Tech Sheet #SPD 205

Secondary Pressure Drainer (SPD) Receiver / Reservoir sizing

Type I SPD & Electric Pump Systems

A receiver should be used to collect condensate from a single source or from multiple sources. When collecting condensate from multiple sources, a vented receiver is required to equalize the different source pressures. Refer to FCI Tech Sheet #201.

When sizing a receiver for a Type I SPD in an atmospheric condensate return system, the receiver must be sized to allow for pressure equalization (if there are multiple condensate sources), flash steam separation from the condensate, and for the amount of flash steam to be vented through the atmospheric vent pipe. The Type I SPD receiver should also be sized large enough to hold the back up of the SPD's swept volume during its discharge and motive venting stages. Designers should also include margin factor for system dynamics. See below an example illustration of a Type I SPD.

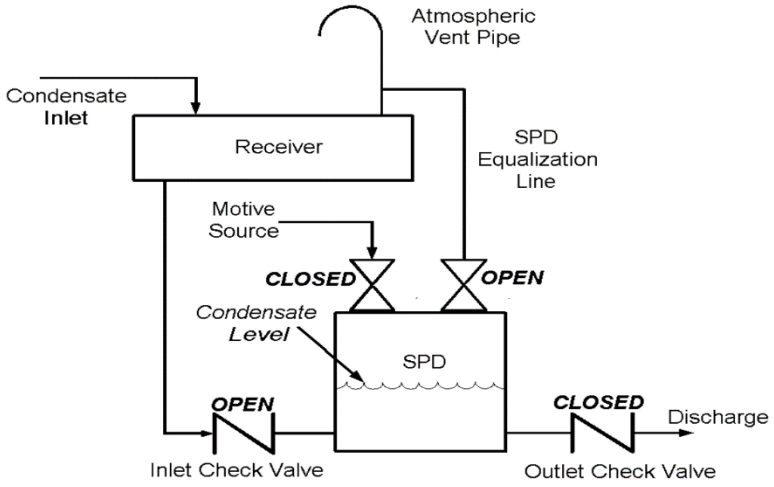

Fig. A Fill Stage

The vent pipe on the receiver should be sized large enough to allow free flow of flash steam from the receiver to the atmosphere, and will help ensure proper drainage of all condensate systems.

Undersizing the vent pipe will gradually create back pressure inside the receiver, and increase the likelihood of moisture carry over which could have considerable safety considerations.

The following steps should be used to properly size the receiver:

1. Determine the pressure, condensate load and the resulting Percentage of Flash Steam. (See Appendix A).

2. Multiply the condensate load by the Percentage of Flash Steam to give the quantity of flash steam in lb/hr.

3. Repeat steps 1 to 2 for all sources of condensate and calculate the total quantity of flash steam in lb/hr.

4. Determine the minimum size of the receiver by selecting the total quantity of flash steam load from the first column of Table 1 and reading across the row to determine receiver dimensions, including vent size.

Table 1

Minimum Vented Receiver Sizing for Type I SPD & electric pumps			
Quantity of Flash Steam (lb/hr)	Receiver Diameter * (inches)	Receiver Length* (inches)	Vent Line Diameter* (inches)
75	4”	36”	1 ½”
150	6”	36”	2”
300	8”	36”	3”
600	10”	36”	4”
900	12”	36”	6”
1200	16”	36”	6”
2000	20”	60”	8”
3000	24”	60”	8”
4000	26”	60”	10”
5000	28”	60”	10”
6000	30”	72”	12”
7000	32”	72”	12”
8000	36”	72”	14”

* Table values based on schedule 40 pipe size.

- Typical minimum hollow tank design for guideline only. Typically, industry flash velocity ranges are 10 ft/s maximum for the receiver and 50 ft/s to 70 ft/s for the vent line. Consult SPD manufacturer for specificrecommendations.
- For safety considerations vent pipes, which can contain both steam and hot condensate, should always be discharged away from personnel in case of carry over.
- Vent lines should always be pitched to drain back to receiver.

Note: Vented receivers may be classified as pressure vessels and as such must be designed to applicable vessel codes, such as ASME.

Type II SPD Systems

A reservoir should be used to collect condensate from a single piece of plant equipment in a Type II SPD system. The system is closed to atmospheric and is typically at varying pressurized conditions, above and / or below atmospheric pressure.

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When sizing a reservoir, a major consideration is to allow enough volume for the back-up of the SPD's swept volume during its pumping or discharge stage, thus preventing back up of condensate into the equipment being drained. Designers should include margin factor for system dynamics. At constant non-atmospheric pressurized conditions, no flash steam is produced. The reservoir is therefore sized on the condensate load and pumped volume of the SPD.

The following steps should be used to properly size the reservoir:

1. Establish the total condensate load to be pumped.

2. Determine the minimum size of the reservoir by selecting the total condensate load from the first column of Table 2 and reading across the row to determine reservoir dimensions.

Table 2

Reservoir Sizing (Pipe Length, Feet)					
Condensate Load (lb/hr)	Reservoir Pipe Size (Nominal Pipe Size)				
	3"	4"	6"	8"	10"
0-500	2'				
1000	2'				
1500	3'	2'			
2000	3.5'	2'	1'		
3000		3'	2'		
4000		4'	2'	1'	
5000		6'	3'	2'	
6000			3'	2'	
7000			3'	2'	
8000			4'	2'	
9000			4.5'	3'	2'
10000			5'	3'	2'
11000			5'	3'	2'
12000				4'	2.5'
13000				4'	2.5'
14000				4'	2.5'
15000				4.5'	3'

*Table volume based on schedule 40 pipe.

- Typical hollow tank design for guideline only. Consult SPD manufacturer for specific recommendations.

Note: Reservoirs are typically classified as pressure vessels and as such should be designed in accordance with applicable ASME codes.

Appendix A

Percentage of Flash Steam Calculation

With the help of steam tables, the following formula may be used to estimate the Percentage of Flash Steam:

$$P = \frac{h_1 - h_2}{L_2} \; x \; 100\%$$

Where:

P = Percentage of condensate flashing into steam
h_1 = Sensible heat (enthalpy) in condensate upstream of traps.
h_2 = Sensible heat (enthalpy) in condensate at flash steam pressure (atmospheric in a Type I SPD system)
L_2 = Latent heat of flash steam.

Example: 1 - @ Atmospheric Pressure (Type I SPD).

2000 lb/hr of condensate from a source at 100 psi is trapped and flashed downstream of the trap to 0 psi.

Sensible heat (h1) at 100 psi = 309 Btu/lb
Sensible heat (h2) at 0 psi = 180 Btu/lb
Latent Heat at 0 psi = 970 Btu/lb

$$P = \frac{h_1 - h_2}{L_2} \; x \; 100\%$$

$$= \frac{309 - 180}{970} \; x \; 100\%$$

P = 13.2%

Flash steam Available = 0.132 x 2000 lb/hr
= 266 lb/hr

Example:2 - @ 10 psi Back Pressure (Type II SPD)

2000 lb/hr of condensate from a source at 100 psi is trapped and flashed downstream of the trap to 10 psi.

Sensible heat (h_1) at 100 psi = 309 Btu/lb
Sensible heat (h_2) at 10 psi = 207 Btu/lb
Latent Heat at 10 psi = 953 Btu/lb

$$P = \frac{h_1 - h_2}{L_2} \; x \; 100\%$$

$$= \frac{309 - 207}{953} \; x \; 100\%$$

P = 10.7%

Flash steam Available = 0.107 x 2000 lb/hr
= 214 lb/hr