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Chris Haslego
President
Cheresources, Inc.

1422 Goswick Ridge Road
Midlothian VA 23114

Fax: 561-658-6489
Email: support@cheresources.com

Content Based
Chemical Engineering

ENGINEERING DESIGN CALCULATION - DENNIS KIRK

ORIFICE FLOW CALCULATIONS - Refer Crane Flow of Fluids 1983 (pages 2-14 to 2-15)

Ver 1.203

Project:
Tag No:
Description:

Upstream Pipe ID	d1		307.94	mm				
Orifice ID	d		184.15	mm				
Orifice Area	A	=PI()*d^2/4	26633.8	mm2				
Beta Ratio	β	=d/d1	0.598	Valid for ratios 0.2 to 0.75				
i) Discharge Coefficient	Cd			(typically 0.6 for near critical flow orifice)	Currently	57%	of critical press ratio	
Flow Coefficient	C	=Cd/Sqrt(1-B^4)	0.650	(See page A-20)				
or ii) if Cd unknown then find C from Table A-20			0.650	then Cd =	0.607	and Korifice = (1-b^2)/(C^2.b^2) =	4.248	
or iii) Value of C auto calculated from Table A-20			0.650					
Upstream Pressure	p1		9315	kPa(g)	Dynamic Viscosity	0.013	cP	
Downstream Pressure	p2		9227.5	kPa(g)	Kinematic Viscosity		cSt	
Differential Press.	dp		87.5	kPa				
Orifice Type - **N**ozzle or Venturi Meter OR **S**quare Edge Orifice			S	Square Edge Orifice				
Reynolds Number			20,648,602	~Turbulent Flow		**CAUTION - Re outside normal range of calculation [3 to 2,000,000]**		

Incompressible Fluids:

Density	D	Density should be blank for Compressible Flow		kg/m3	SG	0.000				
Flow Velocity	V		#DIV/0!	m/sec						
Flow	q	=C.A.Sqrt[2.(p1-p2)/D]	#DIV/0!	m3/sec	#DIV/0!	m3/min	#DIV/0!	m3/hr		
		(Eqn. 2-23)	#DIV/0!	l/sec	#DIV/0!	l/min	#DIV/0!	l/hr		
			#DIV/0!	kg/sec	#DIV/0!	kg/min	#DIV/0!	Tonnes/hr		

Compressible Fluids:

Molecular Weight	MW		17.45		Specific Gravity	0.602				
Upstream Temperature	T1		22.5	deg C						
Compressibility Factor	Z	from tables	0.827							
Density	D		80.832	kg/m3	0.738	kg/Sm3				
Specific Heat Ratio	γ	from tables	1.3	Valid for ratios 1.25 to 1.45						
Difference Press Ratio		=(p1-p2)/p'1	0.009	Valid for ratio 0 to 0.60						
Expansion Factor	Y	from table A-21	0.997							
Flow Velocity	V		10.784	m/sec						
Non Critical Flow	q	=Y.C.A.Sqrt[2.(p1-p2)/D]	0.8031682	Am3/sec	48.190094	Am3/min	2891.406	Am3/hr		
		(Eqn. 2-24)	87.964327	Sm3/sec	5277.8596	Sm3/min	316671.6	Sm3/hr	269.7373	MMSCFD
			64.921715	kg/sec	3895.3029	kg/min	233.7182	Tonnes/hr		
Critical Pressure Ratio	rc	from table A-21	0.563							
Actual Pressure Ratio	r	=p'2/p'1	0.991	**Use Non Critical Flow Calculation Result**						
Critical Pressure	p1cr	=p'2/rc	16463.7	kPa(g)						
	p2cr	=p'1.rc	5201.6	kPa(g)						
Choked Flow	q	=Y.C.A.Sqrt[2.p1.(1-rc)/D]	5.506837	Am3/sec	330.41022	Am3/min	19824.61	Am3/hr		
		(See page 2-15)	603.11799	Sm3/sec	36187.079	Sm3/min	2171225	Sm3/hr	1849.425	MMSCFD
			445.12879	kg/sec	26707.727	kg/min	1602.464	Tonnes/hr		