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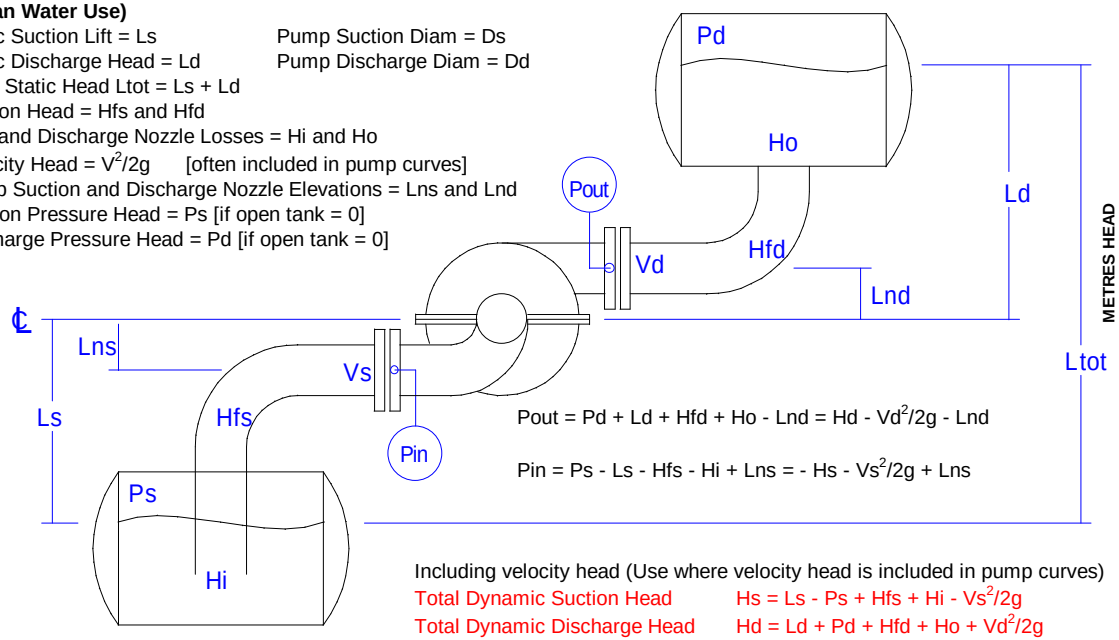
Content Based
Chemical Engineering

ENGINEERING DESIGN CALCULATION - DENNIS KIRK

SINGLE STAGE CENTRIFUGAL PUMP CALCULATION
(Clean Water Use)

Version 1.100 Aug-99

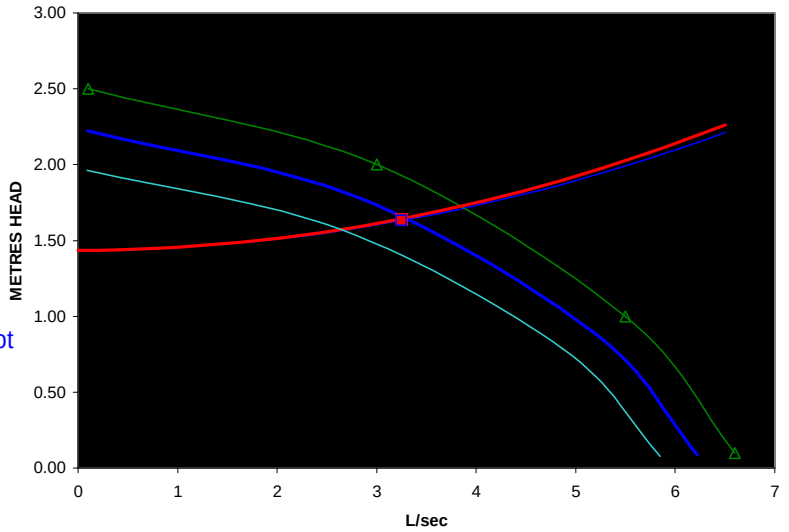
Static Suction Lift = Ls — Pump Suction Diam = Ds
Static Discharge Head = Ld — Pump Discharge Diam = Dd
Total Static Head Ltot = Ls + Ld
Friction Head = Hfs and Hfd
Inlet and Discharge Nozzle Losses = Hi and Ho
Velocity Head = $V^2/2g$ [often included in pump curves]
Pump Suction and Discharge Nozzle Elevations = Lns and Lnd
Suction Pressure Head = Ps [if open tank = 0]
Discharge Pressure Head = Pd [if open tank = 0]



Pout = Pd + Ld + Hfd + Ho - Lnd = Hd - $Vd^2/2g$ - Lnd

Pin = Ps - Ls - Hfs - Hi + Lns = - Hs - $Vs^2/2g$ + Lns

SYSTEM CURVES



Including velocity head (Use where velocity head is included in pump curves)

Total Dynamic Suction Head	Hs = Ls - Ps + Hfs + Hi - $Vs^2/2g$
Total Dynamic Discharge Head	Hd = Ld + Pd + Hfd + Ho + $Vd^2/2g$
Total Dynamic Head	Htot = Hd + Hs

Without velocity head (Use where velocity head not included in pump curves)

Dynamic Suction Head (simple)	Hs(s) = Ls - Ps + Hfs + Hi
Dynamic Discharge Head (simple)	Hd(s) = Ld + Pd + Hfd + Ho
Total Dynamic Head (simple)	Htot(s) = Hd(r) + Hs(r)
NPSHa (simple)	NPSHa(s) = NPSHa - $Vs^2/2g$

Closed Tank: NPSHa(abs) = Ps + Patm - Ls - Hfs - Hi + $Vs^2/2g$ - Pvap [where Pvap = Vapour Pressure(abs)]
Open Tank: or = Pamb - Ls - Hfs - Hi + $Vs^2/2g$ - Pvap [NPSHa should exceed NPSHr by at least 0.5 m]

SYSTEM PROPERTIES					
Q	3.25	l/sec		0.0033	m3/sec
SG	0.9982		D	998.2	kg/m3
Tfluid				20	°C
Pvap	0.24	m(abs)		2.337	kPa(abs)
Ps	3.06	m		30	kPa(g)
Ls	1.000	m		9.8	kPa
Hi	0.000	m		0	kPa
Hfs	0.087	m		0.9	kPa
Ds	0.100	m	As	0.0079	m2
Lns	0	m		0.000	kPa
Pd	0.00	m		0	kPa(g)
Ld	3.500	m		34.273197	kPa
Ho	0.000	m		0	kPa
Hfd	0.107	m		1.0	kPa
Dd	0.080	m	Ad	0.0050	m2
Lnd	0	m		0.000	kPa

SYSTEM CHARACTERISTICS				
Patm	10.347	m	101.325	kPa(abs)
Pamb	10.347	m	101.325	kPa(abs)
Vs	0.009	m	0.41	m/sec
Pinlet	1.976	m	19.353	kPa(g)
Hs	-1.985	m	-19.438	kPa
Hs(s)	-1.976	m	-19.353	kPa
Vd	0.021	m	0.65	m/sec
Poutlet	3.607	m	35.316	kPa(g)
Hd	3.628	m	35.525	kPa
Hd(s)	3.607	m	35.316	kPa
Htot	1.64	m	16.09	kPa
Htot(s)	1.63	m	15.96	kPa
NPSHa	12.09	m(abs)	118.43	kPa(g)
NPSHa(s)	12.09	m(abs)	118.34	kPa(g)

PUMP SELECTION				
Pump Speed N	1650	rpm	Specific Speed	2050
Impeller Diam D	0.15	m	Hydraulic Power	0 kW
Pump Efficiency	69.0%	Motor Power kW		0.1
NPSHr	6	m		
PUMP CURVES:	1750	rpm	[green curve]	
Flow (l/sec)	0.1	3	5.5	6.6
Head (m)	2.5	2	1	0.1
NPSHr	5	6.8	9.2	11
Pump Efficiency	77.0%	75.0%	66.0%	47.0%
Motor Power kW	0.0	0.1	0.1	0.0
		rpm	[pink curve]	
Flow (l/sec)				
Head (m)				
NPSHr		4.6	5.5	7.2
Efficiency		74.5%	70.0%	43.0%
Power kW		0.0	0.0	0.0