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Content Based
Chemical Engineering

Net Positive Suction Head Availiable

REFERENCES: Marks' Standard Handbook for Mechanical Engineers; Perry's Chemical Engineers Handbook 6th Edition; and Crane Technical Paper #410

NOTE: Always begin a new case by retrieving the original file. Direct entry of data in cells that originally contain table lookups could cause functions to be lost, or incorrect calculations. I format cells requiring entry colored **RED**; calculated values are black.

1.) Enter identification at [C4].
2.) Enter the pipe ID at [C7], use [=], then go to pipe table, eg; [=I54] is the ID for 1 1/2" schd 40, or [=J54] metric (40 mm) or directly enter the size if it is not in table.
3.) Enter straight length at [C8].
4.) Enter pipe material at [C9], use [=], then go to material name in table (A49...B56) eg. [=A49] is Carbon Steel. **NOTE: Typing in a material type can LOCK the program up!**
5.) Enter the suction (inlet) liquid elevation at [C10].
6.) Enter the pump centerline elevation at [C11]. Note: the differential!
7.) Enter your elevation "barometric" absolute pressure at [C12].
8.) Enter fluid name at [F7], use [=], then go to liquid table. eg. [=C96] is "WATER", or directly enter if not in table.
9.) Enter fluid temperature at [F8].
10.) If the liquid [F7], is in the liquid table, a representative specific gravity will show at [F9], otherwise directly enter it at [F9]. Check that the sp. gr. value is appropriate for the particular application.
11.) If the liquid [F7], is in the liquid table, the viscosity is automatically calculated at its temperature [F8], otherwise directly enter fluid viscosity at [F11]. Note: no limits are built into viscosity calcs, eg. they will calculate a value for water at 12 deg F. and 450 deg F. If using the calculated viscosity, always check for reasonability, and change of state.
12.) Enter the number of each type of valve & fitting just to their left. [A19]...[A26] & [D19]...[D26].
13.) Misc items: for any item where `K' is not known but an equivalent length is known, enter this value at at [F29] in FEET.
14.) Entrance loss: normally 0.5 is input at [C30] or any value desired.
15.) Misc K: for any item where `K' is known, but not listed above. Enter value at [C31].
16.) If G34 (% Error) is Not Zeroed Push the CALCULATE button at [H37] for the iterative calculation to take place and zero the % error of the calculation.
17.) The calculated NPSHA is calculated and shown at [E43]. The liquid velocity is shown at [F32]. Which normally will be in the 3 - 6 fps (1-2 meter) range for a good design. Vortex formation is a severe problem at low suction conditions a minimum submergence level is noted at [E41].

Print out using direct Excel commands. This application is provided by Chemical Engineers Resource Website, vis[cheresources.com](cheresources.com) for additional selections.

Print out using direct EXCEL commands.

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Consistent with GOOD ENGINEERING PRACTICE, the burden rests with the USER of these spreadsheets to review ALL calculations, and assumptions. The USER IS FULLY RESPONSIBLE for the results or decisions based on calculations.
This Spreadsheet Requires MACROS to be ENABLED to ASSURE proper operation.
See the Workbook Help Sheet for Additional Instructions on Use.

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4/23/2004

Net Positive Suction Head Available

PUMP: CLOUDY WATER SYSTEM

Static			**Dynamic**		
pipe ID:	4.260	in	fluid:	WATER	
length:	3	ft	temp :	100	ºF
material:	Stainless		sp. gr.:	1	
liq level, elev:	5	ft	density:	62.4	lb/cu ft
pump C/L, elev:	2	ft	viscosity:	0.72	µ,cps.
pressure:	33.4	ft abs	vapor press:	2.179	ft abs

Flow: 100 gpm or 50000 lb/hr

Fitting Losses ··· **fitting friction factor, ft** : 0.016796

	valves	**K**		**fittings**	**K**
0	gate valve	0.000	0	thru `T'	0.000
0	globe valve	0.000	0	branch`T'	0.000
0	angle valve	0.000	0	scrwd 90°	0.000
0	ball valve	0.000	0	scrwd 45°	0.000
0	plug valve	0.000	0	short 90°	0.000
0	diaph valve	0.000	0	short 45°	0.000
0	b'fly valve	0.000	1	long 90°	0.235
0	swing check	0.000	0	long 45°	0.000

valves total:	0			
fittings total:	0.2351435	add'l eq. len:	3	feet
entrance loss:	0.5			
misc. K	2	final length, l':	6	feet
ΣK	2.7351435	liquid velocity:	2.25	ft/sec

assum$f$ = 0.0199 calc f = 0.0199 error$f$ = 0.00%

N = 3.0720 12fl'/d = 0.3369 Re = 6.3W/dz = 102,700

Frictional loss =	0.241	hfs, feet
Liquid level =	3.000	hst, feet
Min. submergence (vortexing) =	1.206	feet of liquid

NPSHA = ha - hva (+/-) hst - hfs = 33.98 feet

4/23/2004

Net Positive Suction Head Available

PUMP: CLOUDY WATER SYSTEM

Static			**Dynamic**		
pipe ID:	108.20	mm	fluid:	WATER	
length:	100	meter	temp :	37.777778	ºC
material:	Stainless		sp. gr.:	1.00	
liq level, elev:	1.524	meter	density:	1000	kg/m^3
pump C/L, elev:	0.6096	meter	viscosity:	0.0006794	z, Pa sec
pressure:	10.18032	meter abs	vapor press:	0.664	meter abs

Flow: 35 m^3/hr or 9.72222222 kg/sec

Fitting Losses ··· **fitting friction factor, ft** : 0.016672

	valves	**K**		**fittings**	**K**
0	gate valve	0.000	0	thru `T'	0.000
0	globe valve	0.000	0	branch`T'	0.000
0	angle valve	0.000	0	scrwd 90°	0.000
0	ball valve	0.000	0	scrwd 45°	0.000
0	plug valve	0.000	0	short 90°	0.000
0	diaph valve	0.000	0	short 45°	0.000
0	b'fly valve	0.000	0	long 90°	0.000
0	swing check	0.000	0	long 45°	0.000

valves total:	0			
fittings total:	0	add'l eq. len:	0.75	meter
entrance loss:	0.5			
misc. K	0	final length, l':	100.75	meter
ΣK	0.5	liquid velocity:	1.057	mps

assum f = 0.0217 calc f = 0.0217 error f = 0.00%

N = 20.7038 f ·l/d = 20.2038 Re = 1.27·(W/dz) = 167976

Frictional loss = 1.176421574 hfs, meter

Liquid level = 0.914 hst, meter

Min. submergence (vortexing) = 0.544 meter of liquid

NPSHA = ha - hva (+/-) hst - hfs = 9.254 meter

material table	
matl	epsilon
Carbon Ste	150
Stainless	150
Cast Iron	850
CU tubing	5
SS tubing	5
PVC	5
glass	5
kynar	5

liquid	vis (cp)	sp.gr.
AMMONIA 100%	0.01	0.682
AMMONIA 26%	0.81	0.890
CARBON DIOXIDE	0.06	1.102
CAUSTIC 50%	39.94	1.525
CAUSTIC 20%	2.68	1.219
ETHANOL 100%	0.76	0.789
ETHANOL 95%	0.91	0.804
ETHANOL 40%	1.42	0.935
FUEL OIL #2	2.8	0.876
FUEL OIL #6	185.46	0.993
GASOLINE	0.51	0.751
HYDROCHLORIC 31.5%	1.48	1.159
ISOPROPYL ALCOHOL	1.26	0.785
KEROSENE	1.33	0.815
METHANOL 100%	0.43	0.796
METHANOL 90%	0.45	0.824
METHANOL 40%	1.11	0.937
SULPHUR DIOXIDE	0.28	1.434
SULPHURIC 98%	13.92	1.830
TURPENTINE	1.04	0.864
WATER	0.72	1.000

PIPE			
nominal	inside diameter		
diameter	schd 10S	schd 40	schd 80
1/2	0.674	0.622	0.546
3/4	0.884	0.824	0.742
1	1.097	1.049	0.957
1 1/4	1.422	1.380	1.278
1 1/2	1.682	1.610	1.500
2	2.157	2.067	1.939
2 1/2	2.635	2.469	2.323
3	3.260	3.068	2.900
3 1/2	3.760	3.548	3.364
4	4.260	4.026	3.826
6	6.357	6.065	5.761
8	8.329	7.981	7.625
10	10.420	10.020	9.562
12	12.390	11.938	11.374
14	13.624	13.124	12.500
16	15.624	15.000	14.312
18	17.624	16.867	16.124
20	19.564	18.812	17.938
24	23.500	22.624	21.562