Helix Technologies Pty Ltd

Project	New Project	Client	ABC Metals ..
Project No.	4567	Design Date	15/06/2017
Category	Demo Gas QA	Atmos. Press	1.01 bar
Network Type	Gas	Calc. Method	Modified Darcy
Description	Air Flow Crane 410M pg3-22 Example 2		

Air Flow - Crane Technical Paper 410M pg3-22 Example 2
Air at 7 bar gauge and 30 deg C flowing through 100m of 4" ISO steel pipe 6.3mm wall thickness has a pressure of 1 bar.
Find the flow rate in m3/min at metric standard conditions (1.01325 bar, 15 deg C)
Add two tanks, one at 8.01325 bar and the second at 7.01325 bar - pressure drop = 1 bar.
Add pipe connecting the tanks, set fluid to Air at 30 deg C and set pipe size and length to 100m.
Pipe roughness is not given assumed 0.03mm.

Solve Network.

Helix delta-Q Calculation Results Isothermal	Publication	Helix delta-Q Modified Darcy	
Pressure drop bar (given)	1.0	1.0	
Density of fluid rho	9.21 (Table A10)	9.21 Calculated	
Mass flow rate W	9900 kg/hr	9882 kg/hr	9938 kg/hr
Flow rate at SMC qm	134.7 m3/min	134.41 m3/min	135.17 m3/min

Results are close. Published results were read from nomographs, Helix results calculated using methods in Crane 410M.
Check calculation in second portion of network - set second node to a Nozzle and set flow out as -17.89m3/min and solve.
Calculated mass flow rate is now 9883kg/hr and pressure drop 1.0 bar.

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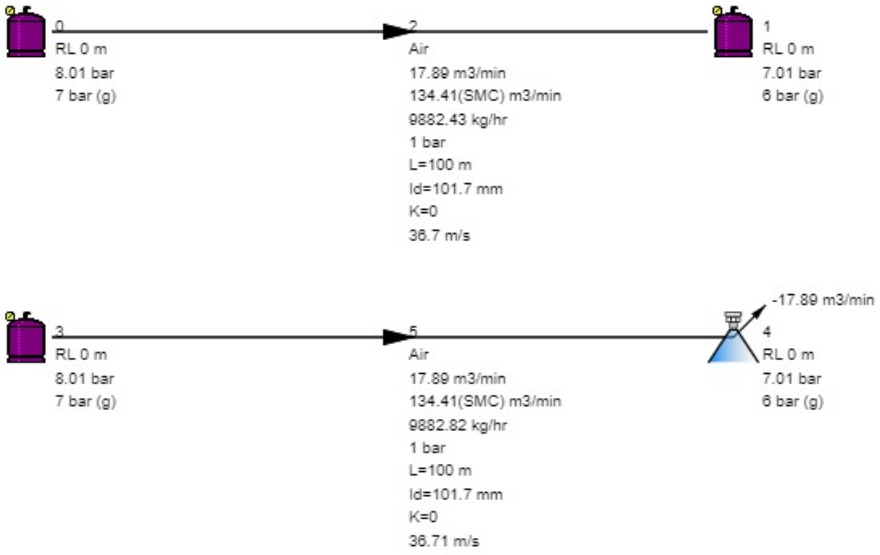

Air Flow Crane 410M pg3-22 Example 2

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Description	Air Flow Crane 410M pg3-22 Example 2		

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	0.019 cP
Temperature	30 C	Density	9.21 kg/m3
Gas SG to Air	1	Gas Specific Vol	0.11 m3/kg
Gas Constant R	287.1	Abs. Gas Temp.	0.11 deg K
Flow Condition	Free Flow	Net Exp.Factor Y	0.95
Pipe Description	Steel Pipe 4" ISO 336 / BS 3600 6.3mm wall	Pipe Class	
Nominal Diameter	100 mm	Inside Diameter	101.7 mm
Outside Diameter	114.3 mm	Pipe Length	100 m
Pipe Roughness	0.03 mm	Allowable Press.	0 bar
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	17.89 m3/min	Flow at SMC	134.41 m3/min
Mass Flow Rate	9882.43 kg/hr	Velocity	36.7 m/s
Mach number	0.44		
Friction Loss	1 bar	Fitting Losses	0 bar
Orifice Losses	0 bar	Fixed Pressure Drop	0 bar
Total Pressure Drop	1 bar		
Entry Total Pressure	8.01 bar	Exit Total Pressure	7.01 bar
Reynolds No.	16653905.7	Friction Factor	0.01493 (Darcy f)

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Project No.	4567	Design Date	15/06/2017
Category	Demo Gas QA	Atmos. Press	1.01 bar
Description	Air Flow Crane 410M pg3-22 Example 2		

Pipe No	5	From node to node	3 - 4
Description		Equipment No	
Gas	Air	Molecular Mass	28.96 kg/kmol
Ratio Cp/Cv	1.4	Viscosity	0.019 cP
Temperature	30 C	Density	9.21 kg/m3
Gas SG to Air	1	Gas Specific Vol	0.11 m3/kg
Gas Constant R	287.1	Abs. Gas Temp.	0.11 deg K
Flow Condition	Free Flow	Net Exp.Factor Y	0.95
Pipe Description	Steel Pipe 4" ISO 336 / BS 3600 6.3mm wall	Pipe Class	
Nominal Diameter	100 mm	Inside Diameter	101.7 mm
Outside Diameter	114.3 mm	Pipe Length	100 m
Pipe Roughness	0.03 mm	Allowable Press.	0 bar
Orifice Plate Dia	-	Non Return Valve	No
Total Fittings k	0	Total Fittings kf	0
Flow Rate	17.89 m3/min	Flow at SMC	134.41 m3/min
Mass Flow Rate	9882.82 kg/hr	Velocity	36.71 m/s
Mach number	0.44		
Friction Loss	1 bar	Fitting Losses	0 bar
Orifice Losses	0 bar	Fixed Pressure Drop	0 bar
Total Pressure Drop	1 bar		
Entry Total Pressure	8.01 bar	Exit Total Pressure	7.01 bar
Reynolds No.	16654562.38	Friction Factor	0.01493 (Darcy f)

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Category	Demo Gas QA	Atmos. Press	1.01 bar
Description	Air Flow Crane 410M pg3-22 Example 2		

Node No	0	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	8.01 bar
Ext Flow (+In/-Out)	-	Abs. Node Pressure	8.01 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	7.01 bar
Ext Flow (+In/-Out)	-	Abs. Node Pressure	7.01 bar
Int.(Gauge) Head	2167514.19 bar		

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Node No	3	Node Type	Tank
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	8.01 bar
Ext Flow (+In/-Out)	-	Abs. Node Pressure	8.01 bar
Int.(Gauge) Head	0 bar		

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Description	Air Flow Crane 410M pg3-22 Example 2		

Node No	4	Node Type	Nozzle
Description		Equipment No	
Rel. Level (RL)	0 m	Pressure Input	7.01 bar
Ext Flow (+In/-Out)	-17.89 m3/min	Abs. Node Pressure	7.01 bar
Int.(Gauge) Head	701316.29 bar		