DATA INPUT

Project Data

Prepared by	S. Hall	Client	Sample
Date	19-Jan-2019	W.O.	10314
Units	• US ∘ SI	Unit	Process
		Area	Tank Farm

Errors and Warnings

General Data

Calculation Description		Sample Manifold Calculation
Pressure at Discharge from Manifold	(psig)	0
Pipe Roughness	(ft)	0.000151

Brief Instructions

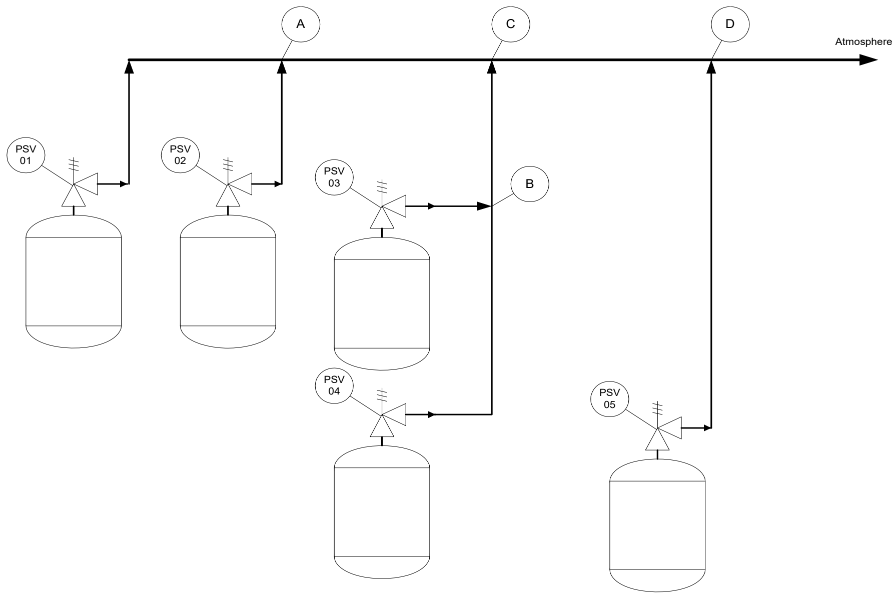
1. Make a system sketch, label each intersection with a "Node" name.
2. Enter the system data in the space provided at left. An error message appears below if the system data is inconsistent.
3. Enter process data below. For emergency vents, "temperature" is usually the boiling point at the relieving pressure.
4. Play "what-if…" with pipe sizes and flow rates to ensure the system backpressure doesn't exceed allowable limits for all possible venting scenarios.

Pipe Manifold Data / Process Data / Result

	Segmnt	Upstream Node	Downstream Node	Equiv. Length (ft)	Pipe I.D. (nominal) (in.)	Flowing Material	Flow Rate (lb/h)	Molecular Weight	Temp. (deg F)	Viscosity (cP)	Allowable Back Pressure (psig)	Calculated Upstream Pressur (psig)
Last	1	D	Disch.	49.9	8	MeOH + Toluene						1.6
Intermediate Segments	2	C	D	60	6	MeOH + Toluene						7.6
	3	A	C	40	6	MeOH + Toluene						9.3
	4	B	C	20	6	MeOH + Toluene						7.9
	5											
	6											
	7											
	8											
	9											
	10											
	11											
	12											
	13											
	14											
	15											
Segments connected to Relief Devices	16	PSV-01	A	49.9	6	MeOH	10,000	32	280	0.013	13	9.8
	17	PSV-02	A	60	6	Toluene	15,000	92	350.1	0.011	10	9.8
	18	PSV-03	B	40	4	MeOH	8,000	32	280	0.013	13	10.1
	19	PSV-04	B	60	3	Toluene	5,000	92	350.1	0.011	10	9.9
	20	PSV-05	D	60	3	Toluene	6,499	92	350.1	0.011	10	5.0
	21											
	22											
	23											
	24											
	25											
	26											
	27											
	28											
	29											
	30											

INSTRUCTIONS

1. On a piece of paper, or with your computer, draw a SYSTEM SKETCH, showing the tanks to be relieved and piping network on the relief header.
2. Assign labels (letters are best) to each NODE (i.e. branch connection) on the sketch. Here's an example of a completed sketch:



Example data input corresponding to the sketch

Segment	Upstream Node	Downstream Node	Equiv. Length (ft)	Pipe I.D. (nominal) (in.)	Flowing Material
	Pipe Manifold Data				
1	D	Discharge	30	8	MeOH + Toluene
2	C	D	60	8	MeOH + Toluene
3	A	C	30	6	MeOH + Toluene
4	B	C	25	6	MeOH + Toluene
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16	PSV-01	A	50	6	MeOH
17	PSV-02	A	60	6	Toluene
18	PSV-03	B	40	4	MeOH
19	PSV-04	B	60	3	Toluene
20	PSV-05	D	60	3	Toluene
21					
22					
23					
24					
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27					
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29					
30					

3. For each segment, make a list with pipe size, equivalent length, and pipe roughness. The eqivalent length is the physical length plus the equivalent length for each bend or fitting. Pipe roughness is expressed in units of feet; normal carbon steel pipe has a roughness of 0.00015 ft.
4. For each relief valve, make a list with the fluid name, relieving rate, molecular weight, temperature and viscosity.
5. Your sketch contains three types of pipe segments. A) segments connected to the relief valves. These are called "primary segments." B) pipe headers not connected to valves. C) the final segment that discharges to atmosphere (or wherever). Organize your list into the three types. In the example they are:
   A) Primary Segments
      PSV01 - A
      PSV02 - A
      PSV03 - B
      PSV04 - B
      PSV05 - D
   B) Headers
      A - C
      B - C
      C - D
   C) Discharge
      D - Discharge
   Notice that the first letter always refers to the "upstream" end of the segment.
6. Now you are ready to fill in the input section in the Excel spreadsheet template. Blank out any data that is already there, then enter the segment designations and equivalent length for the three types of segments.
7. For Primary Segments only, enter the molecular weight, temperature and viscosity at the relieving condition.
8. Enter the pipe size (or your first guess pipe size) for each segment.
9. Enter the DISCHARGE PRESSURE
10. Enter the ALLOWABLE BACKPRESSURE for each of the relieving devices (i.e. maximum pressure allowed at the upstream nodes for the Primary Segments.
11. Work with alternatives until the calculated backpressure values do not exceed the allowable values.
12. Repeat the calculation for other scenarios, such as a different mix of simultaneous relief or different temperatures.

Notes: Higher pressure drops are computed with higher temperatures (all other factors being equal). Therefore, good practice is to assume the temperature of each vent equals the boiling point at the relieving pressure. So, if the vessel contains methanol relieving at 130 psig, the temperature to use would be about 280 deg F which is the temperature at which methanol has a vapor pressure of 130 psig.

Conventional relief valves usually function when the backpressure is up to 10% of the relieving pressure. For the methanol example above, a backpressure of 13 psig would be acceptable. For balanced relief valves a backpressure up to 50% of relieving pressure is often permissible (65 psig in the example). Consult manufacturer's literature for your specific valves to determine the allowed backpressure.

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VENT MANIFOLD PRESSURE PROFILE		
CLIENT **Sample**	*EQUIP. NO*	*PAGE*
W.O. 10314		
UNIT Process / *AREA* Tank Farm		

REV	PREPARED BY	DATE	APPROVAL
0	S. Hall	19-Jan-2019	
1			
2			

Sample Manifold Calculation

Pressure at discharge from manifold 0 (psig)

Segment	Node Name Up Stream	Node Name Down Stream	Equiv Length (ft)	Pipe Size (in.)	Compound	Flow (lb/h)	MW	Temp (deg F)	Viscosity (cP)	Allowed Back Pr. (psig)	Calculated Back Pr. (psig)
1	D	Disch.	49.9	8	MeOH + Toluene	44,499	52.3	304	0.012		**1.63**
2	C	D	60	6	MeOH + Toluene	38,000	48.7	300	0.012		**7.57**
3	A	C	40	6	MeOH + Toluene	25,000	52.6	304	0.012		**9.27**
4	B	C	20	6	MeOH + Toluene	13,000	42.7	293	0.013		**7.85**
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12											
13											
14											
15											
16	PSV-01	A	49.9	6	MeOH	10,000	32.0	280	0.013	13	**9.82**
17	PSV-02	A	60	6	Toluene	15,000	92.0	350	0.011	10	**9.82**
18	PSV-03	B	40	4	MeOH	8,000	32.0	280	0.013	13	**10.14**
19	PSV-04	B	60	3	Toluene	5,000	92.0	350	0.011	10	**9.90**
20	PSV-05	D	60	3	Toluene	6,499	92.0	350	0.011	10	**4.98**
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Notes:

1. Compound properties are at the relieving conditions.
2. This calculation gives a "snapshot" of the pressure profile through the manifold at the simultaneous relieving conditions shown. Additional cases may be necessary to ensure that no forseeable combination of simultaneous venting will cause excessive pressure in the system.
3. "Allowed Back Pressure" is the maximum pressure at the *discharge* side of the relieving device that does not impact the *relieving* pressure of the device. Conventional relief valves are usually limited to a backpressure of 10% of the relieving pressure; balanced relief valves may work with backpressure up to 50% of relief pressure.
4. Assumes isothermal flow, ideal gas behavior, and single (gas) phase.