FOR REFERENCE
SIGNATURE _____ DATE _____

TANK FARM STORAGE

Process Design Criteria

Rev.	Date	Description	Prepared	Checked	Approved
04					
03	19.Feb.2015	Issued for Reference	A.Farahmand	S.Kharrazi	M.Kazemi
02	07.Feb.2015	Issued for Approval	A.Farahmand	S.Kharrazi	M.Kazemi
01	25.Dec.2014	Issued for Approval	A.Farahmand	S.Kharrazi	M.Kazemi
00	26.Nov.2014	Issued for Approval	A.Farahmand	S.Kharrazi	M.Kazemi

Page	REVISION				
	00	01	02	03	04
1	X				
2	X				
3	X				
4	X				
5	X				
6	X				
7	X				
8	X	X			
9	X	X			
10	X	X			
11	X	X			
12	X				
13	X				
14	X	X	X		
15	X	X			
16	X	X			
17					
18					
19					
20		X	X		
21		X			
22		X			
23					
24		X			
25		X			
26					
27					
28					
29					
30					

Page	REVISION				
	00	01	02	03	04
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

CONTENTS: PAGE NO.

1. GENERAL

1.1. Scope

This Specification covers the minimum requirements for Process design criteria including essential instructions and points of noteworthy to be applied during implementation of process and/or utility design and engineering activities of plant, inside battery Limits or adjacent areas.

The purpose of this Specification is to standardize the basis of design for all process and/or utility units.

In case of conflict between this Specification and other project Specifications / engineering dossiers, the requirements as stipulated in this Specification are in first priority. Cases not covered in these criteria shall be handled as individual cases. Applicable codes and standards shall be consulted for these cases.

1.2. Project Definitions

- Project Title: Tank Farm Storage
- Client: Ofogh Company
- Consultant: SazehPardazi Iran
- Contractor: Energy Tejarat Sam

2. DESIGN CONDITIONS

The design conditions include design pressure and design temperature. These parameters are maximum and/or minimum pressure or temperature for which the mechanical calculations of the equipment shall be performed.

2.1. Design Pressure

2.1.1. Design Pressure for Individual Equipment Items

The design pressure is the maximum and / or minimum pressure for which the mechanical calculation shall be performed. The design pressure shall be established according to the following criteria except in special cases approved by the Company. In addition, where, process fluid static head or other appropriate loads significantly increase the internal pressure, the design pressure shall be increased accordingly for the vessel section concerned.

a) For maximum normal operating pressure less than 1.5 barg (except item “d” below), design pressure is 3.5 barg.

b) For maximum normal operating pressures between 1.5 and 20 barg, use the maximum normal operating gage pressure + 2 bar.

c) For maximum normal operating pressures above 20 barg, use 110% of the maximum normal operating gage pressure.

d) For equipment operating under Atmospheric pressure, use hydrostatic (water) pressure + 50 mm Water column.

For Atmospheric storage tanks operated under blanketed gas with seal pressure lower than 100 mm of H2O, use hydrostatic (water) pressure + 150 mm Water column.

e) Design pressure of the fired heater coils shall be calculated considering the design pressure of the downstream vessel plus fouling allowance (if any) plus 120% of the allowable pressure drop in clean conditions.

2.1.2. Exchangers, Vessels and Other Equipment on the Discharge of A Pump

Equipment which could have to bear the shut-off pressure of a pump in case of a valve closing (either control valve or block valve) shall have a design pressure equal to or higher than the shut-off pressure of the pump. Pump shut-off pressure shall be estimated according to the following criteria, whichever is greater:

a) Design pressure of the suction vessel plus liquid height at vessel HLL at pump suction + pump differential pressure at rated flow of the pump.

b) Normal suction pressure plus liquid height at vessel HLL at pump suction + 120% of pump differential pressure at rated flow of the pump.

Shut off pressure of the centrifugal pumps shall be rechecked when Vendor's characteristic curves of selected pumps are available. If it exceeds the estimated pump shut-off pressure, the design pressure of downstream equipment shall be revised accordingly.

2.2. Design Temperature

Unless otherwise specified, equipment design temperature shall be established according to the following criteria:

Design Temperature = Max. Operating Temperature + 25ºC or Maximum Exceptional Operating Temperature, whichever is the greater.

Minimum upper design temperature should be 85ºC due to solar radiation for outdoor equipments. For those equipment not influenced by solar radiation the design temperature for all equipment shall be at least 55ºC. This is the maximum estimated temperature that can be achieved in insulated equipment after prolonged shutdown.

3. CORROSION ALLOWANCE (FOR EQUIPMENT AND LINES)

3.1. Carbon Steel (Including Low Alloy < 5% Cr. Steels)

Whichever is greater:

- Corrosion allowance calculated for 20 years of service for equipment and 10 years of service for piping.

- Corrosion allowance of 1.0 mm for piping and 3.0 mm for equipment (except for storage tanks' roof which shall be 1.5 mm).

Note (1): For removable carbon steel parts of internals, a minimum of 1.5 mm of corrosion allowance on each side in contact with the operating fluid shall be given.

Note (2): The corrosion allowance to be considered for any equipment and line should notbe greater than 6 mm. Should in specific cases, a corrosion allowance greater than 6 mm is required, alternate solutions such as application of coating or lining or change of material to be considered.

3.2. High Alloy / Stainless Steels

In general, corrosion allowance of High Alloy / Stainless Steel piping or equipment are zero. However, corrosion allowance shall be specified for internals which are submitted to sever condition.

4. LINE SIZING CRITERIA

4.1. General

A.1. The fluid quantities to be used in determining line sizes shall be those called for by the maximum process design flowrates and in any case shall not be less than 110% of the unit design throughput.

A.2. The friction loss shall be calculated in accordance with the standards of Hydraulic Institute on the basis of the following figures for absolute roughness of pipe:

PIPE MATERIAL	ABSOLUTE ROUGHNESS (mm)
Commercial steel	0.05
Cast Iron	0.26
Drawn Tubing	0.0015
Concrete/Cement Lining	0.30

4.2. Liquid Line Sizing Criteria

4.2.1. Available Pressure Drop

Line sizing shall be based on the total available pressure drop that will ensure a minimum line diameter. Care shall be exercised to limit the velocity in the pipes. The pressure drop limitations are mentioned in following sections. These values are intended to be applied for continuous service, and may be exceeded for intermittent services, while problems of noise, erosion, and water hammer shall be considered.

4.2.2. Pressure Drop Limitations

Service	FrictionLossRanges (Bar/100 m)
Pump Suction	0.05 ~ 0.10
Pump discharge	0.20 ~ 0.45
Gravity Flow	0.035 (Max.)

4.2.3. Velocity Limitations

		Subcooled (m/s)	Boiling (m/s)
Pump suction:	up to 2”	0.3 ~ 0.6	Max. 0.5
(Note 1& 2)	from 3” to 6”	0.6 ~ 1.0	Max. 0.9
	from 8” to 10”	0.8 ~ 1.5	Max. 1.2
	over 12”	0.9 ~ 3.0	Max. 2.0
Pump discharge	up to 2”	0.6 ~ 1.2	Max. 1.0
	from 3” to 6”	1.0 ~ 2.4	Max. 2.0
	from 8” to 10”	1.5 ~ 2.8	Max. 2.4
	over 12”	2.4 ~ 3.6	Max. 3.2

Note (1) Saturated liquid pump suction lines call for larger suction nozzles to prevent vortexing, when no enough liquid depth on vessel is provided. The line

must run 6 ~ 8 times nozzle diameter vertically before reducing the size of the line.

Note (2) Pump suction lines to be primarily sized by NPSH requirement.

Note (3) In general for corrosive or erosive fluids velocity limits should be halved. Lines in corrosive and erosive services shall be investigated individually and in case of requirement of lower velocity then such lower velocity shall be based upon for the design of such line.

Note (4) Above friction loss/velocity ranges can be slightly exceeded for short branch lines, when pressure-drop is not limiting or in intermittent services.

5. VESSELS

5.1. Liquid Level Positions

Vessels shall be designed to the following minimum criteria:

	Horizontal Vessels	Vertical Vessels
LLLL	300 mm (12”) Above Bottom	300 mm (12”) Above Bottom Seam
LLLL to LLL	Greater of 3 mins or150mm (6”)	Greater of 3 mins or150mm (6”)
LLL to HLL	Required hold up or300mm (12”)	Required hold up or300mm (12”)
HLL to HHLL	Greater of 3 mins or150mm (6”)	Greater of 3 mins or150mm (6”)

These are minimum requirements only and may be overridden by process requirements.

5.2. Length to Diameter (L/D) Ratio

Generally, inside diameter will be specified on data sheets and diagrams. If the required vessel diameter is less than 800 mm, a piping element may be acceptable. For vessels having diameters less than 1000 mm, flanged heads may

be specified. For horizontal separators, the length-to-diameter (L/D) ratio shall be as follows:

Operating Pressure (Barg)	L/D Ratio
0.00 to 17.25	1.5 to 3.0
17.25 to 34.50	3.0 to 4.0
> 34.50	4.0 tp 6.0

5.3. Nozzles

Minimum flange rating shall be 150 pounds except for the following cases which shall be 300 pounds:

- Level instrumentation pipe columns.
- Pressure relief valve connections.
- Nozzle sizes lower than 11/2”.

All nozzles except process nozzles over DN 40 (1 1/2") shall be flanged. Process nozzles' size shall be minimum DN 25 (1") and all connections shall be flanged.

Connections 1 1/2” and smaller may be with forged steel couplings. Such connections shall be limited to vessels for which the design pressure and temperature is less than 41.4 barg and 232 ºC respectively. Couplings shall be 6000 PSI rating for 1 1/ 2” and smaller connections. Couplings shall not be used in lined portions of alloy lined vessels, on bottom heads of vertical vessels. Threaded fittings or tapped holes are not permitted. The minimum size of nozzles shall be 1” except that for alloy lined nozzles the minimum size is 1 1/ 2”.

5.4. Nozzles Sizing

Size of nozzles on vessels and tanks is to be same as the line size which its sizing criteria is mentioned above.

5.5. Ventilation Nozzle

On horizontal vessels over 3 meters in tangent length, a blanked off ventilation nozzle shall be provided on the top of the vessel near the end, opposite the manway. The ventilation nozzle shall be sized as follows:

Vessel Tangent Length	Blanked off Nozzle Size
3.0 meters through 4.4 meters	4”
Over 4.4 meters through 7.5 meters	6”
Over 7.5 meters	8”

5.6. Vent & Drain Nozzles

Sizing criteria of nozzles on vessels:

Vessel Volume (m^3) and Vessel ID (mm) (Note-1)	Vent Size	Drain Size
V<45, D<1200	DN 40 (1½")	DN 40 (1½")
45<V<75, 1200<D<2500	DN 50 (2")	DN 50 (2")
45<V<75, 2500<D<3500	DN 80 (3")	DN 80 (3")
45<V<75, 3500<D<4500	DN 100 (4")	DN 80 (3")
75<V<220, 4500<D<6000	DN 100 (4")	DN 80 (3")
220<V<420, D>6000	DN 100 (4")	DN 100 (4")
V>420, D>6000	DN 150 (6")	DN 100 (4")

Note (1): Size of nozzles shall be selected based on vessel volume and vessel inside diameter, whichever to be greater.

Note (2): Drain on vertical vessel may be located on bottom line.

Note (3): Select drain size to be same as process line, when process connection is to be smaller than the above table.

5.7. Man Ways

On unlined horizontal vessels, a manway shall be provided on the top or side of the vessel at or below the horizontal centerline. If the bottom half of the horizontal vessel is lined, the manway shall be located on the upper side or the top of the vessel.

Size of manways shall be 24" (NPS). Minimum inside diameter shall be 18". Larger size to be specified when required accommodating internals.

Manways shall be provided as follows:

- Horizontal Vessels:
  - 900 to 1300 mm ID: Manway on the head, 18" ID
  - Larger than 1300 mm ID: Manway on the side or Top shell, 20" ID
- Vertical vessels:
  - Under 900 mm ID: Top head flanged
  - 900 to 1300 mm ID: Manway in shell, 18" ID
  - Larger than 1300 mm ID: Manway in shell, 20" ID

5.8. Nozzles Identification

The following symbols shall be used for identification of the nozzles on pressure vessels, tanks, pumps and etc.

Nozzle	Identification Symbol
A, A1, A2	Inlet
B	Outlet
D	Drain
F	Feed
G	Level Gauge / Gauge Glass
H	Hand hole
L	Level Instrument
M	Manhole
P	Pressure Connection

S	Sample Connection
T	Temperature Connection
V	Vapor Vent
W	Relief Valve Connection
E or K	Others

6. PUMPS

6.1. Pump Calculations

6.1.1. Normal, Rated Flow, and Over Capacity

Capacity is defined as the percent difference between the normal and rated flows. The normal and rated flows will be computed by the process section and will be indicated on the “pump calculation sheet”. Normally following over capacity will be provided:

- Centrifugal and Rotary Pump 10%
- Chemical Injection Pumps 20%
- Other Pumps 10%

6.1.2. Over plus

The over plus is a differential head which will be added as a safety factor to the calculated pump head requirements, in order to provide for actual site condition under tolerances allowed by API 676 and API 610.

6.1.3. Pump Suction Pressure

The pump suction pressure shall be calculated as the minimum vessel or Storage Tank pressure plus the static head of the liquid from vessel tangent on vertical vessels (blowing Column and K.O. Drum) and the bottom of the horizontal vessels (Pre-Heater), to the centerline of the pump, minus the friction loss due to the suction line piping. Where minimum operating level is fixed by the process, the static head will be calculated accordingly.

6.1.4. Pump Discharge Head

The pump discharge pressure shall be calculated as the maximum pressure requirement at battery limit or at receiving equipment plus the static head plus the line and fittings and orifice losses.

6.1.5. NPSH Available

The minimum available NPSH is the difference between the pump suction pressure and the fluid's vapor pressure at the flow conditions.

For NPSHA, normally, a minimum of 500 mm differential head will be provided over NPSH requirement of pumps.

The available NPSH for vertical pumps is described in API 676. The net positive inlet pressure available is the absolute pressure above fluid vapor pressure at the pump inlet and is determined as follows:

$$\text{NPSH Available} = Pa + Pz - Pf - Pvp$$

Where:

- Pa = Absolute pressure at surface of liquid in kPa absolute (psia)
- Pz = Static head (+) or Static Lift (-) in kPa (psi) for level of fluid above or below inlet
- Pf = Inlet line, valve and fitting friction losses at maximum viscosity in kPa (psi)
- Pvp = Fluid vapor pressure or gas dissolution pressure at suction temperature in kPa (psi) (Refer to IPS-E-PR-440)

NPSH required is a function of pump type, speed and viscosity of fluid pumped. $NPSH_A$ must always be greater than $NPSH_R$ to prevent occurrence of cavitation. $NPSH_R$ should be finalized by pump vender and pump type.

6.1.6. Pump Shutoff Pressure

The shut-off pressure shall be estimated according to the following criteria whichever is higher:

- Differential head at rated flow x 120 % + HLL (level high) suction static head + max operating pressure suction side.
- Differential head of pump at rated flow + HHLL (level high high) suction static head + design pressure suction side x 120 %.

No over design shall be applied to the rated pressure.

6.2. General Considerations

- Continuous service process pumps shall be provided with full (100%) spares unless otherwise approved by the client.
- All pumps shall be equipped with permanent strainer. The strainers shall be shown on P&IDs. “Y” type strainer can be used for all pumps with suction line size of 2” and less. Basket or "T" type strainer shall be used for all other pumps. Strainers DN150 (6 inch) and larger shall have DN 25 (one inch) drain valve.
- Pumps in the process area shall be specified to conform to API-610 standards. For light duty, non-hydrocarbon services outside the process area, non API pumps in conformity with project Specifications may be used.
- Vertical pumps application shall be limited to the services where NPSH or head limitations make use of horizontal pumps impractical.
- Dual seals (double or tandem depending upon process requirements) shall be used for specific services such as:
  - Hydrocarbons above their auto ignition temperature or at a temperature above 250°C,
  - Dirty service,
  - Vapour pressure of pump fluid greater than 5 bar (abs) on each operation temperature in seal chamber,
- Horizontal pumps shall be centerline mounted.
- Shaft sleeves are required for all pumps.
- Mechanical seal end plate should be stainless steel material.

- Bellows type mechanical seals with all metallic parts shall be used for hot services where liquid is clean and fluid temperature is 232 ºC and higher up to 426 ºC.
- Centerline discharge nozzle pumps (AVS type) are not acceptable.
- NPSH calculation considerations:
  - The suction line losses shall be based on rated flow capacity of the pump. Pressure drop through any permanent strainer should be 0.61m of liquid head for NPSHA calculations.
  - For subcooled liquids, the source pressure shall be at the maximum operating pumping temperature.
  - Static head shall be measured from the vessel bottom tangent line to the centerline of a horizontal pump, or to the suction nozzle of a vertical pump.
  - If vortex breaker is installed at vessel outlet, the pressure drop through it shall be considered.
  - For horizontal centrifugal pumps, the elevation of the pump centerline shall normally be 0.9m above grade unless the actual elevation is known.
- The following criteria shall be applied to sizing of pump valves:
  - Suction block valve to be same size as suction line if the pump nozzle is one size smaller than line. Suction block valve may be one size smaller than suction line if the pump nozzle is two sizes smaller than line.
  - Discharge block and check valve could be one size smaller than the discharge line, but not smaller than pump discharge nozzle. For lines 2” and smaller, all valves (block and check) shall be line size.
- A warm-up bypass shall be provided for pumps which may be idle or on standby during plant operation and which will operate at or above 170ºC, or if the process fluid will solidify at ambient temperature. The bypass shall be sized for 3% of normal flow or shall be a ¾” line (whichever is greater). The

bypass shall have a globe valve and shall be installed around the pump discharge check valve.

- Rotary Positive Displacement Pump Max. Pressure:
  - Pump stalling pressure shall be checked to determine it does not exceed the maximum pressure of the piping and equipment which could be subject to this pressure. If the stalling pressure is higher than the system pressure rating, either the system pressure rating must be increased accordingly or a pressure relief valve must be installed on the pump discharge.
  - Maximum allowable pressure is defined as the highest pressure which can occur in the pump when bypassing the full of the pump through its relief valve with an accumulation of not more than 10% above the maximum set pressure.

7. STORAGE TANKS

7.1. Roof and Shell Manways

The minimum number and size of shell and roof manways shall be as follow:

Nominal Tank Diameter	Shell		Roof			
	All Tanks Types		Fixed Roof Tank		Floating Roof Tank	
m	Number	mm	Number	mm	Number	mm
3 to 6	1	600	1	500	1	900
>6 to 9	2	600	2	500	1	900
>9 to 12	2	600	2	500	2	900
>12 to 18	1	600	2	500	2	900
	1	900				
>18 to 27	1	600	2	600	2	900
	1	900				
>27 to 60	2	600	2	600	2	900
	1	900				
>60	2	600	2	600	2	900
	2	900				

Note: In addition, floating roofs shall be provided with at least one 500 mm manway for each pontoon compartment. Where two deck manways are required, they shall be located at diametrically opposite positions. An emergency vent cover shall be fitted to one manway on each cone roof tank.

7.2. Free Vents

The venting capacity required shall be determined in accordance with the rules specified in API Std. 2000. These requirements shall be considered as minimum requirements. The capacity of vents and relief valves shall always be morethan adequate.

The venting requirements shall include the following conditions:

- Inbreathing resulting from a maximum outflow of oil from the tank.
- Inbreathing resulting from contraction of vapours caused by a maximum decrease in atmospheric temperature, see Thermal Venting Section.
- Outbreathing resulting from a maximum inflow of oil into the tank and maximum evaporation caused by such inflow.
- Outbreathing resulting from expansion and evaporation due to a maximum increase in atmospheric temperature (thermal breathing).
- Outbreathing, resulting from pressure rise.

7.3. Thermal Venting

Special attention is required to the influence of a sudden drop in temperature due to rainfall, on the venting requirements of tanks containing warm oil and of tanks in tropical areas. A drop of 15 to 20ºC or more in 15 minutes may be experienced.

Where these conditions apply the venting capacity for tanks with low pumping rates in particular, shall be increased by at least 20% of the thermal venting capacity requirements.

7.4. Dip hatches

Unless otherwise specified, all tanks shall be supplied with one DN 200 dip hatch if additional dip hatches are required, a special note shall be made when ordering.

Dip hatches are also available as a fitting incorporated in the top of the freevent thereby reducing the number of nozzles that would otherwise be required on large tanks. All hatches shall be spark-proof self-closing type.

7.5. Heating Coils

Heating coils shall be fitted to tanks when products will be maintained at above ambient temperatures to facilitate pumping, e.g. on bitumen storage tanks. In tanks where water may be present on the bottom e.g. crude oil tanks the heating coils shall be placed sufficiently above the bottom to prevent heating of the water. The heating surface shall be in accordance with the requirements specified. Schedule 80 pipeshall be used for all heater coils.

8. HEATERS

- Vertical firing is preferred for all heaters unless otherwise specified.
- A pilot burner shall be provided for each burner.
- Maximum reasonably attainable heater efficiency shall be approached.
- Minimum stack height above grade shall be calculated such that to minimize pollution in accordance with the latest European standards. Moreover, furnace stacks shall reach at least 7 meters above the highest platforms located within 30 m, which may require attendance during operation. Individual stack supported from each heater shall be provided unless otherwise indicated on the heater data sheet.
- Low NOx emission burners shall be used.
- All heaters shall be provided with knife edge skin thermocouples for each pass.
- 10% over design factor shall be applied to the heaters.
- For more requirements refer to “Project Specification for Hot Oil System”.

9. RELIEF SYSTEM

9.1. Design Requirements

A detailed analysis shall be made on every possible situation in order to determine maximum loadings of relief system. The probability of entirely unrelated failures occurring at the same time is remote, and need not be considered.

Pressure safety or relief valve shall be provided for all cases as outlined below:

9.1.1. Vessels

When designed in accordance with Section VIII, ASME Unfired Pressure Vessel Code and the overpressure exceed the Design Pressure.

Special attention shall be paid to the cases where process conditions are changed during the engineering stage or after initial start-up of the plant and require increased operating pressure.

When designed in accordance with Section I, ASME Power Boiler Code and overpressure exceeds the Maximum Allowable Working Pressure as defined in that code.

9.1.2. Pumps

On the discharge of positive displacement pumps.

On the discharge of centrifugal pumps to protect downstream equipment from overpressure when the pump shutoff pressure exceeds the design pressure of the downstream equipment.

On discharge of all pumps where under blocked discharge, the horsepower rating (in kilowatts) of the electric motor drive may be exceeded.

On pump suction lines from a "bottled in" system where overpressure can be imposed on suction piping by backflow through the pump or through a control valve bypassing from pump discharge to suction.

9.1.3. Fired Process Heaters

To prevent overpressure due to heat input resulting from an action blocking the lines at downstream of the heater, where check valves or other valves upstream of the heater are closed by the same action blocking the upstream line(s), except for the condition covered under (a) below. The safety valve may be located anywhere between the upstream and downstream blocking valves.

9.2. Selection of Type

9.2.1. Conventional (Unbalanced) Safety Relief Valves

Use the conventional safety relief valve where the service is:

- Clean and non-corrosive
- Corrosive, with provision of corrosion resistant materials

Do not use this valve where service is:

- Corrosive and corrosive materials may damage the guide and disk, or guide and spindle or spring and bonnet.
- Such that the variable backpressure is greater than 10% where 10% accumulation is allowed or greater than 20% where 20% accumulation is allowed under fire conditions.
- Such that the differential pressure when the valve is relieving compared to the normal differential pressure across the protected equipment is less than 10%. This particularly applies when starting up a Unit where the initial back pressure on a valve is zero and the differential pressure across the valve may be below the intended operating pressure or closer than 10% above the normal operating pressure.
- Such that the material relieved may contain coke in suspension or slurries containing particles which may clog the guiding surfaces.

9.2.2. Balanced Bellows Safety Relief Valves

Use the balanced bellows safety relief valve where:

- The relieving pressure is to be independent of the backpressure.
- The bellows is used to prevent clogging of the guiding surfaces with coke or other particles in suspension.
- The bellows is used to prevent corrosive products from damaging the guiding surfaces, spring or associated pieces.
- Variable backpressure is greater than 10% where 10% accumulation is allowed or greater than 20% where 20% accumulation is allowed under fire conditions.
- The differential pressure when the valve is relieving compared to the normal differential pressure across the protected equipment is greater than 10%.
- Savings in discharge piping and size of flare header may be realized through use of higher backpressure in the flare header.
- Where the balanced bellows safety valve is used in closed flare system and the variable backpressure is above 30 percent of the relieving pressure, check with the manufacturer on the decrease in the capacity of the particular valve when sizing.

Do not use this type of safety valve

- Where the liquid being discharged could accumulate and set up in the convolutions or bellows and make safety valve inoperative.
- Superimposed backpressure due to operation of emergency depressuring valves shall be disregarded when evaluating the necessity of balanced type valves, since simultaneous operation of relief and depressuring valves should not normally occur. As variable backpressure the highest pressure shall be taken that can be generated in the outlet of a valve by the valve itself, and possibly other valves at the same time of blowing.
- Bellows balanced valves shall not be used for services involving materials with their pour point at or above lowest ambient temperature (e.g., materials containing wax) or where coking may be expected. Balanced valves with a piston only shall be used in such cases.

9.3. Set Pressure

Unless otherwise specified in this Section, safety relief valves shall be set to relieve initially at the design pressure of the equipment, within the limitations of the allowable blowdown and accumulation specified in this Section.

Unless otherwise specified in this Section, the stated set pressure is the initial relieving pressure.

In general, Set Pressures (SP) and Maximum Relief Pressures (MRP) of safety/relief valves, expressed in relation to the Design Pressure (DP) of the protected equipment, all expressed in gage pressure shall not exceed the values given below:

Description	Set Pressure (SP)		Maximum Relieving Pressure (MRP)	
	Non-fire Conditions	Fire Conditions	Non-fire Conditions	Fire Conditions
Single Valve	100% of DP	100% of DP	110% of DP	121% of DP
Multiple Valves	One Valve 100% of DP the other at 105% of DP**	110% of DP*	110% of DP	121% of DP

* Relief valves for fire protection may only be set at 110% of DP if they are installed in addition to adequate relief protection of the process equipment against non-fire situations.

** For set pressures below 1000 kPa (10 bar), staggering of set pressure becomes impracticable because of the difference between the set pressure tolerance of 3% (according to ASME VIII UG 134) and the value of 5% of the DP becomes too small.

The above shall also apply to safety/relief valves discharging liquid and flashing liquid.

9.4. Sizing

Safety relief valve capacity formulas used for calculation of the required orifice area shall be in accordance with API Recommended Practice 520 Part I, Section 4 "Procedures for Sizing".

The standard effective orifice areas and the corresponding letter designations shall be according to API Standard 526.

The thermal expansion valves can be 3/4" NPT × 1” NPT.

9.5. Positive Displacement Pumps Safety Relief Valve Capacity

Safety valves on positive displacement pumps shall be sized for the maximum pumping capacity at recommended speed.

Where the pump and equipment pumped into are designed for the stalling pressure of the pump under normal conditions, the safety valve shall be sized for 25 percent of the pump rated capacity under continuous operating conditions.

10. EQUIPMENT AND PIPING INSULATION

Consideration shall be given to the following:

All surfaces above 70°C (160° F) which could be touched, or where the radiant heat could be dangerous in the course of normal operating duties, shall be guarded or insulated to reduce the surface temperature to a maximum of 70°C. These requirements may not be applied to the surfaces where the high surface temperature is caused solely by local climatic conditions.

Pumps shall not normally be insulated unless it is desired from process or safety aspects.

If credit is taken for thermal insulation in determination of heat input to a vessel during fire condition, and the pressure relief valve is sized on this basis, then the clad insulation shall be secured such that to resist the force of fire hose streams.

The type of insulation to be used and the thickness required shall be evaluated for each service to provide the best combination of thermal efficiency and low cost.