

SPD0035ERN

PROCESS DESIGN MANUAL

FLARE AND BLOWDOWN SYSTEMS

REV. : 3

DATE : 2013. 08. 23



**SAMSUNG
ENGINEERING**

SAMSUNG ENGINEERING CO., LTD.

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013. 08. 23</u>		REV.: <u>3</u> Page i of ii

Table of Contents

1. INTRODUCTION	1
2. PIPING	1
2.1 General	1
2.1.1 Standard (HP/LP) Flare	1
2.1.2 Acid Gas Flare	1
2.1.3 Cold Flare	2
2.2 Design Condition	2
2.2.1 Short-term Design Conditions	3
2.2.2 Long-term Design Conditions	3
2.3 Details	3
2.3.1 Line Class Break	3
2.3.2 Piping Arrangement	4
2.3.3 Low Point of Outlet Line for Safety/Relief Valve	4
2.3.4 Purge Point of Gas for Dry Seal	5
2.3.5 Insulation of Flare Line	5
2.3.6 Location of Safety/Relief Valve	5
2.3.7 Valves on Inlet/Outlet Line of Safety/Relief Valve	5
2.3.8 Bypass Valve for Safety/Relief Valve	5
2.3.9 Connection between Main Header and Branch Header below Main Header	6
2.3.10 Free-Draining Requirement	6
2.3.11 Absorption of Thermal Expansion in Headers by Looped Pipes	6
2.3.12 Absorption of Thermal Expansion by Expansion Joints	6

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013. 08. 23</u>		REV.: <u>3</u> Page ii of ii

3. MATERIAL SELECTION	7
4. KNOCK-OUT DRUM	7
4.1 General	7
4.2 Details	7
5. QUENCH DRUM	8
5.1 General	8
5.2 Details	8
6. BLOWDOWN SYSTEM	9
6.1 General	9
6.2 Blowdown System for Vapor Relief Stream.....	9
6.2.1 Vapor Discharge to Atmosphere.....	9
6.2.2 Vapor Discharge to Lower Pressure Process Vessel or System	10
6.2.3 Vapor Discharge to Closed Pressure Relief System and Flare	10
6.3 Blowdown System for Liquid Relief Stream.....	11
6.3.1 Liquid Discharge to Onsite Liquid Blowdown Drum	11
6.3.2 Liquid Discharge to Lower Pressure Process Vessel or System	11
6.3.3 Liquid Discharge to Oily Water Sewer	11
6.3.4 Liquid Discharge to Pump Suction.....	11
6.3.5 Liquid Discharge to Burnpit.....	12
6.3.6 Liquid Discharge to Vaporizer.....	12
7. REFERENCES	12
8. TABLES AND FIGURES	13
FIGURE-1. CLASS BREAK OF PIPING	13
FIGURE-2. DRAIN POT	13
9. ATTACHMENT-1	14
10. REVISION HISTORY.....	15

 DATE: 2013. 08. 23	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN REV.: 3 Page 1 of 15
---	---	---

1. INTRODUCTION

This Basic Design Manual covers the basic concepts of the flare and blowdown systems.

2. PIPING

2.1 General

Flare headers and relief valve tail pipes are to be routed without pockets and sloped to allow free drainage to the respective knock-out drum. Relief valves and other overpressure protection devices are to be located at high points in the piping system.

The upstream and the downstream laterals of a PSV shall be sized based on the rated capacity of the PSV. Piping to pressure relief valve inlet shall be as short as possible. The upstream line shall be sized so that the pressure loss is below 3% of the valve set pressure to avoid valve chattering.

The main flare header design is based on the appropriate sum of the required relieving rates.

The headers can be segregated in accordance with the process characteristics such as HP flare, LP flare, acid gas flare, and cold flare.

2.1.1 [Standard \(HP/LP\) Flare](#)

[Relief valves that discharge flammable or toxic fluids are typically routed to the standard relief header for safe disposal. Both liquid and vapor can be discharged to the standard relief header, but liquid knockout facilities may be required within the process unit to prevent liquid from entering the main relief header.](#)

[If the relieving fluid autochills to a temperature between a -29°C and -45°C, a note should be added to the header detail requiring impact-tested killed carbon steel.](#)

2.1.2 [Acid Gas Flare](#)

[An acid gas relief header is typically specified for Sour Water Stripping, Amine Treating, Amine Guard FS, and the Selexol process units, etc. If the relieved vapor has a concentration of hydrogen sulfide too high for a standard relief header \(generally over 50 wt%\), then the pressure relief device can be routed to the acid gas relief header.](#)

[The preferred metallurgy for this header is 316L SS which provides corrosion protection. \(Steam-jacketed killed carbon steel can be used instead of 316L, but this design is inherently less safe. This design](#)

 SAMSUNG ENGINEERING	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN REV.: <u>3</u>
DATE: <u>2013. 08. 23</u>		Page 2 of 15

utilizes a steamjacket to maintain the killed carbon steel piping above the water dew point of the relief stream. Thus, corrosion protection will be compromised if steam is lost or if the steam trap fails closed.)

- If the lowest ambient temperature is below 0°C, heat tracing is required to prevent ice build-up in the header. When ice formation is an issue, set the objective temperature for the heat tracing at 5°C.
- If the acid gas contains both ammonia and hydrogen sulfide, ammonium bisulfide salt may build-up and restrict or block flow in the header. This hazard is addressed by tracing the acid gas header. Set the objective temperature for the heat tracing above the dissociation temperature of ammonium bisulfide, i.e. 85°C. If ammonium bisulfide does not solidify at the low ambient temperature, heat tracing is not required.

2.1.3 Cold Flare

Cold flare headers are used when relief streams are sufficiently cold to cause embrittlement.

Cold flare header shall be designed to prevent ice plugging or hydrate formation at the relief streams. Therefore relief streams containing water are generally not discharged to the cold flare header. And, if the flash temperature of relieving stream is below -45°C, route the relief valve discharge to a cold flare header. But if the flash temperature is between -29°C and -45°C, preferentially route the relief valve discharge to a cold flare header, when available, or to an impact-tested killed carbon steel relief header.

It is acceptable to add a valve (with blankoff) for methanol injection to allow methanol to be injected to deice a flare header.

A cold flare header is typically constructed of 304 SS to withstand low temperature embrittlement. Refer to Attachment 1 for guidance in selecting the appropriate relief header based on the adiabatic flash temperature and water dew point of the relieving stream.

Although this procedure primarily applies to relieving stream, it can also be applied to depressuring operations and manual drains and vents routed to the relief header. If the venting/draining operation is expected to last for fifteen minutes or more, follow the logic given in Attachment 1.

2.2 Design Condition

It is inconceivable that the design relief loads and conditions in the case of a

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: 2013. 08. 23		REV.: 3 Page 3 of 15

failure will continue for long periods. Thus, the design relief conditions can be regarded as short-term conditions.

Accordingly, the following are the design short-term conditions and long term conditions for relief systems.

2.2.1 Short-term Design Conditions

The short-term design conditions in the case of a failure shall be determined as follows:

- a) Design temperature shall be the maximum/minimum temperature of the pipes.
- b) Design pressure shall be the maximum pressure to be attained within the system.
- c) No allowance shall be given above the design temperature and design pressure if they are based on short-term conditions.
- d) If a steam purge is to be carried out, the following assumptions should be included as part of the short term design conditions.
 - [Maximum design](#) Temperature shall be [over](#) 150°C.
 - [Minimum design](#) Pressure shall be 0 kg/cm²G.

2.2.2 Long-term Design Conditions

The long-term design conditions shall be determined based on the following:

- a) Normal operating temperature shall be ambient temperature.
- b) Normal operating pressure shall be atmospheric pressure.
- c) Design temperature shall be 150°C.
- d) Design pressure shall be the lowest design pressure of the vessel
(Typically 3.5 kg/cm²G or so).

2.3 Details

2.3.1 Line Class Break

- a) If the material or class of tail pipes are altered because of an extremely high or low design temperature, class break shall be made at tail pipes or midway along a header as shown in Figure-

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013. 08. 23</u>		REV.: <u>3</u> Page 4 of 15

1. Heat loss calculations may be required to estimate tail pipe temperature profile, as needed.

- b) The method of connecting pipes at a class break point shall be determined by consulting with the Piping Design Department. Class break point on tail piping is located 1~3 meters apart from high grade material header against longitudinal thermal conduction, but it is influenced by insulation, pipe diameter, and so on.

2.3.2 Piping Arrangement

- a) Flare headers and subheaders are based upon a maximum velocity of 0.6 times the Mach No.
- b) PSV discharge lines, depressuring lines are based upon a maximum velocity of 0.7 times the Mach No..
- c) Two phase relieving for potential slug/plug flow: $V < 50$ m/s.

Where these criteria cannot be met, additional calculations might be required to document that the selected pipe size is still acceptable. This involves evaluating piping stress levels, noise, etc. All of these criteria should not be applied for corrosive, erosive systems.

If $\rho v^2 > 200000$, the piping discipline shall be consulted in order to consider reaction forces (ρ is fluid density in kg/m^3 and v is velocity in m/s for gas, liquid two-phase flow).

The basic criterion for sizing the discharge piping and the relief manifold is-that the back pressure (which can exist or be developed at any point in the system) shall not reduce the relieving capacity of any of the pressure-relieving devices below the amount required to protect the corresponding vessels from overpressure.

2.3.3 Low Point of Outlet Line for Safety/Relief Valve

In principle, a safety/relief valve should be located at an elevation above the flare header to permit free draining.

However, if a safety/relief valve must be installed below the flare header, the outlet line leading to the flare header shall be steam-traced from the safety/relief valve to its highest point. But this arrangement must be reviewed, as such an arrangement is not

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013. 08. 23</u>		REV.: <u>3</u> Page 5 of 15

permitted for safety/relief valves discharging a medium which can leave a residue or safety/relief valve outlines which can accumulate condensed liquid from the flare header.

The steam-tracing can be omitted if the safety/relief valve and the safety/relief valve outline in question will handle only products which do not condense and vaporize completely at the lowest ambient temperature.

2.3.4 Purge Point of Gas for Dry Seal

A continuous fuel gas purge is usually [introduced into](#) the end of the main header and the end of any major subheader [to prevent oxygen ingress](#). The fuel gas purge shall be controlled by means of a restriction orifice.

2.3.5 Insulation of Flare Line

Normally insulation of flare lines (including outlet line of safety/relief valve) is not required unless it is required for personnel protection. However, insulation or steam tracing shall be considered, if prevention of hydrate formation or ice accumulation, etc., within the flare line is applicable.

2.3.6 Location of Safety/Relief Valve

More than one piece of equipment may be protected by a common safety/relief valve, provided they are connected by a line of sufficient size and all block valves in the connecting line are locked open.

2.3.7 Valves on Inlet/Outlet Line of Safety/Relief Valve

Isolation block valves may be used for maintenance purposes to isolate a pressure-relief device from the equipment it protects or from its downstream disposal system. Since improper use of an isolation valve may render a pressure-relief device inoperative, the design, installation, and administrative controls placed on these isolation valves should be carefully evaluated to ensure that plant safety is not compromised. See API RP 520, Part II, Section 6 for additional details.

A thermal expansion relief valve will typically have block valves on the inlet and outlet lines, when venting to a closed system and a block valve on the inlet line, when venting to the atmosphere.

2.3.8 Bypass Valve for Safety/Relief Valve

Where an equipment item requires venting during regular maintenance and does not have a dedicated vent line to the flare, a bypass valve shall be installed at the relevant safety/relief valve.

SAMSUNG ENGINEERING DATE: <u>2013. 08. 23</u>	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN REV.: <u>3</u> Page 6 of 15
--	--	---

2.3.9 Connection between Main Header and Branch Header below Main Header

A drain pot must be installed for the branch header, which must be connected to the main header from a lower level, e.g. sleeper flare piping. This is shown in Figure-2.

2.3.10 Free-Draining Requirement

The relief header and all piping associated with the relief valve must be free-draining. If liquid is allowed to accumulate in the piping, severe damage to the relief header can occur when liquid slugs are accelerated downstream by vapor discharging into the header. In addition, free-draining helps minimize corrosion caused by standing pools of acidic water.

The pressure relief device is generally elevated above the relief header to facilitate free-draining of the tailpipe to the header.

And, a slope of 1 meter for every 500 meters of piping run is suggested for the flare header.

2.3.11 Absorption of Thermal Expansion in Headers by Looped Pipes

- a) As a rule, headers shall be designed so that thermal expansion generated in headers can be absorbed by the bent parts of the headers. In other words, the piping route of headers shall incorporate several bends.
- b) If thermal expansion cannot be absorbed by the above method, absorption by looped pipes shall be considered. Looped parts shall have no drain pockets.

2.3.12 Absorption of Thermal Expansion by Expansion Joints

- a) As a rule, no expansion joints shall be used. The use of expansion joints is limited to the case in which thermal expansion cannot be absorbed by pipes alone because of a short route, e.g. the route between the seal-drum (or knock-out drum) and the flare stack.
- b) Drain pipes shall be installed at bellows or other concave parts, where condensate is likely to accumulate.
- c) The conditions for selecting bellows (design conditions, materials) shall be specified clearly.

 DATE: <u>2013. 08. 23</u>	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN REV.: <u>3</u> Page 7 of 15
--	---	--

3. MATERIAL SELECTION

For an acid gas header, the tailpipe and the relief header should be specified as 316L SS because this design is inherently safer than a steam-jacketed killed carbon steel header.

The metallurgy required for cryogenic service is based on the auto-chill temperature of the relief stream when flashed at the nominal header pressure, i.e. 0.35 kg/cm² G. If the temperature is above -29°C, killed carbon steel is adequate. If the auto-chill temperature is between -20°F and -45°C, impact-tested killed carbon steel is used. But if the flash temperature is -45°C or lower, 304 SS piping is required.

Note that the standard metallurgy for the PRV body is 316SS when the autochill temperature or the lowest ambient temperature is below -29°C.

Material selection should be reviewed in the event the fuel gas purge is deemed to be a wet H₂S service.

4. **KNOCK-OUT DRUM**

4.1 **General**

The flare knock-out drum shall be sized to accommodate liquid accumulation and still have sufficient room for an available gas volume to handle the separation requirements.

The knock-out drum liquid containment capacity should be based on the largest foreseeable liquid condensation rate for a recommended period from LAH to LAHH level trip. This period should provide realistic time to identify a problem and allow for operator intervention.

The knock-out drums shall be designed to prevent development of waves or entrainment of disengaged liquids during flaring at high gas and liquid rates.

4.2 **Details**

- a) The knock-out drum shall be designed in accordance with API Standard 521 / ISO 23251, Section 7.3.2.1. "Knock-out Drums", based on 300~600 μm droplet size range as the separation requirement. If the knock-out drum would become disproportionately large, adoption of the vane type knock-out drum or cyclone type knock-out drum should be considered.
- b) The liquid space in the knock-out drum between high level alarm and minimum pump-out level shall be able to contain at least the maximum liquid quantity released during a period of 20~30 minutes.

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: 2013.08.23		REV.: 3 Page 8 of 15

- c) The knock-out drum shall have a design pressure capable of withstanding the maximum back pressure.
- d) Minimum design pressure is 3.5 kg/cm²G (see API Standard 521, Section 7.3.2.4,h).
- e) The knock-out drum shall be provided with a pump sized to empty the drum in two hours. The pump shall discharge to a slop tank or other suitable equipment.
- f) The knock-out drum shall be provided with a level alarm to indicate when liquid begins to accumulate in the drum. This will alert the operator that remedial actions are required before the drum spills over into a flare line. The pump may also be automatically level controlled.
- g) A heating coil may be provided in the knock-out drum in place of the pump if the liquid can be vaporized. Sizing of the heating coil is based on vaporizing all the liquid that is stored in the drum from low level to high level in two hours.

5. QUENCH DRUM

5.1 General

A quench drum is provided as a means to prevent liquid hydrocarbon condensation in the flare system, to reduce flare capacity requirements, or to prevent discharge of condensable hydrocarbons to the atmosphere. In some cases, they serve the additional purpose of reducing the maximum temperature of flare gases and, hence, minimizing thermal expansion problems in the mechanical design of flare headers. The quench drum functions by means of a direct contact water spray arrangement which condenses the entering heavy hydrocarbon vapors. Condensed hydrocarbons and effluent water are discharged through a seal to the sewer or pumpout to slop tankage. On the other hand, uncondensed hydrocarbon vapors are vented to the flare or to the atmosphere.

5.2 Details

- a) The quench drum shall be designed in accordance with API Standard 521 Section 7.3.2.3.3 [“Atmospheric knockout drums\(with quench provisions\)”](#).
- b) The quench drum shall have a design pressure capable of withstanding the maximum back pressure. Minimum design pressure is 3.5 kg/cm²G.

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: 2013.08.23		REV.: 3 Page 9 of 15

- c) A common criterion is to reduce the temperature of the stream so that the exit liquid and vapor do not exceed the range of 66°C to 93°C (150°F to 200°F) and, typically, to assume that no more than 40% or 50% of the liquid fed is vaporized. The water supply should be taken from a reliable water system. If a recirculating cooling water system is used, then the circulating pumps and cooling water basin must have adequate capacity to supply the maximum quench drum requirements for a period of [30](#) minutes.
- d) The seal height in the liquid effluent line (assuming 100% water) is sized for 175% of the maximum operating pressure, or 3 meters, whichever is greater (see API RP 521 Annex D).
- e) [The quench water system shall be equipped with suitable winterization and freeze protection.](#)

6. BLOWDOWN SYSTEM

6.1 General

The selection of a disposal system shall be conducted in accordance with the expected frequency, duration of operation, required capacity, and fluid properties. The various systems for the disposal of voluntary or involuntary vapor or liquid discharges are mentioned in the following.

6.2 Blowdown System for Vapor Relief Stream

Systems for the disposal of voluntary and involuntary vapor discharges are the following:

- a) To atmosphere
- b) To lower pressure process vessel or system
- c) To closed pressure relief system and flare

6.2.1 Vapor Discharge to Atmosphere

Vapor relief streams [can](#) be vented directly to atmosphere if all of the following conditions are satisfied:

- a) Such disposal is not in conflict with the present regulations concerning pollution and noise.
- b) The vapor is effectively non-toxic and non-corrosive.

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013. 08. 23</u>		REV.: <u>3</u> Page 10 of 15

- c) Vapor which is lighter than air or vapor of any molecular weight that is non-flammable, non-hazardous, and non-condensable.
- d) There is no risk of condensation of flammable or corrosive materials.
- e) There is no chance of simultaneous release of liquid, apart from water.
- f) Exceptions:
Vapor from emergency depressuring valves shall be discharged to a closed pressure relief system.

Individual vent pipe to the atmosphere can be sized for a relatively high exit velocity, however the outlet piping should not be smaller than pressure-relief device outlet.

6.2.2 Vapor Discharge to Lower Pressure Process Vessel or System

Individual safety/relief valves may discharge to a lower pressure process system or vessel capable of handling the discharge. Although this type is infrequently used, it is effective for discharges that contain materials which need to be recovered.

6.2.3 Vapor Discharge to Closed Pressure Relief System and Flare

In all cases where the atmospheric discharge of vapor or discharge to a lower pressure system is not permissible or practicable, vapor shall be collected in a closed pressure relief system which terminates in a flare system.

Where the concentration of H₂S is more than 10% by volume, a dedicated flare header that is steam-traced to prevent condensation in the line should be installed to the flare.

And Sour gas release system may be referred to SHELL Design Specification, DEP 80.45.10.10-Gen.

The following factors should be considered before deciding that a separate H₂S flare need not be installed, in which case the sour gas release can be tied into the HC flare:

- a) Continuous HC release with an H₂S content <2% by volume
- b) Intermittent HC release (only during start-up and shutdown) with an H₂S content < 20 % by volume, provided this stream is less than 10 % by volume of the total continuous HC release rate;
- c) Emergency HC release (e.g. PSV, emergency depressuring)

 SAMSUNG ENGINEERING	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013. 08. 23</u>		REV.: <u>3</u> Page 11 of 15

with an H₂S content < 50 % by volume.

In all cases, the installation of a closed pressure relief system shall result in minimum air pollution and minimum release of combustion products.

6.3 Blowdown System for Liquid Relief Stream

Systems for the disposal of voluntary and involuntary liquid discharges are the following:

- a) To onsite liquid blowdown drum
- b) To lower pressure process vessel or system
- c) To oily water sewers, if the material will not cause hazardous conditions
- d) To pump suction, if pump will not overheat or can withstand the expected temperature rise
- e) To burnpit
- f) To vaporizer

Thermal expansion relief valves may discharge small quantities of volatile liquid or vapor into the atmosphere, provided the valve outlet is located in a safe location.

6.3.1 Liquid Discharge to Onsite Liquid Blowdown Drum

The liquid shall be discharged to an onsite liquid blowdown drum which is capable of retaining the liquid discharged at the required liquid relief rate for a period of 20 minutes.

This drum shall have a vapor discharge line to the closed pressure relief system.

6.3.2 Liquid Discharge to Lower Pressure Process Vessel or System

The liquid shall be discharged to a lower pressure process vessel or system which is capable of handling the required liquid relief rate plus any flashed vapor.

6.3.3 Liquid Discharge to Oily Water Sewer

Liquid discharge to an oily water sewer shall be nonvolatile and nontoxic. The required liquid relief rate shall be within the oil removal capability of the oily water treating system.

6.3.4 Liquid Discharge to Pump Suction

	PROCESS DESIGN MANUAL FLARE AND BLOWDOWN SYSTEMS	SPD0035ERN
DATE: <u>2013.08.23</u>		REV.: <u>3</u> Page 12 of 15

Required liquid relief shall discharge to an appropriate pump suction. The liquid relief may discharge directly to the pump suction line if sufficient cooling is provided to prevent a temperature rise of the liquid recycled through the pump when the safety/relief valve opens or when a constant displacement pump is used.

6.3.5 Liquid Discharge to Burnpit

Liquid relief or voluntary liquid blowdown which need not be returned to the process or discharged to an oily water sewer, shall be discharged to a burnpit, if environmentally accepted.

6.3.6 Liquid Discharge to Vaporizer

The liquid shall be discharged to a vaporizer which is capable of vaporizing a liquid relief of no more than 5 tons/hr.

7. REFERENCES

- a) API Standard 520 Part I, Eighth Edition, December 2008
- b) API RP 520 Part II, Fifth Edition, August 2003
- c) ANSI/API Standard 521 (ISO 23251), Fifth Edition, January 2007

8. TABLES AND FIGURES

FIGURE-1. CLASS BREAK OF PIPING

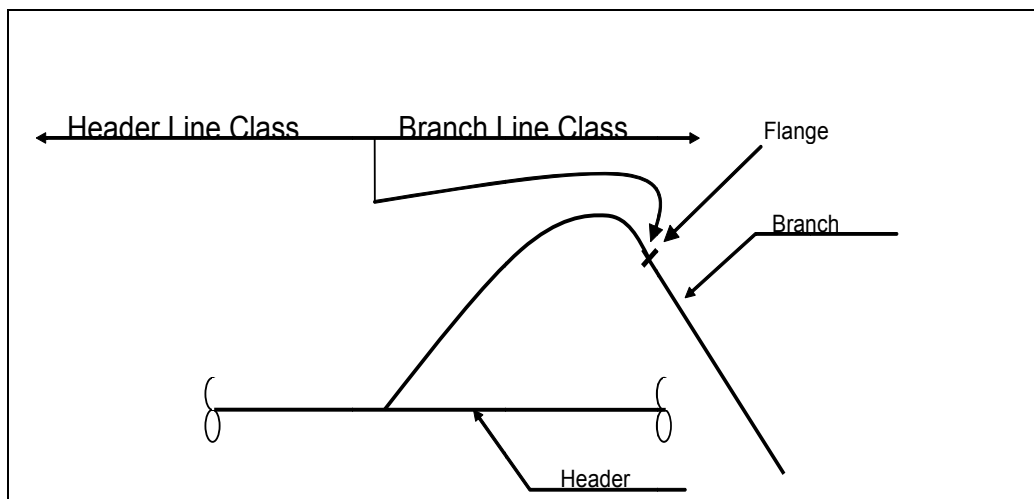
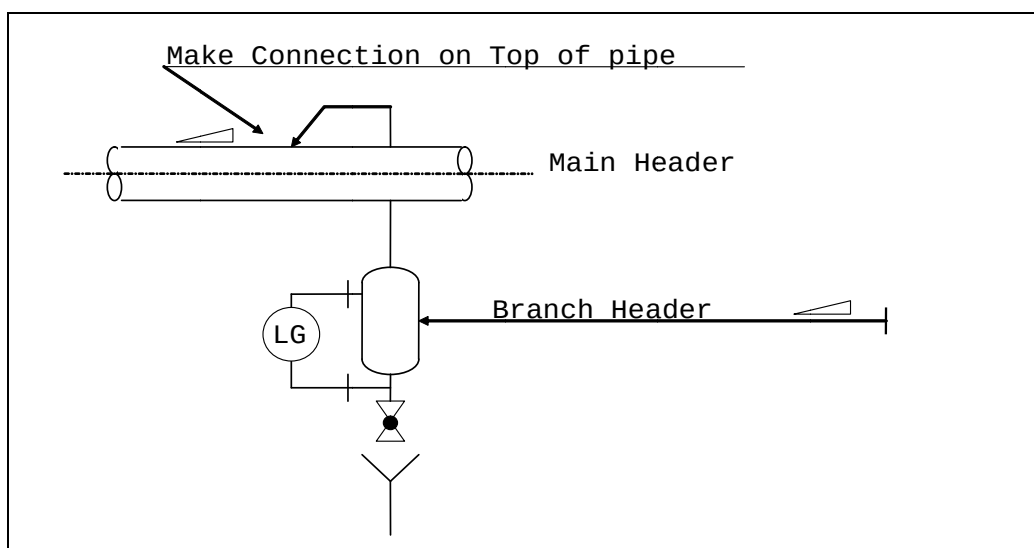


FIGURE-2. DRAIN POT



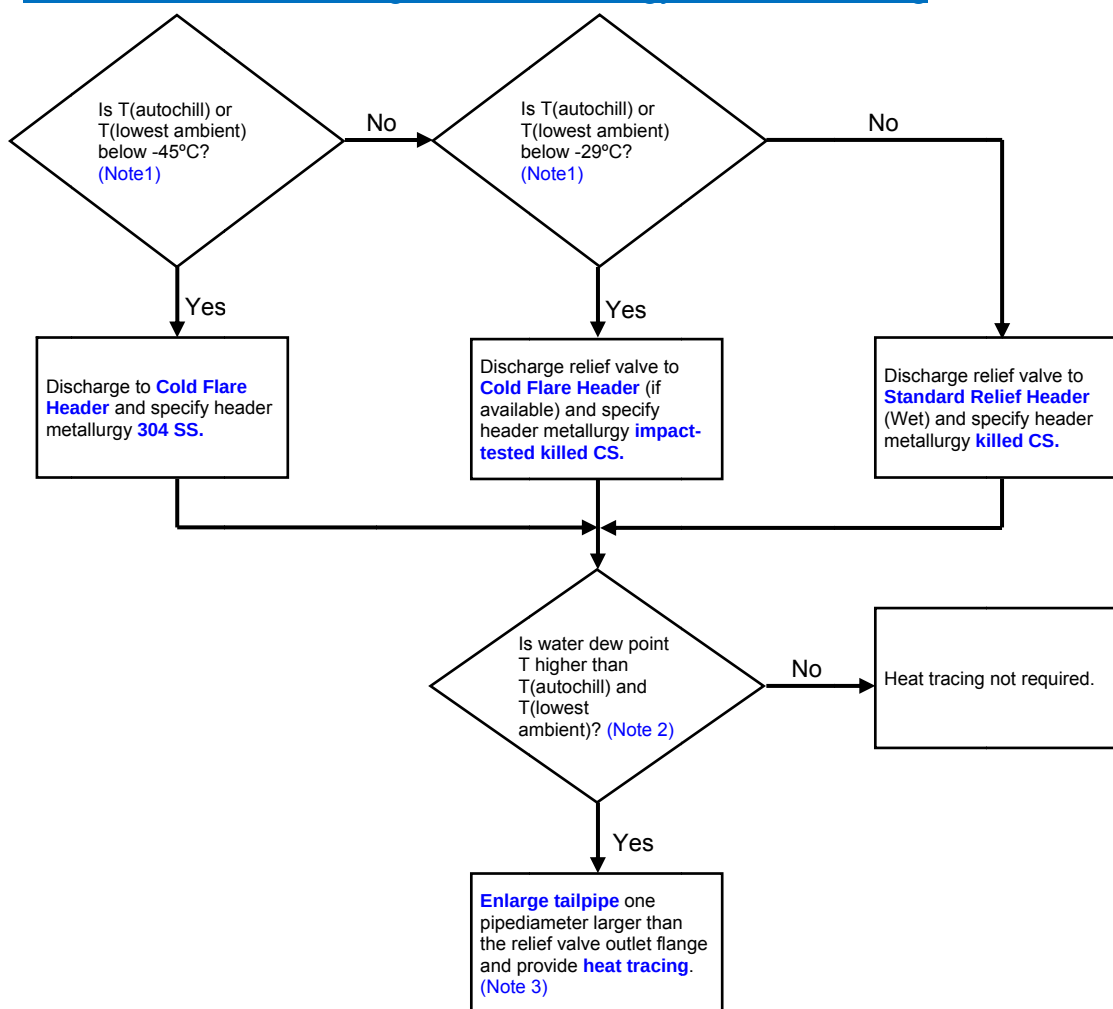
Drain Pot Size

Diameter: The larger between twice [of](#) the cross-sectional area of the branch header and a diameter of 10 inches.

Height : Minimum 800 mm

9. ATTACHMENT-1

Decision Tree for Selecting Header Metallurgy and Heat Tracing



Note 1. Relief and vent streams containing light liquids (C4 minus) will flash when entering the relatively low pressure relief header and auto-chill. If the auto-chill temperature is lower than -29°C, carbon steel will be susceptible to brittlefracture. This hazard is addressed by upgrading the piping metallurgy.

Note 2. If the water dew point temperature is above the auto-chill temperature, a separate water phase will occur in the relief header. If the auto-chill temperature is lower than 0°C, ice will form in the header. This hazard is addressed by enlarging the tailpipe one pipe diameter to accommodate the ice build-up during a short-lived relief event.

Note 3. If the water dew point, lowest ambient, and the auto-chill temperature are such that ice will form when the relief valve leaks, heat tracing is required to prevent an undetected ice build-up in the header piping. Since the tailpipe size is not given on the P&ID, add a note to specification instructing the contractor to enlarge the tailpipe at least one pipe size to accommodate ice build-up.

10. REVISION HISTORY

개정번호	개 정 일 자	개정 페이지	개 정 사 유
0	98.04.17	전 페이지	신규 제정 - 작성부서 : 공정팀 - 작성자 : 이의덕 이상복 - 검토자 : 이봉일 조석범 노재철 - 승인자 : 오성국
1	2004.03.30	4,5,6,7,10	개정 누락항목(to be later)의 삽입, 일부보충, 당사와 무관한 매뉴얼언급 정정, 오타자 수정. - 작성부서 : 공정팀 - 작성자 : 송창수 이승용 - 검토자 : 노재철 박종현 오명환 이의덕 - 승인자 : 정찬설
2	2010.11.20	전 페이지	Document number revision - 작성자 : 이태화 - 검토자 : 헨리성, 노재철, 곽홍해, 오명환, 홍성은 - 승인자 : 이의덕
3	2013.08.23	ALL PAGES	- MADE BY : S.M. JUNG - Checked by : P.M. Hur - Approved by : S.B. LEE