

			10/29/19		Created B	
thlon ayport, TX		Revision: Relief Valve No.:			Checked B	y:
alat Diaina Camanata		INLET PIPING	CALCULATION	ONS		
nlet Piping Segments izing Basis:	Pine Size (n	ominal diameter) =	2 00	inches		
1: Closed Outlet on	• ' '	side Diameter, d =		inches		
essels	· ·	Pipe Spec =				
		Pipe Schedule =				
	(5)Moody	Friction Factor, f =	0.019			
		f Straight Pipe, L =				
(4)		th of 90° Elbows =		# Elbows=		$L_{eq}/d = 30$
(1)E	quivalent Length of 90° Lon	-		# Elbows=		L _{eq} /d = 20
		th of 45° Elbows =		# Elbows= # Tees=		$L_{eq}/d = 16$ $L_{eq}/d = 60$
	⁽¹⁾ Equivalent Length ⁽¹⁾ Equivalent Length			# Tees=		$L_{eq}/d = 20$ $L_{eq}/d = 20$
		gth of Gate Valve=	-	# Valves=		$L_{eq}/d = 8$
		gth of Ball Valve =		# Valves=		$L_{eq}/d = 3$
	(4)Equivalent Length			K-factor=		'
	(1)Equivalent Length			-	1	Crane pg. A-29
	Equivalent Le	ength of Reducer =		(6)	4.15	Reduced id = 1.048
	Equivalent Le	ength of Enlarger =		⁽⁶⁾ K-factor=		Enlarged id =
Other Fitting:		Equivalent Length=		# Fittings=		⁽⁸⁾ Cv =
Other Fitting:	F : 1 (1 (1 (1)(1)	Equivalent Length=		# Fittings=		L _{eq} /d =
lotal	Equivalent Length of Valves	and Fittings, L _{eq} =	43.9 ft	as 2 in. pipe		
let Piping Stream Prop	erties					
Relief Rate of Liquid of	or Vap Valve Capacity, W =	1,952	_			
	Set Pressure = Inlet Piping Temperature =	165 387.7	_psig ∘⊏	847.7	D	
	Molecular Weight =		lb/lbmol	041.1	N	
	Density in Inlet Line =		lb/ft ³			
	Viscosity in Inlet Line =	0.02	- '			
⁽⁷⁾ Reynolds	Number (Re) in Inlet Line =	397,074.89	(Laminar flow oc	curs when Re	£ 2000.)	
nlet Line Pressure Drop	Calculation					
•						
Total Equivalent Len	gth (valves & fittings), L _{eq} =	43.9	-	For valves and	l fittings ⁽²⁾ :	
	Friction Factor, f =	0.019	-	A.D. 0.000	$\int I$	$\mathcal{L}_{eq}W^2$
Tot	al Ctraight Dina Langth I =	2.0		$\Delta P_{psi} = 0.000$	JUU336	$\frac{1}{2d^5}$
	al Straight Pipe Length, L =	0.019	_ft			
	n Factor (straight pipe), f = side Diameter of Piping, d =		-	For valves and		. m.2
IIIs	ide Diameter of Fiping, d =	1.939		$\Delta P_{psi} = 0.00$	000336 ^{<i>f1</i>}	<u> </u>
Inlat Dining To	.t-I D				r	•••
	otal Pressure Drop, ΔP_{psi} = Percent of Set Pressure =	0.87	psi % ^(a)	Note: Resistar		ent K = or valves and fittings
ΔP _{psi} , r	reicent of Set Pressure -	0.53	- 70			
				1	*(L/D) for st	raignt pipe
OTES						
	Part II, Sect. 4.2.2, inlet pipir	ng is not to exceed	a pressure drop o	of 3% of the set	pressure.	
he current inlet piping i	s adequate.					
EFERENCES						
Crane Co., "Flow of Fluid	ds" Technical Paper No. 410), "Resistance Coe	fficients for Valves	and Fittings" ¡	pages A-26	thru A-30
Crane Co. "Flow of Fluid	t Length of Valves and Fittin Is" Technical Paper No. 410	igs in Pipeline Pres N. "Pressure Drop i	sure Drop Calcula n Straight Pine" no	ations" article C	neresource	s.com
	ıs Tecnnicai Paper No. 410 ı, "Typical K-factors for pipe				14	
	or steel pipe, for all other pi					orrect Friction Factor, f.
Crane Co., page A-26 a	nd 2-11.					
Crane Co., "Flow of Fluid						
Crane Co., "Flow of Fluid	ls" Technical Paper No. 410 combining Crane Co. Tech	nical Paper No. 410	0 (08/11 Reprint) e			
Crane Co., "Flow of Fluid		nical Paper No. 410				



		Date:	10/29/19		Created	By: CJM
thlon	Revision: A			Checked By:		
ayport, TX		Relief Valve No.:	PSV-XX2			
	OU	TLET PIPING C	CALCULATIO	ONS		
utlet Piping Segments						
izing Basis:	Pipe Size (n	ominal diameter) =	2.	00 inches		
1: Closed Outlet on Vessels		side Diameter, d =		00 inches		
	·	Pipe Spec =		CS		
		Pipe Schedule =				
	(5)Moody	Friction Factor, f =				
	•					
		f Straight Pipe, L = th of 90° Elbows =		oft oft #Elbow	- 1	$L_{eq}/d = 30$
	(1)Equivalent Length of 90° Lon			# Elbow		$L_{eq}/d = 30$ $L_{eq}/d = 20$
		y Radius Elbows = ith of 45° Elbows =		# Elbow		$L_{eq}/d = 20$ $L_{eq}/d = 16$
	(1)Equivalent Length			# Tee		$L_{eq}/d = 60$
	(1)Equivalent Length			# Tee		$\frac{L_{eq}/d = 00}{L_{eq}/d = 20}$
	· · · · · · · · · · · · · · · · · · ·	gth of Gate Valve=		# Valve		$L_{eq}/d = 8$
	the state of the s	gth of Ball Valve =		# Valve		$\frac{1}{L_{eq}/d} = 3$
	(4)Equivalent Length			K-facto		
		ngth of Exit Loss =		K-facto		Crane pg. A-29
		ength of Reducer =		(6)K-facto		Reduced id =
	Equivalent Le	ength of Enlarger =		(6)K-facto	_	Enlarged id =
Other Fitting:		Equivalent Length=		# Fitting	s=	⁽⁹⁾ Cv =
Other Fitting:		Equivalent Length=		# Fitting		L _{eq} /d =
	Total Equivalent Length of Valves	and Fittings, L _{eq} =	5.0	ft as 2 in. pip	е	<u> </u>
utlet Piping Stream Properties						
Relief Rate of L	iquid or Vap Valve Capacity, W = Relief Valve Set Pressure =	1,952	-			
	(c)Header Pressure, P _H =	14.70	psig		psig	
	Outlet Piping Temperature, T =	672	- '	212.	00 °F	
Ratio of Specif	ic Heats at Outlet Conditions, k =	1.3			_	
	Gas Compressibility Factor, Z =	0.98		$M_{cl} = 1.70$	$02x10^{-5} \left(\frac{W}{n d} \right)$	$(ZT)^{0.5}$
	s Relative Molecular Weight, M =	18.0	lb/lbmol	$ma_2 = 1.70$	$\left(\frac{p_{H}d_{H}}{p_{H}d_{H}}\right)$	(\overline{M})
	ach Number at Pipe Outlet, Ma ₂ =	0.493	•		·	
Set	Outlet Line Outlet Pressure, Po=	14.70	psia	If Ma ₂ < 1.0	$P_o = P_H$; howe	ever, if Ma $_2$ > 1.0, set P $_o$ = P $_{crit}$
	iguid Danaituin Outlet Line a -		II- 1640	nM		
	Liquid Density in Outlet Line, $\rho_L =$ erage Density in Outlet Line, $\rho_V =$	0.08	lb/ft3	$\rho_V = \frac{pM}{ZTR}$	-	
1 apo. 7 ti	Viscosity in Outlet Line =		ср	ZIN		
(8)Reyn	olds Number (Re) in Outlet Line =	511,933.50	(Laminar flow	occurs when Re	e ≤ 2000.)	
utlet Line Pressure Drop Calculat		7.05	:-	Critical abou	luta propouro: co	t Ma =1 0 (again flow); if the
Total Fauivalent	Critical absolute pressure, P _{crit} =	7.25	= "			et Ma ₂ =1.0 (sonic flow); if the
rotai Equivalent	Length (valves and fittings), $\mathbf{L}_{eq} = \mathbf{M}_{eq}$ Moody Friction Factor, $\mathbf{f} = \mathbf{f}$	0.019	_π	the flow is s		the pipe outlet pressure then
	Line Diameter, d =	2.00	in			
	Total Straight Pipe Length, L =	3.0	-	$P_{corr} = 1.702$	$\times 10^{-5} \left(\frac{W}{d^2} \right) \left(\frac{Z \cdot T}{M} \right)$	0.3
	Friction Factor (straight pipe), f =	0.019	-	cm	d^2 / M)
Inside [Diameter of Piping at Header, d_H=	2.000	in	P	+ P	
Valve	e Design Backpressure Allowed =	21%		$P_{AVG} = \frac{P_o}{}$	2	
	Max Back Pressure Allowed, P _B =	49.40	psia		2	
Outlet Line Avg.	Press. at Max BP Allowed, P _{AVG} =	32.05	psia (b)	A.D. 0.0	00000226 fLW	-2
	•			$\Delta r_{psi} = 0.0$	$00000336 \frac{fLW}{\rho d^5}$	
	let Piping Pressure Drop, $\Delta P_{psi} =$	0.75	psi			
	utlet Piping Back Pressure, BP _C =		psig	$BP_{c} = A$	$\Delta P_{PSI} + P_o$	- 14 .7
Pressure	Drop, Percent of Set Pressure =	0.45%	(a)			
(7)Reaction Force fo	r Atmospheric Relief Valves, F=	26.82	lbf	_ W	kT	>
(Reaction force calculation is not		20.02		$F = \frac{77}{366}$	$\sqrt{\frac{kT}{(k+1)M}} + (A$	P)
relief dev				500	V (** 1 1)111	
<u>OTES</u>		_				
Outlet piping built-up pressure drop	not to exceed 10% of the set pres	sure for conventio	nal valves (API	STD 521, Sect.	. 7.3.1.3 pg. 103)	l.
he current outlet piping is adequate P _{AVG} , Outlet Line Average Pressure		ine everen de de	, in and+-	ara alaas bi	noont the first i	noity in the outlet -i-i

- Crane Co., "Flow of Fluids" Technical Paper No. 410, "Resistance Coefficients for Valves and Fittings" pages A-26 thru A-30
- API STD 521, 5th edition, "Design of relief device discharging piping", pg. 105 Equation #28: Isothermal outlet Mach number
- ³⁾ Crane Co., "Flow of Fluids" Technical Paper No. 410, "Pressure Drop in Straight Pipe" pg. 3-2, Eq. 3-5
- API STD 521, 5th edition, "Typical K-factors for pipe fittings and reducers", pg. 110 Table 13 and Table 14
- ⁵⁾ This calculation is valid for steel pipe, for all other pipe material see Crane pg. A-26 or pg. A-23, to determine the correct Friction Factor, f.

⁶⁾ Crane Co., page A-26 and 2-11.

- 7) This calculation should be used as a reference only, a competent mechanical engineer should determine the required support design. API RP 520 Part II, 5th edition, "Determining Reaction Forces" Section 4.4.1.1 for any gas, vapor, or steam discharging to the atmosphere.
- ⁸⁾ Crane Co., "Flow of Fluids" Technical Paper No. 410, pages 1-6 thru 1-7. Friction factor for straight pipe in laminar flow is equal to 64/Re.
- ⁹⁾ Cv converted to L_{ed}/d by combining Crane Co. Technical Paper No. 410 (08/11 Reprint) equations 2-11 and 2-4 as follows:

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 $\frac{L_{eq}}{D} = 890.4256 \frac{d^4}{f * Cv^2}$



Athlon Bayport, TX		Date: 10/29/19 Revision: A					Created By: CJM Checked By: 0					
				Relie	f Requirements	Summary						
PSV Number						rotected Eq						
P&ID	SK-19282010-001 Rev.	.A] '	Equipment #		quipment De			MAWP	<u> </u>		
Set Pressure	165 psig			E-778 Shell S	1	E-778 S	hell		165	psig @		°F
Manufacturer										psig @		°F
Model #	JOS-H-E			'						psig @		°F
Orifice	E									psig @		°F
Area		Multivalve										
Style	Conventional											
			Relief		Required Relief		Capacity	Inlet Pres	ssure Loss	Outlet P	ressure Loss	Mitigation
	Relief Condition		Description	Mass (lb/hr)	Volume (gpm)	Area (in ²)		(psi)	(%)	(psi)	(%)	required
	utlet on Vessels			1,100			34,798	0.87	0.53%	0.75	<mark>5</mark> 0.45%	,
02: Cooling-wa	ater Failure								0.00%		0.00%	
03: Top-tower	Reflux Failure								0.00%	,	0.00%	
	m Reflux Failure								0.00%		0.00%	
05: Lean-oil Failure to Absorber								0.00%		0.00%		
06: Accumulation of Noncondensables								0.00%		0.00%		
	of Highly Volatile Material								0.00%		0.00%	
	Storage or Surge Vessel								0.00%		0.00%	
	Automatic Control								0.00%		0.00%	
10: Abnormal I	Heat or Vapor Input								0.00%		0.00%	
11: Split Excha									0.00%		0.00%	
12: Internal Ex									0.00%		0.00%	
13: Chemical F								<u> </u>	0.00%		0.00%	
14: Hydraulic E								<u> </u>	0.00%		0.00%	
15: Exterior Fir	re		<u> </u>	<u> </u>					0.00%		0.00%	
16: Power Fail	ilure (steam, electric, air, o	or other)							0.00%		0.00%	
	nt Valve Operation			<u> </u>				'	0.00%		0.00%	
18: Other				 '					0.00%		0.00%	
j 									0.00%		0.00%	
<u> </u>				<u> </u>				<u> </u>	0.00%		0.00%	
									0.00%		0.00%	
NOTES	eering, Management, & In:											Rev 1.29.1



Date: 10/29/19 Created By: CJM Athlon Revision: A Checked By: 0 Bayport, TX Orifice Calculation - Liquid Relief PSV INFORMATION PSV Number: PSV-XX2 Vessel Item # E-778 Shell Side Vessel Description: E-778 Shell Flow Sheet Reference #: SK-19282010-001 Rev.A Relieving State: Liquid 01: Closed Outlet on Vessels Sizing Basis: INPUT DATA 2.53_gpm Flowrate, Q = 1100.2 lbs/hr 165.0 psig Set Pressure, P_s = Allowable Overpressure = 21 % Relieving Pressure, P_R = 199.7 psig Back Pressure P_B= psig 0.87 Specific Gravity at oper temp, G = 0.1355 cP Viscosity, μ = 54.22690209 lb/ft3 Density, ρ = Manufacturer Coefficient of Discharge⁽¹⁾, $\mathbf{K_d} =$ 0.65 Default K_d=0.65 certified, Kd=0.62 for non-certified $R = \frac{Q(2800 \times G)}{}$ Reynolds Number⁽²⁾, **R** = 96.635 1.000 If back pressure is atm., $\rm K_w$ =1 otherwise see API 520, Fig 31. Capacity Correction Factor due to Back Pressure⁽³⁾, $\mathbf{K_w}$ = $K_{v} = \left(0.9935 + \frac{2.878}{R^{0.5}} + \frac{342.75}{R^{1.5}}\right)^{-1.0}$ Capacity Correction Factor due to Viscosity⁽⁴⁾, $\mathbf{K_v} =$ 0.997 Combination Correction Factor for Rupture Disks $^{(5)}$, $\mathbf{K_c}$ = 1.0 K_c =1.0 if rupture disk not installed, else 0.9, if MFG not available Correction Factor due to Overpressure⁽⁶⁾, \mathbf{K}_{p} = 0.6 At 25%, $K_p = 1.0$; at 10% $K_p = 0.6$ CALCULATED RESULTS PSV Liquid Capacity Certification Required? Y or N = $A_{cert} = \frac{Q}{38K_d K_w K_c K_v} \sqrt{\frac{G}{p_1 - p_2}}$ $0.007 in^2$ Required Orifice Area for a Liquid Certified Relief Valve (7), Acert = $A_{non-cert} = \frac{Q}{38K_d K_w K_c K_v K_p} \frac{G}{1.25p - p_b}$ N/A in² Required Orifice Area for a *Non-Certified* Liquid Relief Valve ⁽⁸⁾, **A**_{non-cert} = Available Orifice Area, A_v = 0.221 in² Relief Valve Maximum Flow Rate = Q (A_v / A) = 80 gpm Relief Valve Maximum Mass Flowrate = 34,798 lb/hr NOTES REFERENCES ⁽¹⁾API RP 520, 7th Edition, "Rated Coefficient of Discharge, K_d" pg. 52 (certified) and pg. 54 (non-certified) API RP 520, 7th Edition, "Sizing for Liquid Relief", Equation 3.10, pg. 53 API RP 520, 7th Edition, "Capacity Correction Factor due to Backpressure", pg. 52; Figure 31, pg. 38 API RP 520, 7th Edition, "Capacity Correction Factor due to Viscosity", pg.52; Figure 36, pg. 54 API RP 520, 7th Edition, "Capacity Correction Factor for Rupture Disks", pg.52 API RP 520, 7th Edition, "Capacity Correction Factor due to Overpressure", Figure 37, pg.55 API RP 520, 7th Edition, "Sizing for Liquid Relief: Pressure Relief Valves Requiring Capacity Certification", Equation 3.9, pg. 52 API RP 520, 7th Edition, "Sizing for Liquid Relief: Pressure Relief Valves Not Requiring Capacity Certification", Equation 3.12, pg. 54

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The provided by the property of the provided by the provided	PSV Nimbor Vessel Item # Vessel Description: Flow Sheet Reference #: Relieving State: Relieving State: Sizing Basis: Sizing Bas	hlon	Date: 10/29/19 Revision: A	Created By: CJM Checked By: 0
PSV Number: Vessel Item # Vessel Description: Flow Sheet Reference #: Relieving State: Sizing Basis: PSV-XX2 E-778 Shell Side E-776 Shell S	SV INFORMATION PSV Number: Vessel Item # Vessel Poscription: Flow Sheet Reference #: Relieving State: Sizing Basis: Flowrate, W (lb/hr) = Relieving Temperature, T (deg F) = Allowable Overpressure = Ratio of Specific Heats, k = 1.40 Coefficient of the ratio of specific heats (**), c = 356.1 Coefficient of Specific Heats (**), c = 356.1 Coefficient of Subcritical Flow **Op-/P*, r = 0.0816 Ratio of P_rP^n , r = 0.0816 Ratio of P_rP^n , r = 0.0816 Ratio of P_rP^n , r = 0.0816 PSV Type (conv, pilot, bellows) = Back Pressure Ratio (**), Psupple (**), P	ayport, TX		
PSV Number: Vessel Item # Vessel Description: Flow Sheet Reference #: E-778 Shell Side E-7	PSV Number: Vessel Item # Vessel Reference #: Relieving State: Sizing Basis: Sizing S	Orifice C	alculation - Vapor Relief	
Vessel Item # Vessel Description: Flow Sheat Reference #: Relieving State: Sizing Basis: To: Closed Outlet on Vessels Flowrate, W (lb/hr) = Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% Ratio of Specific Heats, k = 1.40 Coefficient of the ratio of specific heats), C = 366.1 Compressibility Factor, Z = 1 Molecular Weight, M = Ratio of Pp., r = 0.0816 Coefficient of Subcritical Flow Pp., r = 0.0816 PSV Type (conv., pilot, bellows) = Back Pressure, PQ (psig) = 165 Back Pressure Correction Factor, K _B = 1.0 Back Pressure Correction Factor, K _B = 1.0 Manufacturer Coefficient of Discharge ⁽ⁱ⁾ , K _a = 0.9 Combination Correction Factor for Rupture Disks, K _c = 1 Sub-critical Flow Area Calculation ⁽²⁾ , A = Available Orifice Area, A _r = 0.221 in² Available Orifice Area, A _r = 0.221 in²	Vessel Description: Flow Sheet Reference #: Relieving State: Sizing Basis: Sizing Bas	SV INFORMATION		
Vessel Description: Flow Sheet Reference $\frac{k}{SK-19282010-001}$ Rev.A. SK-19282010-001 Rev.A. SK-19282010-001 Rev.A. Oi: Closed Outlet on Vessels PUTS Flowrate, W (lb/hr) = Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % % Ratio of Specific heats! 1 , C = 386.1 Coefficient of the ratio of specific heats! 1 , C = 366.1 Compressibility Factor, Z = 1 Molecular Weight, M = 18.015 Ratio of P_2P_1, r = 0.0816 Coefficient of Subcritical Flow 10 , 1 , 1 = 0.2332 F ₂ = 1	Vessel Description: Flow Sheet Reference #: SK-19282010-001 Rev.A. Relieving State: Sk-19282010-001 Rev.A. Relieving State: Sk-19282010-001 Rev.A. Vapor			_
Flow Sheet Reference #: Relieving State: String Basis: String Basis: String Basis: String Basis: String Basis: String Basis: O1: Closed Outlet on Vessels Flowrate, W (lb/hr) = 1100.2 Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % Ratio of Specific Heats, k = 1.40 Coefficient of the ratio of specific heats'), C = 386.1 Compressibility Factor, Z = 1 Molecular Weight, M = 18.015 Ratio of P ₂ P ₁ , r = 0.0316 Coefficient of Subcritical Flow ⁽²⁾ , P ₂ = 0.2332 Critical Flow Pressure Ratio ⁽³⁾ , P ₄ I P ₇ = 0.528 Set Pressure, P (psig) = 165 PSV Type (conv., pilot, bellows) = Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, K ₈ = 1.0 Manufacturer Coefficient of Discharge ⁽⁶⁾ , K ₈ = 0.9 Combination Correction Factor for Rupture Disks, K _c = 1 ALCULATIONS: Upstream Relieving Pressure: P ₁ (psig) = 165.3465 Set Pressure + Allowable Overpressure AlCULATIONS: Upstream Relieving Pressure: P ₁ (psig) = 165.3465 Set Pressure + Allowable Overpressure AlCulation Flow Area Calculation ⁽²⁾ , A = 0.131 Available Orifice Area, A _r = 0.221	Flow Sheel Reference #: Relieving State: Sizing Basis: $\frac{SK-19282010-001 \text{ Rev.A}}{Vapor}$ PIPUTS Flowrate, W (lb/hr) = 1100.2 Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % Ratio of Specific Heats, k = 1.40 Coefficient of the ratio of specific heats 1.40 Coefficient of the ratio of specific heats 1.40 Rolecular Weight, M = 18.015 Rolecular Weight, M = 18.015 Rolecular Weight, M = 10.0816 Rolecular Weight, M = 10.0816 Rolecular Weight, M = 10.0816 Rolecular Weight, M = 1.65 PSV Type (conv. pilot, bellows) = 0.2332 Critical Flow Pressure Ratio P _d / P _r = 0.528 Set Pressure, P (psig) = 165 PSV Type (conv., pilot, bellows) = 0 Back Pressure, P (psig) = 0 Back Pressure Correction Factor, K _e = 1.0 Manufacturer Coefficient of Discharge N _d = 0.9 Combination Correction Factor for Rupture Disks, K _e = 1 Combination Correction Factor for Rupture Disks, K _e = 1 Critical Flow Area Calculation A = 0.131			_
PUTS Flowrate, W (lb/hr) = Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % % Ratio of Specific Heats, k = 1.40 Coefficient of the ratio of specific heats \(^0\), C = 356.1 Compressibility Factor, Z = 1 Molecular Weight, M = 18.015 Ratio of P_x/P_1 , r = 0.0816 Coefficient of Subcritical Flow\(^0\), P_z = 0.2332 Critical Flow Pressure Ratio\(^0\), P_z = 0.528 Set Pressure, P(psig) = 165 PSV Type (conv, pilot, bellows) = Back Pressure, P2(psig) = 0 Back Pressure Correction Factor, K _s = 1.0 Manufacturer Coefficient of Discharge\(^0\), K _d = 0.9 Combination Correction Factor for Rupture Disks, K _c = 1 Critical Flow Area Calculation\(^0\), A = 0.131 Sub-critical Flow Area Calculation\(^0\), A = 0.221 Available Orifice Area, A _r = 0.221 In 2 In 3 In 2 Available Orifice Area, A _r = 0.221 In 2 In 3 In 2 In 3 In 2 In 3 In 3 In 3 In 3 In 3 Available Orifice Area, A _r = 0.221 In 3 I	NPUTS Flowrate, W (lb/hr) = 1100.2 Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % % Coefficient of specific heats, k = 1.40 Coefficient of the ratio of specific heats, k = 1.40 Coefficient of Subcritical Flow Pressure Ratio of P ₂ /P ₁ , r = 0.8816 Coefficient of Subcritical Flow P ₂ P ₁ P ₂ = 0.2332 Critical Flow Pressure, P (psig) = 165 Back Pressure, P (psig) = 0 Back Pressure P (psig) = 0 Combination Correction Factor for Rupture Disks, K _c = 1.0 Combination Correction Factor for Rupture Disks, K _c = 1 Critical Flow Area Calculation Pressure: P ₁ (psig) = 165.3465 Set Pressure + Allowable Overpressure Pressure	•		_
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Flowrate, W (lb/hr) = Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % Ratio of Specific Heats k = 1.40 Coefficient of the ratio of specific heats $^{(1)}$, C = 356.1 Compressibility Factor, Z = 1 Molecular Weight, M = 18.015 Ratio of P ₂ /P ₁ , r = 0.0816 Coefficient of Subcritical Flow $^{(2)}$, F_2 = 0.2332 F ₂ = $\sqrt{\left(\frac{k}{k-1}\right)^{(r)^2}} \left(\frac{1-r^{\frac{(k-1)}{k-1}}}{1-r}\right)^{\frac{(k-1)}{k-1}}$ For this pressure, P2 (psig) = 165 PSV Type (conv., pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, K _b = 1.0 Manufacturer Coefficient of Discharge $^{(5)}$, K _d = 0.9 Combination Correction Factor for Rupture Disks, K _c = 1 ALCULATIONS: Upstream Relieving Pressure: P ₁ (psig) = 165.3465 Set Pressure + Allowable Overpressure Alculation $^{(2)}$, A = 0.131 Sub-critical Flow Area Calculation $^{(2)}$, A = 0.131 Available Orifice Area, A _v = 0.221 Availabl	Flowrate, W (lb/hr) = Relieving Temperature, T (deg F) = 387.7 Allowable Overpressure = 21% % % Ratio of Specific Heats, k = 1.40 \$ Coefficient of the ratio of specific heats! $^{\circ}$, C = 356.1 $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right$	Sizing Basis:	01: Closed Outlet on Vessels	
Relieving Temperature, T (deg F) = Allowable Overpressure = 21%	Relieving Temperature, T (deg F) = Allowable Overpressure = 21%	PUTS		
Allowable Overpressure = Ratio of Specific Heats, $\mathbf{k} = 1.40$ Coefficient of the ratio of specific heats(s), $\mathbf{C} = 356.1$ Coefficient of the ratio of specific heats(s), $\mathbf{C} = 356.1$ Molecular Weight, $\mathbf{M} = 18.015$ Ratio of P_2/P_1 , $r = 0.0816$ Coefficient of Subcritical Flow?) $P_2 = 0.2332$ Critical Flow Pressure Ratio(3), $P_{cf}/P_1 = 0.528$ Set Pressure, $P_1/P_2 = 0.528$ PSV Type (conv. pilot, bellows) = Conventional Back Pressure Correction Factor, $\mathbf{K}_1 = 0.9$ Manufacturer Coefficient of Discharge(s), $\mathbf{K}_4 = 0.9$ Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = 1.0$ MFG not available Set Pressure + Allowable Overpressure ALCULATIONS: Upstream Relieving Pressure: $P_1/P_1/P_1/P_2/P_1/P_1/P_1/P_1/P_1/P_1/P_1/P_1/P_1/P_1$	Allowable Overpressure = Ratio of Specific Heats, \mathbf{k} = 1.40 Coefficient of the ratio of specific heats $^{(1)}$, \mathbf{C} = 356.1 Compressibility Factor, \mathbf{Z} = 1 Molecular Weight, \mathbf{M} = 18.015 Ratio of P_2P_1 , \mathbf{r} = 0.0816 Coefficient of Subcritical Flow $^{(2)}$, \mathbf{F}_2 = 0.2332 Critical Flow Pressure Ratio $^{(3)}$, $\mathbf{P}_{\mathbf{q}'}$ \mathbf{P}_1 = 0.528 Set Pressure, $\mathbf{P}(\mathbf{psig})$ = 165 PSV Type (conv, pilot, bellows) = Back Pressure, $\mathbf{P}(\mathbf{psig})$ = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge $^{(5)}$, \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Critical Flow Area Calculation $^{(2)}$, \mathbf{A} = 0.131 Sub-critical Flow Area Calculation $^{(4)}$, \mathbf{A} = Critical Flow in 2 $A = \frac{W}{CK_dP_1K_bK_c} \sqrt{\frac{TZ}{MP_1(P_1 - P_2)}}$ Sub-critical Flow Area Calculation $^{(4)}$, \mathbf{A} = Critical Flow in 2 $A = \frac{W}{735*F_2K_dK_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$	Flowrate, W (lb/hr) =	1100.2	
Ratio of Specific Heats, $\mathbf{k} = 1.40$ Coefficient of the ratio of specific heats ⁽¹⁾ , $\mathbf{C} = 356.1$ Compressibility Factor, $\mathbf{Z} = 1$ Molecular Weight, $\mathbf{M} = 18.015$ Ratio of P_2/P_1 , $r = 0.0816$ Coefficient of Subcritical Flow ⁽²⁾ , $P_2 = 0.2332$ Critical Flow Pressure Ratio ⁽³⁾ , $P_{cf}/P_1 = 0.528$ Set Pressure, $P(pig) = 165$ PSV Type (conv, pilot, bellows) = Conventional Back Pressure, $P(pig) = 0.9$ Back Pressure P2 (psig) = 0 Back Pressure Correction Factor, $\mathbf{K} = 0.9$ Manufacturer Coefficient of Discharge ⁽³⁾ , $\mathbf{K}_d = 0.9$ Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = 1.0$ for conventional Upstream Relieving Pressure: $P_1(psig) = 165.3465$ Set Pressure + Allowable Overpressure ALCULATIONS: Upstream Relieving Pressure: $P_1(psig) = 165.3465$ Set Pressure + Allowable Overpressure $A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{MP_1(P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A}_r = 0.221$ in $P(x) = 1.40$ $P($	Ratio of Specific Heats, $\mathbf{k} = 1.40$ Coefficient of the ratio of specific heats $^{(1)}$, $\mathbf{C} = 356.1$ Compressibility Factor, $\mathbf{Z} = 1$ Molecular Weight, $\mathbf{M} = 18.015$ Ratio of $\mathbf{P}_2/\mathbf{P}_1$, $\mathbf{r} = 0.0816$ Coefficient of Subcritical Flow $^{(2)}$, $\mathbf{F}_2 = 0.2332$ Critical Flow Pressure Ratio $^{(3)}$, $\mathbf{P}_{cf}/\mathbf{P}_1 = 0.528$ Set Pressure, P (psig) = 165 PSV Type (conv., pilot, bellows) = Back Pressure, P2 (psig) = 0 Back Pressure, P2 (psig) = 0 Back Pressure Coefficient of Discharge $^{(5)}$, $\mathbf{K}_d = 0.9$ Combination Correction Factor, $\mathbf{K}_b = 1.0$ Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = 1.0$ Critical Flow Area Calculation $^{(2)}$, $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation $^{(4)}$, $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation $^{(4)}$, $\mathbf{A} = 0.131$ C = $520\sqrt{k\left(\frac{2}{k+1}\right)^{k+1}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{k+1}}$ $C = 520\sqrt{k\left(\frac{2}{k+1}\right$	Relieving Temperature, T (deg F) =	387.7	
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Compressibility Factor, $\mathbf{Z} = 1$ Molecular Weight, $\mathbf{M} = 18.015$ Ratio of $\mathbf{P}_2 \mathbf{P}_1$, $\mathbf{r} = 0.0816$ Coefficient of Subcritical Flow $^{(2)}$, $\mathbf{F}_2 = 0.2332$ Set Pressure, P(psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure Correction Factor, $\mathbf{K}_b = 1.0$ Manufacturer Coefficient of Discharge $^{(5)}$, $\mathbf{K}_d = 0.9$ Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = 1$ MFG not available Sub-critical Flow Area Calculation $^{(2)}$, $\mathbf{A} = 1$ Critical Flow Area Calculation $^{(4)}$, $\mathbf{A} = 1$ Available Orifice Area, $\mathbf{A}_v = 1$ Available Orifice Area, $\mathbf{A}_v = 1$ D.9816 18.015	Compressibility Factor, $\mathbf{Z} = M$ Molecular Weight, $\mathbf{M} = R$ atto of P_2/P_1 , $r = 0.0816$ Coefficient of Subcritical Flow ²), $\mathbf{F}_2 = 0.2332$ Critical Flow Pressure Ratio ⁽³⁾ , $\mathbf{P}_{cf}/P_1 = 0.528$ Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, $\mathbf{K}_b = 1.0$ Manufacturer Coefficient of Discharge ⁽⁵⁾ , $\mathbf{K}_d = 0.9$ Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = 1$ ALCULATIONS: Upstream Relieving Pressure: \mathbf{P}_1 (psig) = 165.3465 Set Pressure + Allowable Overpressure: \mathbf{P}_1 (psig) = 165.3465 Set Pressure + Allowable Overpressure: \mathbf{P}_1 (psig) = 165.3465 Sub-critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = 0.131$ in \mathbf{P}_1 Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$	Coefficient of the ratio of specific heats ⁽¹⁾ , C =	356.1	$C = 520\sqrt{k\left \frac{2}{k+1}\right ^{k-1}}$
Ratio of P_2/P_1 , $r = 0.0816$ Coefficient of Subcritical Flow ⁽²⁾ , $P_2 = 0.2332$ Critical Flow Pressure Ratio ⁽³⁾ , $P_{cf}/P_1 = 0.528$ Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, $K_b = 0.9$ Manufacturer Coefficient of Discharge ⁽⁵⁾ , $K_d = 0.9$ Combination Correction Factor for Rupture Disks, $K_c = 0.9$ ALCULATIONS: Upstream Relieving Pressure: P_1 (psig) = 165.3465 Set Pressure + Allowable Overpressure Critical Flow Area Calculation ⁽²⁾ , $A = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $A = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $A = 0.131$ Available Orifice Area, $A_v = 0.221$ Available Orifice Area, $A_v = 0.221$ in ² Available Orifice Area, $A_v = 0.231$ Available Orifice Area, $A_v = 0.221$ in ² In $A = \frac{W}{V} \sqrt{\frac{V}{MP_1(P_1 - P_2)}}$	Ratio of P_2/P_1 , $r = 0.0816$ Coefficient of Subcritical Flow ⁽²⁾ , $F_2 = 0.2332$ Critical Flow Pressure Ratio ⁽³⁾ , $P_{cf}/P_1 = 0.528$ Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Back Pressure Correction Factor, $K_0 = 0.9$ Manufacturer Coefficient of Discharge ⁽⁵⁾ , $K_d = 0.9$ Combination Correction Factor for Rupture Disks, $K_c = 0.9$ Critical Flow Area Calculation ⁽²⁾ , $A = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $A = 0.131$ Sub-critical Flow Area Calculation Area Calculatio	Compressibility Factor, Z =	1	V (K+1)
Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Critical Flow Area Calculation ⁽²⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 0.131 Available Orifice Area, \mathbf{A}_v = 0.221 Available Orifice Area, \mathbf{A}_v = 0.221 in ² Available Orifice Area, \mathbf{A}_v = 0.221 in ²	Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 ALCULATIONS: Upstream Relieving Pressure: P ₁ (psig) = 165.3465 Critical Flow Area Calculation ⁽²⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 1 Critical Flow Area Calculation Area Calculati	Molecular Weight, M =	18.015	
Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Critical Flow Area Calculation ⁽²⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 0.131 Available Orifice Area, \mathbf{A}_v = 0.221 Available Orifice Area, \mathbf{A}_v = 0.221 in ² Available Orifice Area, \mathbf{A}_v = 0.221 in ²	Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 C	Ratio of P_2/P_1 , $\mathbf{r} =$	0.0816	$ \left[\begin{pmatrix} k \end{pmatrix} \right]$
Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Critical Flow Area Calculation ⁽²⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = 0.131 Available Orifice Area, \mathbf{A}_v = 0.221 Available Orifice Area, \mathbf{A}_v = 0.221 in ² Available Orifice Area, \mathbf{A}_v = 0.221 in ²	Set Pressure, P (psig) = 165 PSV Type (conv, pilot, bellows) = Conventional Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , \mathbf{K}_d = 0.9 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 Combination Correction Factor for Rupture Disks, \mathbf{K}_c = 1 C		0.2332	$F_2 = \int \left \frac{\kappa}{k-1} \left (r)^{\frac{2}{k}} \right \frac{1-r^{-\alpha}}{1-\alpha} \right $
PSV Type (conv, pilot, bellows) = Back Pressure, $P2$ (psig) = 0 Back Pressure Correction Factor, K_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , K_d = 0.9 Combination Correction Factor for Rupture Disks, K_c = 1 ALCULATIONS: Upstream Relieving Pressure: P_1 (psig) = 165.3465 Critical Flow Area Calculation ⁽²⁾ , A = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , A = 0.131 Sub-critical Flow Area Calculation ⁽⁴⁾ , A = 0.131 Available Orifice Area, A_v = 0.221 Available Orifice	PSV Type (conv, pilot, bellows) = Back Pressure, P2 (psig) = 0 Back Pressure Correction Factor, \mathbf{K}_b = 1.0	Critical Flow Pressure Ratio ⁽³⁾ , $P_{cf} / P_1 =$	0.528	$ \begin{bmatrix} & & & & & & & & & & & \\ & & & & & & &$
Back Pressure, P2 (psig) = 0	Back Pressure, $P2$ (psig) = 0 Back Pressure Correction Factor, K_b = 1.0 Manufacturer Coefficient of Discharge ⁽⁵⁾ , K_d = 0.9 Combination Correction Factor for Rupture Disks, K_c = 1 Combination Correction Factor for Rupture Disks, K_c = 1 Combination Correction Factor for Rupture Disks, K_c = 1 Combination Correction Factor for Rupture Disks, K_c = 1 Combination Correction Factor for Rupture Disks, K_c = 1 Combination Correction Factor for Rupture Disks, K_c = 1 Correction Factor for Rupture Disk	Set Pressure, P (psig) =	165	<u>_</u>
Back Pressure Correction Factor, $\mathbf{K}_b = 1.0$	Back Pressure Correction Factor, $\mathbf{K}_b = 1.0$ $\mathbf{K}_b = 1.0$ $\mathbf{K}_b = 1.0$ for conventional Manufacturer Coefficient of Discharge ⁽⁵⁾ , $\mathbf{K}_d = 0.9$ $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ in $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ in $\mathbf{K}_c = 1.0$ if rupture disk not installed, else MFG not available $\mathbf{K}_c = 1.0$ in \mathbf{K}	PSV Type (conv, pilot, bellows) =	Conventional	_
Manufacturer Coefficient of Discharge ⁽⁵⁾ , $\mathbf{K_d} = 0.9$ Combination Correction Factor for Rupture Disks, $\mathbf{K_c} = 1$ Combination Correction Factor for Rupture Disks, $\mathbf{K_c} = 1$ MFG not available ALCULATIONS: Upstream Relieving Pressure: $\mathbf{P_1}$ (psig) = 165.3465 Set Pressure + Allowable Overpressure Critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = 0.131$ in $A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A_v} = 0.221$ in	Manufacturer Coefficient of Discharge ⁽⁵⁾ , $\mathbf{K_d} = 0.9$ Combination Correction Factor for Rupture Disks, $\mathbf{K_c} = 1$ Combination Correction Factor for Rupture Disks, $\mathbf{K_c} = 1$ MFG not available Set Pressure + Allowable Overpressure: Critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Critical Flow in ² $A = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$	Back Pressure, P2 (psig) =	0	
Combination Correction Factor for Rupture Disks, $\mathbf{K_c} = \frac{1}{1}$ Kc=1.0 if rupture disk not installed, else 0. MFG not available ALCULATIONS: Upstream Relieving Pressure: $\mathbf{P_1}$ (psig) = 165.3465 Set Pressure + Allowable Overpressure in² $A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{C}}{\mathbf{F}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{C}}{\mathbf{F}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\mathbf{F}}$ in²	Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = 1$ Kc=1.0 if rupture disk not installed, else MFG not available CalculationS: Upstream Relieving Pressure: \mathbf{P}_1 (psig) = 165.3465 Critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = 0.131$ Critical Flow in ² $A = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$	Back Pressure Correction Factor, $\mathbf{K_b}$ =	1.0	K _b =1.0 for conventional
Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = \frac{1}{1}$ MFG not available ALCULATIONS: Upstream Relieving Pressure: $\mathbf{P_1}(\text{psig}) = \frac{165.3465}{1000}$ Set Pressure + Allowable Overpressure Critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = \frac{0.131}{1000}$ in $\mathbf{A} = \frac{W}{CK_dP_1K_bK_c}\sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{C}(\text{ritical Flow})}{1000}$ in $\mathbf{A} = \frac{W}{735*F_2K_dK_c}\sqrt{\frac{ZT}{MP_1(P_1-P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{1000}$ in $\mathbf{A} = \frac{W}{V}$	Combination Correction Factor for Rupture Disks, $\mathbf{K}_c = \frac{1}{M}$ MFG not available WALCULATIONS: Upstream Relieving Pressure: $\mathbf{P_1}$ (psig) = 165.3465 Set Pressure + Allowable Overpressure: $\mathbf{P_1}$ in $\mathbf{P_1}$ in $\mathbf{P_2}$ and $\mathbf{P_1}$ in $\mathbf{P_2}$ in $\mathbf{P_3}$ Sub-critical Flow Area Calculation $\mathbf{P_4}$ in $\mathbf{P_3}$ in $\mathbf{P_4}$ and $\mathbf{P_4}$ in \mathbf	Manufacturer Coefficient of Discharge ⁽⁵⁾ , $\mathbf{K_d}$ =	0.9	
ALCULATIONS: Upstream Relieving Pressure: $\mathbf{P_1}(\mathrm{psig}) = 165.3465$ Set Pressure + Allowable Overpressure Critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = 0.131$ in ² $A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A_v} = 0.221$ in ²	EALCULATIONS: Upstream Relieving Pressure: $\mathbf{P_1}(\mathrm{psig}) = 165.3465$ Set Pressure + Allowable Overpressure: $A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$			Kc=1.0 if rupture disk not installed, else 0.9
Upstream Relieving Pressure: $\mathbf{P_1}(\mathrm{psig}) = 165.3465$ Set Pressure + Allowable Overpressure	Upstream Relieving Pressure: $\mathbf{P_1}$ (psig) = 165.3465 Set Pressure + Allowable Overpressure: $\mathbf{P_1}$ (psig) = 0.131 in ² $A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , \mathbf{A} = $\frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$	Combination Correction Factor for Rupture Disks, K _c =	1	MFG not available
Critical Flow Area Calculation (2), $\mathbf{A} = \frac{0.131}{A} = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation (4), $\mathbf{A} = \frac{W}{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1 (P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{A} = \frac{W}{A} = \frac$	Critical Flow Area Calculation ⁽²⁾ , $\mathbf{A} = \frac{0.131}{A = \frac{W}{CK_d P_1 K_b K_c}} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$			
$A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{W}{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\mathbf{M}}$ in ²	$A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1 (P_1 - P_2)}}$	Upstream Relieving Pressure: P_1 (psig) =	165.3465	Set Pressure + Allowable Overpressure
$A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{W}}{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\mathbf{W}}$	$A = \frac{W}{CK_d P_1 K_b K_c} \sqrt{\frac{TZ}{M}}$ Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{W}}{A} = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$	Critical Flow Area Calculation ⁽²⁾ , A =	0.131	in ²
Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{Critical Flow}}{A} = \frac{\mathbf{W}}{735*F_2K_dK_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\mathbf{W}}$	Sub-critical Flow Area Calculation ⁽⁴⁾ , $\mathbf{A} = \frac{\mathbf{Critical Flow}}{A} = \frac{W}{735*F_2K_dK_c} \sqrt{\frac{ZT}{MP_1(P_1 - P_2)}}$			$W = \overline{TZ}$
$A = \frac{W}{735*F_2K_dK_c}\sqrt{\frac{ZT}{MP_1(P_1-P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\mathbf{MP_1}}$	$A = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1 (P_1 - P_2)}}$			$A = \frac{1}{CK_d P_1 K_b K_c} \sqrt{\frac{1}{M}}$
$A = \frac{W}{735*F_2K_dK_c}\sqrt{\frac{ZT}{MP_1(P_1-P_2)}}$ Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\mathbf{MP_1}}$	$A = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1 (P_1 - P_2)}}$			
Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\text{in}^2}$	2	Sub-critical Flow Area Calculation ⁽⁴⁾ , A =	Critical Flow	_in²
Available Orifice Area, $\mathbf{A_v} = \frac{0.221}{\text{in}^2}$	2			W = ZT
· · · · · · · · · · · · · · · · · · ·	Available Orifice Area, $\mathbf{A_v} = \underline{0.221}$ in ²			$A = \frac{1}{735 * F_2 K_d K_c} \sqrt{\frac{MP_1(P_1 - P_2)}{MP_1(P_1 - P_2)}}$
· · · · · · · · · · · · · · · · · · ·	Available Orifice Area, $\mathbf{A_v} = \underbrace{0.221}_{\text{in}^2}$			
		Available Orifice Area, $\mathbf{A_v}$ =	0.221	in ²
\\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	VI M : FI / WAYA /A)		4050.0	
Valve Maximum Flowrate = W * (AV / A) 1858.8 IDs/nr	Valve Maximum Flowrate = W * (AV / A) 1858.8 IDS/nr	valve Maximum Flowrate = W ^ (AV / A)	1858.8	ibs/nr
Valve Maximum Flowrate = W * (Av / A) 1858.8 lbs/hr	Valve Maximum Flowrate = W * (Av / A) 1858.8 lbs/hr	Available Orifice Area, A _v =	0.221	$A = \frac{W}{735 * F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1)}}$ in^2