Helix Technologies Pty Ltd

Project	Helix QA	Client	Helix QA
Project No.	4567	Design Date	17/03/2017
Category	Demo Gas QA	Atmos. Press	1.0133 bar
Network Type	Gas	Calc. Method	Modified Darcy
Description	Air at sub-sonic velocity Crane 410M Ex4-22		

Air flow in pipe at sub-sonic Velocity. ref. 'Flow of Fuids Through Valves, Fittings and Pipe', Crane Technical Paper 410 M Example 4-22 pg 4-14.
A 1/2" Schedule 80 pipe with a pressure of 133 bar at a point 3m from the end discharges to atmospher.
Find the discharge flow rate in m3/hr at Standard Metric Conditions (15 deg C and 101.325kPa)
Pipe roughness adjusted to 0.0446 mm to give Darcy friction factor close to 0.0275 as used in example.

Calculation Results		Publication		Helix delta-Q	
Shock loss K for exit	K	1.0		1.0	
Friction factor f		0.0275	assumed	0.0270	Calculated
using adjusted roughness = 0.0446mm					
Net Expansion Factor	Y	0.76		0.7550	
Mass flow rate W Darcy		-		129.067 kg/hr	
Modified Darcy method					
Volume Flow rate at SMC		1.76 m3/hr		1.7554 m3/hr	
Free or Choked Flow		Free flow		Free flow	

Results are very close.

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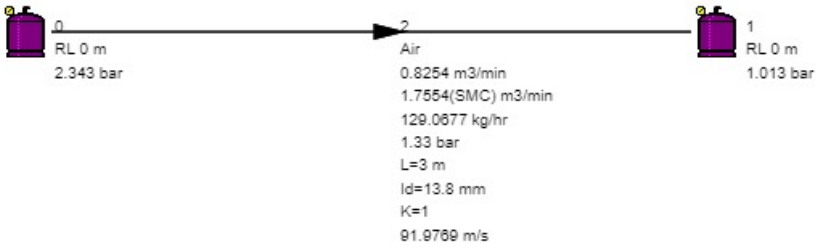

Air at sub-sonic velocity Crane 410M Ex4-22

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Pipe No	2	From node to node	0 - 1
Description		Equipment No	
Gas	Air	Molecular Mass	28.96 kg/kmol
Ratio Cp/Cv	1.4	Viscosity	0.02 cP
Temperature	40 C	Density	2.6061 kg/m3
Gas SG to Air	1	Gas Specific Vol	0.3837 m3/kg
Gas Constant R	287.0991	Abs. Gas Temp.	0.3837 deg K
Flow Condition	Free Flow	Net Exp.Factor Y	0.755
Pipe Description	Steel Pipes 1/2" AS1836 (ANSI B36.10)	Pipe Class	Sch 80
Nominal Diameter	15 mm	Inside Diameter	13.8 mm
Outside Diameter	21.3 mm	Pipe Length	3 m
Pipe Roughness	0.0446 mm	Allowable Press.	999 bar
Orifice Plate Dia	-	Non Return Valve	No

Pipe Fitting Description	Qty	K value	Kft value
Exit - Sharp edged	1	1	0

Total Fittings k	1	Total Fittings kf	0
Flow Rate	0.8254 m3/min	Flow at SMC	1.7554 m3/min
Mass Flow Rate	129.0677 kg/hr	Velocity	91.9769 m/s
Mach number	0		
Friction Loss	1.2198 bar	Fitting Losses	0.1102 bar
Orifice Losses	0 bar	Fixed Pressure Drop	0 bar
Total Pressure Drop	1.33 bar		
Entry Total Pressure	2.343 bar	Exit Total Pressure	1.013 bar
Reynolds No.	431026.583	Friction Factor	0.0270252 (Darcy f)

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Node No	0	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	2.343 bar
Ext Flow (+In/-Out)	-	Abs. Node Pressure	2.343 bar
Int.(Gauge) Head	0 bar		

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Node No	1	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	1.013 bar
Ext Flow (+In/-Out)	-	Abs. Node Pressure	1.013 bar
Int.(Gauge) Head	0 bar		