

SCOPE

- I 1.1 This practice covers the design and layout of suction and discharge piping for centrifugal pumps.
- I 1.2 **An asterisk (*)** indicates that additional information is required. If a job is contracted, this additional information is furnished in the Job Specification.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the standards which shall be used with this practice.

TABLE 1

STANDARDS	
API Standard	
610	Centrifugal Pumps for General Refinery Service
HI Standard	
	Hydraulic Institute Standards

VALVE ARRANGEMENT, SIZING, AND RATINGS

- I 3.1 **Discharge and suction valves** shall be arranged per **Figure 1**.
- O,R 3.2 **Check valve installation** in the pump discharge line shall be per **Figure 1** and the following:
 - a. **A single check valve** shall be installed if there is any possibility of a reversal of flow.
 - * b. **Two check valves** are required in a hydrocarbon service when the pump differential pressure exceeds 1000 psig (6900 kPa).
- O,C 3.3 **Valve sizing** shall be as follows:
 - a. **Check valves and discharge block valves** shall be **line-size**. However, if the discharge line is two or more sizes larger than the pump discharge nozzle, the valves may be the **next standard size smaller**.
 - b. **Suction valves** shall be **line-size**. However, a size reduction to **one size larger than the nominal size of the pump suction nozzle** may be used if:
 - 1. The result is a lower total installed cost, and
 - 2. The effect on NPSH is tolerable at design and all anticipated operating conditions.
- S 3.4 **Suction valve ratings** shall be as follows:
 - a. With a single pump in the line, the suction valve and any components between the valve and the pump shall have a pressure-temperature rating of not less than 75 percent of the residual discharge pressure after the pump is shut down at maximum operating temperature.
 - b. **When two or more pumps are manifolded**, the suction valves and any components between the valves and the pumps shall have a pressure-temperature rating of not less than 75 percent of the maximum discharge pressure of the pump at maximum operating temperature.

OVERPRESSURE PROTECTION FOR PUMP CASINGS AND MECHANICAL SEALS

- S 3.5 **A pressure relief (PR) valve** shall be provided to **protect the pump casing or mechanical seal** if the pump can be exposed to excessive pressure from the discharge of an associated operating pump, a source of residual pressure in the discharge line, or from an external flushing supply source, while the pump is idle with its suction valve closed.
If only the pump casing requires protection, increasing the casing design pressure to a safe level shall be evaluated as an **alternative to a PR valve installation**.
- S 3.6 **If a PR valve is required**, it shall be **located** on the pump suction pipe between the pump and the suction valve. (See **Figure 1**.)
- S 3.7 **PR valves** shall be **set** to open at the **lowest of the following pressure conditions**:
 - a. Maximum static pressure rating of the mechanical seal(s).
 - b. Pump casing maximum allowable working pressure (MAWP).
 - c. MAWP of any other limiting component between the pump suction and discharge valves.

S **3.8 PR valves** shall be sized on the following bases:

SOURCE OF POTENTIALLY EXCESSIVE PRESSURE	PR VALVE SIZING BASIS
a. External flushing only	Total maximum flushing rate to pump (for mechanical seal(s) and wearing rings)
b. Pump discharge only	10% of pump rated capacity plus the maximum flow through any drilled check valve or bypass in the pump discharge
c. External flushing and pump discharge	The greater of: the total maximum flushing rate, or the sum of 10% of rated pumping capacity plus maximum flow rate through any drilled check valve or bypass in the pump discharge

S **3.9 Discharge from the PR valve** shall be piped to the pump suction source upstream of the suction valve.

PIPING LAYOUT

- O * 4.1 **Length of suction line.** For pumps taking suction from drumless condensers, the length of the sloped "horizontal" suction line under the condenser must be minimized to avoid local vapor lock caused by velocity losses.
- O 4.2 **Slope of suction line:**
 - a. **If vapors can be present** in the suction line, it shall be **sloped not less than 1:50** downward from the vessel toward the pump.
 - b. In all services, **high point vapor traps** in the suction line shall be avoided.
 - * c. If it is impractical to meet the requirements of **Par. 4.2 a or b** due to layout considerations, **alternative piping arrangements to avoid high point vapor traps** shall be approved by the Owner's Engineer.
- O 4.3 **Reducers in horizontal suction lines** shall be eccentric and shall be installed as shown in **Figure 1**, to avoid pocketing of vapors in the horizontal line.
- O,M 4.4 **Pumps handling C₅ and lighter** shall be **provided with an NPS 1 valved connection** in the discharge piping for priming cooldown and/or clearing purposes. The connection is to be made at an appropriate location on the pump discharge piping (preferred location is between check and discharge block valves to permit clearing of the piping before maintenance) and shall be accessible from grade.
- O 4.5 **A valved vent** shall be **provided in the suction piping of pumps in low temperature service** [below -40°F (-40°C)] **or volatile liquid service** with pumping temperature below the specified maximum ambient temperature. The vent shall be located close to the pump suction nozzle to remove vapor which can form along the suction piping during startup.
- O 4.6 **Elbow on suction line to double suction pump.** The plane of the first elbow shall be perpendicular to the pump shaft.
- O 4.7 **The suction intake and sump design for pumps taking suction from an open well**, e.g., cooling tower, sump pumps etc., shall meet or exceed the requirements of the Hydraulic Institute Standards.
- O,M 4.8 **Strainer installation:**
 - * a. **Temporary strainers** shall be installed per **Figure 1** unless permanent strainers have been specified.
 - b. **Piping layout** shall permit insertion and removal of the **temporary strainer** without disturbing equipment alignment. Pipe fittings such as Tee's, "Y"s, or fabricated piping spool pieces are acceptable for this purpose.
 - c. **The design and location of permanent strainers** shall permit cleaning without removing the strainer body.
 - d. **A plugged connection for future addition of a pressure gage** shall be provided in the suction piping **on each side of a permanent strainer**.
- O 4.9 Pump vendor recommendations regarding **control valve location relative to pump discharge flange** shall be observed.