

# PUMP CALCULATION SHEET

(RECIPROCATING PUMP)

(            )

CLIENT : \_\_\_\_\_  
 PROJECT : \_\_\_\_\_  
 TITLE : \_\_\_\_\_  
 JOB NO. : \_\_\_\_\_  
 DOC. NO. : \_\_\_\_\_ (            )

REV.	1	2	3	MADE	
BY				CHKD	
CHKD				APVD	
APVD					
DATE				DATE	

1	ITEM NO. :				
2	SERVICES :				
3		<b>FLUID</b>	<b>Symbol</b>	<b>Note</b>	
4	PUMPED LIQUID	<b>WATER</b>			
5	OPERATING TEMPERATURE °C	<b>90</b>		Data	
6	VISCOSITY AT OPERERATING TEMP. cP	<b>0.23</b>	VIS	Data	
7	VAPOR PRESSURE kg/cm <sup>2</sup> A	<b>0.15</b>	PV	Data	
8	SP. GR. AT OPERATING TEMP.	<b>0.99</b>	SG	Data	
9	GRAVITY m/s <sup>2</sup>	<b>9.81</b>	g	Data	
10					
11	CAPACITY m <sup>3</sup> /hr	<b>120</b>	Q	Data	
12	EXCESS CAPACITY %	<b>0</b>	Qe%		
13	MAX. CAPACITY m <sup>3</sup> /hr	120	Q'	Q' = 0.01 Q (100+Qe%)	
14	VOLUMETRIC EFFICIENCY %	<b>94</b>	η <sub>v</sub>	Page 7	
15	PLUNGER DISPLACEMENT CAPACITY m <sup>3</sup> /hr	127.7	Q <sub>p1</sub>	Q <sub>p1</sub> = 100 Q / η <sub>v</sub>	
16	ESTIMATED STROKE LENGTH mm	<b>152</b>	L	Fig. 10, 9, app. A      z=3 triplex, L = 152 mm	
17	EST'D SPEED RPM	<b>360</b>	N	N=360 rpm	
18	EST'D PLUNGER DIA. mm	<b>133</b>		Eq. 13 or Appendix A	
19	NUMBER OF PLUNGER	<b>3</b>	z		
20	SUCTION PIPE DIA. AND DISCHARGE mm	194 / 146	Dps, Dpd	Appendix A	
21	SUCTION PIPE LENGTH and DISCHARGE m	9 / 50	Lps, Lpd	Data	
22					
23		<b>SUCTION</b>			
23	PRESSURE AT EQUIPMENT kg/cm <sup>2</sup> A	<b>3</b>	P1	Data	
24	MIN. STATIC HEAD ( + or - ) m	<b>1</b>	H1	Data (minus if bellow pump elevation)	
25	PIPE FRICTION kg/cm <sup>2</sup>	<b>0.12</b>		Data <i>See note 1)</i>	
26	PRESS. DROP AT EQUIPMENT(.....) kg/cm <sup>2</sup>	<b>0.05</b>		Data <i>See note 1)</i>	
27	SUCTION PUMP DIA. mm	<b>146</b>	ID	App. A	
28	VELOCITY HEAD AT SUCTION kg/cm <sup>2</sup>	0.020	HV	Eq. 1 and 2 <i>See note 1)</i>	
29	SUCTION HEAD kg/cm <sup>2</sup>	-0.091	DP1	= 0.1 SG.H1 - Loss in line 25&26 - HV	
30	PUMP SUCTION PRESSURE kg/cm <sup>2</sup> A	<b>2.909</b>	PS	Eq. 1 to 3	
31	NPSH AVAILABLE m	27.868	NPSHA	Eq. 8	
32					
33		<b>DISCHARGE</b>			
33	PRESSURE AT EQUIPMENT kg/cm <sup>2</sup> A	<b>12</b>	P2	Data	
34	STATIC HEAD m	<b>24</b>	H2	Data	
35	PRESSURE DROP AT :				
36	PIPE (include fittings & valves) kg/cm <sup>2</sup>	<b>0.12</b>		Data	
37	Equipment 1 (.....) kg/cm <sup>2</sup>	<b>0.11</b>		Data	
38	Equipment 2(.....) kg/cm <sup>2</sup>	<b>0.1</b>		Data	
39	Equipment 3 (.....) kg/cm <sup>2</sup>	<b>0.05</b>		Data	
40	DISCHARGE PRESSURE DROP kg/cm <sup>2</sup>	0.380	DP2	= total of line no. 36 up to 39	
41	DISCHARGE HEAD kg/cm <sup>2</sup>	3.136	DP12	= DP2 + 0.1(H2)(SG)	
42	ORIFICE PRESS. DROP RATIO %	<b>20</b>	η <sub>p</sub>	If require pulsation dampener. If not fill with 0	
43	ORIFICE PRESS. DROP kg/cm <sup>2</sup>	0.627	DP <sub>OR</sub>	Eq. 18	
44	ACCELERATION HEAD kg/cm <sup>2</sup>	0.000		If does not require pulsation dampener use eq. 15	
45	PUMP DISCHARGE PRESSURE kg/cm <sup>2</sup> A	18.139	PD	PD = P2+0.1(H2)(SG)+DP2	
46	PUMP SUCTION PRESSURE kg/cm <sup>2</sup> A	2.909	PS	= line 22	
47	PUMP DIFF. PRESSURE kg/cm <sup>2</sup>	15.230	DP	DP=PD-PS	
48	TOTAL HEAD (CALCULATED) m	153.84	H	H=10(DP)/SG	
49	TOTAL HEAD (TAKE) m	154.00	H		
50	MECHANICAL EFFICIENCY %	<b>88</b>	η <sub>M</sub>	Page 7	
51	GEAR EFFICIENCY %	<b>93</b>	η <sub>GEAR</sub>	Page 7	
52	LIQUID HORSE POWER kW	59.21	LHP	Eq. 9 and 10	
53	PUMP BHP kW	71.57	BHP <sub>PUMP</sub>	Eq. 11	
54	DRIVER BHP kW	76.96	BHP <sub>DRIVER</sub>	Eq. 12	
55	ESTIMATED NPSH R m	21.83	NPSHR	Eq. 20	
56	MINIMUM SUCTION EQP. PRESS. kg/cm <sup>2</sup> A	2.40	P1 <sub>MIN</sub>	=0.1 NPSHR.SG + PV - DP1	
57					
58	NOTES :	1) THIS PRESSURE DROP SHALL HAS BEEN MULTIPLIED FROM CONTINOUS FLOW PRESS. DROP CALCULATION BY :			
59		<i>10 times for simplex</i>			
60		<i>2.6 times for duplex      Note 2). Pulsation dampener vol. = (25 Lt x 18/11.2)/22 = 1.8 Lt</i>			
61		<i>1.2 times for triplex      Value of 25 Lt provided from fig. 13</i>			

# PUMP CALCULATION SHEET (RECIPROCATING METERING PUMP)

(            )

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REV.	1	2	3	MADE	
BY				CHKD	
CHKD				APVD	
APVD					
DATE				DATE	

1	ITEM NO. :				
2	SERVICES :				
3		<b>FLUID</b>	<b>Preliminary</b>	<b>Recalculation</b>	<b>Note</b>
4	PUMPED LIQUID	NH3	NH3		
5	OPERATING TEMPERATURE °C	-33	-33		Data
6	VISCOSITY AT OPERERATING TEMP. cP	0.23	0.23		Data
7	VAPOR PRESSURE kg/cm <sup>2</sup> A	1.002	1.002		Data
8	SP. GR. AT OPERATING TEMP.	0.72	0.72		Data
9	GRAVITY m/s <sup>2</sup>	9.81	9.81		Data
10					
11	CAPACITY m <sup>3</sup> /hr	5	5		Data
12	EXCESS CAPACITY %	0	0		
13	MAX. CAPACITY m <sup>3</sup> /hr	5	5.00		Q' = 0.01 Q (100+Qe%)      83      lt/min
14	VOLUMETRIC EFFICIENCY %	94	94.00		Page 7
15	PLUNGER DISPLACEMENT CAPACITY m <sup>3</sup> /hr	5.32	5.32		Op1 = 100 Q / η <sub>v</sub>
16	ESTIMATED STROKE LENGTH mm	80	80		Fig. 10, 9, app. A      z=3 triplex, L = 80 mm
17	EST'D SPEED RPM	130	130		N=130 rpm
18	EST'D PLUNGER DIA. mm	105	105		Eq. 13 or Appendix A
19	NUMBER OF PLUNGER	3	3		
20	SUCTION PIPE DIA. AND DISCHARGE mm	80 / 65	80      65		Appendix A
21	SUCTION PIPE LENGTH AND DISCHARGE m	8 / 40	8      40		Data
22	<b>SUCTION</b>				
23	PRESSURE AT EQUIPMENT kg/cm <sup>2</sup> A	1.013	1.013		Data
24	MIN. STATIC HEAD ( + or - ) m	2	7.5		Data (minus if bellow pump elevation)
25	PIPE FRICTION kg/cm <sup>2</sup>	0.05	0.05		Data      See note 1)
26	PRESS. DROP AT EQUIPMENT(.....) kg/cm <sup>2</sup>	0	0.00		Data      See note 1)
27	SUCTION PUMP DIA. mm	100	100.0		App. A
28	VELOCITY HEAD AT SUCTION kg/cm <sup>2</sup>	0.000	0.000		Eq. 1 and 2      See note 1)
29	SUCTION HEAD kg/cm <sup>2</sup>	0.094	0.490		= 0.1 SG.H1 - Loss in line 25&26 - HV
30	PUMP SUCTION PRESSURE kg/cm <sup>2</sup> A	1.107	1.503		Eq. 1 to 3
31	NPSH AVAILABLE m	1.457	6.957		Eq. 8
32	<b>DISCHARGE</b>				
33	PRESSURE AT EQUIPMENT kg/cm <sup>2</sup> A	12	12.00		Data
34	STATIC HEAD m	24	24.00		Data
35	PRESSURE DROP AT :				
36	PIPE (include fittings & valves) kg/cm <sup>2</sup>	0.12	0.12		Data
37	Equipment 1 (.....) kg/cm <sup>2</sup>	0.11	0.11		Data }      See note 1)
38	Equipment 2(.....) kg/cm <sup>2</sup>	0.1	0.10		Data
39	Equipment 3 (.....) kg/cm <sup>2</sup>	0.05	0.05		Data
40	DISCHARGE PRESSURE DROP kg/cm <sup>2</sup>	0.380	0.38		= total of line no. 36 up to 39
41	DISCHARGE HEAD kg/cm <sup>2</sup>	2.488	2.488		= DP2 + 0.1(H2)(SG)
42	ORIFICE PRESS. DROP RATIO %	20	20.00		If require pulsation dampener. If not fill with 0
43	ORIFICE PRESS. DROP kg/cm <sup>2</sup>	0.498	0.498		Eq. 18
44	ACCELERATION HEAD kg/cm <sup>2</sup>	0.00	0.00		If does not require pulsation dampener use eq. 15
45	PUMP DISCHARGE PRESSURE kg/cm <sup>2</sup> A	16.714	16.714		PD = P2+0.1(H2)(SG)+DP2
46	PUMP SUCTION PRESSURE kg/cm <sup>2</sup> A	1.107	1.503		= line 22
47	PUMP DIFF. PRESSURE kg/cm <sup>2</sup>	15.607	15.211		DP=PD-PS
48	TOTAL HEAD (CALCULATED) m	216.76	211.26		H=10(DP)/SG
49	TOTAL HEAD (TAKE) m	217.00	212.00		
50	MECHANICAL EFFICIENCY %	88	88		Page 7
51	GEAR EFFICIENCY %	93	93		Page 7
52	LIQUID HORSE POWER kW	2.27	2.27		Eq. 9 and 10
53	PUMP BHP kW	2.75	2.75		Eq. 11
54	DRIVER BHP kW	2.95	2.95		Eq. 12
55	ESTIMATED NPSH R m	5.66	5.66		Eq. 20
56	MINIMUM SUCTION EQP. PRESS. kg/cm <sup>2</sup> A	1.18	0.42		=0.1 NPSHR.SG + PV - DP1
57	IS NPSHA IS ADEQUATE ?	NO	YES		See note 2)
58	NOTES :	1) This value shall has been multiplied from continous flow pressure drop calculation by :			
59		10 times for simplex      Note 2)      First calculation, NPSHA is not adequate. Recalculate by			
60		2.6 times for duplex      elevating liquid level.			
61		1.2 times for triplex      Note 3) Pulsation dampener vol. = (9 Lt x 5/11.2)/22 = 0.6 Lt			