/Branches, Reducers/Expanders, Couplings, Olets, etc.



# ASME piping components

| Reference   | Title                                                                                                               |
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| ASME V      | Boiler and Pressure Vessel Code - Section V - Non Destructive Examination                                           |
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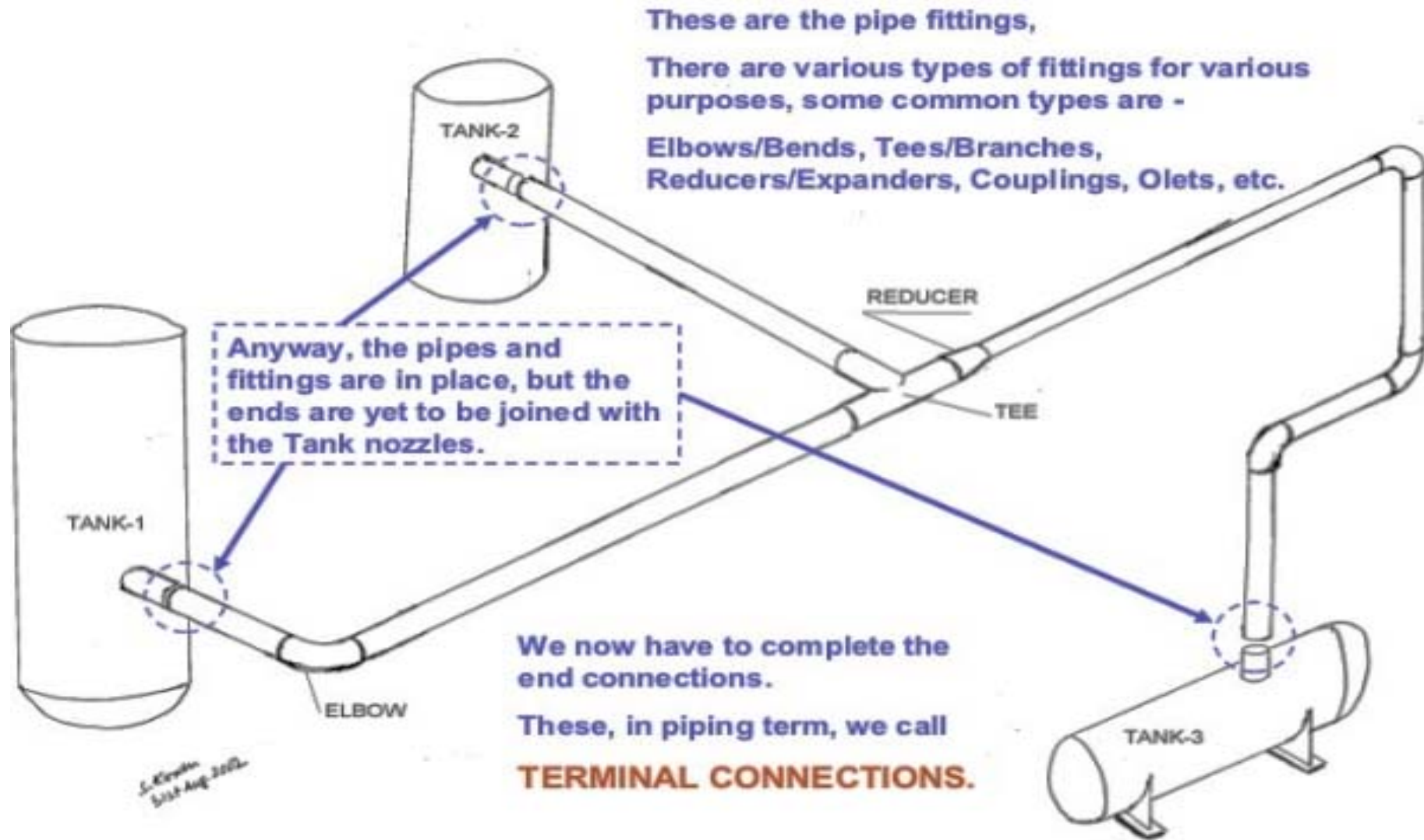
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| ASTM A312 | Seamless ,Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes                                                      |
| ASTM A320 | Alloy Steel and Stainless Steel Bolting Materials for Low Temperature Service                                                  |
| ASTM A333 | Seamless and Welded Steel Pipe for Low Temperature Service                                                                     |
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| ASTM A358 | Electric Fusion -Welded Austenitic Chromium - Nickel Stainless Steel Pipe for High-Temperature Service and General application |
| ASTM A370 | Test Methods and Definitions for Mechanical Testing of Steel Products                                                          |
| ASTM A403 | Wrought Austenitic Stainless Steel Piping Fittings                                                                             |
| ASTM A420 | Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service                                              |
| ASTM A351 | Standard Specification for Castings, Austenitic (stainless steel) for Pressure-Containing Parts                                |

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|------------|---------------------------------------------------------------------------------------------------------------------|
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| ASTM A860  | Wrought High-Strength Low Alloy Steel Butt Welding Fittings                                                         |
| ASTM B466  | Seamless Copper-Nickel Pipe and Tube                                                                                |
| ASTM B608  | Welded Copper Alloy Pipe                                                                                            |
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| ASTM D1418 | Practice for Rubber and Rubber Lattices- Nomenclature                                                               |

# FLANGES

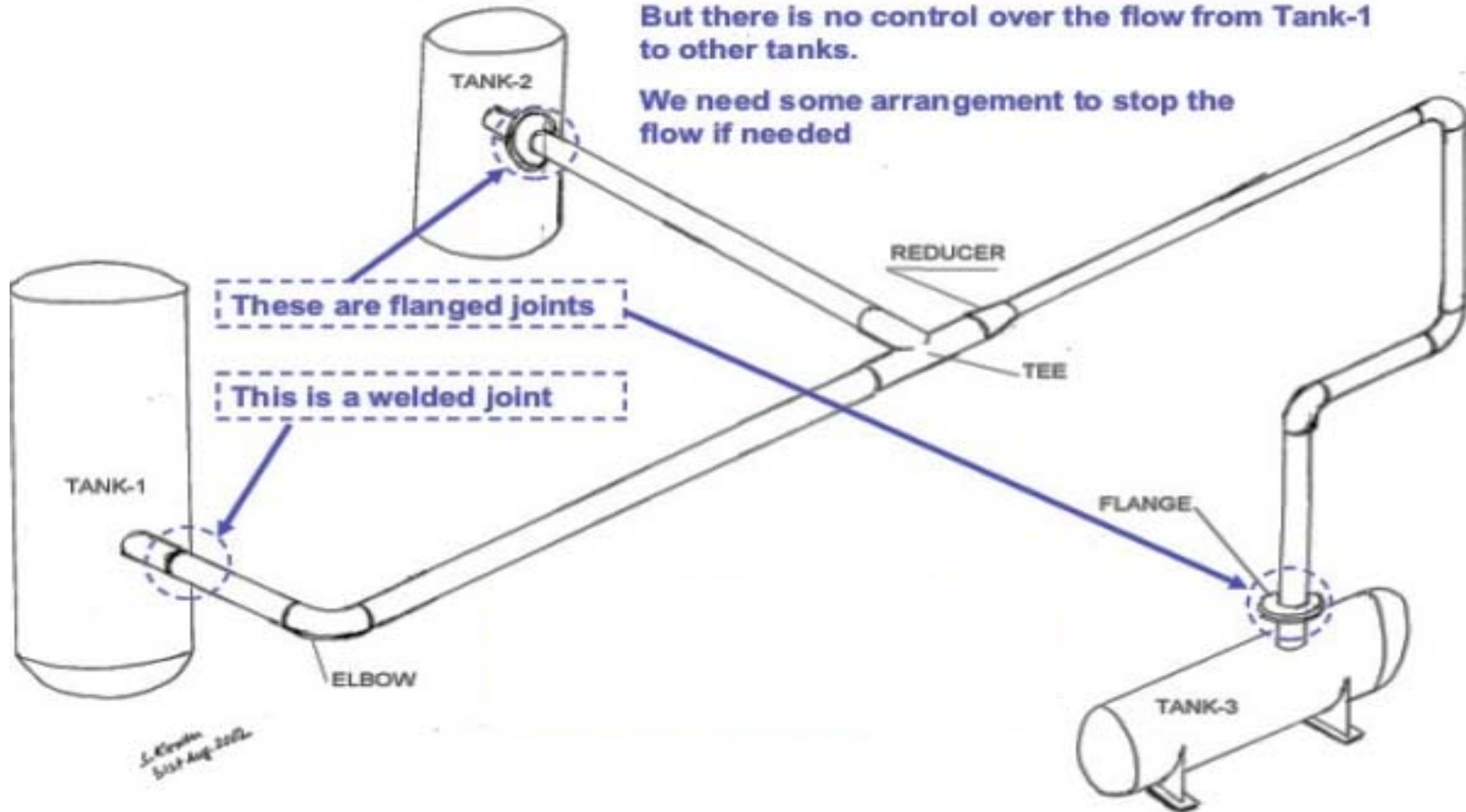


# FLANGES

So far this is a nice arrangement.

But there is no control over the flow from Tank-1 to other tanks.

We need some arrangement to stop the flow if needed



# ASME piping components

| Reference   | Title                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------|
| ASME V      | Boiler and Pressure Vessel Code - Section V - Non Destructive Examination                                           |
| ASME VIII   | Boiler and Pressure Vessel Code - Section VIII Div. 1 and Div. 2 - Rules for Construction of Pressure Vessels       |
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| ASME B1.1   | Unified Inch Screw Threads (UN and UNR Thread Form)                                                                 |
| ASME B1.2   | Gauges and Gauging for Unified Screw Threads                                                                        |
| ASME B16.5  | Pipe Flanges and Flanged Fittings                                                                                   |
| ASME B16.9  | Factory-Made Wrought Steel Butt Welding Fittings                                                                    |
| ASME B16.10 | Face to Face and End to End Dimensions of Valves                                                                    |
| ASME B16.11 | Forged Fittings, Socket Welding and Threaded                                                                        |
| ASME B16.20 | Metallic Gaskets for Pipe Flanges - Ring Joint, Spiral Wound and Jacketed                                           |
| ASME B16.21 | Non Metallic Flat Gaskets for Pipe Flanges                                                                          |
| ASME B16.24 | Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500 and 2500 and Flanged Fittings Class 150 and 300 |

# ASME piping components

| Reference    | Title                                                                     |
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| ASME B16.25  | Butt Welding Ends                                                         |
| ASME B16.28  | Wrought Steel Butt Welding Short Radius Elbows and Returns                |
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| ASME B31.3   | Process Piping                                                            |
| ASME B31.4   | Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids |
| ASME B31.8   | Gas Transmission and Distribution Piping Systems                          |
| ASME B36.10  | Welded and Seamless Wrought Steel Pipe                                    |
| ASME B36.19  | Stainless Steel Pipe                                                      |
| ASME B46.1   | Surface Texture                                                           |

# ASTM piping components

| Reference | Title                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------------|
| ASTM A53  | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless                                          |
| ASTM A105 | Carbon Steel Forgings for Piping Applications                                                                |
| ASTM A106 | Seamless Carbon Steel Pipe for High Temperature Service                                                      |
| ASTM A153 | Standard Specification for Zinc Coating (Hot dip) on Iron and Steel Hardware                                 |
| ASTM A671 | Electric-fusion Welded Steel Pipe for Atmospheric and Lower Temperatures                                     |
| ASTM A182 | Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service |
| ASTM A192 | Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service                               |
| ASTM A194 | Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service                         |
| ASTM A216 | Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service                            |

# ASTM piping components

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| ASTM A240 | Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Application           |
| ASTM A262 | Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels                                                |
| ASTM A269 | Seamless and Welded Austenitic Stainless Steel Tubing for General Service                                                      |
| ASTM A312 | Seamless ,Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes                                                      |
| ASTM A320 | Alloy Steel and Stainless Steel Bolting Materials for Low Temperature Service                                                  |
| ASTM A333 | Seamless and Welded Steel Pipe for Low Temperature Service                                                                     |
| ASTM A350 | Carbon and Low Alloy Steel Forgings Requiring Notch Toughness Testing for Piping Components                                    |
| ASTM A358 | Electric Fusion -Welded Austenitic Chromium - Nickel Stainless Steel Pipe for High-Temperature Service and General application |
| ASTM A370 | Test Methods and Definitions for Mechanical Testing of Steel Products                                                          |
| ASTM A403 | Wrought Austenitic Stainless Steel Piping Fittings                                                                             |
| ASTM A420 | Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service                                              |
| ASTM A351 | Standard Specification for Castings, Austenitic (stainless steel) for Pressure-Containing Parts                                |

# ASTM piping components

| Reference  | Title                                                                                                               |
|------------|---------------------------------------------------------------------------------------------------------------------|
| ASTM A435  | Straight-Beam Ultrasonic Examination of Steel Plates                                                                |
| ASTM A450  | General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes                                   |
| ASTM A519  | Seamless Carbon and Alloy Steel Mechanical Tubing                                                                   |
| ASTM A530  | General Requirements for Specialized Carbon and Alloy Steel Pipe                                                    |
| ASTM A672  | Electric-Fusion- Welded Steel Pipe for High Pressure Service at Moderate Temperatures                               |
| ASTM A694  | Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Service |
| ASTM A700  | Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment                                    |
| ASTM A790  | Seamless and Welded Ferritic / Austenitic Stainless Steel Pipe                                                      |
| ASTM A815  | Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings                              |
| ASTM A860  | Wrought High-Strength Low Alloy Steel Butt Welding Fittings                                                         |
| ASTM B466  | Seamless Copper-Nickel Pipe and Tube                                                                                |
| ASTM B608  | Welded Copper Alloy Pipe                                                                                            |
| ASTM B633  | Electrodeposited Coatings of Zinc on Iron and Steel                                                                 |
| ASTM D1418 | Practice for Rubber and Rubber Lattices- Nomenclature                                                               |

# ASME piping components

| Reference   | Title                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------|
| ASME V      | Boiler and Pressure Vessel Code - Section V - Non Destructive Examination                                           |
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# ASTM piping components

| Reference | Title                                                                                                                                                                                     |
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| ASTM A106 | Seamless Carbon Steel Pipe for High Temperature Service                                                                                                                                   |
| ASTM A153 | Standard Specification for Zinc Coating (Hot dip) on Iron and Steel Hardware                                                                                                              |
| ASTM A671 | Electric-fusion Welded Steel Pipe for Atmospheric and Lower Temperatures                                                                                                                  |
| ASTM A182 | Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service                                                                              |
| ASTM A192 | Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service                                                                                                            |
| ASTM A194 | Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service                                                                                                      |
| ASTM A216 | Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service                                                                                                         |
| ASTM A193 | Alloy steel and stainless steel bolting material for pressure vessels, valves, flanges, and fittings for high temperature or high pressure service, or other special purpose applications |

# ASTM piping components

| Reference | Title |
|-----------|-------|
|-----------|-------|

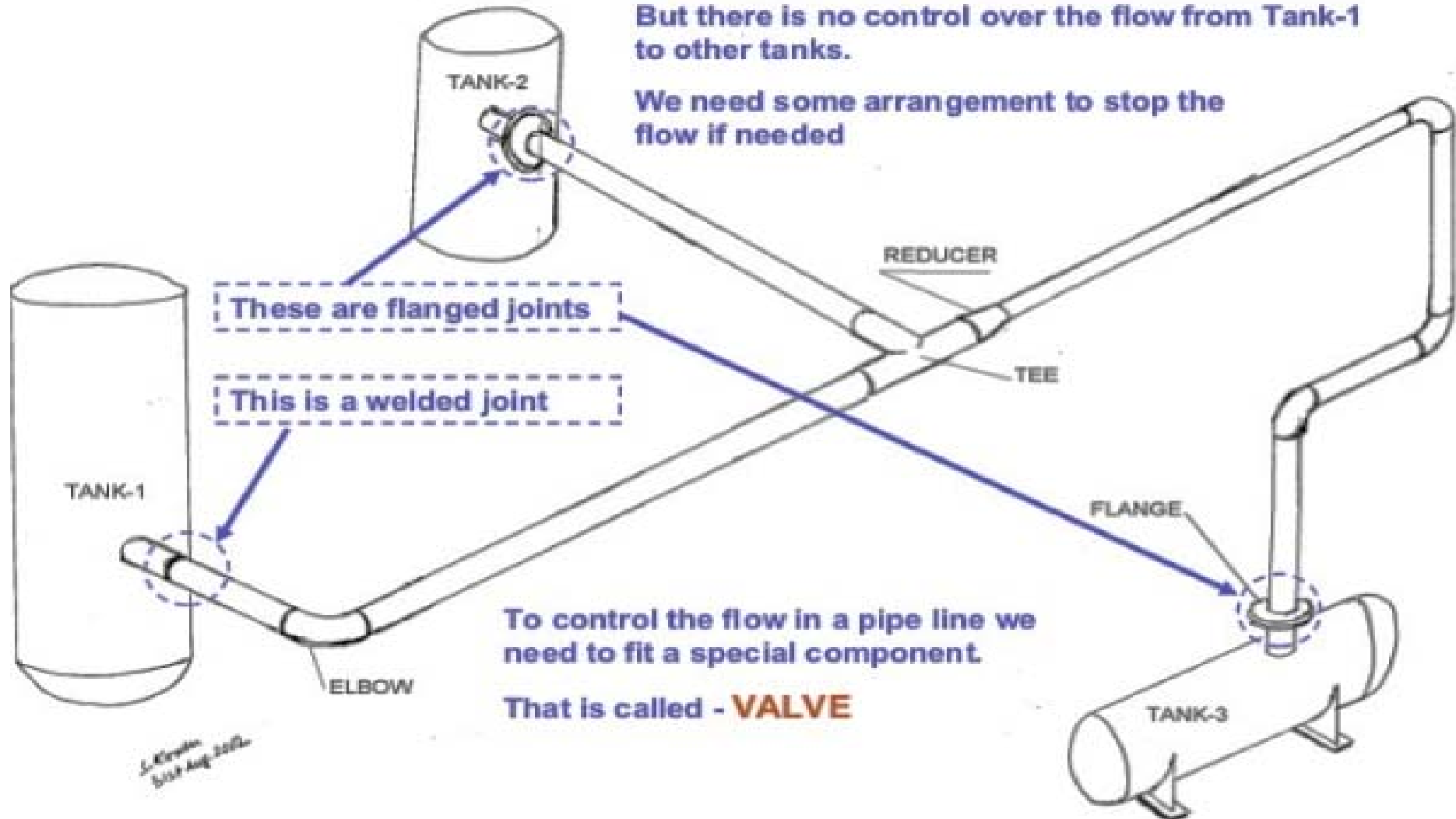
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| ASTM A350 | Carbon and Low Alloy Steel Forgings Requiring Notch Toughness Testing for Piping Components                                    |
| ASTM A358 | Electric Fusion -Welded Austenitic Chromium - Nickel Stainless Steel Pipe for High-Temperature Service and General application |
| ASTM A370 | Test Methods and Definitions for Mechanical Testing of Steel Products                                                          |
| ASTM A403 | Wrought Austenitic Stainless Steel Piping Fittings                                                                             |
| ASTM A420 | Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service                                              |

# VALVES

**So far this is a nice arrangement.**

**But there is no control over the flow from Tank-1 to other tanks.**

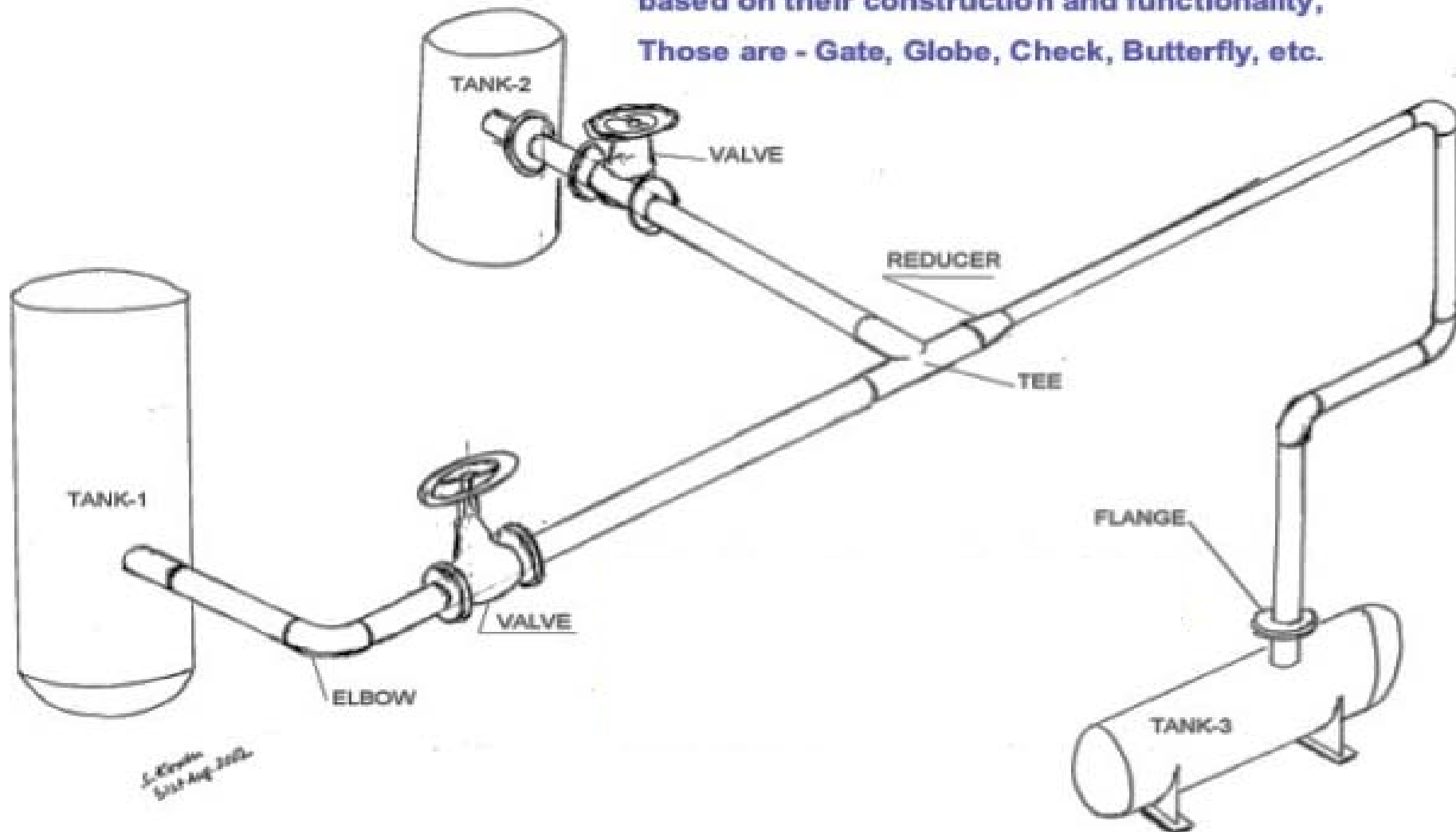
**We need some arrangement to stop the flow if needed**



1. *Director*  
2. *Assoc. Dir.*

# VALVES

There are many types of valves, categorized based on their construction and functionality, Those are - Gate, Globe, Check, Butterfly, etc.



# ASME piping components

| Reference   | Title                                                                                                               |
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| ASTM A194 | Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service                         |
| ASTM A216 | Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service                            |

# ASTM piping components

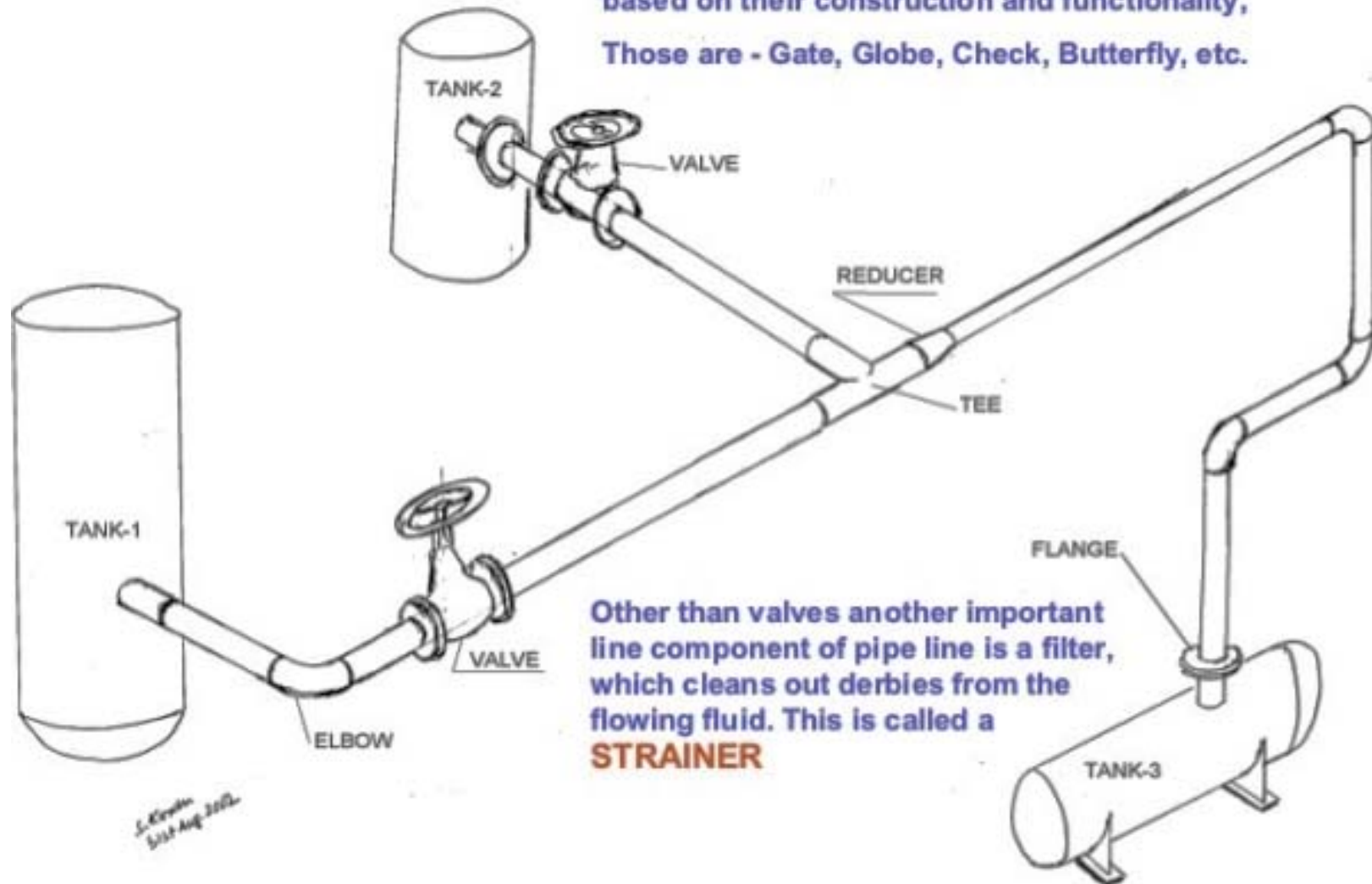
| Reference | Title                                                                                                                          |
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| ASTM A234 | Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature service                              |
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| ASTM A312 | Seamless ,Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes                                                      |
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| ASTM A351 | Standard Specification for Castings, Austenitic (stainless steel) for Pressure-Containing Parts                                |

# API piping components

| Reference  | Title                                                                  |
|------------|------------------------------------------------------------------------|
| API 5 L    | Line Pipe                                                              |
| API 6A     | Valves and Well Head Equipment                                         |
| API 6D     | Pipeline Valves                                                        |
| API 6FA    | Fire Test for Valves (Trunnion Ball Valves)                            |
| API 6FB    | Fire Test for End Connections                                          |
| API 15LR   | Low Pressure Fibreglass Line Pipe                                      |
| API 590    | Steel Line Blanks                                                      |
| API 594    | Wafer Type Check Valves                                                |
| API 598    | Valve Inspection and Test                                              |
| API 599    | Metal Plug Valves- Flanged, Threaded and Welding Ends                  |
| API 600    | Steel Gate Valves, Flanged or Buttweld Ends                            |
| API 602    | Compact Steel Gate Valves                                              |
| API 607    | Fire Test of Soft Seated Quarter Turn Valves                           |
| API 608    | Metal Ball Valves - Flanged, Threaded and Welding Ends                 |
| API 609    | Lug and Wafer -Type Butterfly Valves                                   |
| API RP 14E | Design and Installation of Offshore Production Platform Piping Systems |

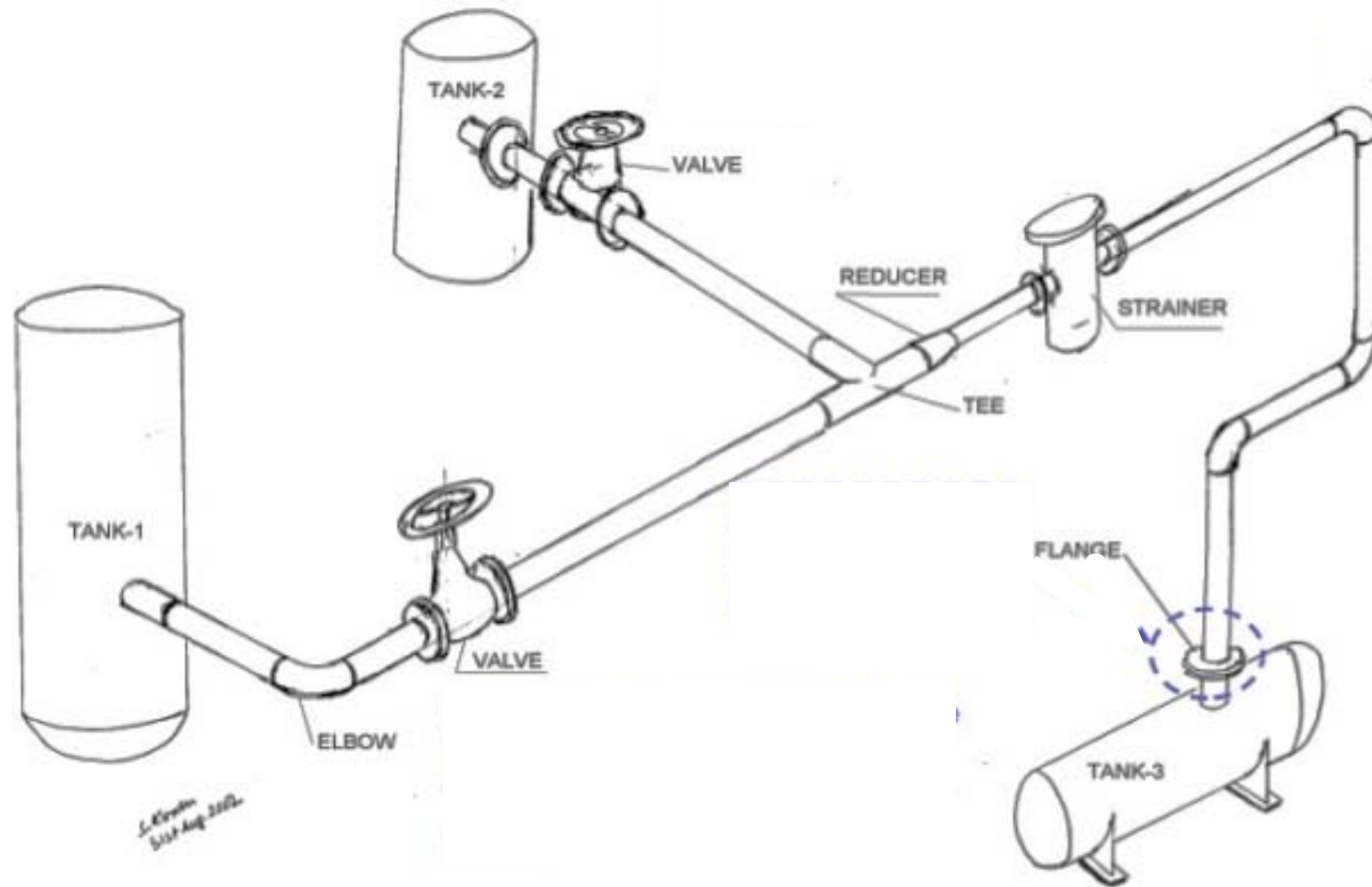
# STRAINER

There are many types of valves, categorized based on their construction and functionality, Those are - Gate, Globe, Check, Butterfly, etc.



Other than valves another important line component of pipe line is a filter, which cleans out derbies from the flowing fluid. This is called a **STRAINER**

# STRAINER



# ANSI/ASME B31.3 Process piping code

## Listed components:

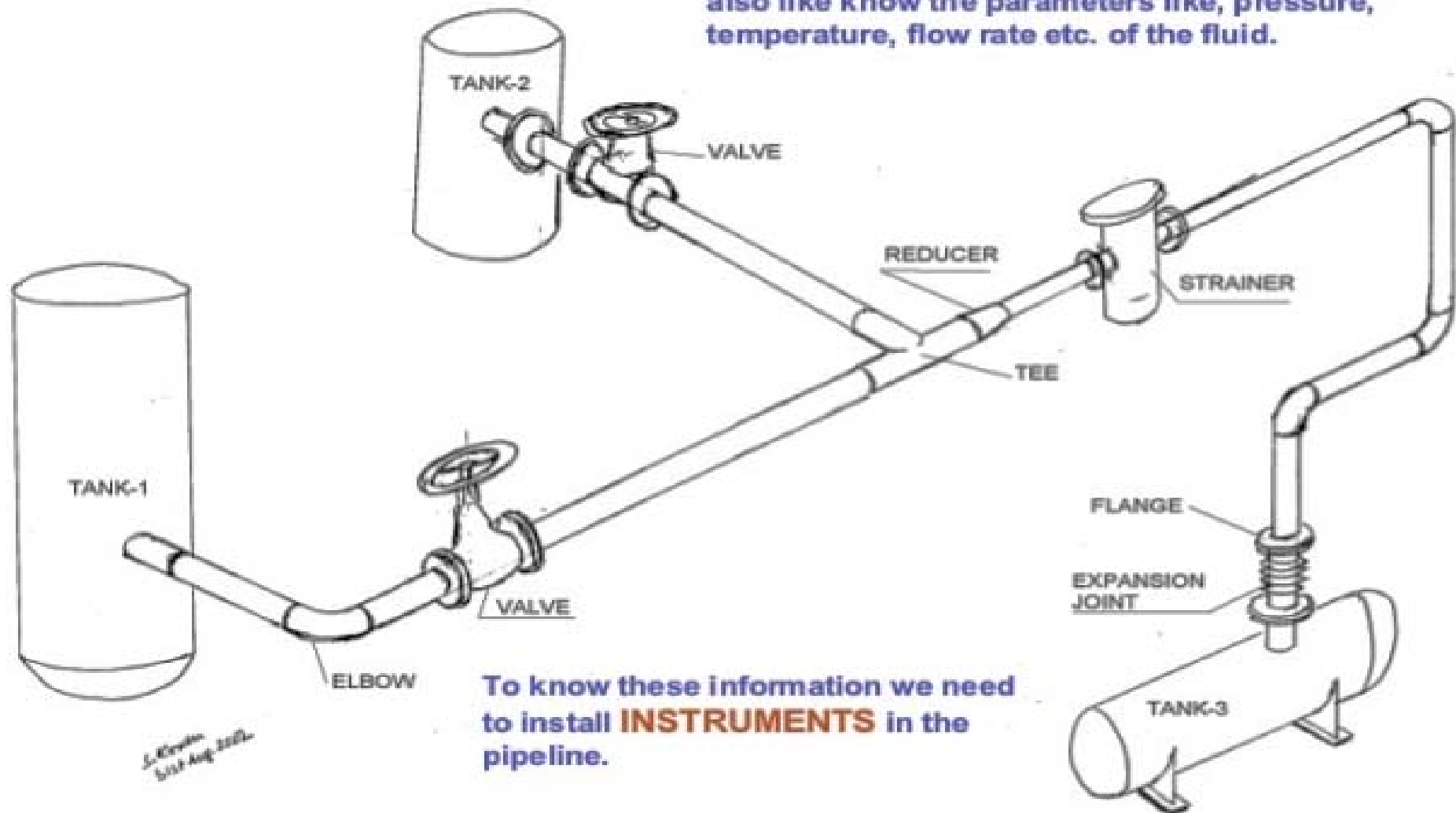
Can be used with their pressure temperature ratings and any additional limitations described in code

## Un-listed components:

Such as Strainers → as long as the product can provide strength & performance equivalent to standard components and qualified for pressure temperature design as required in the code.

# INSTRUMENT

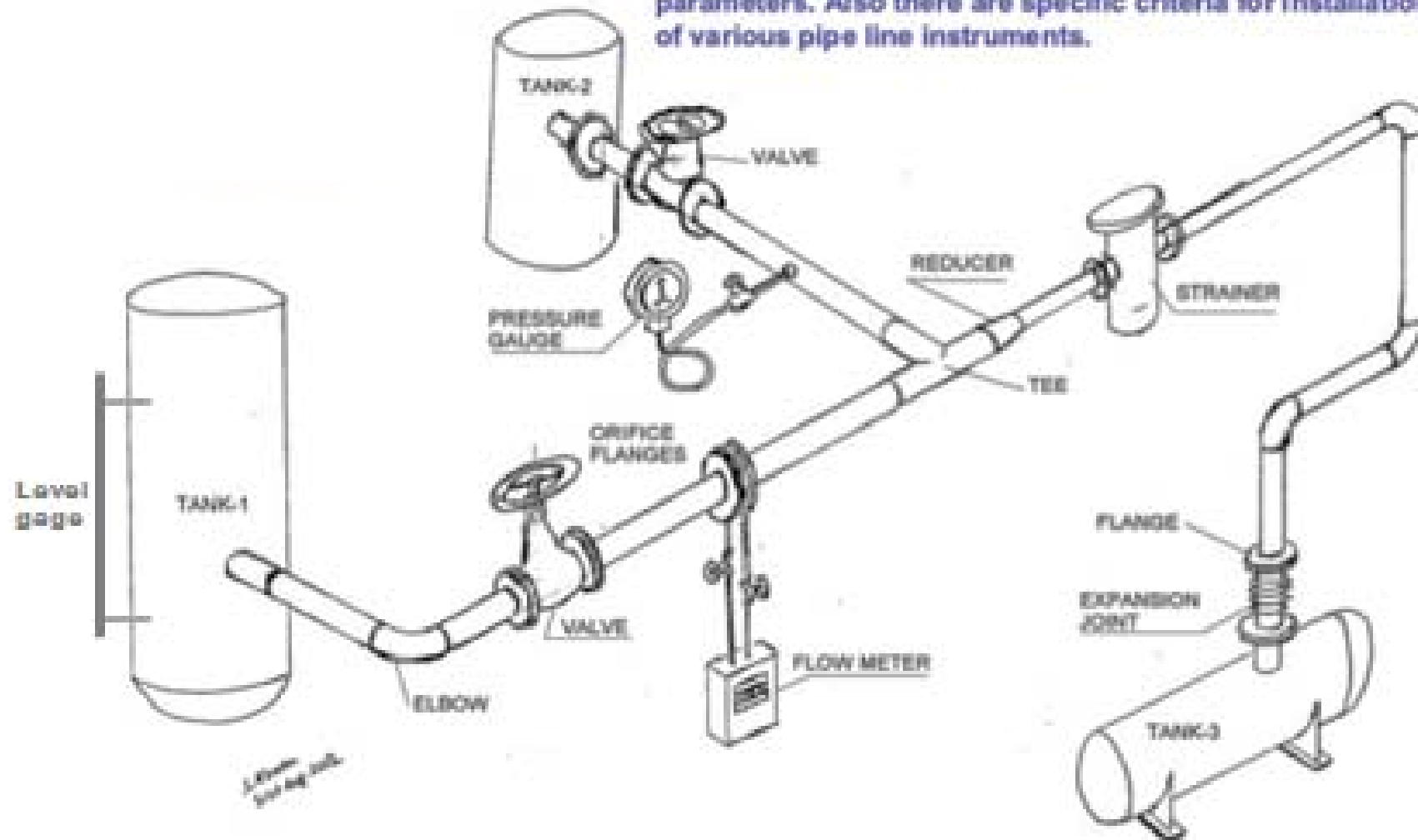
When some fluid is flowing in a pipe we may also like know the parameters like, pressure, temperature, flow rate etc. of the fluid.



To know these information we need to install **INSTRUMENTS** in the pipeline.

# INSTRUMENT

There are various types instruments to measure various parameters. Also there are specific criteria for installation of various pipe line instruments.



# Standard related to instrument

**ANSI/IEEE Std 1008**

Software Unit Testing

**ANSI/IEEE Std 610.12**

Software Requirements

**ANSI PTC 19.3**

Thermowells (chapter 1, section 8-19)

**ANSI/FCI 70-2**

Control valve seat leakage.

**API RP 520**

Sizing, Selection, and Installation Of Pressure-Relieving Devices in Refineries, Part I and II.

**API RP 551**

Process Measurement Instrumentation

**API RP 552**

Transmission Systems

**API RP 553**

Refinery Control Valves

**API RP 554**

Process Control Systems

**API RP 555**

Process Analyzers

**API RP 557**

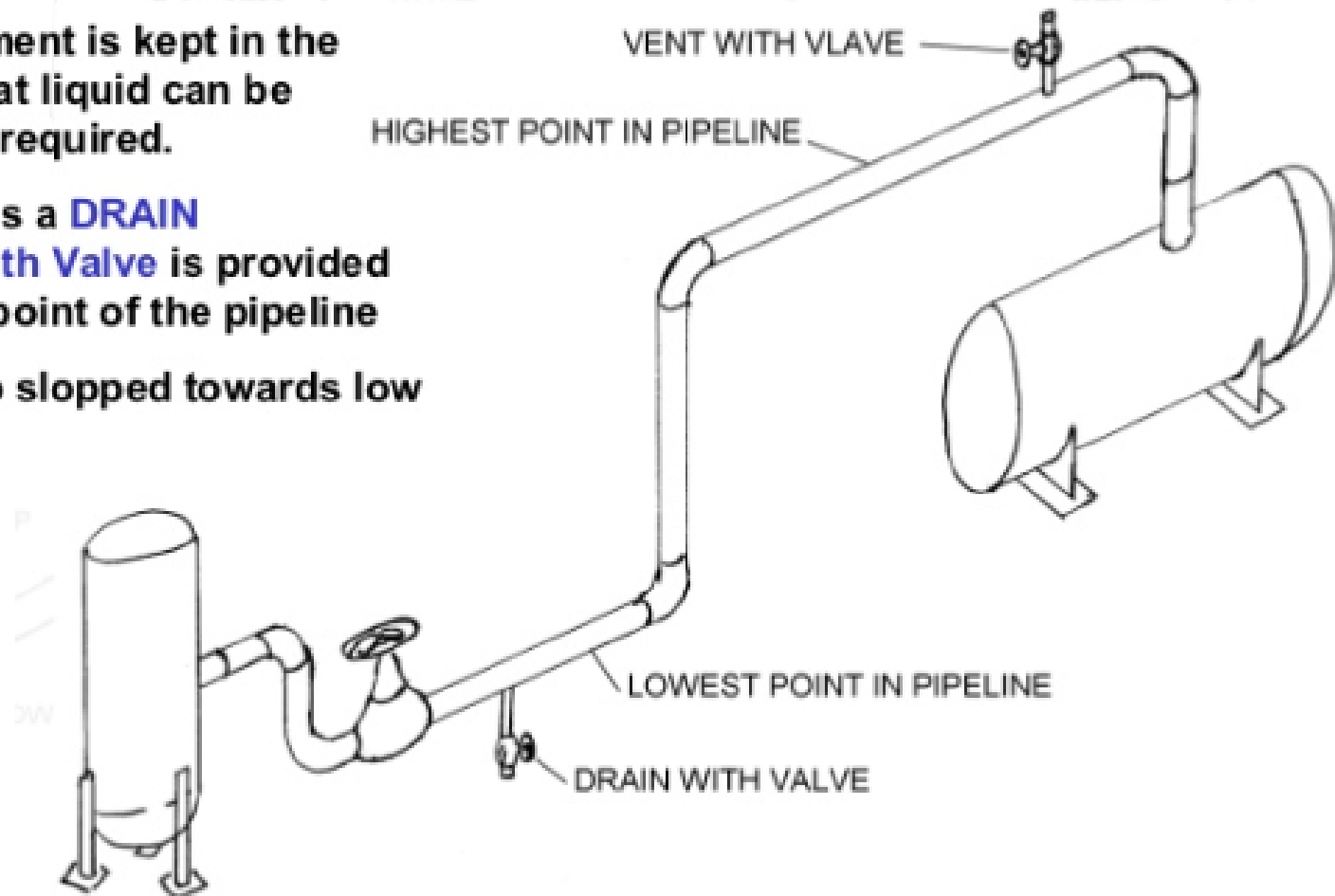
Guide to Advanced Control Systems

# Standard related to instrument

|                       |                                                                                                                                                                      |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ANSI B1.20.1</b>   | Pipe threads general purpose (imperial units)                                                                                                                        |
| <b>ANSI B16.5</b>     | Pipe Flanges and Flanged Fittings                                                                                                                                    |
| <b>ANSI B16.10</b>    | Face-to-face and end-to-end dimensions of valves.                                                                                                                    |
| <b>ANSI B16.34</b>    | Valves-flanged, threaded and                                                                                                                                         |
| <b>ANSI B16.36</b>    | Steel orifice flanges                                                                                                                                                |
| <b>API Publ 2501A</b> | Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities                                                      |
| <b>API RP 14B</b>     | Recommended Practice for Design, Installation, Repair and Operation of Subsurface Safety Valves Systems                                                              |
| <b>API RP 14C</b>     | Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms (basis for ISO 10418).                                   |
| <b>API RP 14E</b>     | Design and Installation of Offshore Production Platform Piping System (basis for ISO 13703).                                                                         |
| <b>API RP 14FZ</b>    | Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Zone 0, Zone 1 and Zone 2 Locations |
| <b>API RP 14G</b>     | Fire Prevention and Control on Open Type Offshore Production Platforms                                                                                               |
| <b>API RP 14H</b>     | Installation, Maintenance, and Repair of Surface Safety Valves and Underwater Safety Valves Offshore                                                                 |
| <b>API RP 14J</b>     | Design and Hazards Analysis for Offshore Production Facilities                                                                                                       |
| <b>API RP 520</b>     | Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries                                                                                      |
| <b>API RP 526</b>     | Flanged steel safety relief valves.                                                                                                                                  |
| <b>API RP 527</b>     | Seat Tightness of Pressure Relief Valves.                                                                                                                            |
| <b>API RP 537</b>     | Flare Details for General Refinery and Petrochemical Services                                                                                                        |
| <b>API RP 574</b>     | Inspection Practices for Piping System Components                                                                                                                    |
| <b>API RP 576</b>     | Inspection of Pressure-Relieving Devices                                                                                                                             |
| <b>API RP 678</b>     | Accelerometer-based Vibration Monitoring System.                                                                                                                     |
| <b>API RP 2001</b>    | Fire protection in refineries                                                                                                                                        |
| <b>API Spec 6A</b>    | Wellhead and Christmas Tree Equipment                                                                                                                                |
| <b>API Std 598</b>    | Valve Inspection and Testing                                                                                                                                         |
| <b>API Std 670</b>    | Vibration, axial position and bearing temperature system.                                                                                                            |
| <b>API Std 521</b>    | Guide for Pressure-Relieving and Depressuring Systems (identical to ISO 23251)                                                                                       |
| <b>API Std 2000</b>   | Venting Atmospheric and Low Pressure Storage Tanks Nonrefrigerated and Refrigerated.                                                                                 |

# Vent & drain

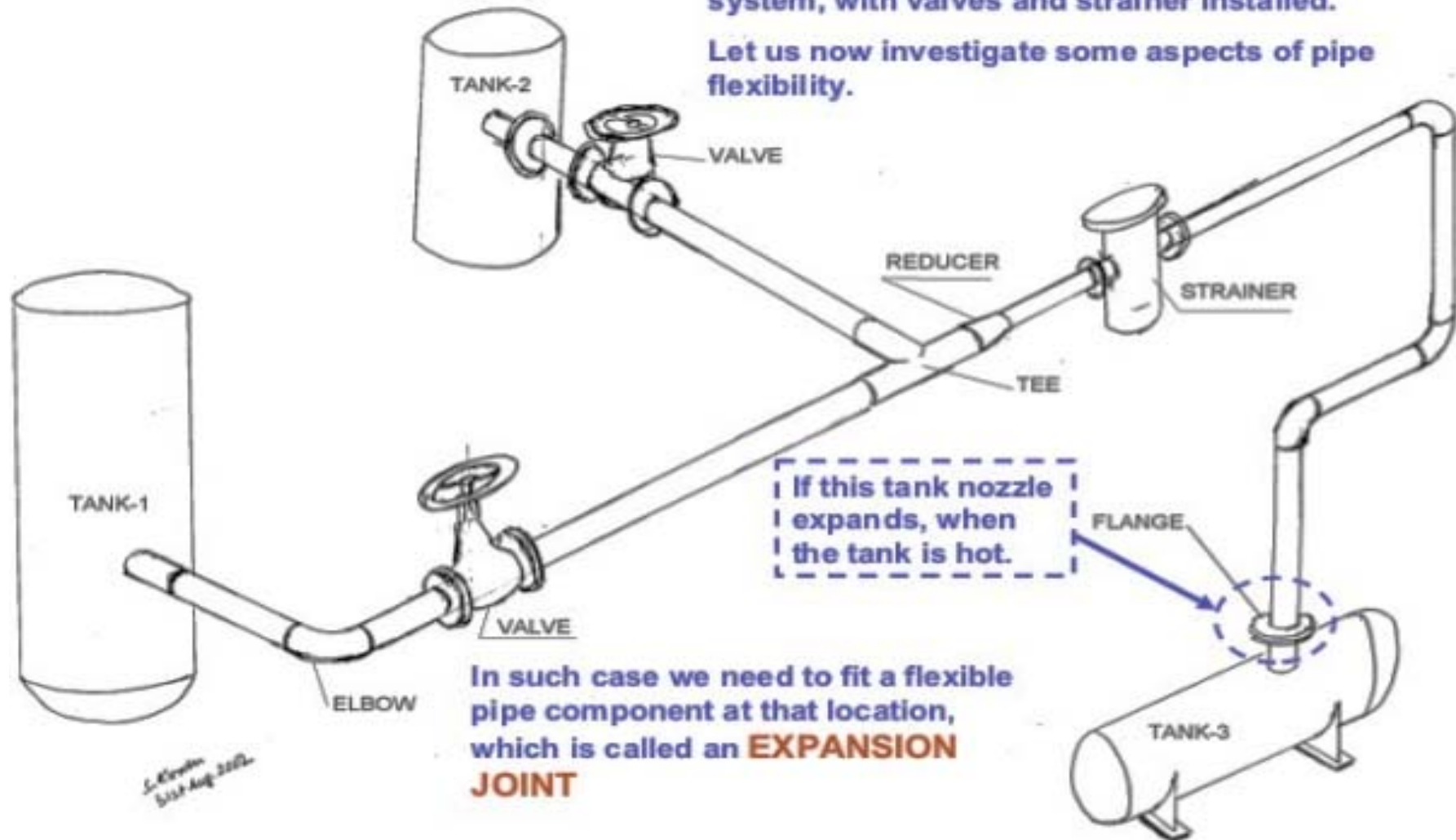
- } For Pipeline which shall carry liquid, we have to make sure that all air is allowed to vent out of the line when the line is filled with liquid.
- } To achieve this a **VENT connection with Valve** is provided at the top most point of the pipeline.
- } Also arrangement is kept in the pipeline so that liquid can be drained out if required.
- } To achieve this a **DRAIN connection with Valve** is provided at the lowest point of the pipeline
- } Pipes are also slopped towards low points.



# EXPANSION JOINT

Here we see a more or less functional piping system, with valves and strainer installed.

Let us now investigate some aspects of pipe flexibility.



# EXPANSION JOINT

When some fluid is flowing in a pipe we may also like know the parameters like, pressure, temperature, flow rate etc. of the fluid.

