



About this document

This document contains screenshots of software available from Cheresources.com. You can find this title in our online store at:

<http://www.cheresources.com/cheplusstore/catalogue.php>

Clicking the above link should activate your default browser and launch the site.

We recommend using our search feature to find the title.

If you haven't visited our site before, you can find the main page at:

<http://www.cheresources.com>

Thanks for visiting our site,

Chris Haslego
President
Cheresources, Inc.

© COPYRIGHT, 2005. 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

Compressible Fluid Flow Through Thin Square Edge Orifice Plates

Ver 1.000

Calculation utilises data from Cunningham (ASME 1951) to extend the typical orifice calculation limits of $P_2'/P_1' > 0.8$ or 0.6

Calculation is valid for $1.0 > P_2'/P_1' > 0$ and $0.8 > \beta > 0.1$ and is similar to AGA 3 for $1.0 > P_2'/P_1' > 0.8$

Upstream Pipe ID	D		100	mm	
Orifice ID	d		50	mm	
Orifice Area	$A_o = \pi \cdot \frac{d^2}{4}$		1963.5	mm ²	
Beta Ratio	$\beta = \frac{d}{D}$		0.500	OK	
Upstream Pressure	P ₁		4000	kPa(g)	
	P ₁ '		4101.325	kPa(a)	
Differential Press.	dP		4000	kPa	
Downstream Pressure	P ₂		0	kPa(g)	
	P ₂ '		101.325	kPa(a)	
Molecular Weight	MW		29		
	CO ₂		0	mole%	
	N ₂		0	mole%	
	Z _{base}		0.993		
	S _{Greal}		1.008		
Specific Heat Ratio	γ ₁ - from tables		1.4		
Upstream Temperature	T ₁		25	°C	
	T ₁ '		298.15	°K	
Absolute Viscosity	μ ₁		0.014	cP	
Compressibility Factor	Z ₁ - from AGA 8 GCM2		0.659		
Density	$\rho_1 = \frac{MW \cdot P_1'}{Z_1 \cdot 8.3145 T_1'}$		72.779	kg/m ³	
			1.235	kg/Sm ³	
Inflection Pressure Ratio	[Cunningham]		0.63		
Actual Pressure Ratio	$r = \frac{P_2'}{P_1'}$	Use Second Equation for Y	0.025	$r' = \frac{dP}{P_1'}$	0.975
Expansion Factor for P2 >	2483 kPa(g) $Y = 1 - (0.41 + 0.35 \cdot \beta^4) \cdot \frac{\left(1 - \frac{P_2'}{P_1'}\right)}{k}$		0.699		
for P2 <	2483 kPa(g) $Y = Y_{0.63} - (0.49 + 0.45 \cdot \beta^4) \cdot \frac{\left(0.63 - \frac{P_2'}{P_1'}\right)}{k}$		0.662		
Reynolds Number	$Re_1 = \frac{D \cdot v_1 \cdot \rho_1}{\mu_1} = \frac{4 \cdot w \cdot 10^6}{\pi \cdot \mu_1 \cdot D}$		17,732,244		
Discharge Coefficient	Cd(FT) - from AGA 3 method for Flange Taps		0.60205		
Velocity of Approach Factor	$E_v = \frac{1}{\sqrt{1 - \beta^4}}$		1.03280		OK
Flow Coefficient	AGA 3	$C = C_d \cdot E_v$	0.62179		
	or Cunningham	$C = 0.608 + 0.415 \cdot \beta^4$ for fully turbulent flow	0.63394		not used in calculation
Volumetric Flowrate	$q_1 [Am^3 / sec] = Y \cdot C \cdot A_o \cdot \sqrt{\frac{2 \cdot (P_1 - P_2) \cdot 1000}{\rho_1}}$		0.2679	Am³/sec	
			15.7830	Sm³/sec	
			19.4976	kg/sec	
Mass Flowrate	$w [kg / sec] = Y \cdot C \cdot A_o \cdot \sqrt{2 \cdot \rho_1 \cdot (P_1 - P_2) \cdot 1000}$				
Velocity Upstream	v ₁		34.110	m/sec	