

Process Systems, inc

A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL

Pump Performance Test Report

Client: *Ministry of Municipalities & Public Works
General Directorate for Water*

Project: *Mosul Water Scheme – Right Bank*

Location: *Mosul – Iraq*

Contractor:

El Concorde Construction Ltd.
P.O. Box 926638, Jebel El Hussein
Amman 11190 Jordan
Tel:+962-6-5511691
Fax:+962-6-5511692
Contact: Mr. Khalid Eid

Manufacturer:

Process Systems, Inc.
23633 Pinewood
Warren, MI 48091 - USA
Phone: (586) 757-5711
Fax : (586) 758-6996
Contact: Mr. Mark Kostka

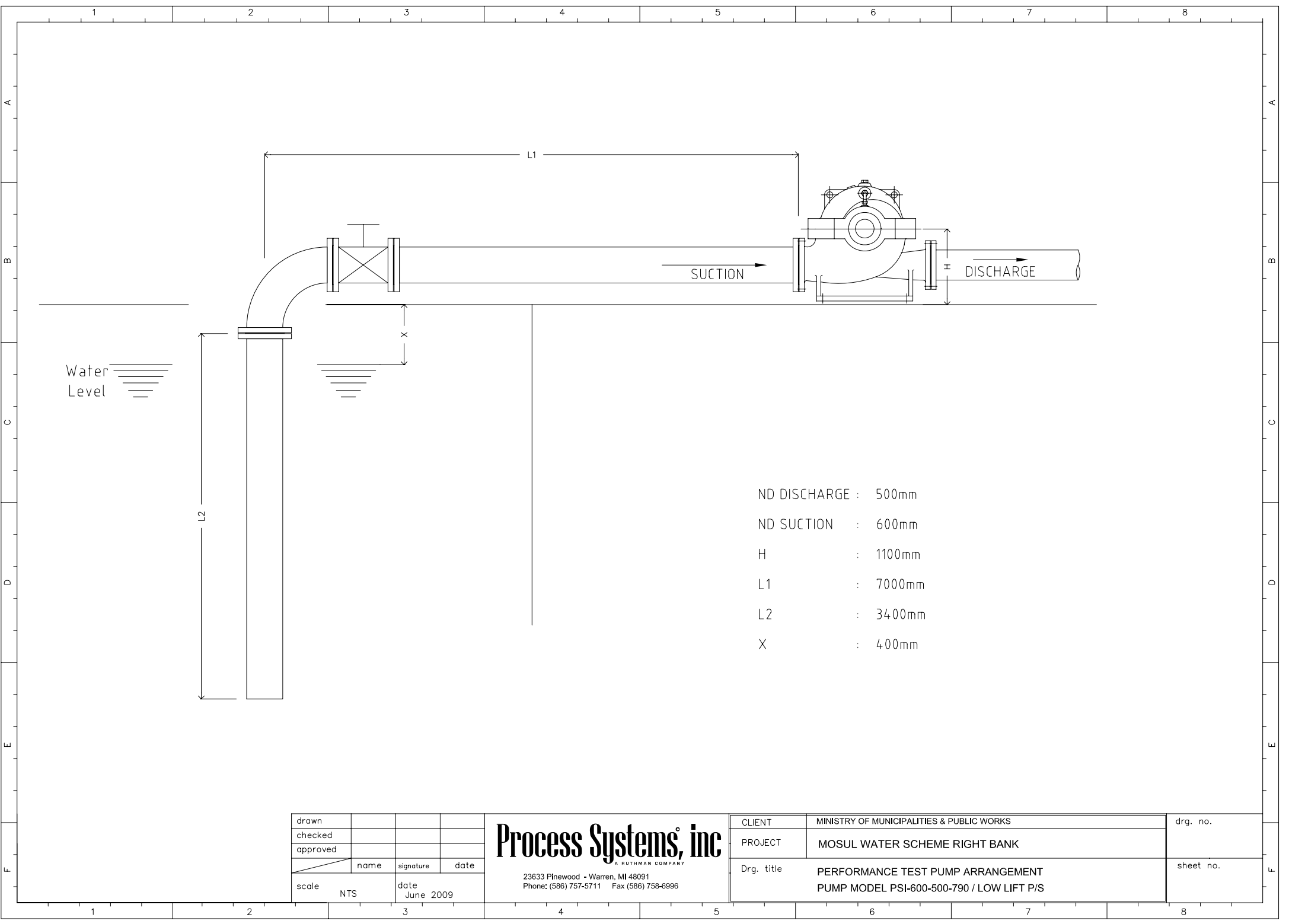
Project Ref: IRQ/P15/02/2008
Test Date: As shown on the individual Test Sheets.
Test Time: As shown on the individual Test Sheets.
Test Location: Manufacturing Facility.

Test Parameters: As shown on the individual Test Sheets.
Data Collection: Computerized.
Test Type: As shown on the individual Test Sheets.



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ND DISCHARGE : 500mm
ND SUCTION : 600mm
H : 1100mm
L1 : 7000mm
L2 : 3400mm
X : 400mm

drawn			
checked			
approved			
	name	signature	date
scale	NTS		date June 2009

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CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	
PROJECT	MOSUL WATER SCHEME RIGHT BANK	
Drg. title	PERFORMANCE TEST PUMP ARRANGEMENT PUMP MODEL PSI-600-500-790 / LOW LIFT P/S	

drg. no.
sheet no.

PERFORMANCE TEST RECORD FOR PUMP

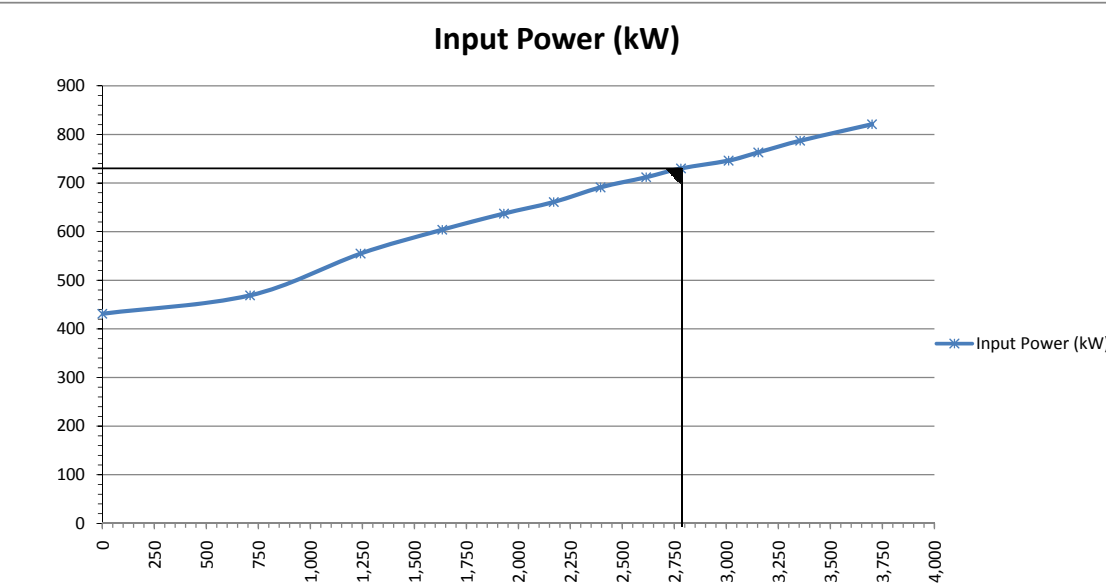
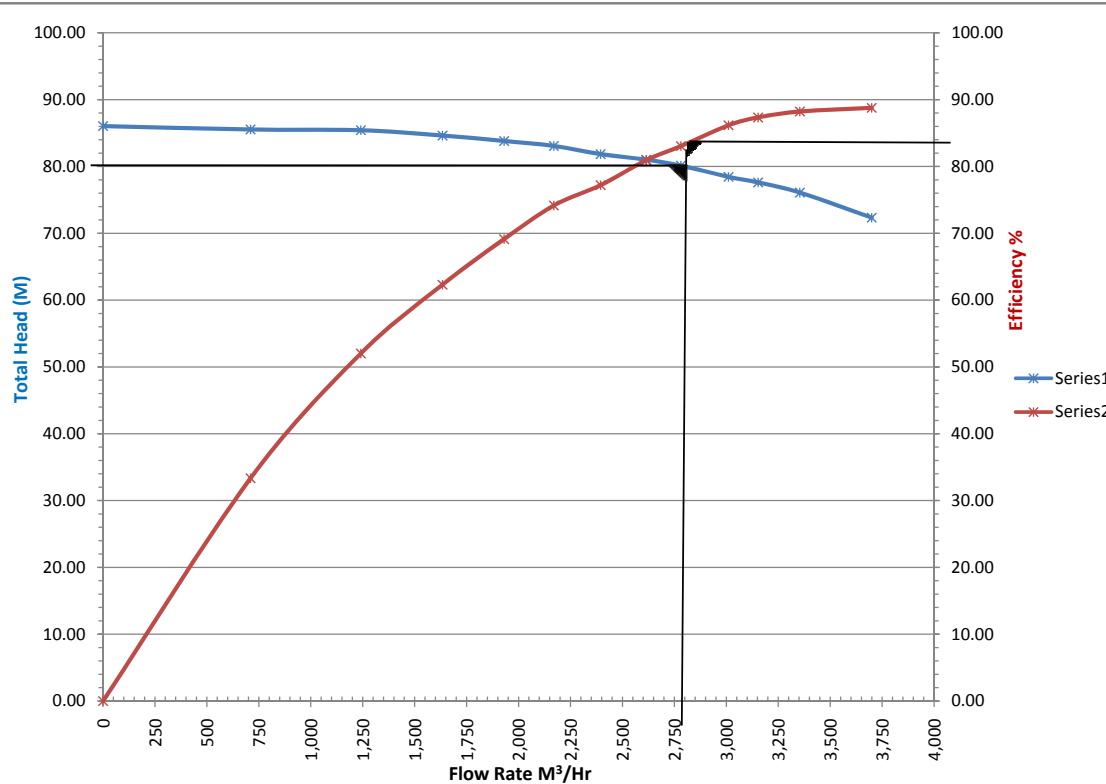
Test No: S2009007

Type of pump: PSI-600-500-790

n	THE MEASURED VALUES							
	Flow Rate		Out. Press (MPa)	Inl. Press. (Mpa)	Head (m)	Vel.Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)						
1	0.00	0.00	0.8660	-0.0090	89.23	0.00	998.0	4361
2	200.88	723.17	0.8600	-0.0097	88.68	0.03	998.0	5013
3	350.72	1262.59	0.8550	-0.0112	88.33	0.08	997.0	5600
4	461.71	1662.16	0.8450	-0.0124	87.43	0.15	997.0	6096
5	545.54	1963.94	0.8350	-0.0137	86.54	0.20	997.0	6430
6	612.60	2205.36	0.8240	-0.0148	85.53	0.26	996.0	6661
7	676.16	2434.18	0.8100	-0.0159	84.22	0.31	996.0	6960
8	738.07	2657.05	0.8000	-0.0169	83.30	0.37	996.0	7173
9	785.25	2826.90	0.7890	-0.0184	82.33	0.42	996.0	7356
10	849.94	3059.78	0.7700	-0.0198	80.54	0.49	996.0	7514
11	890.16	3204.58	0.7600	-0.0208	79.62	0.54	996.0	7682
12	945.97	3405.49	0.7410	-0.0222	77.82	0.61	995.0	7915
13	1043.40	3756.24	0.6990	-0.0251	73.84	0.75	995.0	8249
n	THE CALCULATED VALUES				Correction to n _p = 980 r/min			
	Flow Rate (m ³ /h)	Total Head (m)	Hydrolic Power (kW)	Input Power (kW)	Flow Rate (m ³ /h)	Total Head (m)	Input Power (kW)	Efficiency (%)
1	0.00	89.23	0.00	455.67	0.00	86.04	431.46	0.00
2	723.17	88.71	174.71	523.85	710.12	85.54	496.01	33.35
3	1262.59	88.41	304.00	584.61	1241.06	85.42	555.22	52.00
4	1662.16	87.58	396.42	636.31	1633.81	84.62	604.31	62.30
5	1963.94	86.75	463.96	671.23	1930.46	83.81	637.48	69.12
6	2205.36	85.79	515.25	694.65	2169.93	83.06	661.70	74.17
7	2434.18	84.53	560.36	725.76	2395.07	81.84	691.34	77.21
8	2657.05	83.67	605.46	748.05	2614.37	81.01	712.58	80.94
9	2826.90	82.75	637.08	767.14	2781.49	80.12	730.76	83.05
10	3059.78	81.03	675.22	783.62	3010.63	78.45	746.46	86.17
11	3204.58	80.16	699.58	801.07	3153.10	77.61	763.08	87.33
12	3405.49	78.44	727.45	824.61	3354.15	76.09	787.87	88.22
13	3756.24	74.58	762.94	859.34	3699.61	72.35	821.06	88.78
Note	Flow Coefficient: 750.0000 1/L Potential difference between inland out. 0 m Diameter, of the outlet Pipe: 0.500 m Diameter, of the inlet Pipe: 0.600 m							
					Test Date: 2009. 6.18 Test Time: 02:00 am			

Flow Rate (M ³ /Hr)	Total Head (M)	Efficiency (%)
0.00	86.04	0.00
710.12	85.54	33.35
1241.06	85.42	52.00
1633.81	84.62	62.30
1930.46	83.81	69.12
2169.93	83.06	74.17
2395.07	81.84	77.21
2614.37	81.01	80.94
2781.49	80.12	83.05
3010.63	78.45	86.17
3153.10	77.61	87.33
3354.15	76.09	88.22
3699.61	72.35	88.78

Flow Rate (M ³ /Hr)	Input Power (kW)
0.00	431.00
710.12	469.00
1241.06	555.00
1633.81	604.00
1930.46	637.00
2169.93	661.00
2395.07	691.00
2614.37	712.00
2781.49	730.00
3010.63	746.00
3153.10	763.00
3354.15	787.00
3699.61	821.00



ISO 2548-C

Established Duty Point:

Flow : 2799 M³/hr
Head : 79.9 Meter
Efficiency : 84 %
Power : 731 kW
RPM : 980

Test Number: S2009007
Test Date: 18 June 2009
Pump Model: 600-500-790
Horizontal Split Case
Duty Impeller Dia: 758 mm
Max. Impeller Dia: 790 mm

Comments:

Pump Test Sheet

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CAVITATION TEST RECORDS FOR PUMP

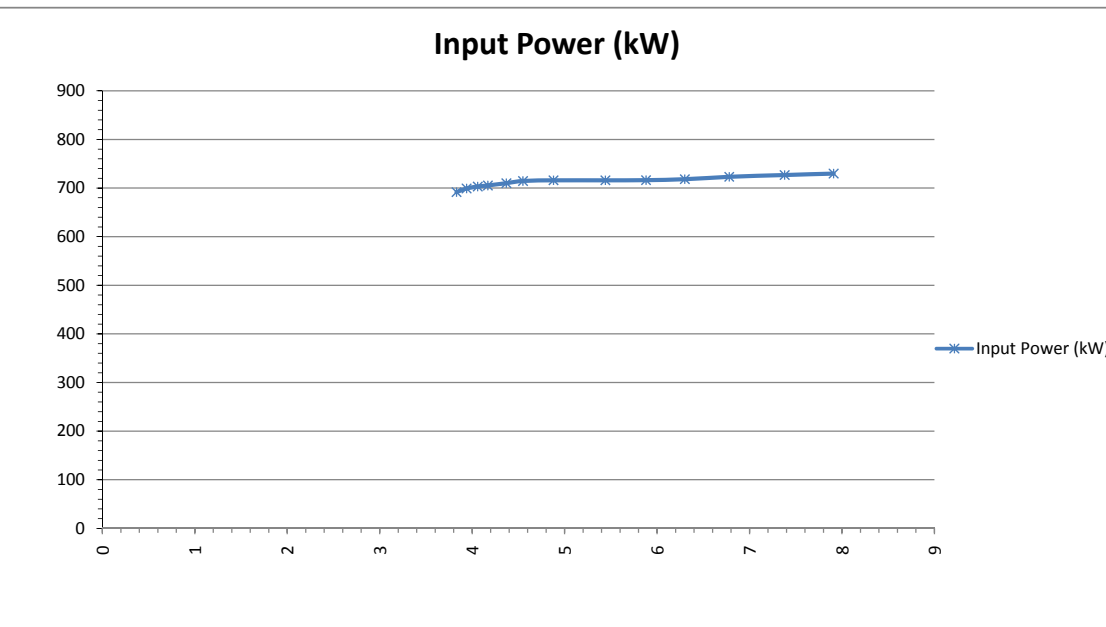
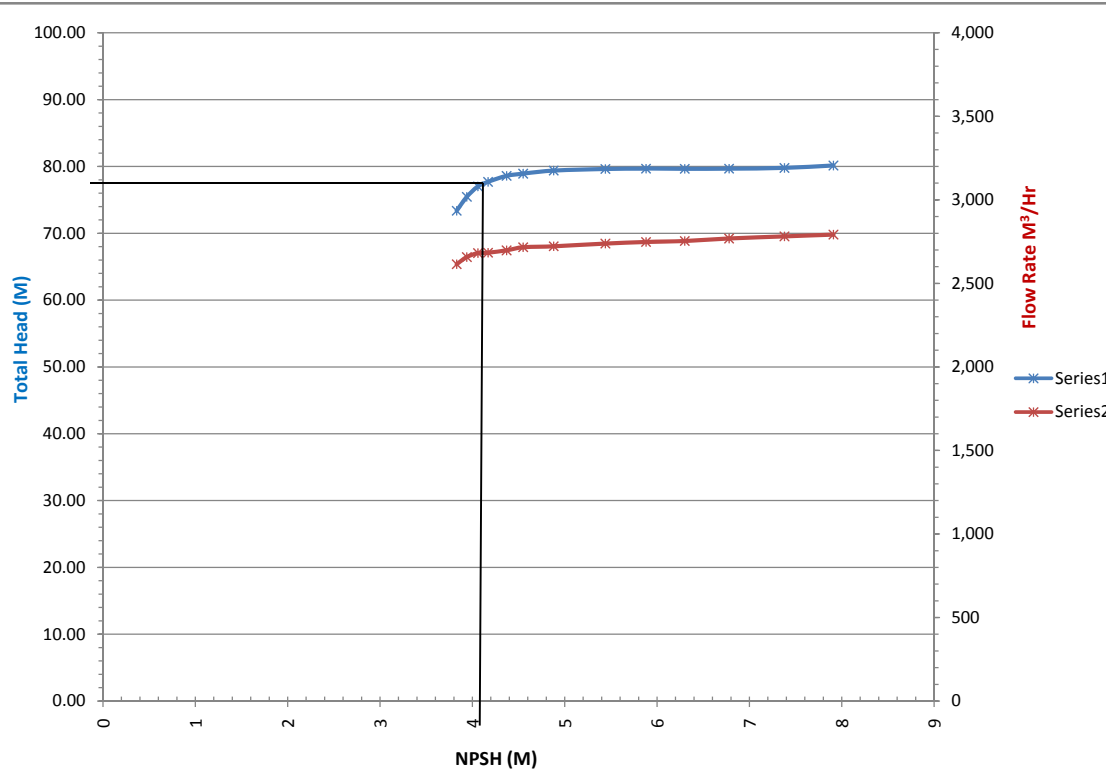
Test No: S2009007

Type of pump: PSI-600-500-790

n	THE MEASURED VALUES							
	Flow Rate		Out. Press.	Inl. Press	Head (m)	Vel. Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)	(MPa)	(MPa)				
1	788.20	2837.52	0.7890	-0.0186	82.35	0.43	996.0	7345
2	785.34	2827.22	0.7800	-0.0240	81.99	0.42	996.0	7316
3	781.65	2813.94	0.7730	-0.0300	81.88	0.42	996.0	7281
4	777.48	2798.93	0.7680	-0.0348	81.86	0.41	996.0	7230
5	775.81	2792.92	0.7640	-0.0391	81.89	0.41	996.0	7210
6	773.03	2782.91	0.7590	-0.0435	81.83	0.41	996.0	7207
7	768.46	2766.46	0.7510	-0.0491	81.59	0.40	996.0	7206
8	766.84	2760.62	0.7430	-0.0525	81.12	0.40	996.0	7192
9	761.66	2741.98	0.7380	-0.0542	80.78	0.40	996.0	7146
10	757.62	2727.43	0.7270	-0.0562	79.86	0.39	996.0	7099
11	756.99	2725.16	0.7190	-0.0573	79.16	0.39	996.0	7077
12	750.26	2700.94	0.7020	-0.0585	77.55	0.39	996.0	7037
13	738.19	2657.48	0.6800	-0.0595	75.41	0.37	996.0	6962
n	THE CALCULATED VALUES				Correction to n _{sp} = 980 r/min			
	Flow Rate (m ³ /h)	Total Head (m)	NPSH (m)	Input Power (kW)	Flow Rate (m ³ /h)	Total Head (m)	Input Power (kW)	NPSH (m)
1	2837.52	82.78	8.17	765.95	2791.94	80.14	729.63	7.91
2	2827.22	82.41	7.62	762.95	2781.81	79.78	726.76	7.38
3	2813.94	82.30	7.01	759.23	2768.74	79.68	723.22	6.78
4	2798.93	82.28	6.51	753.92	2753.97	79.65	718.17	6.30
5	2792.92	82.31	6.07	751.89	2748.05	79.68	716.23	5.88
6	2782.91	82.24	5.62	751.58	2738.20	79.62	715.94	5.44
7	2766.46	81.99	5.04	751.50	2722.01	79.38	715.86	4.88
8	2760.62	81.52	4.70	750.01	2716.28	78.92	714.44	4.55
9	2741.98	81.18	4.52	745.25	2697.93	78.59	709.91	4.37
10	2727.43	80.26	4.31	740.33	2683.62	77.70	705.22	4.17
11	2725.16	79.55	4.20	737.99	2681.39	77.02	702.99	4.06
12	2700.94	77.93	4.07	733.89	2657.55	75.45	699.08	3.94
13	2657.48	75.78	3.95	725.99	2614.79	73.37	691.57	3.83
Note	Flow Coefficient: 750.0000 1/L Potential difference between inland out. 0 m Diameter, of the outlet Pipe: 0.500 m Diameter, of the inlet Pipe: 0.600 m Test Date: 2009. 6.18 Test Time: 04:00 am							

NPSH (M)	Total Head (M)	Flow Rate (M ³ /Hr)
3.83	73.37	2614.79
3.94	75.45	2657.55
4.06	77.02	2681.39
4.17	77.70	2683.62
4.37	78.59	2697.93
4.55	78.92	2716.28
4.88	79.38	2722.01
5.44	79.62	2738.20
5.88	79.68	2748.05
6.30	79.65	2753.97
6.78	79.68	2768.74
7.38	79.78	2781.81
7.91	80.14	2791.94

NPSH (M)	Input Power (kW)
3.83	691.57
3.94	699.08
4.06	702.99
4.17	705.22
4.37	709.91
4.55	714.44
4.88	715.86
5.44	715.94
5.88	716.23
6.30	718.17
6.78	723.22
7.38	726.76
7.91	729.63



ISO 2548-C

Established Duty Point:

Flow : 2792 M³/hr
Head : 80.14 Meter
HeadX0.3 : 2.404 Meter
Power : 729 kW
RPM : 980
NPSH : 4.181 Meter

Test Number: S2009007

Test Date: 18 June 2009

Pump Model: 600-500-790

Horizontal Split Case

Duty Impeller Dia: 758 mm

Max. Impeller Dia: 790 mm

Comments:

Pump NPSH Test Sheet

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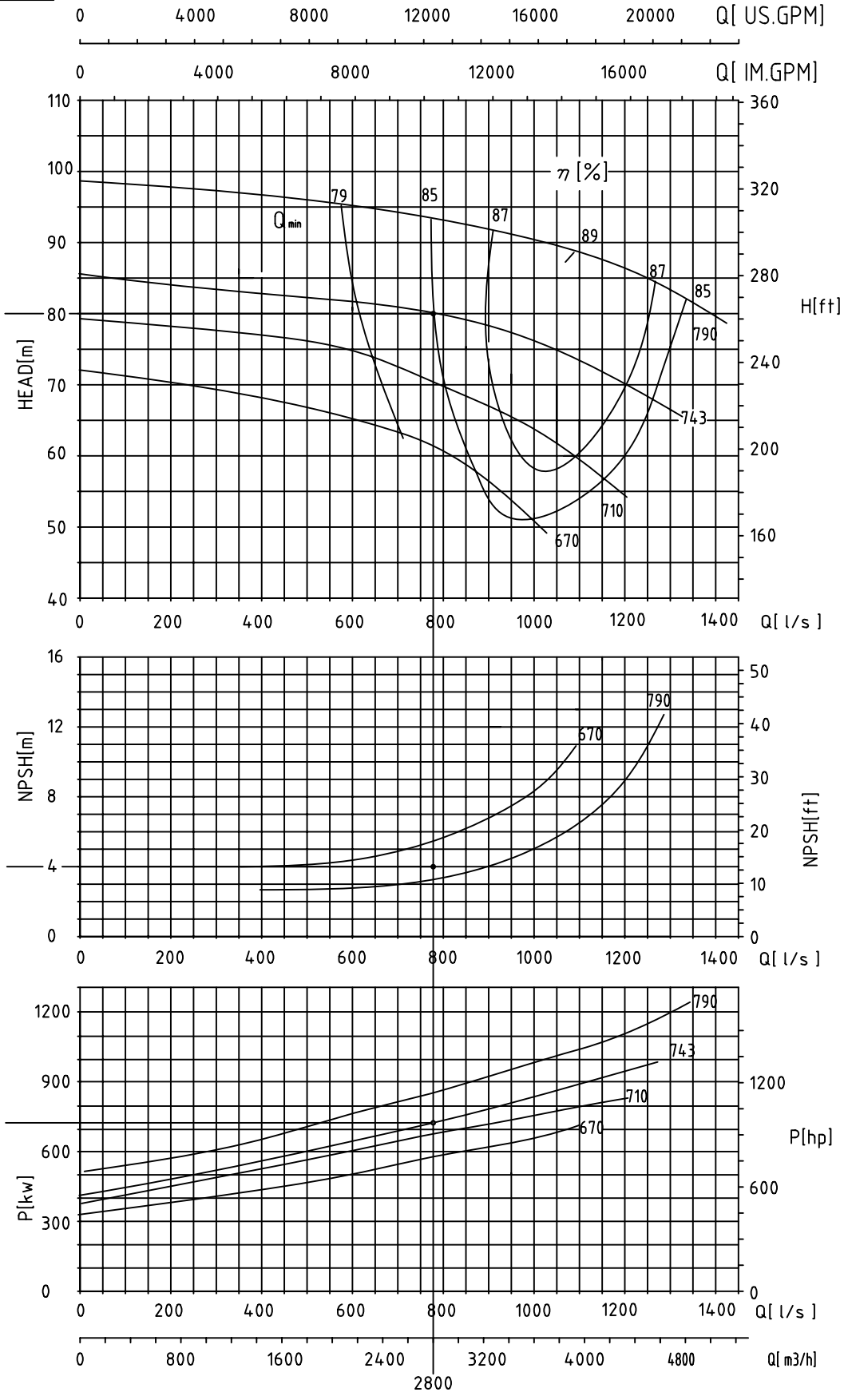


PUMP DATA SHEET

Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.600-500-790	
1	Customer	El Concorde Construction Ltd.				Station No.	Low Lift
2	Location	Mosul - Iraq				Req. Qty.	9 Set + 1 Set Spare
3	Project	Mosul Water Scheme				Duty	6 Set
4	Ref. No.	MSL				Stand By	3 Set
PUMP SPECIFICATIONS							
5	Pump Type	Horizontal Split Case				Capacity	2800 M³/Hr
6	Stages	1				TDH	80 mtr
7	Liquid	Raw River Water				Eff.	85%
8	Temp.	Ambient				Shaft P.	750 Kw
9	NPSHA	5.11 mtr				Motor P.	900 Kw
10	NPSHR	4.00 mtr				Speed	980 RPM
11	Suction	600 mm (PN-16)				Rotation	CW
12	Discharge	500 mm (PN-16)				Duty Imp.	743 mm
13	Weight	App. 5200 Kg				Max Imp.	790 mm
MATERIALS				ACCESSORIES			
14	Casing	Ductile GGG60				Base Plate	Included
15	Impeller	Stainless Steel 304				Flex Coplg	Included
16	Shaft	SS420				O&M	Included
17	Sh. Sleeve	SS304				Docs.	1.Layout Dimensional
18	Sh. Couplg	CS TPD6-2100				Docs.	Ref: MXT-128F-1 & 128F-2
19	Bearing	SKF				Docs.	3.Performance Curve
20	Seal	Stuffing				Docs.	4.Data Sheet
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor				Voltage	11000V/50Hz/3Ph
22	Mfg.	EC / USA				Protection	IP-54
23	Type	Squirrel Cage Induction				Insulation	Class F
24	Rated	900 Kw				Starting	DOL
25	Speed	980 RPM				Weight	App. 6200 Kg
FINISHING & PAINT							
26	Prep.	Gritt Blasting				Test	Hydostatic 24 Bars
27	Primer	100 micron				Test	Dimensional Tolerances
28	Final	Epoxy Blue 200 micron				Test	DFT (Dry Film Thickness)
Revisions							
29	Rev O	21-Aug-08				Rev B	
30	Rev A	25-Jan-09				Rev C	

No: 9060

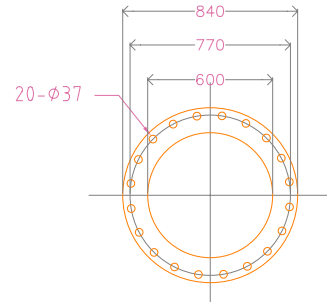
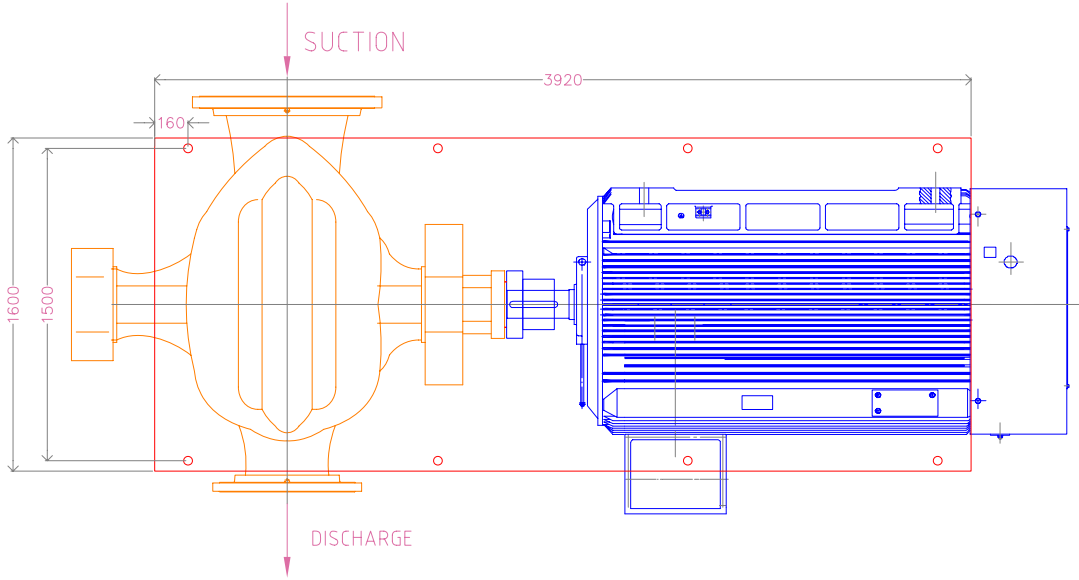
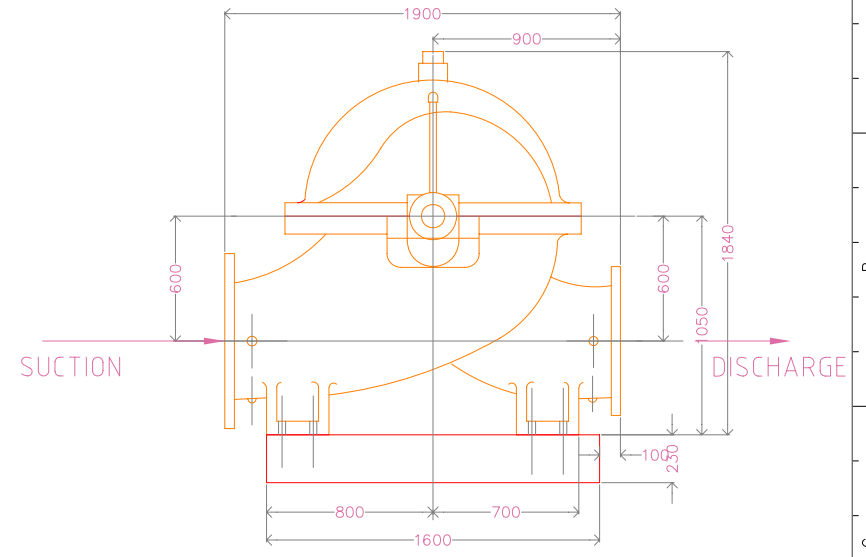
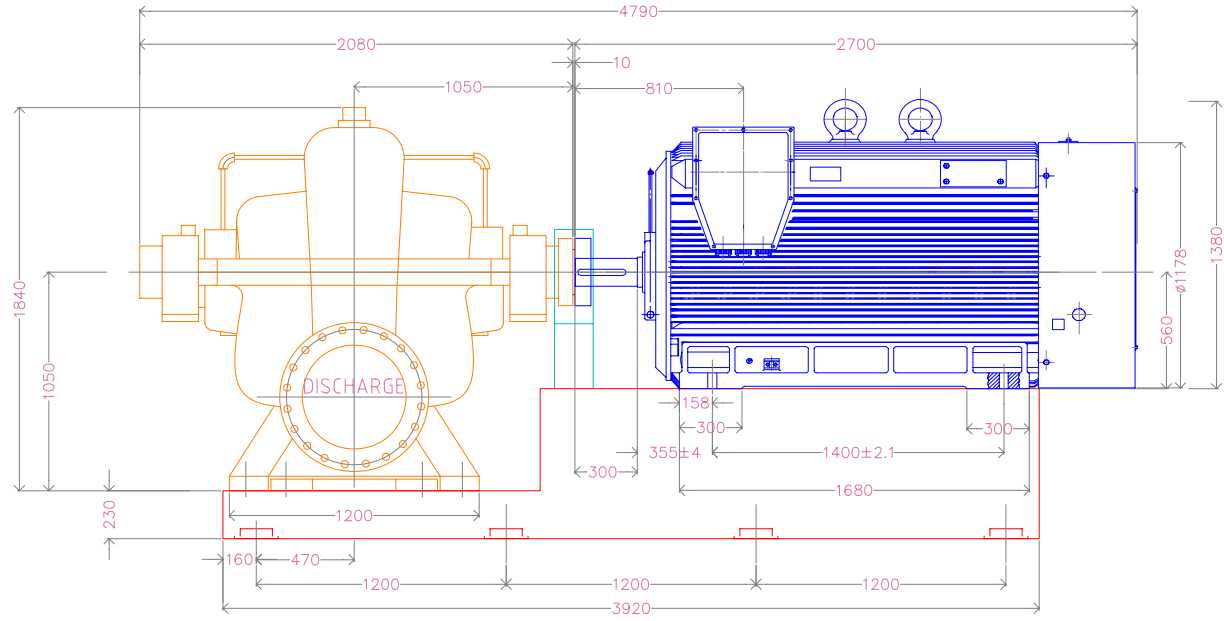
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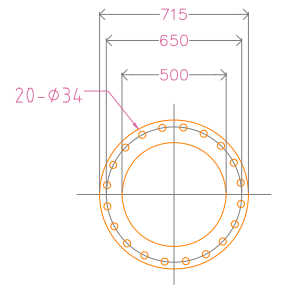
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drawn	checked	approved	name	signature	date
					August 2008
scale	NTS				

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	DRG. no.	MXT-9060
PROJECT	MOSUL WATER SCHEME RIGHT BANK LOW LIFT PUMPING STATION	SHEET no.	
DRG. title	PUMP PERFORMANCE CURVE MODEL PSI-600-500-790		



SUCTION FLANGE
DN600 PN16



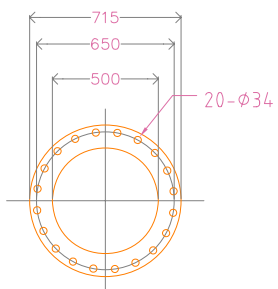
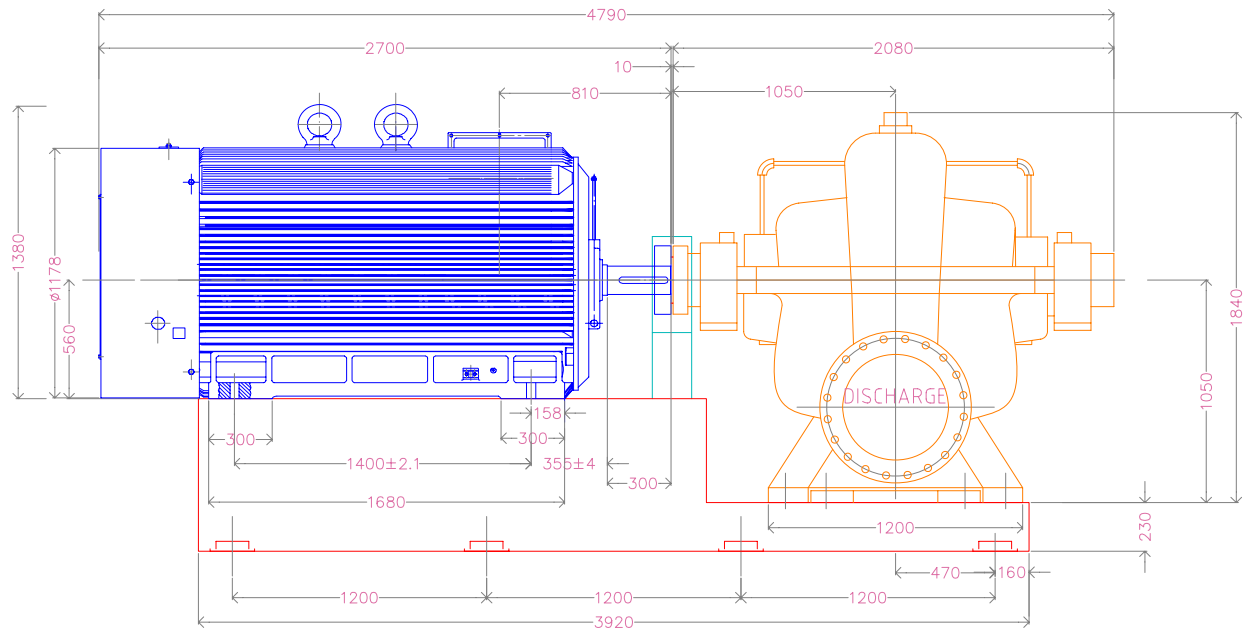
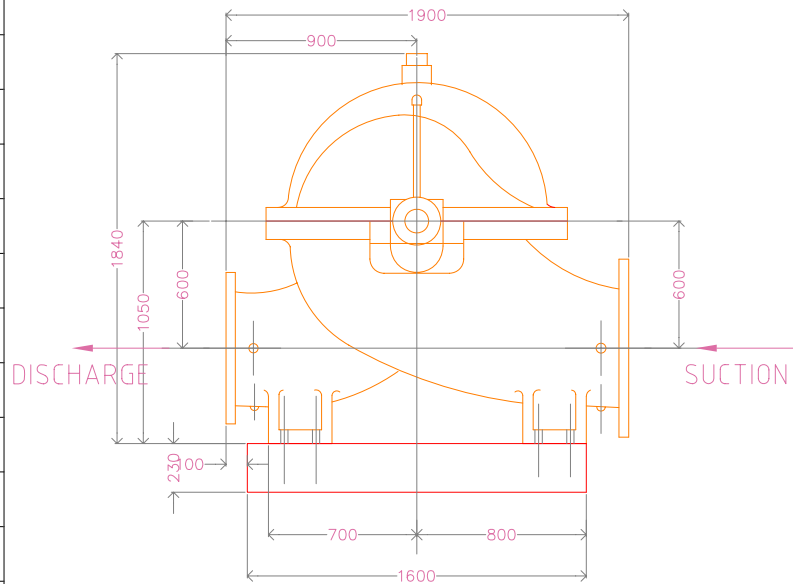
DISCHARGE FLANGE
DN500 PN16

QTY = 5

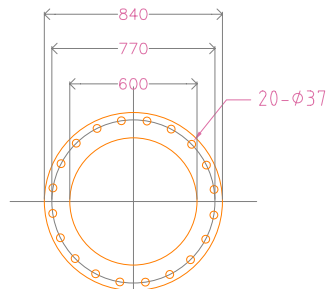
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name	signature	date	
scale	NTS	date	January 2009

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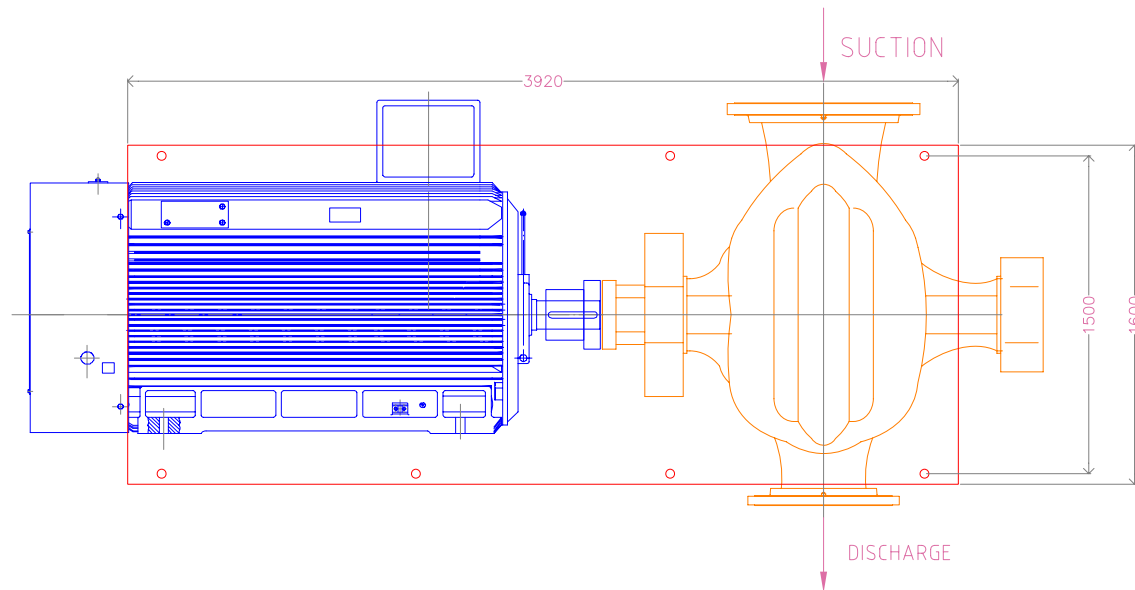
CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK LOW LIFT PUMPING STATION	MXT-128F-1
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-600-500-790	sheet no.



DISCHARGE FLANGE
DN500 PN16



SUCTION FLANGE
DN600 PN16



QTY = 5

drawn			
checked			
approved			
	name	signature	date
scale	NTS	date	January 2009

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PROJECT	MOSUL WATER SCHEME RIGHT BANK LOW LIFT PUMPING STATION
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-600-500-790

drg. no.	MXT-128F-2
sheet no.	

Pumps Calculations

LOW LIFT PUMP STATION

TOTAL HEAD =80m
CAPACITY/PUMP=2800m3/hr
NPSHr=4m

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH)\gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

LOW LIFT PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =	218	m
FLOOR LEVEL OF PUMP STATION=	221.7	m
SUCTION WELL AVERAGE WATER LEVEL=	221.223	m
SUCTION WELL MINIMUM WATER LEVEL=	219.71	m
MAX WATER LEVEL IN THE RECEIVING CHAMBER=	277.57	m
TEMPERATURE=	30	°C
VAPOR PRESSURE=	0.0428	bar
AVERAGE FLOW=	2.3333333	m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.4666666		0.9333332		1.3999998		1.8666664		2.333333		2.7999996		3.2666662		3.7333328		4.1999994	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BUTTERFLY VALVE	1	0.46	1.2		0.41283316	0.003995839	0.825666313	0.015983356	1.2384995	0.03596255	1.6513326	0.063933422	2.064165782	0.09989597	2.4769989	0.1438502	2.88983209	0.195796105	3.302665251	0.255733689	3.71549841	0.32366295
2	HEADER TO LINE	1	1	1.5		0.26421322	0.003558034	0.52842644	0.014232136	0.7926397	0.032022305	1.0568529	0.056928543	1.3210661	0.08895085	1.5852793	0.128089221	1.84949254	0.174343662	2.113705761	0.227714171	2.37791898	0.288200748
3	11.25° BEND	5	0.05	1.5		0.26421322	0.000889508	0.52842644	0.003558034	0.7926397	0.008005576	1.0568529	0.014232136	1.3210661	0.02223771	1.5852793	0.032022305	1.84949254	0.043585916	2.113705761	0.056928543	2.37791898	0.072050187
4	REDUCER	2	0.5	1.2		0.41283316	0.008686606	0.825666313	0.034746425	1.2384995	0.078179456	1.6513326	0.1389857	2.064165782	0.21716516	2.4769989	0.312717826	2.88983209	0.425643707	3.302665251	0.555942801	3.71549841	0.703615108
5	FLOW METER	1	0.5	1.2		0.41283316	0.004343303	0.825666313	0.017373213	1.2384995	0.039089728	1.6513326	0.06949285	2.064165782	0.10858258	2.4769989	0.156358913	2.88983209	0.212821854	3.302665251	0.277971401	3.71549841	0.351807554
6	BUTTERFLY VALVE	1	0.46	1.2		0.41283316	0.003995839	0.825666313	0.015983356	1.2384995	0.03596255	1.6513326	0.063933422	2.064165782	0.09989597	2.4769989	0.1438502	2.88983209	0.195796105	3.302665251	0.255733689	3.71549841	0.32366295
7	INCREASER	1	0.5	1.2		0.41283316	0.004343303	0.825666313	0.017373213	1.2384995	0.039089728	1.6513326	0.06949285	2.064165782	0.10858258	2.4769989	0.156358913	2.88983209	0.212821854	3.302665251	0.277971401	3.71549841	0.351807554
8	22.5° BEND	8	0.075	1.5		0.26421322	0.00213482	0.52842644	0.008539281	0.7926397	0.019213383	1.0568529	0.034157126	1.3210661	0.05337051	1.5852793	0.076853533	1.84949254	0.104606197	2.113705761	0.136628503	2.37791898	0.172920449
9	45° BEND	9	0.22	1.5		0.26421322	0.007044907	0.52842644	0.028179629	0.7926397	0.063404165	1.0568529	0.112718515	1.3210661	0.17612268	1.5852793	0.253616658	1.84949254	0.345200452	2.113705761	0.450874059	2.37791898	0.570637481
10	exit	1	1	1.5		0.26421322	0.003558034	0.52842644	0.014232136	0.7926397	0.032022305	1.0568529	0.056928543	1.3210661	0.08895085	1.5852793	0.128089221	1.84949254	0.174343662	2.113705761	0.227714171	2.37791898	0.288200748
11	TEE CONNECTION	1	0.5	1.5		0.26421322	0.001779017	0.52842644	0.007116068	0.7926397	0.016011153	1.0568529	0.028464271	1.3210661	0.04447542	1.5852793	0.064044611	1.84949254	0.087171831	2.113705761	0.113857086	2.37791898	0.144100374
12	PIPE (C=100)		100	1.5	2000	0.26421322	0.144521273	0.52842644	0.520999456	0.7926397	1.103077684	1.0568529	1.878204001	1.3210661	2.8380908	1.5852793	3.976597093	1.84949254	5.288873158	2.113705761	6.770928901	2.37791898	8.419385982
13	PIPE (C=140)		140	1.5	2000	0.26421322	0.077552341	0.52842644	0.279576333	0.7926397	0.591928475	1.0568529	1.007873196	1.3210661	1.52296324	1.5852793	2.133903249	1.84949254	2.838090798	2.113705761	3.633384737	2.37791898	4.517972197
FRICTION LOSS (C=100)							0.188850484		0.6983163		1.502040585		2.58747138		3.94632108		5.572448695		7.461004504		9.607998414		12.01005209
FRICTION LOSS (C=140)							0.121881552		0.456893177		0.990891376		1.717140574		2.63119351		3.729754851		5.010222144		6.47045425		8.1086383

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=100	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=100	C=140	C=100	C=140
1680.0	0.2	0.1	57.9	56.3		58.0	58.0	56.5	56.5
3360.0	0.7	0.5	57.9	56.3		58.6	58.3	57.0	56.8
5040.0	1.5	1.0	57.9	56.3		59.4	58.9	57.8	57.3
6720.0	2.6	1.7	57.9	56.3		60.4	59.6	58.9	58.1
8400.0	3.9	2.6	57.9	56.3		61.8	60.5	60.3	59.0
10080.0	5.6	3.7	57.9	56.3		63.4	61.6	61.9	60.1
11760.0	7.5	5.0	57.9	56.3		65.3	62.9	63.8	61.4
13440.0	9.6	6.5	57.9	56.3		67.5	64.3	66.0	62.8
15120.0	12.0	8.1	57.9	56.3		69.9	66.0	68.4	64.5

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.15555556		0.31111111		0.46666667		0.62222222		0.777777775		0.93333333		1.08888889		1.24444444	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.05	1.055		0.17803728	8.0778E-05	0.356074558	0.000323112	0.5341118	0.000727002	0.7121491	0.001292447	0.890186396	0.00201945	1.0682237	0.002908007	1.24626095	0.00395812	1.424298234	0.00516979
2	90° BEND	1	0.3	0.9		0.2446419	0.000915132	0.489283809	0.00366053	0.7339257	0.008236192	0.9785676	0.014642119	1.223209523	0.02287831	1.4678514	0.032944768	1.71249333	0.044841489	1.957135236	0.058568476
3	REDUCER	1	0.25	0.6		0.55044429	0.003860715	1.10088857	0.01544286	1.6513329	0.034746435	2.2017771	0.06177144	2.752221426	0.09651787	3.3026657	0.138985739	3.85311	0.189175034	4.403554282	0.247085758
4	PIPE	1	100	0.9	13	0.2446419	0.001478798	0.489283809	0.005331069	0.7339257	0.011287119	0.9785676	0.019218513	1.223209523	0.02904045	1.4678514	0.040690086	1.71249333	0.054117804	1.957135236	0.069282774
5	EXIT	1	1	0.6		0.55044429	0.01544286	1.10088857	0.06177144	1.6513329	0.138985739	2.2017771	0.247085758	2.752221426	0.3860715	3.3026657	0.555942956	3.85311	0.756700135	4.403554282	0.988343033
6	90° BEND	1	0.3	0.5		0.79263977	0.009606694	1.585279541	0.038426777	2.3779193	0.086460249	3.1705591	0.153707109	3.963198854	0.24016736	4.7558386	0.345840994	5.54847839	0.47072802	6.341118166	0.614828434
7	CHECK VALVE	1	2.2	0.5		0.79263977	0.070449091	1.585279541	0.281796366	2.3779193	0.634041823	3.1705591	1.127185463	3.963198854	1.76122729	4.7558386	2.536167291	5.54847839	3.452005479	6.341118166	4.50874185
8	CONTROL VALVE	1	1	0.5		0.79263977	0.032022314	1.585279541	0.128089257	2.3779193	0.288200828	3.1705591	0.512357028	3.963198854	0.80055786	4.7558386	1.152803314	5.54847839	1.5690934	6.341118166	2.049428114
9	BUTTERFLY VALVE	1	2	0.5		0.79263977	0.064044629	1.585279541	0.256178514	2.3779193	0.576401657	3.1705591	1.024714057	3.963198854	1.60111571	4.7558386	2.305606628	5.54847839	3.138186799	6.341118166	4.098856227
10	PIPE	1	100	0.5	7	0.79263977	0.013914729	1.585279541	0.050162625	2.3779193	0.106206007	3.1705591	0.180836354	3.963198854	0.27325572	4.7558386	0.382872851	5.54847839	0.509220798	6.341118166	0.651915392
11	TEE-BRANCH TO LINE	1	1	0.5		0.79263977	0.032022314	1.585279541	0.128089257	2.3779193	0.288200828	3.1705591	0.512357028	3.963198854	0.80055786	4.7558386	1.152803314	5.54847839	1.5690934	6.341118166	2.049428114
TOTAL							0.243838055		0.969271806		2.173493879		3.855167316		6.01340937		8.647565947		11.75712048		15.34164796
PUMP SUCTION LINE PRESSURE LOSS =															0.53652758						

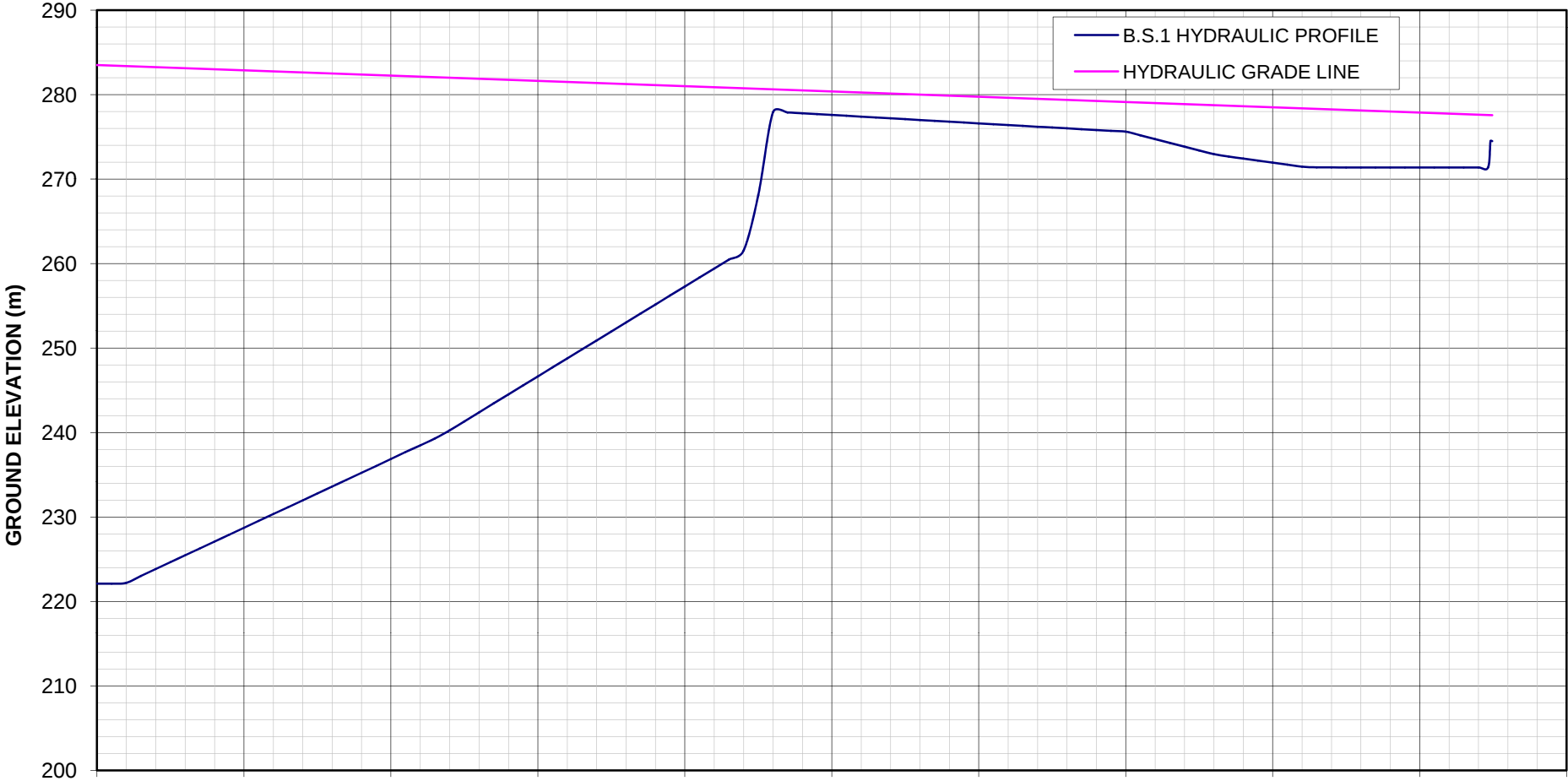
PUMP CHARACTERISTIC HEAD-CAPACITY CURVE		INDIVIDUAL PUMP HEAD LOSS (m)		PUMP MODIFIED HEAD (m)		PUMP CAPACITY PARALLEL COMBINATION	
Capacity (m3/hr)	Total Head (m)					2 PUMPS	3 PUMPS
560.0	84.4	0.2		84.1		1120.0	1680.0
1120.0	83.3	1.0		82.3		2240.0	3360.0
1680.0	82.5	2.2		80.3		3360.0	5040.0
2240.0	81.6	3.9		77.7		4480.0	6720.0
2800.0	80.0	6.0		74.0		5600.0	8400.0
3360.0	77.7	8.6		69.0		6720.0	10080.0
3920.0	73.8	11.8		62.0		7840.0	11760.0
4480.0	68.6	15.34165		53.2		8960.0	13440.0

NET POSITIVE SUCTION HEAD av.= 5.109792421 m

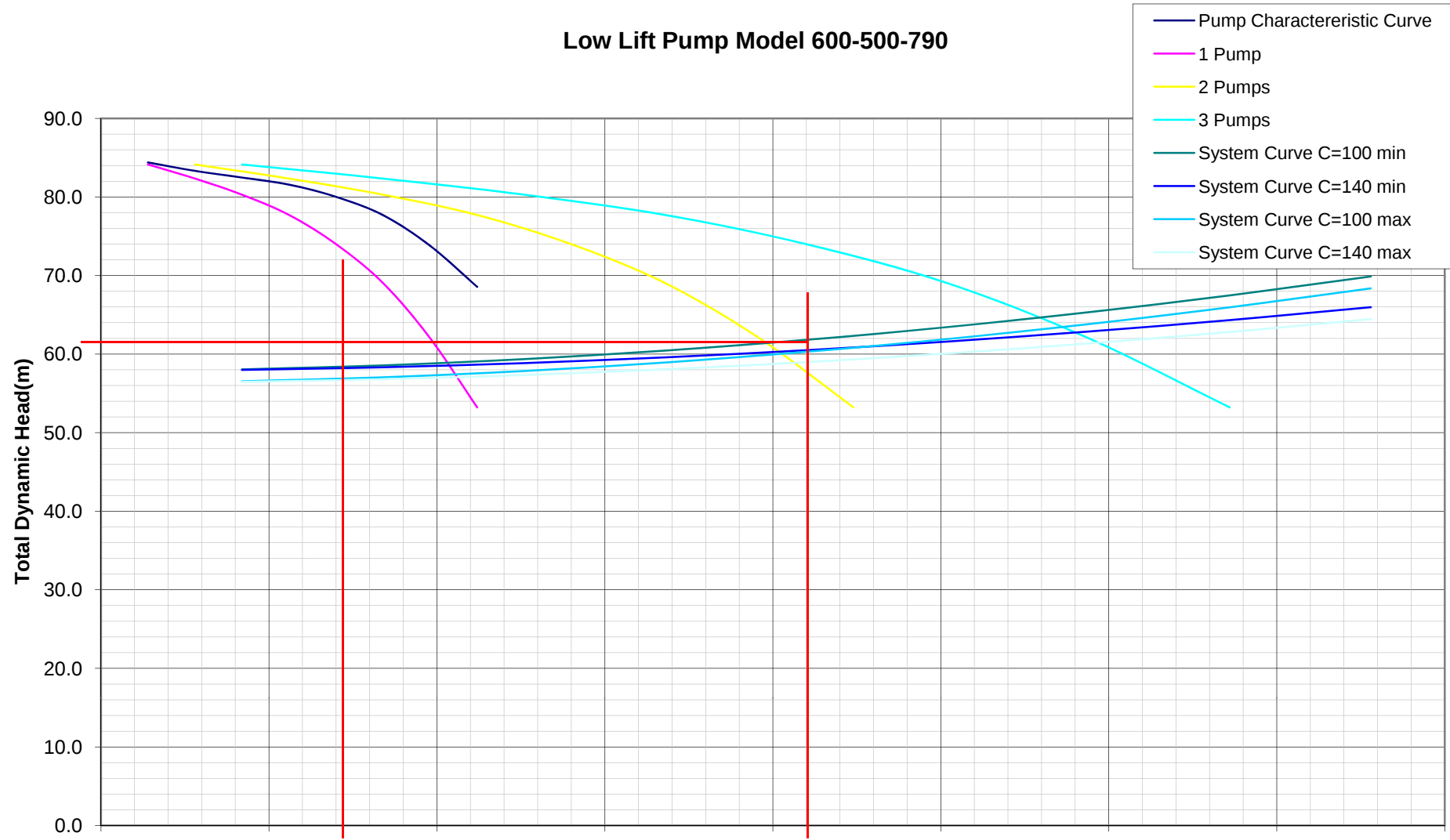
TOATL DYNAMIC HEAD

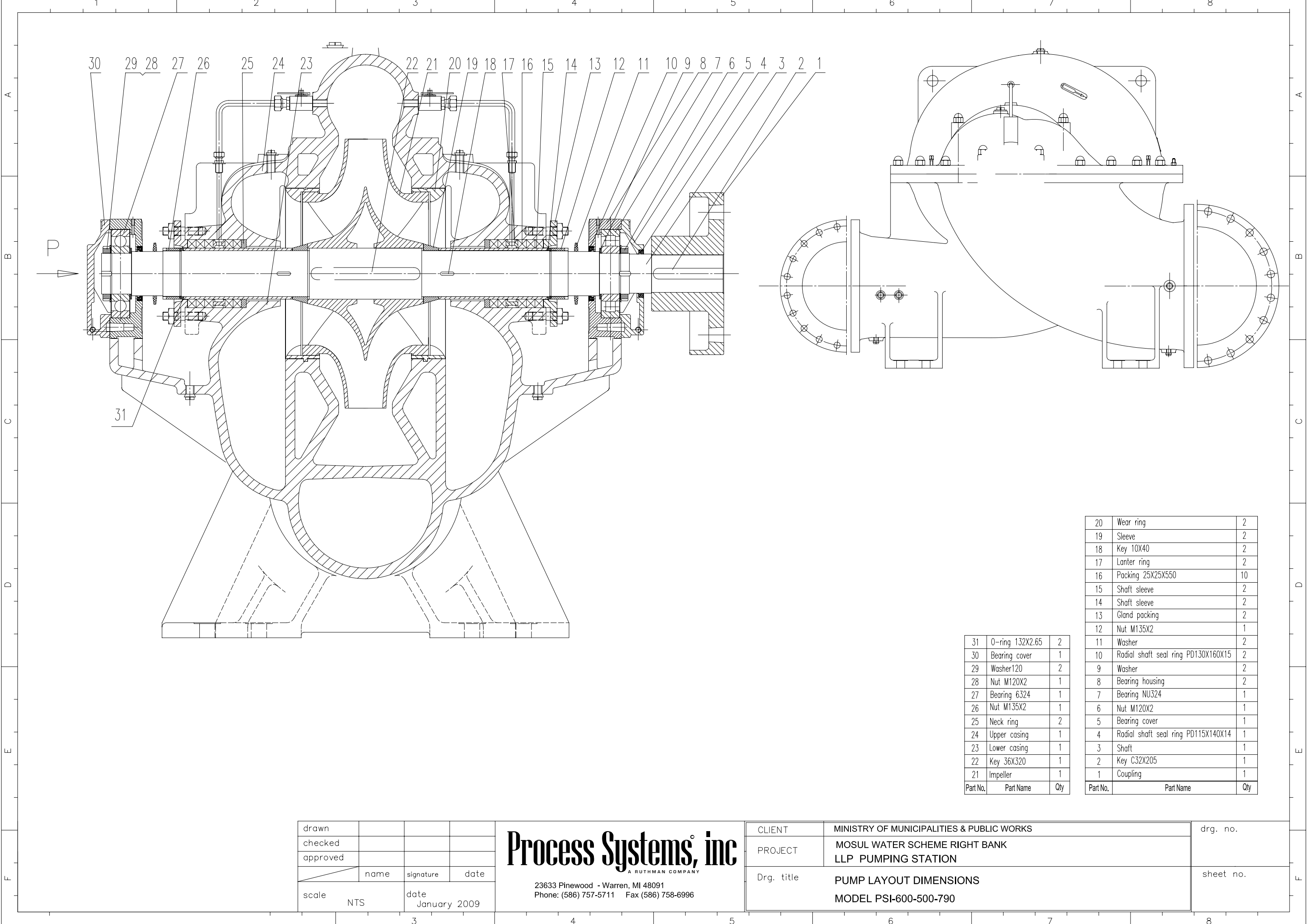
POINTS	STATION	TDH (m)
POINT A	0	283.5
POINT B	1898.759	277.57

LOW LIFT PUMP STATION HYDRAULIC PROFILE



Low Lift Pump Model 600-500-790





31	O-ring 132X2.65	2
30	Bearing cover	1
29	Washer120	2
28	Nut M120X2	1
27	Bearing 6324	1
26	Nut M135X2	1
25	Neck ring	2
24	Upper casing	1
23	Lower casing	1
22	Key 36X320	1
21	Impeller	1
Part No.	Part Name	Qty

20	Wear ring	2
19	Sleeve	2
18	Key 10X40	2
17	Lantern ring	2
16	Packing 25X25X550	10
15	Shaft sleeve	2
14	Shaft sleeve	2
13	Gland packing	2
12	Nut M135X2	1
11	Washer	2
10	Radial shaft seal ring PD130X160X15	2
9	Washer	2
8	Bearing housing	2
7	Bearing NU324	1
6	Nut M120X2	1
5	Bearing cover	1
4	Radial shaft seal ring PD115X140X14	1
3	Shaft	1
2	Key C32X205	1
1	Coupling	1
Part No.	Part Name	Qty

drawn			
checked			
approved			
	name	signature	date
scale	NTS		date January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK LLP PUMPING STATION	
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-600-500-790	sheet no.

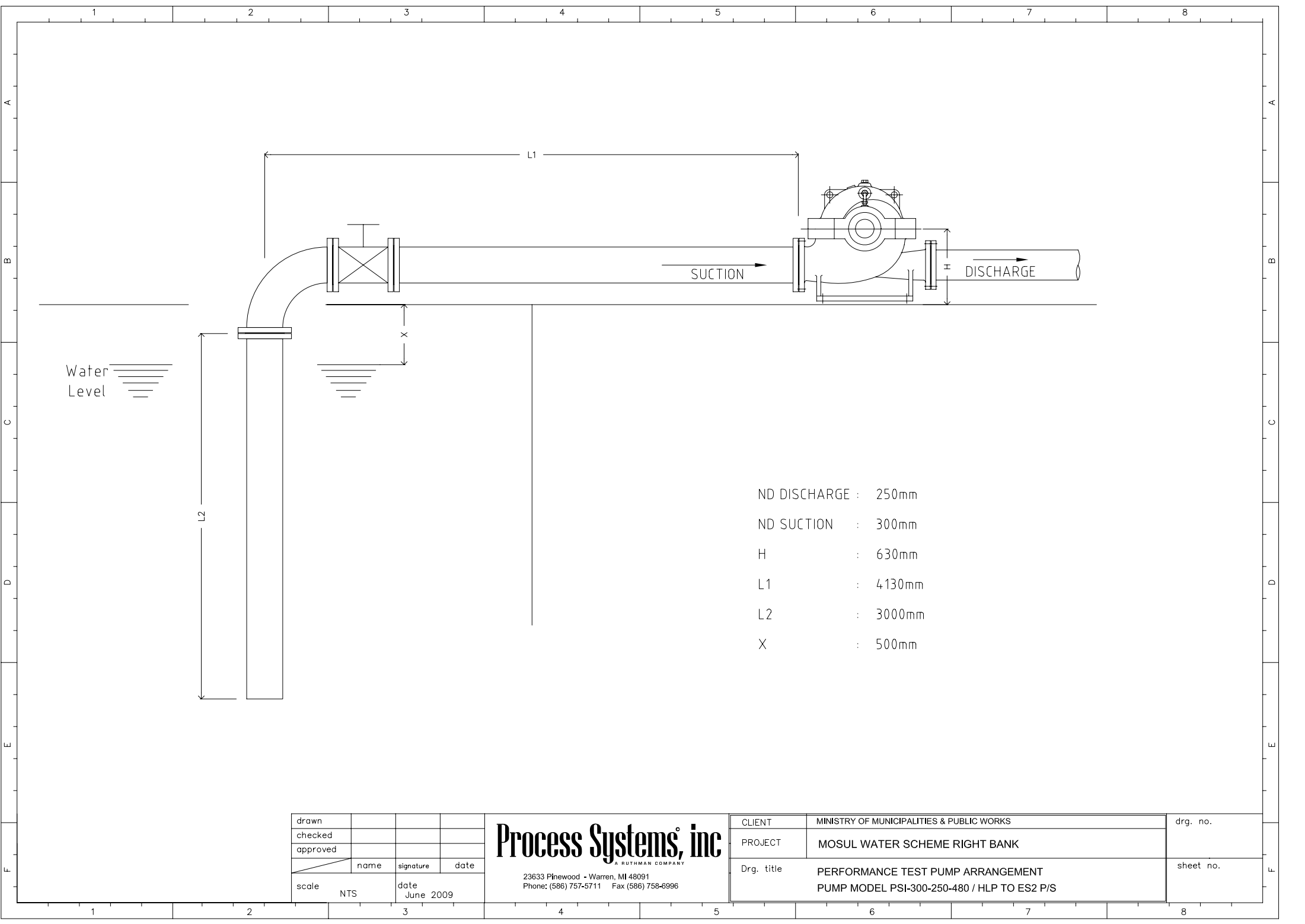
Process Systems, inc

A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL



ND DISCHARGE : 250mm
ND SUCTION : 300mm
H : 630mm
L1 : 4130mm
L2 : 3000mm
X : 500mm

drawn			
checked			
approved			
	name	signature	date
scale	NTS		date June 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	
PROJECT	MOSUL WATER SCHEME RIGHT BANK	
Drg. title	PERFORMANCE TEST PUMP ARRANGEMENT PUMP MODEL PSI-300-250-480 / HLP TO ES2 P/S	

drg. no.
sheet no.

PERFORMANCE TEST RECORD FOR PUMP

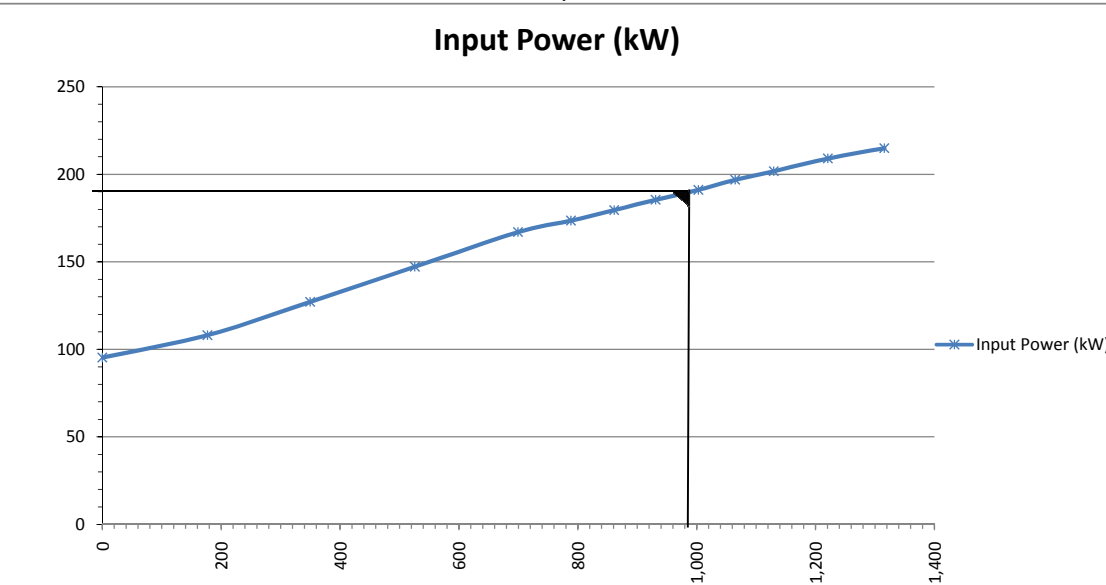
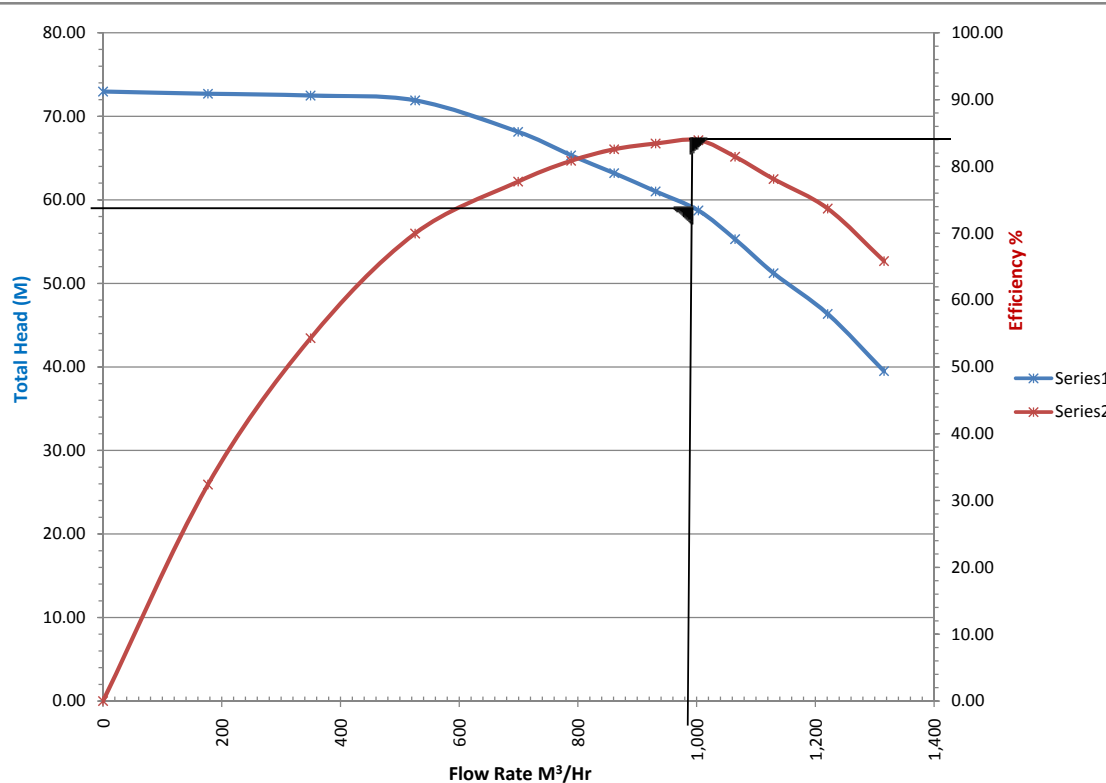
Test No: S2009008

Type of pump: PSI-300-250-480

n	THE MEASURED VALUES							
	Flow Rate		Out. Press (MPa)	Inl. Press. (MPa)	Head (m)	Vel. Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)						
1	0	0	0.7520	-0.0097	77.67	0	1496	668.14
2	50.69	182.49	0.7500	-0.0100	77.50	0	1497	758.56
3	100.19	360.68	0.7450	-0.0117	77.16	0	1496	891.25
4	150.57	542.05	0.7350	-0.0146	76.44	0	1495	1030.54
5	200.27	720.97	0.6920	-0.0185	72.45	0	1495	1169.16
6	225.83	812.99	0.6600	-0.0209	69.43	0	1495	1214.97
7	246.45	887.22	0.6350	-0.0230	67.10	0	1494	1255.34
8	266.44	959.18	0.6100	-0.0253	64.78	0	1494	1296.71
9	286.81	1032.52	0.5830	-0.0276	62.26	0	1493	1334.47
10	304.54	1096.34	0.5450	-0.0300	58.63	0	1493	1374.85
11	323.09	1163.12	0.5000	-0.0326	54.31	0	1493	1408.92
12	348.9	1256.04	0.4450	-0.0362	49.07	0	1492	1458.06
13	376.05	1353.78	0.3700	-0.0400	41.81	0	1492	1498.70
14	399.22	1437.19	0.3000	-0.0443	35.11	0	1492	1536.42
n	THE CALCULATED VALUES				Correction to n _{sp} = 1450 r/min			
	Flow Rate	Total Head	Hydr. Power	Input Power	Flow Rate	Total Head	Input Power	Efficiency
	(m ³ /h)	(m)	(kW)	(kW)	(m ³ /h)	(m)	(KW)	(%)
1	0	77.67	0.00	104.65	0.00	72.97	95.29	0.00
2	182.49	77.50	38.51	118.89	176.76	72.71	108.04	32.40
3	360.68	77.16	75.79	139.59	349.59	72.49	127.10	54.30
4	542.05	76.44	112.84	161.30	525.74	71.91	147.17	69.96
5	720.97	72.45	142.25	182.99	699.27	68.15	166.96	77.74
6	812.99	69.43	153.72	190.16	788.52	65.32	173.50	80.84
7	887.22	67.10	162.12	196.35	861.09	63.20	179.51	82.57
8	959.18	64.78	169.22	202.82	930.93	61.02	185.42	83.43
9	1032.52	62.26	175.08	208.59	1002.78	58.73	191.08	83.93
10	1096.34	58.63	175.06	214.90	1064.77	55.30	196.86	81.46
11	1163.12	54.31	172.03	220.22	1129.62	51.23	201.74	78.12
12	1256.04	49.07	167.84	227.75	1220.68	46.35	209.06	73.70
13	1353.78	41.81	154.14	234.10	1315.67	39.49	214.88	65.84
14	1437.19	35.11	137.41	239.99	1396.73	33.16	220.29	57.26
Note	Flow Coefficient: 250.0000 l/L Potential difference between inl. and out. 0 m Diameter, of the outlet Pipe: 0.250 m Diameter, of the inlet Pipe: 0.300 m Test Date: 2009. 6.19 Test Time: 12:00 pm							

Flow Rate (M ³ /Hr)	Total Head (M)	Efficiency (%)
0.00	72.97	0.00
176.76	72.71	32.40
349.59	72.49	54.30
525.74	71.91	69.96
699.27	68.15	77.74
788.52	65.32	80.84
861.09	63.20	82.57
930.93	61.02	83.43
1002.78	58.73	83.93
1064.77	55.30	81.46
1129.62	51.23	78.12
1220.68	46.35	73.70
1315.67	39.49	65.84

Flow Rate (M ³ /Hr)	Input Power (kW)
0.00	95.29
176.76	108.04
349.59	127.10
525.74	147.17
699.27	166.96
788.52	173.50
861.09	179.51
930.93	185.42
1002.78	191.08
1064.77	196.86
1129.62	201.74
1220.68	209.06
1315.67	214.88



ISO 2548-C

Established Duty Point:

Flow : 983.00 M³/hr
Head : 58.96 Meter
Efficiency : 84 %
Power : 191 kW
RPM : 1450

Test Number: S2009008

Test Date: 19 June 2009

Pump Model: 300-250-480

Horizontal Split Case

Duty Impeller Dia: 455 mm

Max. Impeller Dia: 480 mm

Comments:

Pump Test Sheet

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



PUMP DATA SHEET

Spec No.:	Quote No.: G08TC-2880	Order No.: IRQ-P15-01-2008	Pump No.300-250-480
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1	Customer	El Concorde Construction Ltd.		Station No.	High Lift to ES2
2	Location	Mosul - Iraq		Req. Qty.	2 Set + 1 Set Spare
3	Project	Mosul Water Scheme		Duty	1 Set
4	Ref. No.	MSL		Stand By	1 Set

PUMP SPECIFICATIONS

5	Pump Type	Horizontal Split Case		Capacity	1000 M ³ /Hr
6	Stages	1		TDH	60 mtr
7	Liquid	Water		Eff.	85%
8	Temp.	Ambient		Shaft P.	220 Kw
9	NPSHA	Flooded		Motor P.	250 Kw
10	NPSHR	3.90 mtr		Speed	1450 RPM
11	Suction	300 mm (PN-16)		Rotation	CW
12	Discharge	250 mm (PN-16)		Duty Imp.	452 mm
13	Weight	App. 1080 Kg		Max Imp.	478 mm

MATERIALS

ACCESSORIES

14	Casing	Ductile GGG60		Base Plate	Included
15	Impeller	Alum Bronze		Flex Coplg	Included
16	Shaft	SS420		O&M	Included
17	Sh. Sleeve	SS 1.4300		Docs.	1.Layout Dimensional
18	Sh. Couplg	CS TPD6-2100		Docs.	Ref: MXT-129F
19	Bearing	SKF		Docs.	3.Performance Curve
20	Seal	Stuffing		Docs.	4.Data Sheet

DRIVER SPECIFICATIONS

21	Driver	Electric Motor		Voltage	400V/50Hz/3Ph
22	Mfg.	EC / USA		Protection	IP-55
23	Type	Squirrel Cage Induction		Insulation	Class F
24	Rated	250 Kw		Starting	Star Delta
25	Speed	1450 RPM		Weight	App. 1750 Kg

FINISHING & PAINT

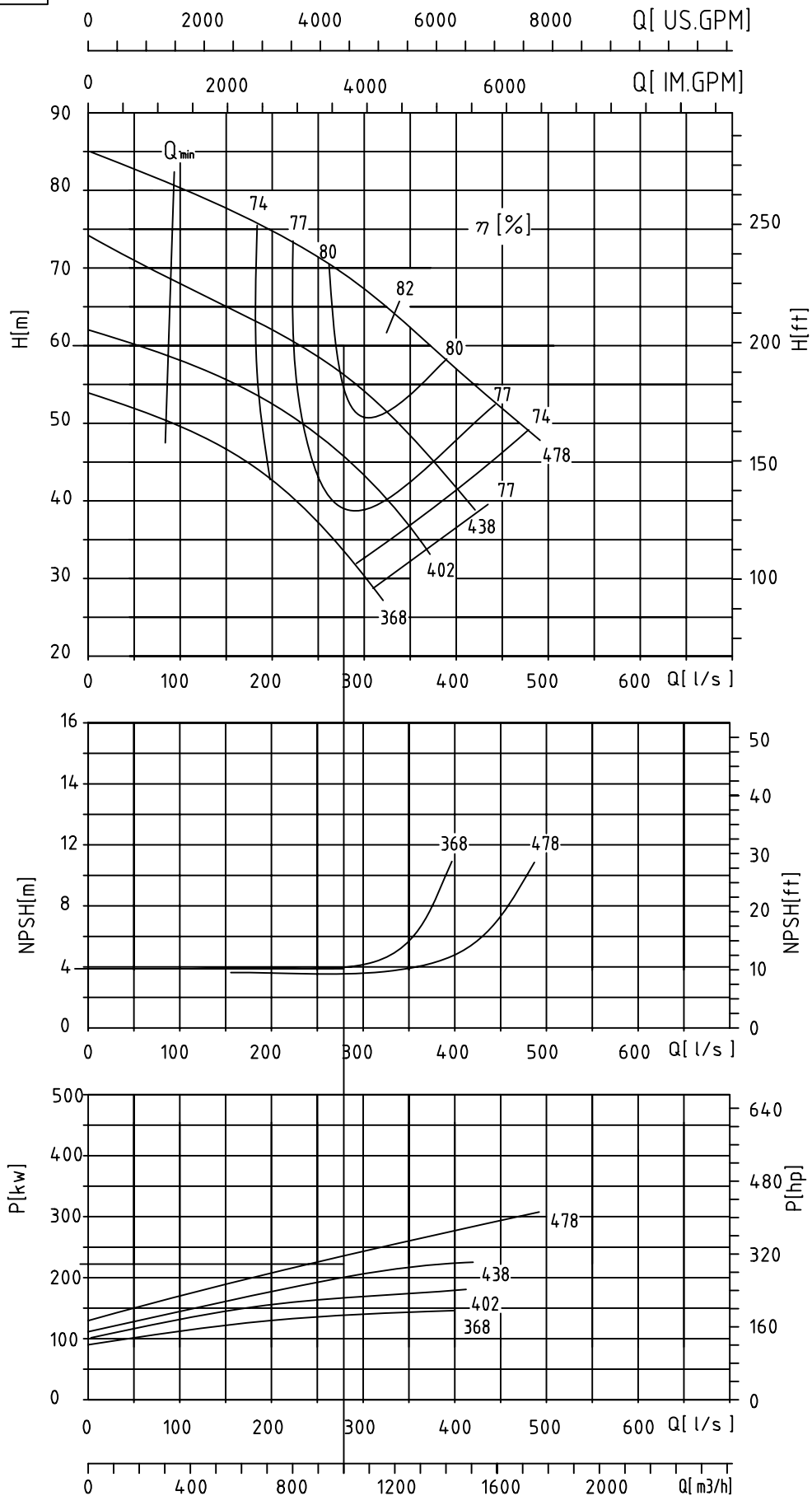
26	Prep.	Gritt Blasting		Test	Hydostatic 24 Bars
27	Primer	100 micron		Test	Dimensional Tolerances
28	Final	Epoxy Blue 200 micron		Test	DFT (Dry Film Thickness)

Revisions

29	Rev O	21-Aug-08		Rev B	
30	Rev A	25-Jan-09		Rev C	

No: 9032

1450 r/min



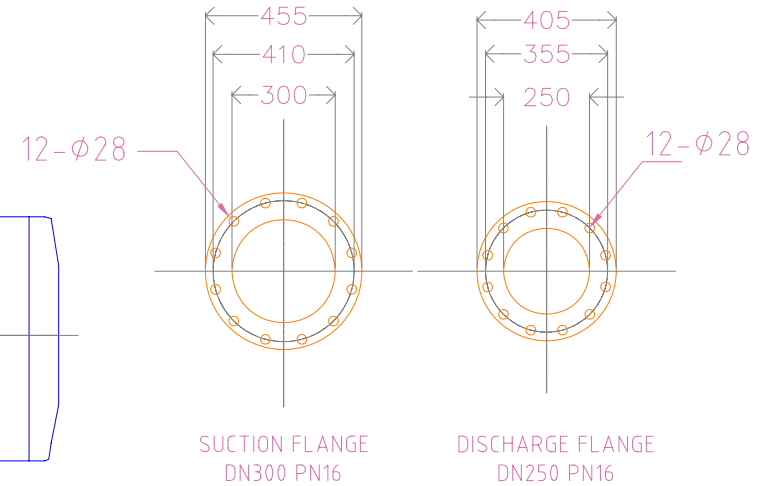
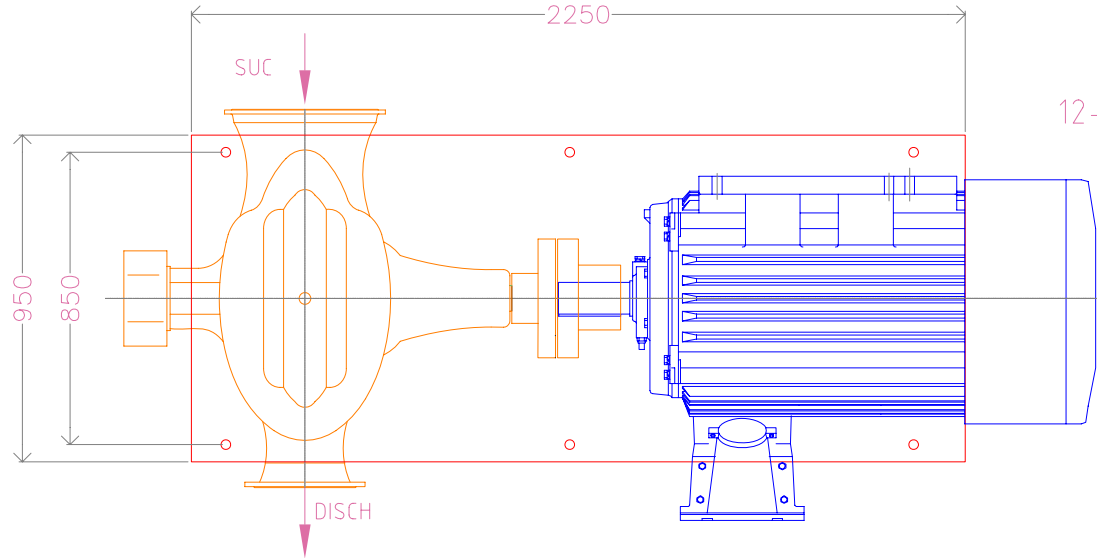
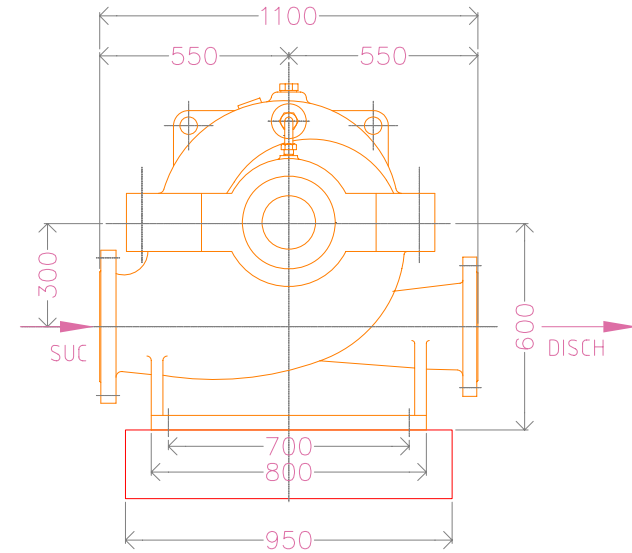
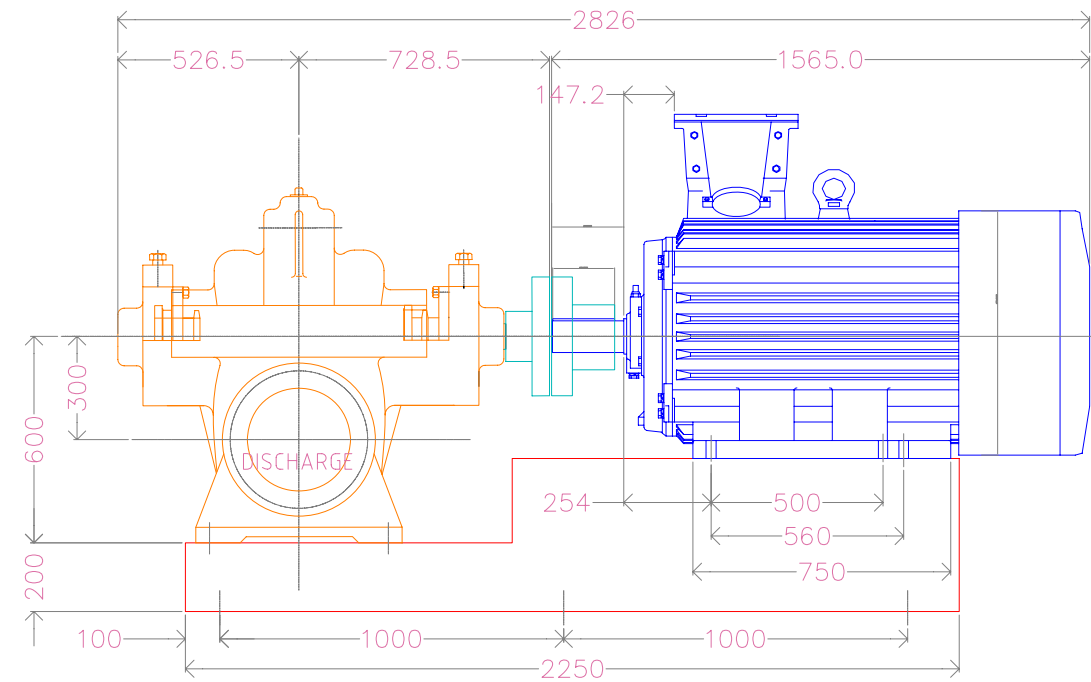
Process Systems, inc
A RUTHMAN COMPANY

23633 Elmwood - Warren, MI 48091
Phone: (586) 757-5711 Fax: (586) 758-6996

drawn	checked	approved	name	signature	date
					August 2008
scale	NTS				

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT	MOSUL WATER SCHEME RIGHT BANK HIGH LIFT PUMPING STATION TO ES2
Dwg. title	PUMP PERFORMANCE CURVE MODEL PSI-300-250-480

drg. no.	MXT-9032
sheet no.	



QTY = 3

drawn			
checked			
approved			
name	signature	date	
scale	NTS	date	January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT	MOSUL WATER SCHEME RIGHT BANK HLP-ES2 PUMPING STATION
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-300-250-480

drg. no.	MXT-129F
sheet no.	

Pumps Calculations

High Lift Pump to E.S.2

TOTAL HEAD =60m
CAPACITY/PUMP=1000m3/hr
NPSHr=4m

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH) \gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

LOW LIFT PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =	263.8	m
FLOOR LEVEL OF PUMP STATION=	267.3	m
SUCTION WELL AVERAGE WATER LEVEL=	267.8	m
SUCTION WELL MINIMUM WATER LEVEL=	265.8	m
MAX WATER LEVEL IN THE RECEIVING CHAMBER (E.S.2)=	309.25	m
TEMPERATURE=	30	°C
VAPOR PRESSURE=	0.0428	bar
AVERAGE FLOW=	0.277777778	m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.0555555		0.111111		0.1666665		0.222222		0.2777775		0.333333		0.3888885		0.444444		0.4999995	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BUTTERFLY VALVE	6	0.46	0.6		0.19658705	0.005436506	0.393174098	0.021746025	0.5897611	0.048928556	0.7863482	0.086984099	0.982935244	0.13591265	1.1795223	0.195714222	1.37610934	0.266388802	1.572696391	0.347936395	1.76928344	0.440357
2	HEADER TO LINE	1	1	0.5		0.28308535	0.004084471	0.566170701	0.016337883	0.8492561	0.036760236	1.1323414	0.065351532	1.415426752	0.10211177	1.6985121	0.147040946	1.98159745	0.200139065	2.264682803	0.261406126	2.54776815	0.330842128
3	90° BEND	3	0.3	0.5		0.28308535	0.003676024	0.566170701	0.014704095	0.8492561	0.033084213	1.1323414	0.058816378	1.415426752	0.09190059	1.6985121	0.132336851	1.98159745	0.180125159	2.264682803	0.235265514	2.54776815	0.297757916
4	REDUCER	2	0.5	0.5		0.28308535	0.004084471	0.566170701	0.016337883	0.8492561	0.036760236	1.1323414	0.065351532	1.415426752	0.10211177	1.6985121	0.147040946	1.98159745	0.200139065	2.264682803	0.261406126	2.54776815	0.330842128
5	FLOW METER	1	0.5	0.5		0.28308535	0.002042235	0.566170701	0.008168941	0.8492561	0.018380118	1.1323414	0.032675766	1.415426752	0.05105588	1.6985121	0.073520473	1.98159745	0.100069533	2.264682803	0.130703063	2.54776815	0.165421064
6	BUTTERFLY VALVE	1	0.46	0.5		0.28308535	0.001878857	0.566170701	0.007515426	0.8492561	0.016909709	1.1323414	0.030061705	1.415426752	0.04697141	1.6985121	0.067638835	1.98159745	0.09206397	2.264682803	0.120246818	2.54776815	0.152187379
7	BUTTERFLY VALVE	1	0.46	0.5		0.28308535	0.001878857	0.566170701	0.007515426	0.8492561	0.016909709	1.1323414	0.030061705	1.415426752	0.04697141	1.6985121	0.067638835	1.98159745	0.09206397	2.264682803	0.120246818	2.54776815	0.152187379
8	INCREASER	1	0.5	0.6		0.19658705	0.000984874	0.393174098	0.003939497	0.5897611	0.008863869	0.7863482	0.015757989	0.982935244	0.02462186	1.1795223	0.035455475	1.37610934	0.048258841	1.572696391	0.063031956	1.76928344	0.079774819
9	22.5° BEND	2	0.075	0.6		0.19658705	0.000295462	0.393174098	0.001181849	0.5897611	0.002659161	0.7863482	0.004727397	0.982935244	0.00738656	1.1795223	0.010636643	1.37610934	0.014477652	1.572696391	0.018909587	1.76928344	0.023932446
10	45° BEND	1	0.22	0.6		0.19658705	0.000433345	0.393174098	0.001733379	0.5897611	0.003900102	0.7863482	0.006933515	0.982935244	0.01083362	1.1795223	0.015600409	1.37610934	0.02123389	1.572696391	0.027773406	1.76928344	0.03510092
11	exit	1	1	0.6		0.19658705	0.001969749	0.393174098	0.007878994	0.5897611	0.017727738	0.7863482	0.031515978	0.982935244	0.04924372	1.1795223	0.07091095	1.37610934	0.096517682	1.572696391	0.126063911	1.76928344	0.159549638
12	TEE CONNECTION	6	0.5	0.6		0.19658705	0.005909246	0.393174098	0.023636983	0.5897611	0.053183213	0.7863482	0.094547933	0.982935244	0.14773115	1.1795223	0.21273285	1.37610934	0.289553046	1.572696391	0.378191734	1.76928344	0.478648913
13	PIPE (C=120)		120	0.6	7259.5	0.19658705	0.631218677	0.393174098	2.275544498	0.5897611	4.817859844	0.7863482	8.203342127	0.982935244	12.395794	1.1795223	17.36839365	1.37610934	23.09995929	1.572696391	29.57306355	1.76928344	36.772951
14	PIPE (C=140)		140	0.6	7259.5	0.19658705	0.474600597	0.393174098	1.710936029	0.5897611	3.622451679	0.7863482	6.16792755	0.982935244	9.32014755	1.1795223	13.05894501	1.37610934	17.36839365	1.572696391	22.23539023	1.76928344	27.64884044
FRICTION LOSS (C=120)							0.663892772		2.40624088		5.111926703		8.726127654		13.2126463		18.54466109		24.70098997		31.66420565		39.41955273
FRICTION LOSS (C=140)							0.507274692		1.84163241		3.916518538		6.690713076		10.1369999		14.23521244		18.96942433		24.32653234		30.29544217

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=120	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=120	C=140	C=120	C=140
200.0	0.7	0.5	43.5	41.5		44.1	44.0	42.1	42.0
400.0	2.4	1.8	43.5	41.5		45.9	45.3	43.9	43.3
600.0	5.1	3.9	43.5	41.5		48.6	47.4	46.6	45.4
800.0	8.7	6.7	43.5	41.5		52.2	50.1	50.2	48.1
1000.0	13.2	10.1	43.5	41.5		56.7	53.6	54.7	51.6
1200.0	18.5	14.2	43.5	41.5		62.0	57.7	60.0	55.7
1400.0	24.7	19.0	43.5	41.5		68.2	62.4	66.2	60.4
1600.0	31.7	24.3	43.5	41.5		75.1	67.8	73.1	65.8
1800.0	39.4	30.3	43.5	41.5		82.9	73.7	80.9	71.7

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.05555555	0.11111111		0.16666667		0.22222222		0.27777775		0.33333333		0.38888885		0.44444444		0.49999995		
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.05	0.685		0.15082615	5.79728E-05	0.301652304	0.000231891	0.4524785	0.000521755	0.6033046	0.000927565	0.754130761	0.00144932	0.9049569	0.002087021	1.05578307	0.002840667	1.206609218	0.003710259	1.35743537	0.004695797
2	90° BEND	1	0.3	0.5		0.28308561	0.001225343	0.56617121	0.004901374	0.8492568	0.011028091	1.1323424	0.019605495	1.415428025	0.03063359	1.6985136	0.044112363	1.98159924	0.060041828	2.264684841	0.078421979	2.54777045	0.099252817
3	REDUCER	1	0.25	0.3		0.7863489	0.007879009	1.572697806	0.031516035	2.3590467	0.070911078	3.1453956	0.126064138	3.931744515	0.19697522	4.7180934	0.283644311	5.50444232	0.386071423	6.290791224	0.504256552	7.07714013	0.638199699
4	PIPE	1	120	0.5	11.5	0.28308561	0.002428549	0.56617121	0.008754923	0.8492568	0.018536219	1.1323424	0.031561512	1.415428025	0.04769154	1.6985136	0.066823102	1.98159924	0.088874709	2.264684841	0.11377931	2.54777045	0.141480134
5	EXIT	1	1	0.3		0.7863489	0.031516035	1.572697806	0.126064138	2.3590467	0.283644311	3.1453956	0.504256552	3.931744515	0.78790086	4.7180934	1.134577243	5.50444232	1.544285692	6.290791224	2.017026209	7.07714013	2.552798796
6	90° BEND	1	0.3	0.4		0.44232126	0.002991561	0.884642516	0.011966244	1.3269638	0.02692405	1.769285	0.047864977	2.21160629	0.07478903	2.6539275	0.107696199	3.09624881	0.146586493	3.538570064	0.19145991	3.98089132	0.242316448
7	CHECK VALVE	1	2.2	0.4		0.44232126	0.021938115	0.884642516	0.087752459	1.3269638	0.197443032	1.769285	0.351009834	2.21160629	0.54845287	2.6539275	0.789772128	3.09624881	1.074967618	3.538570064	1.404039338	3.98089132	1.776987287
8	CONTROL VALVE	1	0.3	0.4		0.44232126	0.002991561	0.884642516	0.011966244	1.3269638	0.02692405	1.769285	0.047864977	2.21160629	0.07478903	2.6539275	0.107696199	3.09624881	0.146586493	3.538570064	0.19145991	3.98089132	0.242316448
9	BUTTERFLY VALVE	1	0.46	0.4		0.44232126	0.00458706	0.884642516	0.018348241	1.3269638	0.041283543	1.769285	0.073392965	2.21160629	0.11467651	2.6539275	0.165134172	3.09624881	0.224765957	3.538570064	0.293571862	3.98089132	0.371551887
10	PIPE	1	120	0.4	7.5	0.44232126	0.004692143	0.884642516	0.016915186	1.3269638	0.035813404	1.769285	0.060979275	2.21160629	0.09214373	2.6539275	0.129107386	3.09624881	0.171712792	3.538570064	0.219830401	3.98089132	0.273350528
11	TEE-BRANCH TO LINE	1	1	0.4		0.44232126	0.00997187	0.884642516	0.039887481	1.3269638	0.089746833	1.769285	0.159549925	2.21160629	0.24929676	2.6539275	0.358987331	3.09624881	0.488621645	3.538570064	0.638199699	3.98089132	0.807721494
	TOTAL					0.090279219		0.358304216		0.802776364		1.423077217		2.21879844		3.189637455		4.335355317		5.655755429		7.150671337	

PUMP SUCTION LINE PRESSURE LOSSES = 1.06465052

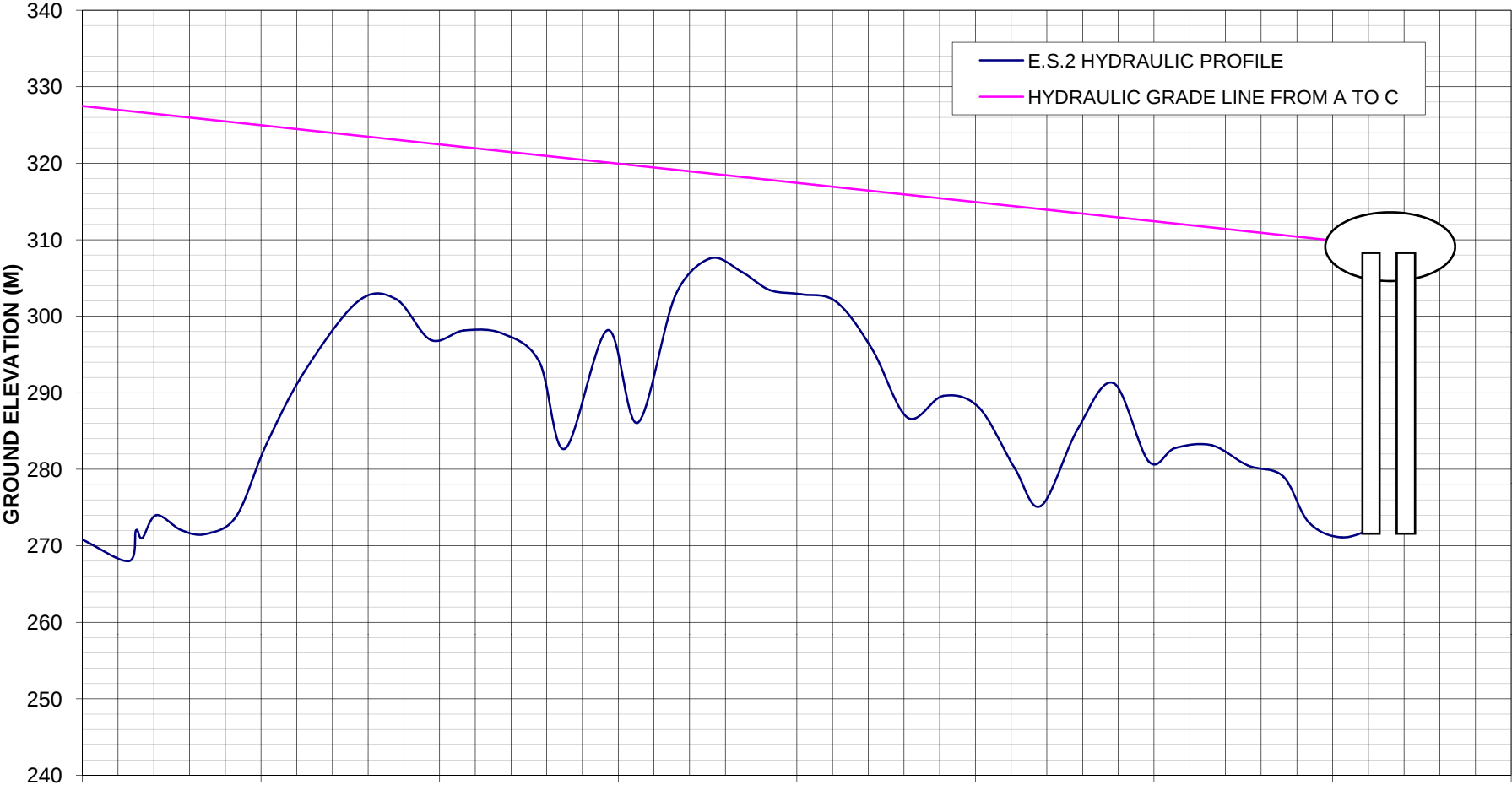
PUMP CHARACTERISTIC HEAD-CAPACITY CURVE		INDIVIDUAL PUMP HEAD LOSS (m)		PUMP MODIFIED HEAD (m)	
Capacity (m3/hr)	Total Head (m)				
200.0	75.0	0.1		74.9	
400.0	72.0	0.4		71.6	
600.0	68.0	0.8		67.2	
800.0	64.5	1.4		63.1	
1000.0	60.0	2.2		57.8	
1200.0	55.0	3.2		51.8	
1400.0	48.0	4.3		43.7	
1600.0	42.5	5.655755		36.8	

NET POSITIVE SUCTION HEAD av.= 5.131669478 m

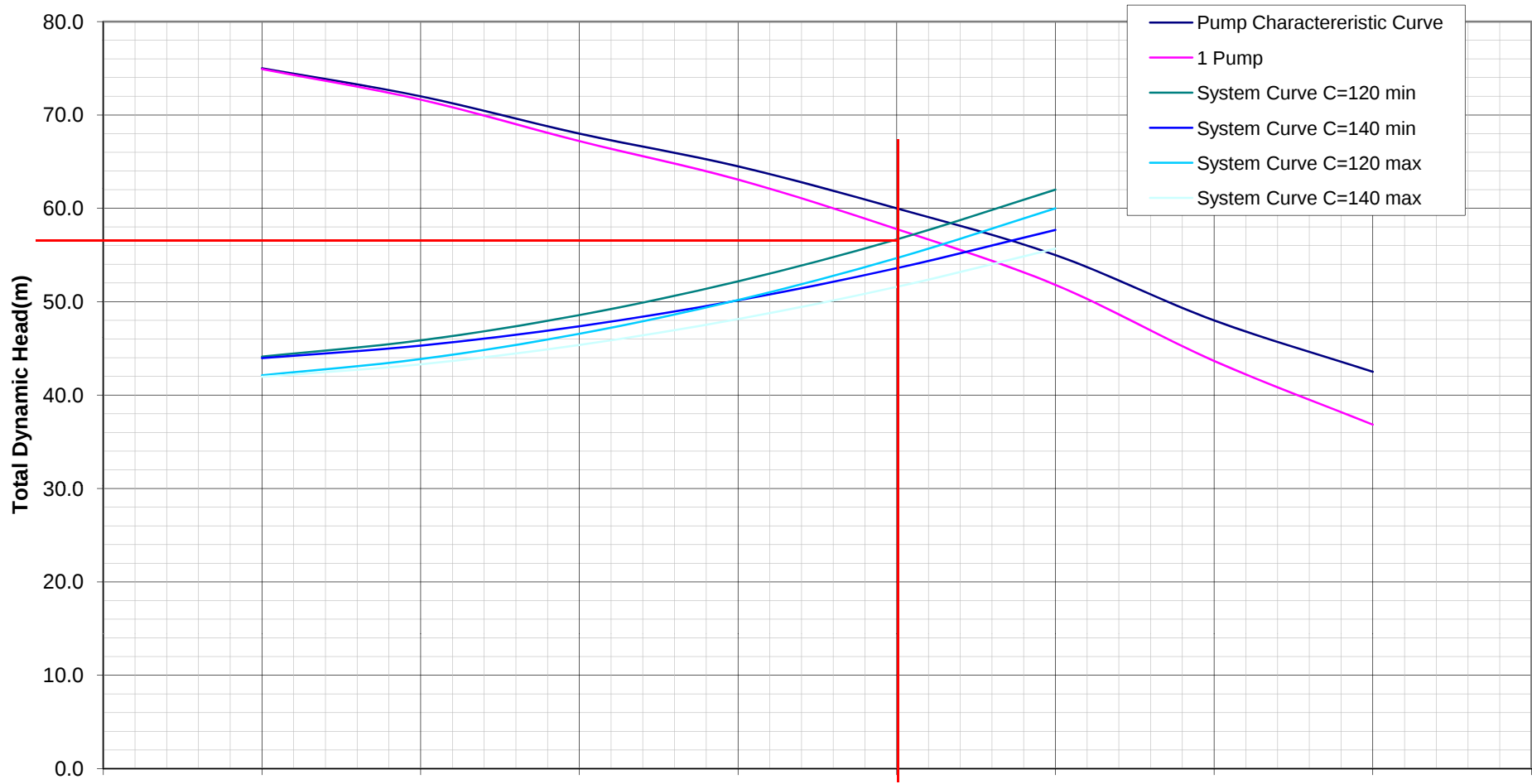
TOTAL DYNAMIC HEAD

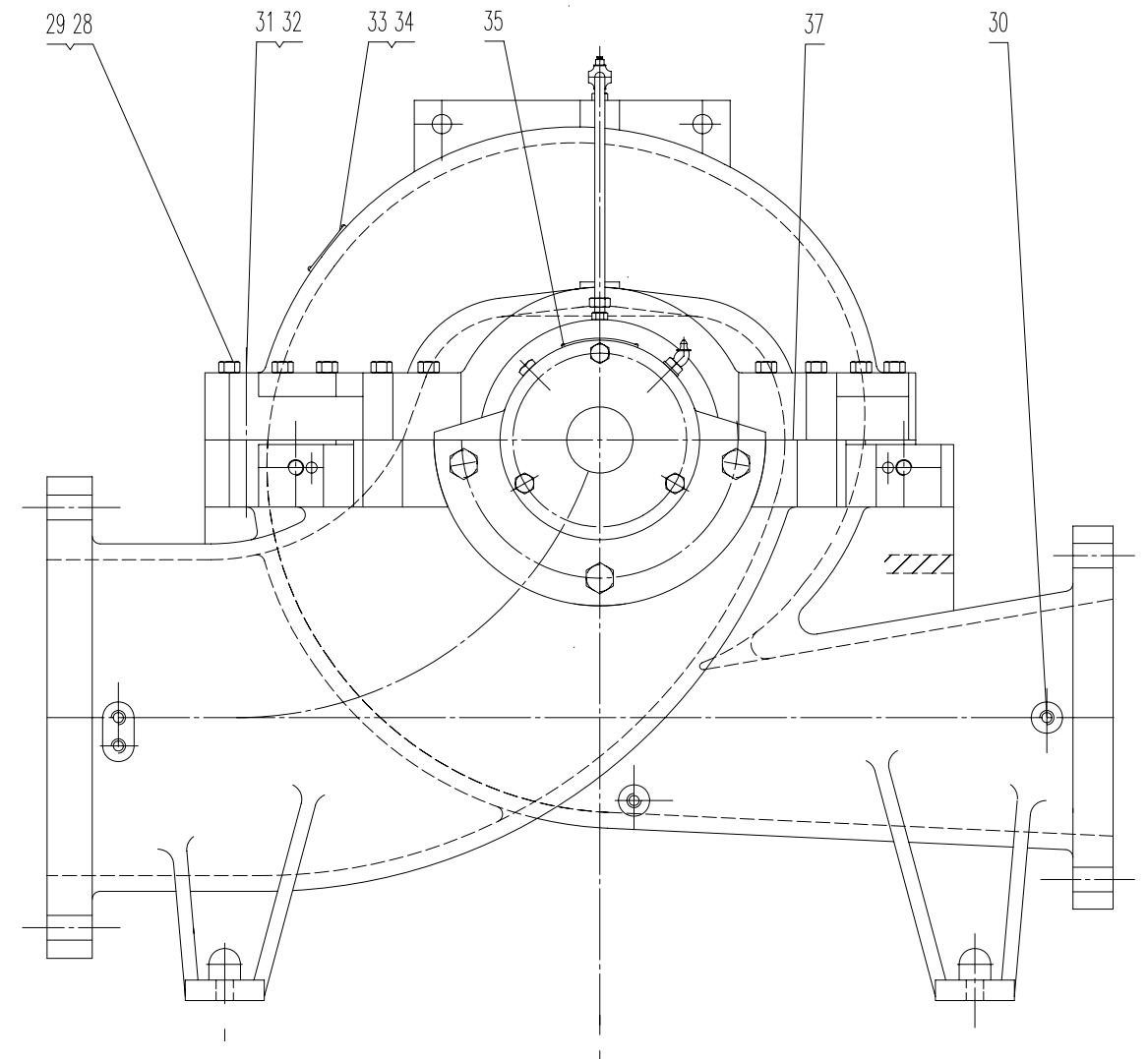
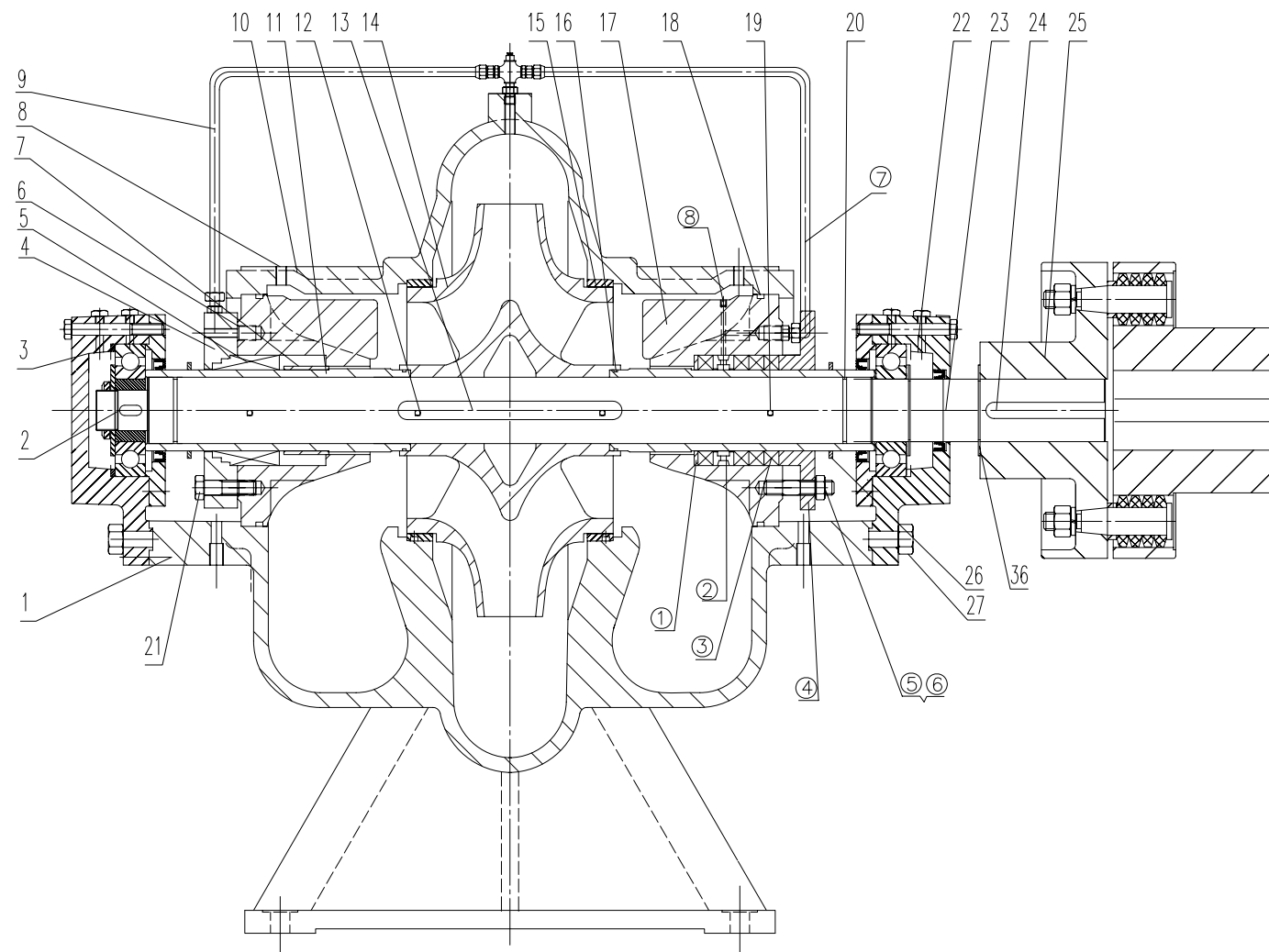
POINTS	STATION (m)	TDH (m)
POINT A	0	327.5
POINT B	7259.5	309.25

E.S.2 HYDRAULIC PROFILE



High Lift Pump Model 300-250-480





9	Flush pipe assembly ofr seal	1	18	O-ring 270X4	2	27	Bolte M20X55	6	36	Washer 75	1	⑧	Bolt M10x12	2
8	Plug 1/2	2	17	Seal housing	2	26	Washer 90	2	35	Rotation plate 14x60	1	⑦	Pipe of Packing	1
7	Bush	2	16	O-ring 87X3.55	2	25	Coupling assembly	1	34	Screw 2x6	6	⑥	Nut M12	4
6	Wash Ø225XØ125X1.2	2	15	Wear ring	2	24	Key C20X138	1	33	Nameplate 63x100	1	⑤	Stud M12x50	4
5	Mehcanical seal 90	2	14	Impelelr	1	23	Shaft	1	32	Nut M12	2	④	Gland packing	2
4	Cover for seal	2	13	key B22X196	1	22	Drive end bearing assembly	1	31	Bolte 12x150	2	③	Packing 16x16x333	8
3	Non-drive end bearing assembly	1	12	Screw 8X14	4	21	Bolte M16X60	8	30	1/2 Plug	8	②	Lantern ring	2
2	Key 8X30	1	11	Sleeve	2	20	O-ring 73X3.55	2	29	Nut M24	20	①	Neck ring	2
1	Lower Casing	1	10	Upper casing	1	19	Screw 10X22	4	28	Stud M24X90	20	37	washer 803X640X0.25	1
No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty	No.	Part Name	Qty

drawn			
checked			
approved			
	name	signature	date
scale	NTS	date	January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK HLP - EST2 PUMPING STATION	
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-300-250-480	sheet no.

Process Systems, inc

A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL



Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK	
Drg. title	PERFORMANCE TEST PUMP ARRANGEMENT PUMP MODEL PSI-500-400-620 / HLP TO BS1 P/S	sheet no.

PERFORMANCE TEST RECORD FOR PUMP

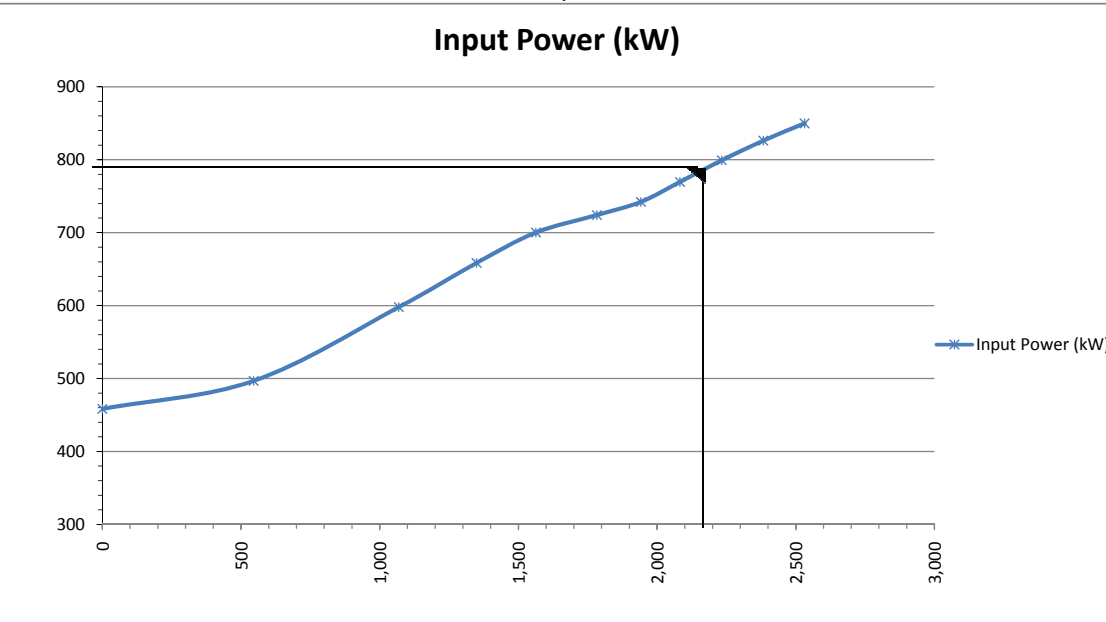
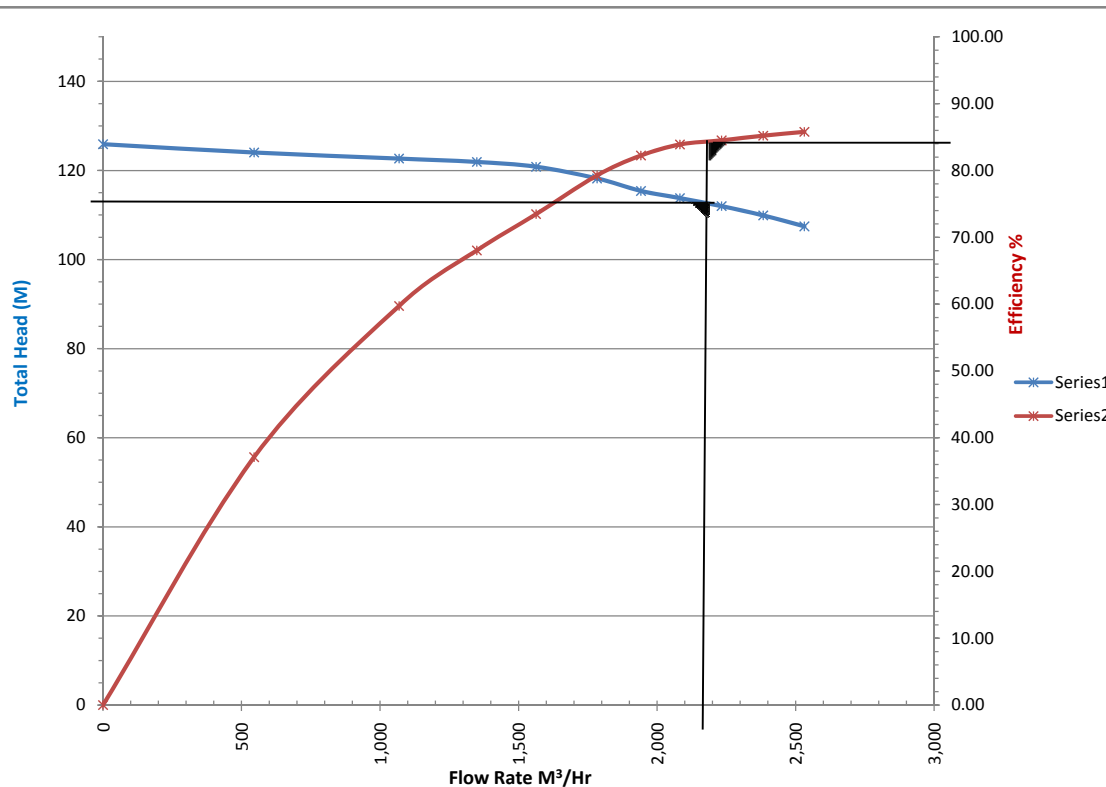
Test No: S2009009

Type of pump: PSI-500-400-620

n	THE MEASURED VALUES							
	Flow Rate		Out. Press (MPa)	Inl. Press. (MPa)	Head (m)	Vel. Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)						
1	0.00	0.00	1.2850	-0.0080	131.85	0.00	1495.0	3162.57
2	153.90	554.04	1.2650	-0.0085	129.86	0.05	1495.0	3426.87
3	301.13	1084.07	1.2450	-0.0100	127.97	0.17	1493.0	4113.83
4	380.19	1368.68	1.2350	-0.0112	127.08	0.28	1493.0	4530.87
5	440.23	1584.83	1.2200	-0.0124	125.67	0.37	1492.0	4811.08
6	501.81	1806.52	1.1890	-0.0138	122.65	0.48	1491.0	4969.56
7	546.81	1968.52	1.1600	-0.0149	119.81	0.57	1492.0	5099.35
8	586.48	2111.33	1.1420	-0.0157	118.05	0.66	1492.0	5287.16
9	628.42	2262.31	1.1200	-0.0167	115.91	0.75	1491.0	5484.16
10	670.20	2412.72	1.0950	-0.0180	113.49	0.86	1490.0	5661.75
11	712.46	2564.86	1.0690	-0.0193	110.98	0.97	1491.0	5831.52
n	THE CALCULATED VALUES				Correction to n _{sp} = 1450 r/min			
	Flow Rate (m ³ /h)	Total Head (m)	Hydraulic Power (kW)	Input Power (kW)	Flow Rate (m ³ /h)	Total Head (m)	Input Power (kW)	Efficiency (%)
1	0.00	131.85	0.00	495.00	0.00	125.89	458.40	0.00
2	554.04	129.91	196.01	536.36	545.42	124.03	496.71	37.09
3	1084.07	128.15	378.32	643.02	1068.64	122.68	597.89	59.72
4	1368.68	127.35	474.69	708.21	1349.20	121.92	658.49	68.04
5	1584.83	126.04	543.98	751.51	1563.31	120.83	700.16	73.48
6	1806.52	123.13	605.77	775.74	1783.19	118.20	724.19	79.26
7	1968.52	120.38	645.32	796.53	1941.80	115.40	742.11	82.24
8	2111.33	118.71	682.55	825.87	2082.67	113.80	769.44	83.89
9	2262.31	116.66	718.76	856.07	2233.10	112.00	799.18	84.50
10	2412.72	114.35	751.35	883.20	2383.17	109.91	826.17	85.21
11	2564.86	111.94	781.91	910.29	2531.74	107.46	849.80	85.78
Note	Flow Coefficient: 500.0000 1/L Potential difference between inland out. 0 m Diameter, of the outlet Pipe: 0.400 m Diameter, of the inlet Pipe: 0.500 m Test Date: 2009. 6.19 Test Time: 03:00 am							

Flow Rate (M ³ /Hr)	Total Head (M)	Efficiency (%)
0.00	125.89	0.00
545.42	124.03	37.09
1068.64	122.68	59.72
1349.20	121.92	68.04
1563.31	120.83	73.48
1783.19	118.20	79.26
1941.80	115.40	82.24
2082.67	113.80	83.89
2233.10	112.00	84.50
2383.17	109.91	85.21
2531.74	107.46	85.78

Flow Rate (M ³ /Hr)	Input Power (kW)
0.00	458.40
545.42	496.71
1068.64	597.89
1349.20	658.49
1563.31	700.16
1783.19	724.19
1941.80	742.11
2082.67	769.44
2233.10	799.18
2383.17	826.17
2531.74	849.80



ISO 2548-C

Established Duty Point:

Flow : 2167 M³/hr
Head : 113.2 Meter
Efficiency : 84 %
Power : 792 kW
RPM : 1450

Test Number: S2009009
Test Date: 19 June 2009
Pump Model: 500-400-620
Horizontal Split Case
Duty Impeller Dia: 610 mm
Max. Impeller Dia: 620 mm

Comments:

Pump Test Sheet

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CAVITATION TEST RECORDS FOR PUMP

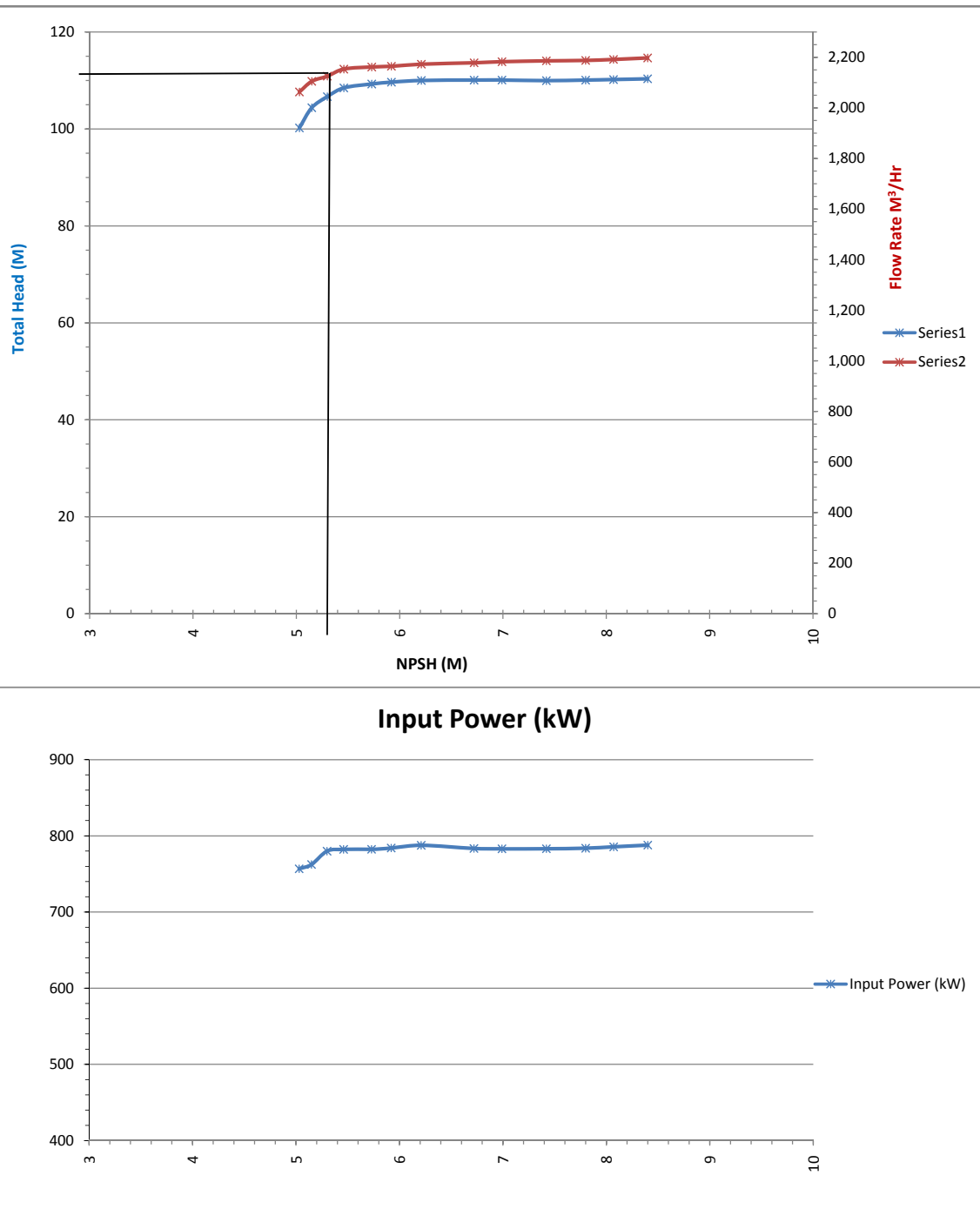
Test No: S2009009

Type of pump: PSI-500-400-620

n	THE MEASURED VALUES							
	Flow Rate		Out. Press.	Inl. Press	Head (m)	Vel. Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)	(MPa)	(MPa)				
1	627.66	2259.58	1.1200	-0.0169	115.93	0.75	1491.0	5487.4600
2	626.05	2253.78	1.1150	-0.0203	115.77	0.75	1491.0	5471.5898
3	624.89	2249.60	1.1110	-0.0231	115.65	0.74	1491.0	5458.5898
4	624.51	2248.24	1.1060	-0.0270	115.53	0.74	1491.0	5454.6099
5	623.42	2244.31	1.1030	-0.0314	115.68	0.74	1491.0	5453.6602
6	622.30	2240.28	1.1000	-0.0342	115.66	0.74	1491.0	5456.8198
7	620.71	2234.56	1.0940	-0.0395	115.58	0.73	1491.0	5485.4302
8	617.92	2224.51	1.0860	-0.0425	115.07	0.73	1490.0	5453.0098
9	617.02	2221.27	1.0800	-0.0445	114.67	0.73	1490.0	5442.1401
10	614.67	2212.81	1.0690	-0.0472	113.82	0.72	1490.0	5441.2500
11	606.71	2184.16	1.0490	-0.0488	111.94	0.70	1490.0	5424.8901
12	600.97	2163.49	1.0240	-0.0502	109.54	0.69	1490.0	5302.8999
13	588.91	2120.08	0.9800	-0.0513	105.16	0.66	1490.0	5263.8301
n	THE CALCULATED VALUES				Correction to n _{sp} = 1450 r/min			
	Flow Rate (m ³ /h)	Total Head (m)	NPSH (m)	Input Power (kW)	Flow Rate (m ³ /h)	Total Head (m)	Input Power (kW)	NPSH (m)
1	2259.58	116.68	8.88	856.58	2197.44	110.35	787.84	8.40
2	2253.78	116.52	8.53	854.11	2191.80	110.20	785.57	8.07
3	2249.60	116.39	8.24	852.08	2187.74	110.08	783.70	7.80
4	2248.24	116.28	7.85	851.46	2186.41	109.97	783.13	7.42
5	2244.31	116.42	7.40	851.31	2182.60	110.10	782.99	6.99
6	2240.28	116.39	7.11	851.80	2178.68	110.08	783.45	6.72
7	2234.56	116.32	6.57	856.27	2173.11	110.01	787.55	6.21
8	2224.51	115.80	6.26	850.63	2164.79	109.67	783.95	5.92
9	2221.27	115.39	6.05	848.94	2161.64	109.28	782.39	5.73
10	2212.81	114.54	5.77	848.80	2153.41	108.47	782.26	5.46
11	2184.16	112.65	5.59	846.25	2125.52	106.68	779.91	5.30
12	2163.49	110.23	5.44	827.22	2105.41	104.39	762.37	5.15
13	2120.08	105.82	5.31	821.12	2063.16	100.22	756.75	5.03
Note	Flow Coefficient: 500.0000 1/L Potential difference between inland out. 0 m Diameter, of the outlet Pipe: 0.400 m Diameter, of the inlet Pipe: 0.500 m Test Date: 2009. 6.19 Test Time: 04:00 am							

NPSH (M)	Total Head (M)	Flow Rate (M ³ /Hr)
5.03	100.22	2063.16
5.15	104.39	2105.41
5.30	106.68	2125.52
5.46	108.47	2153.41
5.73	109.28	2161.64
5.92	109.67	2164.79
6.21	110.01	2173.11
6.72	110.08	2178.68
6.99	110.10	2182.60
7.42	109.97	2186.41
7.80	110.08	2187.74
8.07	110.20	2191.80
8.40	110.35	2197.44

NPSH (M)	Input Power (kW)
5.03	756.75
5.15	762.37
5.30	779.91
5.46	782.26
5.73	782.39
5.92	783.95
6.21	787.55
6.72	783.45
6.99	782.99
7.42	783.13
7.80	783.70
8.07	785.57
8.40	787.84



ISO 2548-C

Established Duty Point:

Flow : 2167 M³/hr
 Head : 113.2 Meter
 HeadX0.3 : 3.311 Meter
 Power : 792 kW
 RPM : 1450
 NPSH : 5.331 Meter
 Test Number: S2009009
 Test Date: 19 June 2009
 Pump Model: 500-400-620
 Horizontal Split Case
 Duty Impeller Dia: 610 mm
 Max. Impeller Dia: 620 mm

Comments:

Pump NPSH Test Sheet

Process Systems, inc
A RUTHMAN COMPANY

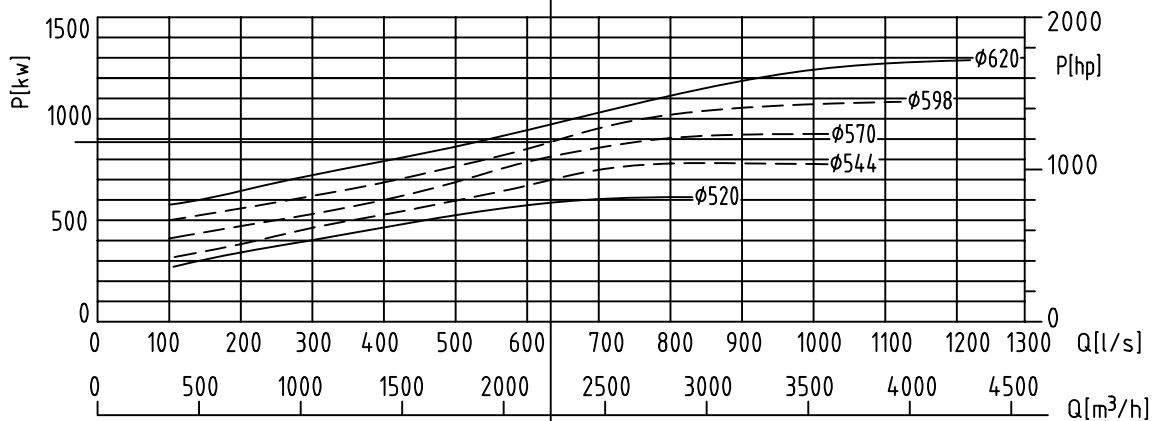
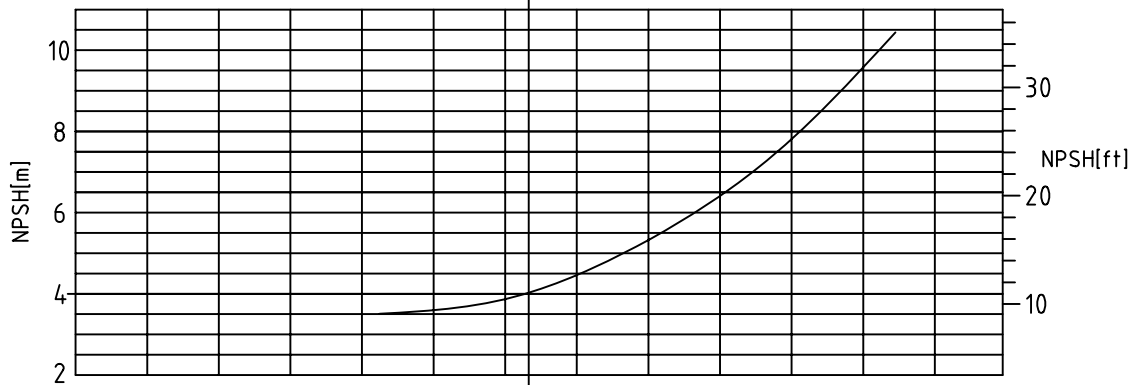
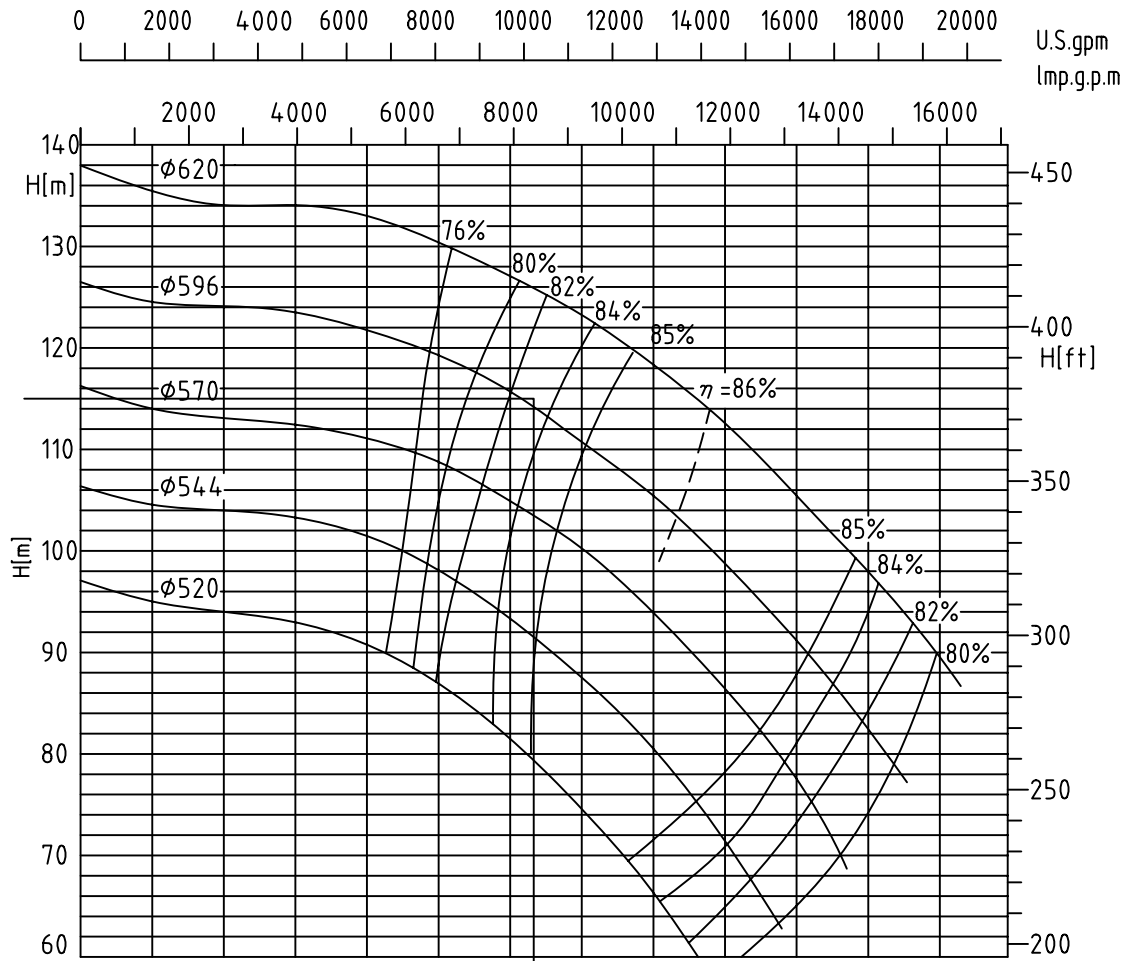
23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



PUMP DATA SHEET							
Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.500-400-620	
1	Customer	El Concorde Construction Ltd.			Station No.	High Lift to BS1	
2	Location	Mosul - Iraq			Req. Qty.	7 Set + 1 Spare Set	
3	Project	Mosul Water Scheme			Duty	5 Set	
4	Ref. No.	MSL			Stand By	2 Set	
PUMP SPECIFICATIONS							
5	Pump Type	Horizontal Split Case			Capacity	2200 M ³ /Hr	
6	Stages	1			TDH	115 mtr	
7	Liquid	Water			Eff.	83%	
8	Temp.	Ambient			Shaft P.	890 Kw	
9	NPSHA	Flooded			Motor P.	1000 Kw	
10	NPSHR	4.00 mtr			Speed	1450 RPM	
11	Suction	500 mm (PN-16)			Rotation	CW	
12	Discharge	400 mm (PN-25)			Duty Imp.	596 mm	
13	Weight	App. 2250 Kg			Max Imp.	620 mm	
MATERIALS				ACCESSORIES			
14	Casing	Ductile GGG60			Base Plate	Included	
15	Impeller	Alum Bronze			Flex Couplg	Included	
16	Shaft	SS420			O&M	Included	
17	Sh. Sleeve	SS 1.4300			Docs.	1.Layout Dimensional	
18	Sh. Couplg	CS TPD6-2100			Docs.	Ref: MXT-130F	
19	Bearing	SKF			Docs.	3.Performance Curve	
20	Seal	Stuffing			Docs.	4.Data Sheet	
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor			Voltage	11000V/50Hz/3Ph	
22	Mfg.	EC / USA			Protection	IP-55	
23	Type	Squirrel Cage Induction			Insulation	Class F	
24	Rated	1000 Kw			Starting	DOL	
25	Speed	1450 RPM			Weight	App. 5200 Kg	
FINISHING & PAINT							
26	Prep.	Gritt Blasting			Test	Hydostatic 24 Bars	
27	Primer	100 micron			Test	Dimensional Tolerances	
28	Final	Epoxy Blue 200 micron			Test	DFT (Dry Film Thickness)	
Revisions							
29	Rev O	21-Aug-08			Rev B		
30	Rev A	25-Jan-09			Rev C		

1450 r/min

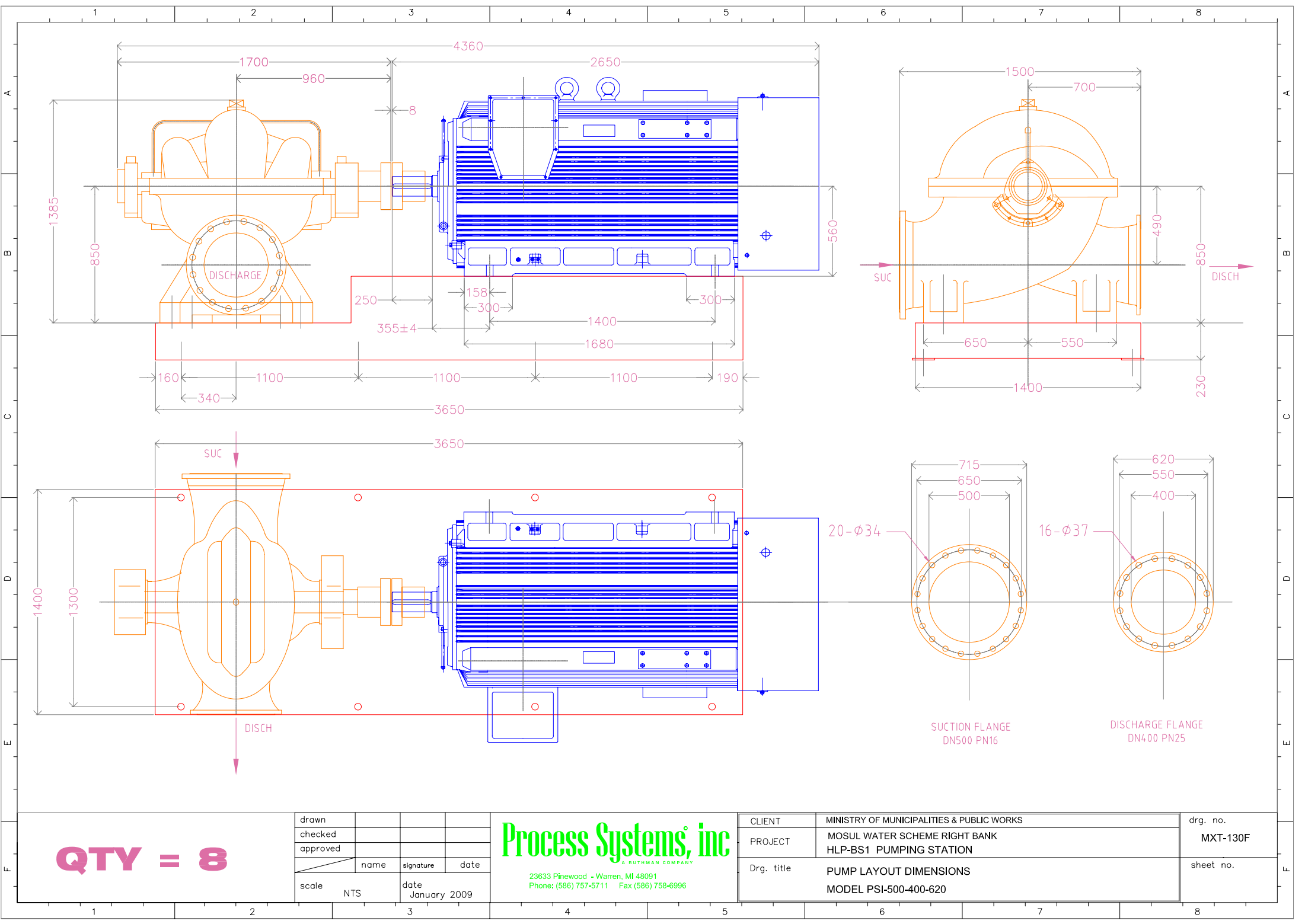
No: 9053



Process Systems, inc
A RUTHMAN COMPANY
23633 Eisenhower - Warren, MI 48091
Phone: (586) 757-5711 Fax: (586) 758-6996

drawn	checked	approved	name	signature	date
					August 2008
scale	NTS				

CLIENT	PROJECT	Drg. title
MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	MOSUL WATER SCHEME RIGHT BANK HIGH LIFT PUMPING STATION TO BS1	PUMP PERFORMANCE CURVE MODEL PSI-500-400-620
drg. no.	MXT-9053	sheet no.



QTY = 8

drawn			
checked			
approved			
name	signature	date	
scale	NTS	date	January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT	MOSUL WATER SCHEME RIGHT BANK HLP-BS1 PUMPING STATION
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-500-400-620

drg. no.	MXT-130F
sheet no.	

Pumps Calculations

High Lift Pump to B.S.1

TOTAL HEAD =115m
CAPACITY/PUMP=2200m3/hr
NPSHr=4m

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH) \gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

LOW LIFT PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =263.8m
FLOOR LEVEL OF PUMP STATION=267.3m
SUCTION WELL MAXIMUM WATER LEVEL=269.8m
SUCTION WELL MINIMUM WATER LEVEL=265.8m
MAX WATER LEVEL IN THE RECEIVING CHAMBER=300m
TEMPERATURE=30°C
VAPOR PRESSURE=0.0428bar
AVERAGE FLOW=3.0555555m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.61111111		1.22222222		1.8333333		2.4444444		3.0555555		3.6666667		4.2777777		4.8888888		5.4999999	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BUTTERFLY VALVE	6	0.46	1.2		0.54061492	0.04111366	1.081229848	0.16445464	1.6218448	0.37002294	2.1624597	0.65781856	2.70307462	1.0278415	3.2436895	1.480091759	3.78430447	2.014569339	4.324919391	2.631274239	4.86553432	3.330206459
2	HEADER TO LINE	1	1	1.2		0.54061492	0.014896254	1.081229848	0.059585014	1.6218448	0.134066283	2.1624597	0.238340058	2.70307462	0.37240634	3.2436895	0.53626513	3.78430447	0.729916427	4.324919391	0.953360231	4.86553432	1.206596543
3	90° BEND	5	0.3	1.2		0.54061492	0.02234438	1.081229848	0.089377522	1.6218448	0.201099424	2.1624597	0.357510087	2.70307462	0.55860951	3.2436895	0.804397695	3.78430447	1.094874641	4.324919391	1.430040347	4.86553432	1.809894814
4	REDUCER	2	0.5	1		0.77848549	0.030888872	1.556970981	0.123555486	2.3354565	0.277999844	3.113942	0.494221944	3.892427452	0.77222179	4.6709129	1.111999374	5.44939843	1.513554704	6.227883924	1.976887776	7.00636941	2.501998592
5	FLOW METER	1	0.5	1		0.77848549	0.015444436	1.556970981	0.061777743	2.3354565	0.138999922	3.113942	0.247110972	3.892427452	0.38611089	4.6709129	0.555999687	5.44939843	0.756777352	6.227883924	0.988443888	7.00636941	1.250999296
6	BUTTERFLY VALVE	1	0.46	1		0.77848549	0.014208881	1.556970981	0.056835524	2.3354565	0.127879928	3.113942	0.227342094	3.892427452	0.35522202	4.6709129	0.511519712	5.44939843	0.696235164	6.227883924	0.909368377	7.00636941	1.150919352
7	BUTTERFLY VALVE	1	0.46	1.2		0.54061492	0.006852277	1.081229848	0.027409107	1.6218448	0.06167049	2.1624597	0.109636427	2.70307462	0.17130692	3.2436895	0.24668196	3.78430447	0.335761557	4.324919391	0.438545706	4.86553432	0.55503441
8	INCREASER	1	0.5	1		0.77848549	0.015444436	1.556970981	0.061777743	2.3354565	0.138999922	3.113942	0.247110972	3.892427452	0.38611089	4.6709129	0.555999687	5.44939843	0.756777352	6.227883924	0.988443888	7.00636941	1.250999296
9	22.5° BEND	2	0.075	1.2		0.54061492	0.002234438	1.081229848	0.008937752	1.6218448	0.020109942	2.1624597	0.035751009	2.70307462	0.05586095	3.2436895	0.08043977	3.78430447	0.109487464	4.324919391	0.143004035	4.86553432	0.180989481
10	45° BEND	1	0.22	1.2		0.54061492	0.003277176	1.081229848	0.013108703	1.6218448	0.029494582	2.1624597	0.052434813	2.70307462	0.08192939	3.2436895	0.117978329	3.78430447	0.160581614	4.324919391	0.209739251	4.86553432	0.265451239
11	exit	1	1	1.2		0.54061492	0.014896254	1.081229848	0.059585014	1.6218448	0.134066283	2.1624597	0.238340058	2.70307462	0.37240634	3.2436895	0.53626513	3.78430447	0.729916427	4.324919391	0.953360231	4.86553432	1.206596543
12	TEE CONNECTION	7	0.5	1.2		0.54061492	0.052136888	1.081229848	0.208547551	1.6218448	0.469231989	2.1624597	0.834190203	2.70307462	1.30342219	3.2436895	1.876927956	3.78430447	2.554707495	4.324919391	3.33676081	4.86553432	4.2230879
13	PIPE (C=100)		120	1.2	12600	0.54061492	3.170355451	1.081229848	11.42913727	1.6218448	24.19815632	2.1624597	41.20206099	2.70307462	62.2590464	3.2436895	87.23439832	3.78430447	116.0217283	4.324919391	148.5335061	4.86553432	184.6956212
14	PIPE (C=140)		140	1.2	12600	0.54061492	2.383726343	1.081229848	8.593337876	1.6218448	18.19410586	2.1624597	30.97899895	2.70307462	46.8113218	3.2436895	65.58978527	3.78430447	87.23439832	4.324919391	111.6793485	4.86553432	138.8689137
FRICTION LOSS (C=120)							3.4040934		12.36408907		26.30179787		44.94186819		68.1024952		95.6489645		127.4748879		163.4927349		203.6283951
FRICTION LOSS (C=140)							2.617464292		9.528289675		20.2977474		34.71880614		52.6547705		74.00435146		98.68755785		126.6385773		157.8016877

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=120	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=120	C=140	C=120	C=140
2200.0	3.4	2.6	34.2	30.2		37.6	36.8	33.6	32.8
4400.0	12.4	9.5	34.2	30.2		46.6	43.7	42.6	39.7
6600.0	26.3	20.3	34.2	30.2		60.5	54.5	56.5	50.5
8800.0	44.9	34.7	34.2	30.2		79.1	68.9	75.1	64.9
11000.0	68.1	52.7	34.2	30.2		102.3	86.9	98.3	82.9
13200.0	95.6	74.0	34.2	30.2		129.8	108.2	125.8	104.2
15400.0	127.5	98.7	34.2	30.2		161.7	132.9	157.7	128.9
17600.0	163.5	126.6	34.2	30.2		197.7	160.8	193.7	156.8
19800.0	203.6	157.8	34.2	30.2		237.8	192.0	233.8	188.0

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.1222222		0.2444444		0.3666666		0.4888888		0.6111111		0.7333332		0.8555554		0.9777776		1.0999998	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.05	1.055		0.13988641	4.9868E-05	0.279772817	0.000199472	0.4196592	0.000448812	0.5595456	0.000797888	0.699432044	0.0012467	0.8393185	0.001795248	0.97920486	0.002443533	1.11909127	0.003191553	1.25897768	0.004039309
2	90° BEND	1	0.3	0.8		0.24327667	0.000904947	0.486553344	0.003619788	0.72983	0.008144524	0.9731067	0.014479153	1.21638336	0.02262368	1.45966	0.032578095	1.7029367	0.044342407	1.946213376	0.057916613	2.18949005	0.073300714
3	REDUCER	1	0.25	0.6		0.43249186	0.0023834	0.864983723	0.009533599	1.2974756	0.021450597	1.7299674	0.038134396	2.162459306	0.05958499	2.5949512	0.08580239	3.02744303	0.116786586	3.45993489	0.152537582	3.89242675	0.193055377
4	PIPE	1	120	0.8	11	0.24327667	0.001014079	0.486553344	0.003655755	0.72983	0.007740088	0.9731067	0.013179004	1.21638336	0.01991435	1.45966	0.027903033	1.7029367	0.037111027	1.946213376	0.047510333	2.18949005	0.059077246
5	EXIT	1	1	0.5		0.62278828	0.019768871	1.245576561	0.079075483	1.8683648	0.177919836	2.4911531	0.31630193	3.113941401	0.49422177	3.7367297	0.711679343	4.35951796	0.968674662	1.265207721	5.60509452	1.601278522	
6	90° BEND	1	0.3	0.5		0.62278828	0.005930661	1.245576561	0.023722645	1.8683648	0.053375951	2.4911531	0.094890579	3.113941401	0.14826653	3.7367297	0.213503803	4.35951796	0.290602398	4.982306242	0.379562316	5.60509452	0.480383557
7	CHECK VALVE	1	2.2	0.5		0.62278828	0.043491515	1.245576561	0.173966062	1.8683648	0.391423639	2.4911531	0.695864247	3.113941401	1.08728789	3.7367297	1.565694555	4.35951796	2.131084255	4.982306242	2.783456987	5.60509452	3.522812749
8	CONTROL VALVE	1	0.3	0.5		0.62278828	0.005930661	1.245576561	0.023722645	1.8683648	0.053375951	2.4911531	0.094890579	3.113941401	0.14826653	3.7367297	0.213503803	4.35951796	0.290602398	4.982306242	0.379562316	5.60509452	0.480383557
9	BUTTERFLY VALVE	1	0.46	0.5		0.62278828	0.00909368	1.245576561	0.036374722	1.8683648	0.081843124	2.4911531	0.145498888	3.113941401	0.22734201	3.7367297	0.327372498	4.35951796	0.445590344	4.982306242	0.581995552	5.60509452	0.73658812
10	PIPE	1	120	0.8	6	0.24327667	0.000553134	0.486553344	0.001994048	0.72983	0.004221866	0.9731067	0.007188548	1.21638336	0.01086237	1.45966	0.015219836	1.7029367	0.020242379	1.946213376	0.025914727	2.18949005	0.032223953
11	TEE-BRANCH TO LINE	1	1	0.5		0.62278828	0.019768871	1.245576561	0.079075483	1.8683648	0.177919836	2.4911531	0.31630193	3.113941401	0.49422177	3.7367297	0.711679343	4.35951796	0.968674662	4.982306242	1.265207721	5.60509452	1.601278522
TOTAL							0.108889687		0.434939701		0.977864224		1.737527142		2.71383858		3.906731948		5.316154651		6.942063422		8.784421625
PUMP SUCTION PIPE PRESSURE LOSS =															0.59759149								

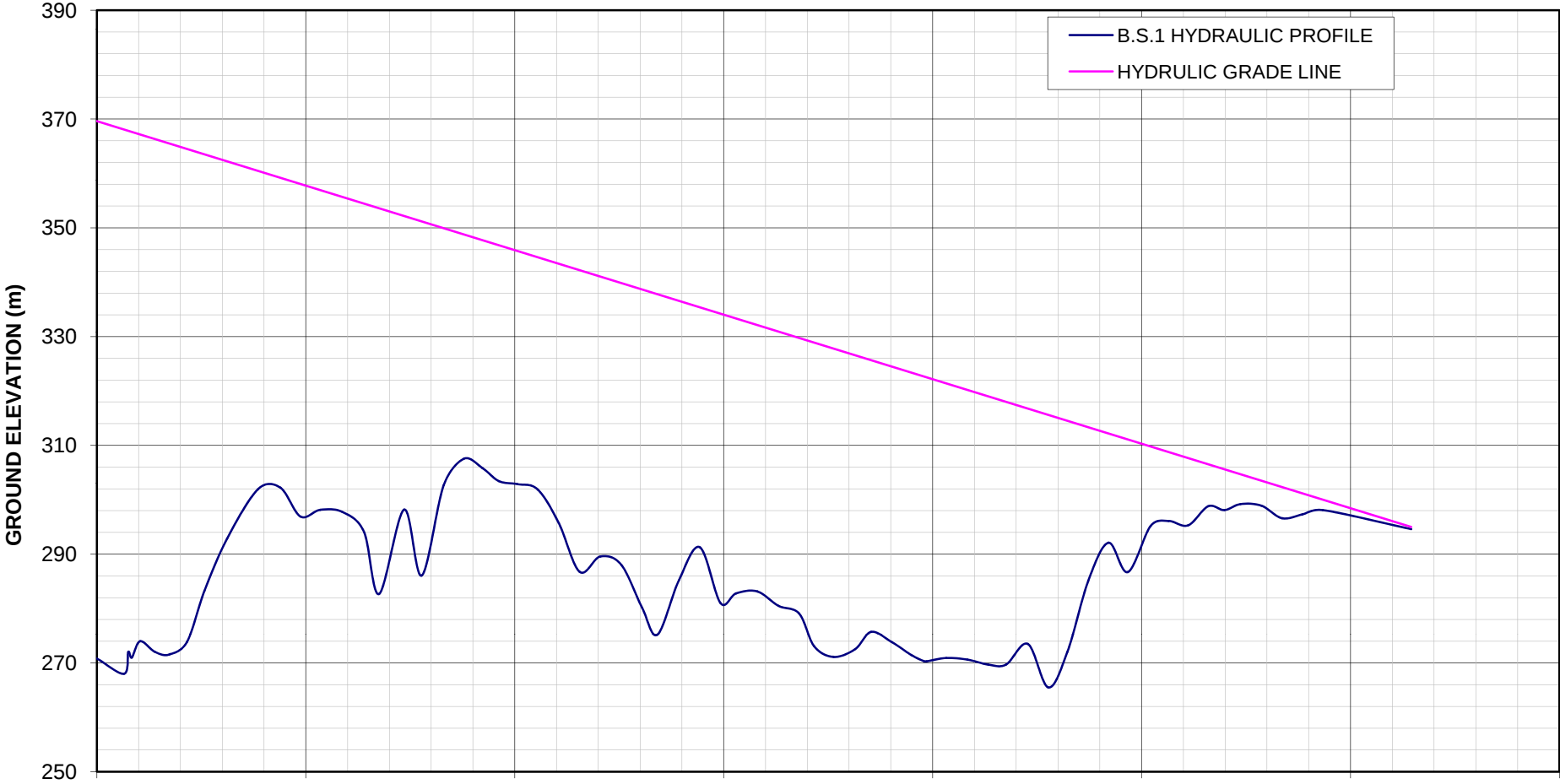
PUMP CHARACTERISTIC HEAD-CAPACITY CURVE		INDIVIDUAL PUMP HEAD LOSS (m)	PUMP MODIFIED HEAD (m)	PUMP CAPACITY PARALLEL COMBINATION			
Capacity (m3/hr)	Total Head (m)			2 PUMPS	3 PUMPS	4 PUMPS	5 PUMPS
440.0	124.3	0.1	124.2	880.0	1320.0	1760.0	2200.0
880.0	124.0	0.4	123.5	1760.0	2640.0	3520.0	4400.0
1320.0	123.0	1.0	122.0	2640.0	3960.0	5280.0	6600.0
1760.0	119.3	1.7	117.6	3520.0	5280.0	7040.0	8800.0
2200.0	114.6	2.7	111.9	4400.0	6600.0	8800.0	11000.0
2640.0	108.2	3.9	104.3	5280.0	7920.0	10560.0	13200.0
3080.0	100.7	5.3	95.3	6160.0	9240.0	12320.0	15400.0
3520.0	91.3	6.942063	84.4	7040.0	10560.0	14080.0	17600.0
3960.0	80.3	8.784422	71.5	7920.0	11880.0	15840.0	19800.0

NET POSITIVE SUCTION HEAD av.= 5.598728515 m

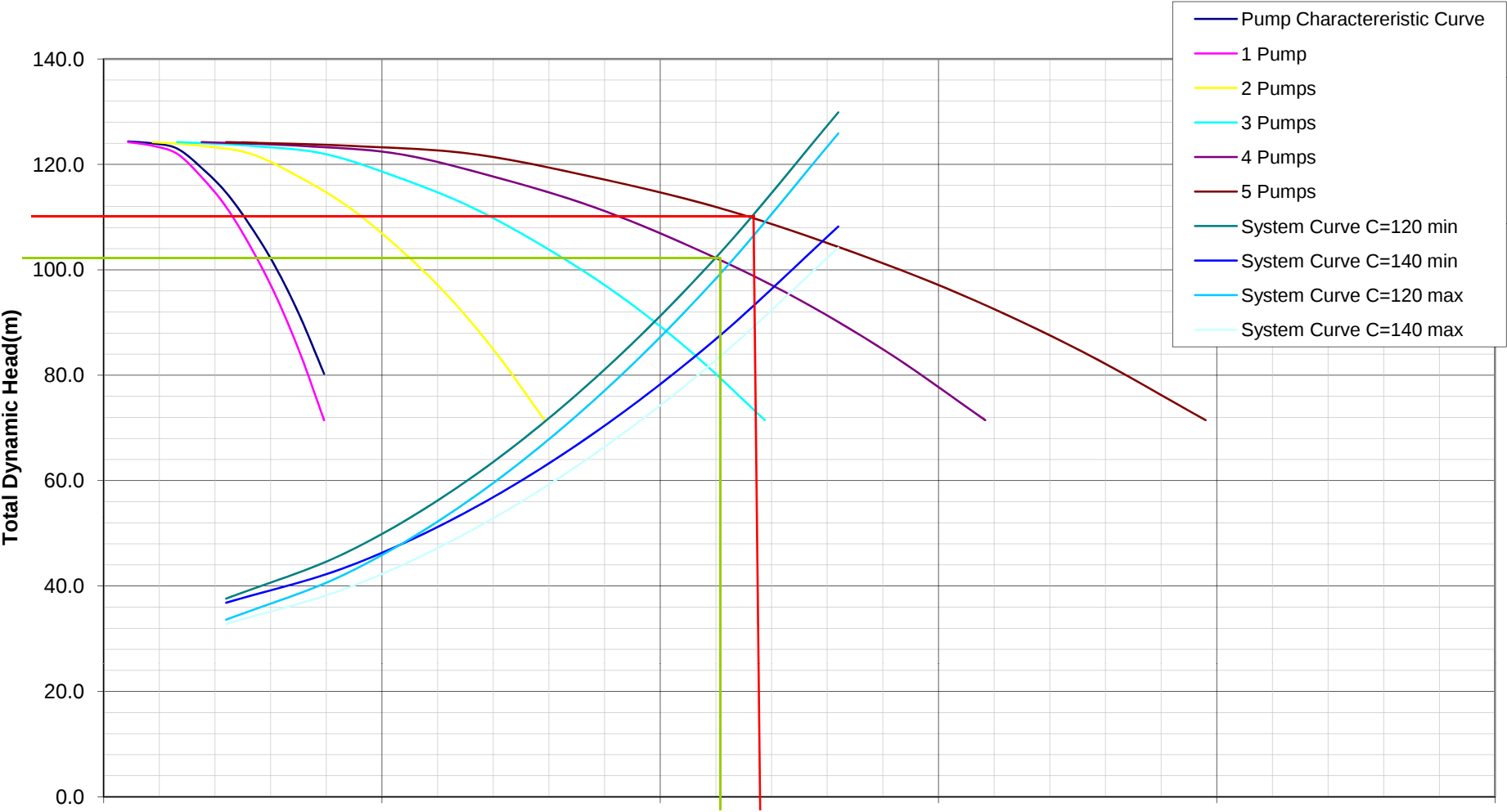
TOATL DYNAMIC HEAD

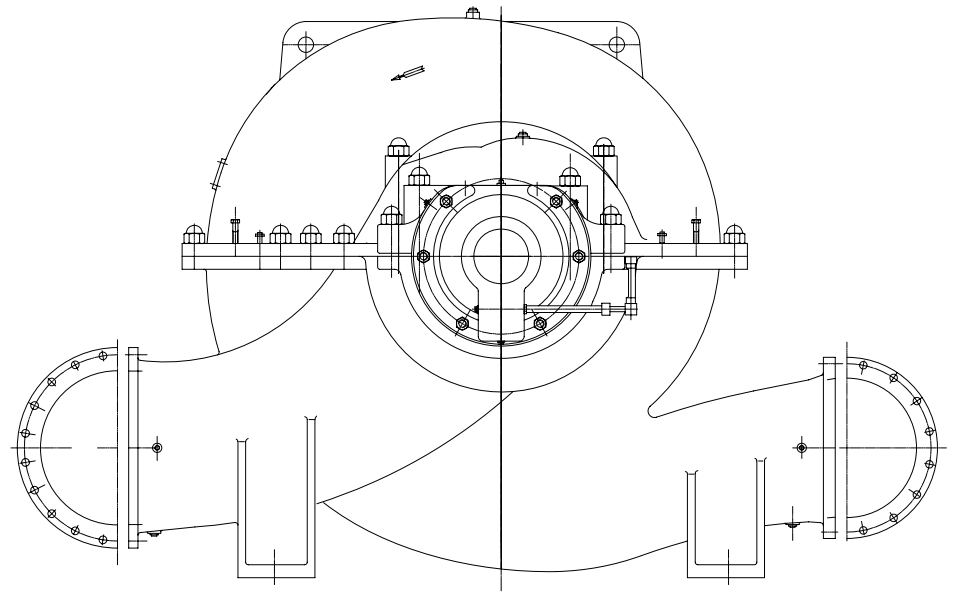
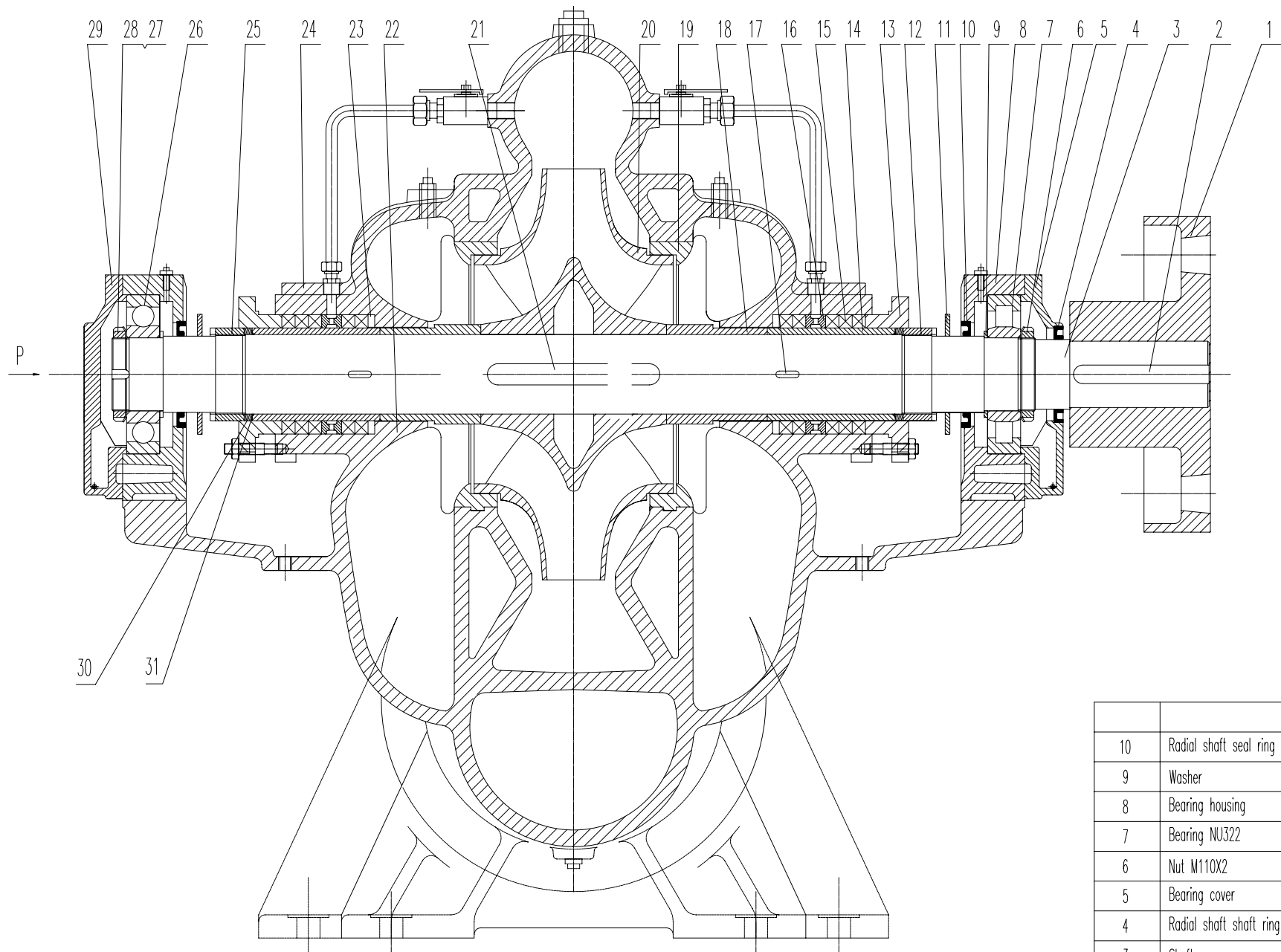
POINTS	STATION	TDH (m)
POINT A	0	369.6
POINT B	12580.6	295

HIGH LIFT PUMP TO B.S.1 HYDRAULIC PROFILE



High Lift Pump Model 500-400-620





						31	O-ring 120X3.55	2
10	Radial shaft seal ring PD115X160X14	2	20	Impeller	1	30	Sleeve	2
9	Washer	2	19	Wear ring	2	29	Bearing cover	1
8	Bearing housing	2	18	Sleeve for impeller	2	28	Washer 110	2
7	Bearing NU322	1	17	Key 10X35	2	27	Nut M110X2	1
6	Nut M110X2	1	16	Lantern ring	2	26	Bearing 6322	1
5	Bearing cover	1	15	Packing 20X20X505	10	25	Nut	1
4	Radial shaft shaft ring PD105X145X14	1	14	Shaft sleeve	2	24	Upper casing	1
3	Shaft	1	13	Gland packing	2	23	Neck ring	2
2	Key C28X200	1	12	Nut	1	22	Lower casing	1
1	Coupling	1	11	Washer	2	21	Key 32X260	1
Part No.	Part Name	Qty	Part No.	Part Name	Qty	Part No.	Part Name	Qty

drawn			
checked			
approved			
	name	signature	date
scale	NTS	date	January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK HLP - BS1 PUMPING STATION	
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-500-400-620	sheet no.

Process Systems, inc

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MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL



drg. no.
sheet no.

PERFORMANCE TEST RECORD FOR PUMP

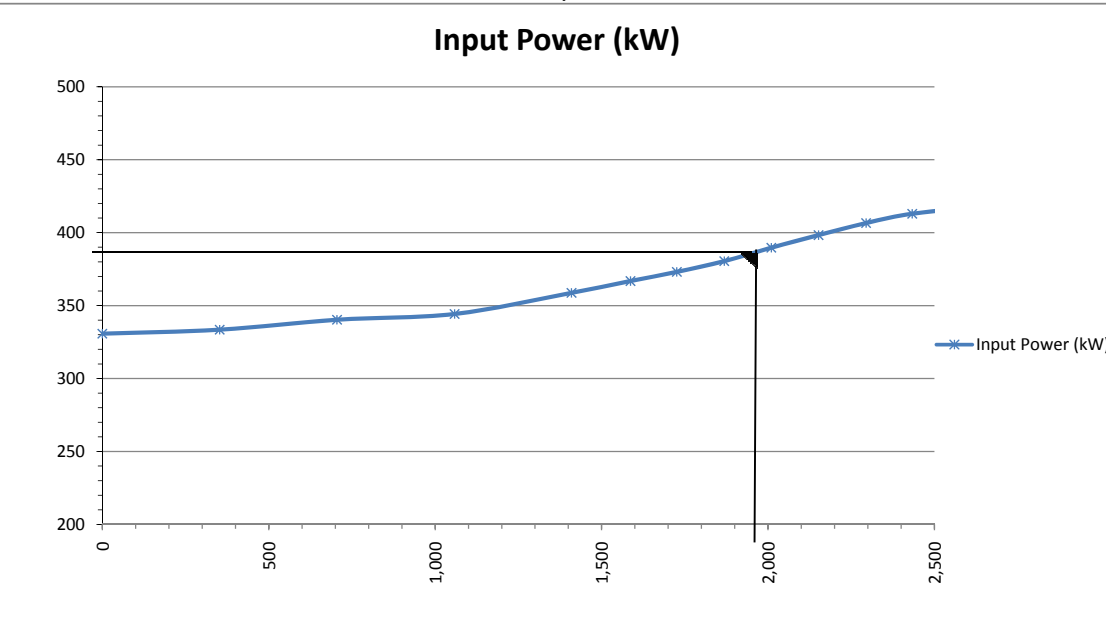
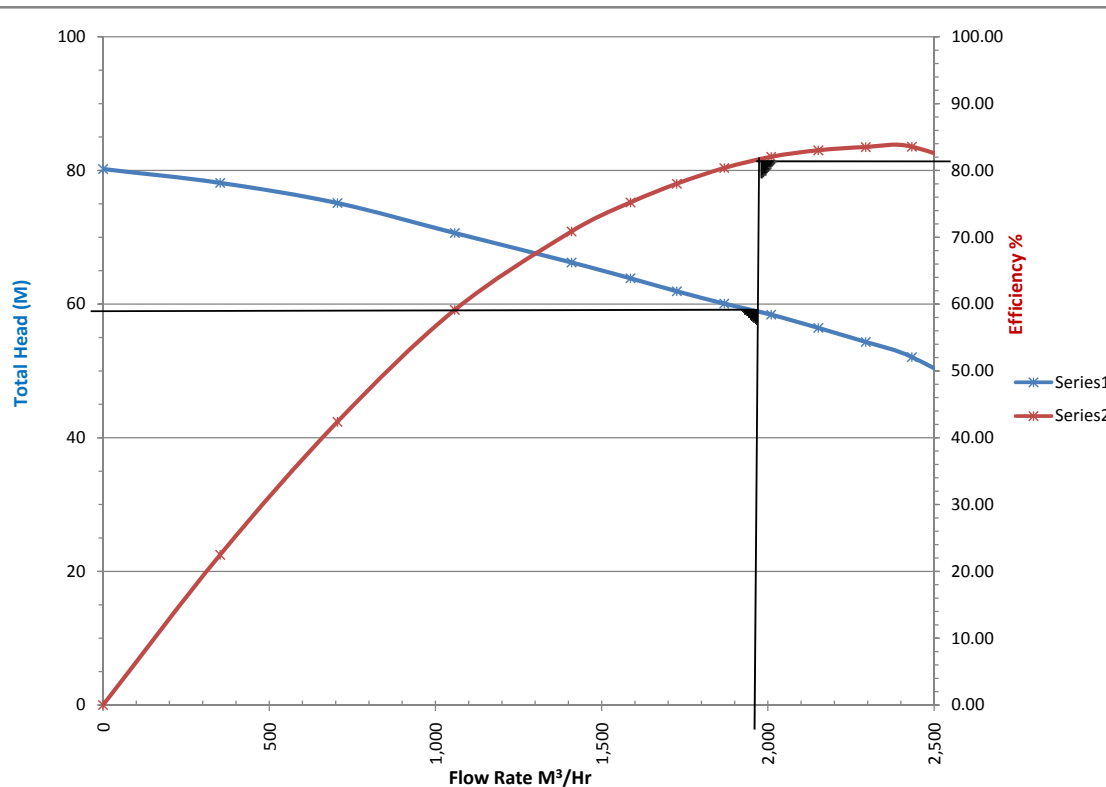
Test No: S2009010

Type of pump: PSI-400-350-510

n	THE MEASURED VALUES							
	Flow Rate		Out. Press (MPa)	Inl. Press. (MPa)	Head (m)	Vel. Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)						
1	00.00	0.00	0.8200	-0.0090	84.53	0.00	1496.0	2296.3799
2	100.07	360.25	0.7980	-0.0100	82.39	0.07	1497.0	2318.5200
3	200.21	720.76	0.7630	-0.0117	79.00	0.28	1497.0	2365.5901
4	300.48	1081.73	0.7100	-0.0149	73.92	0.63	1497.0	2393.3701
5	400.22	1440.79	0.6550	-0.0195	68.78	1.12	1497.0	2493.9399
6	450.51	1621.84	0.6250	-0.0220	65.98	1.42	1497.0	2549.8799
7	490.08	1764.29	0.6000	-0.0244	63.67	1.68	1497.0	2593.7000
8	530.24	1908.86	0.5750	-0.0268	61.37	1.96	1496.0	2641.4500
9	570.28	2053.01	0.5520	-0.0295	59.30	2.27	1496.0	2705.4399
10	610.53	2197.91	0.5250	-0.0327	56.87	2.60	1496.0	2765.1299
11	650.64	2342.30	0.4960	-0.0358	54.23	2.95	1495.0	2818.9700
12	690.45	2485.62	0.4670	-0.0386	51.56	3.33	1496.0	2867.0901
13	760.31	2737.12	0.3860	-0.0442	43.87	4.03	1495.0	2904.0000
n	THE CALCULATED VALUES				Correction to n _{sp} = 1450 r/min			
	Flow Rate	Total Head	Hydr. Power	Input Power	Flow Rate	Total Head	Input Power	Efficiency
	(m ³ /h)	(m)	(kW)	(kW)	(m ³ /h)	(m)	(KW)	(%)
1	0.00	84.53	0.00	359.66	0.00	80.21	330.78	00.00
2	360.25	82.46	80.90	363.37	352.43	78.14	333.51	22.48
3	720.76	79.28	155.61	370.75	705.11	75.12	340.28	42.39
4	1081.73	74.55	219.61	375.10	1058.25	70.64	344.28	59.14
5	1440.79	69.90	274.26	390.87	1409.52	66.24	358.74	70.87
6	1621.84	67.39	297.65	399.63	1586.63	63.86	366.79	75.22
7	1764.29	65.35	313.97	406.50	1725.99	61.92	373.09	78.01
8	1908.86	63.33	329.20	413.71	1868.67	60.08	380.48	80.37
9	2053.01	61.57	344.21	423.73	2009.78	58.42	389.69	82.04
10	2197.91	59.47	355.96	433.08	2151.63	56.43	398.29	83.01
11	2342.30	57.18	364.75	441.22	2294.52	54.33	406.59	83.50
12	2485.62	54.88	371.50	449.05	2433.28	52.08	412.98	83.56
13	2737.12	47.90	357.05	454.53	2681.28	45.51	418.85	79.34
Not e	Flow Coefficient: 250.0000 1/L Potential difference between inl. and out. 0 m Diameter, of the outlet Pipe: 0.350 m Diameter, of the inlet Pipe: 0.400 m Test Date: 2009. 6.20 Test Time: 01:00 am							

Flow Rate (M ³ /Hr)	Total Head (M)	Efficiency (%)
0.00	80.21	0.00
352.43	78.14	22.48
705.11	75.12	42.39
1058.25	70.64	59.14
1409.52	66.24	70.87
1586.63	63.86	75.22
1725.99	61.92	78.01
1868.67	60.08	80.37
2009.78	58.42	82.04
2151.63	56.43	83.01
2294.52	54.33	83.50
2433.28	52.08	83.56
2681.28	45.51	79.34

Flow Rate (M ³ /Hr)	Input Power (kW)
0.00	330.78
352.43	333.51
705.11	340.28
1058.25	344.28
1409.52	358.74
1586.63	366.79
1725.99	373.09
1868.67	380.48
2009.78	389.69
2151.63	398.29
2294.52	406.59
2433.28	412.98
2681.28	418.85



ISO 2548-C

Established Duty Point:

Flow : 1965 M³/hr
Head : 58.95 Meter
Efficiency : 81 %
Power : 387 kW
RPM : 1450

Test Number: S2009010
Test Date: 20 June 2009
Pump Model: 400-350-510
Horizontal Split Case
Duty Impeller Dia: 475 mm
Max. Impeller Dia: 520 mm

Comments:

Pump Test Sheet

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CAVITATION TEST RECORDS FOR PUMP

Test No: S2009010

Type of pump: PSI-400-350-510

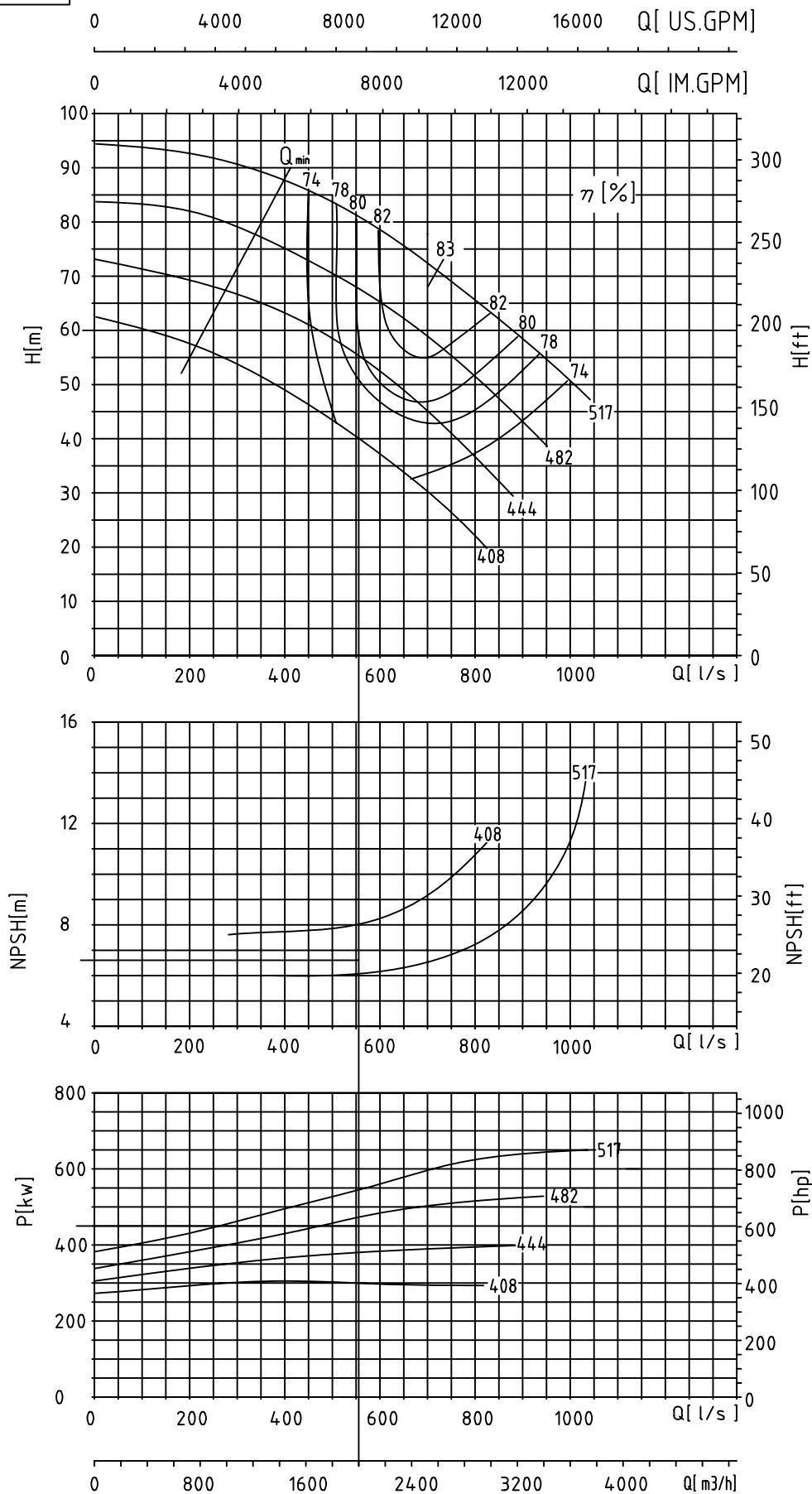
n	THE MEASURED VALUES							
	Flow Rate		Out. Press.	Inl. Press	Head (m)	Vel. Head (m)	Speed (r/min)	Torque (N.m)
	(L/s)	(m ³ /h)	(MPa)	(MPa)				
1	571.76	2058.34	0,5540	-0.0287	59.42	2.28	1496.0	2709.24
2	569.10	2048.76	0,5460	-0.0330	59.04	2.26	1496.0	2708.22
3	567.61	2043.40	0.5420	-0.0355	58.89	2.25	1497.0	2696.40
4	565.43	2035.55	0.5350	-0.0397	58.60	2.23	1496.0	2698.62
5	563.09	2027.12	0.5320	-0.0410	58.43	2.21	1496.0	2682.84
6	561.04	2019.74	0.5280	-0.0437	58.30	2.20	1496.0	2679.34
7	562.26	2024.14	0.5240	-0.0465	58.17	2.21	1497.0	2668.99
8	563.27	2027.77	0.5190	-0.0488	57.90	2.21	1496.0	2666.51
9	560.90	2019.24	0.5120	-0.0514	57.45	2.19	1496.0	2659.50
10	549.16	1976.98	0.4930	-0.0535	55.73	2.10	1496.0	2624.49
11	542.30	1952,28	0.4720	-0.0546	53.70	2.05	1496.0	2588.39
12	524.35	1887,66	0.4380	-0.0560	50.37	1.92	1497.0	2495.27
n	THE CALCULATED VALUES				Correction to n _{sp} = 1450 r/min			
	Flow Rate (m ³ /h)	Total Head (m)	NPSH (m)	Input Power (kW)	Flow Rate (m ³ /h)	Total Head (m)	Input Power (kW)	NPSH (m)
1	2058.34	61.70	8.22	424.33	1995.04	57.96	386.37	7.73
2	2048.76	61.30	7.77	424.17	1985.76	57.59	386.23	7.30
3	2043.40	61.14	7.51	422.60	1979.24	57.36	384.03	7.05
4	2035.55	60.83	7.08	422.66	1972.96	57.15	384.86	6.65
5	2027.12	60.64	6.94	420.19	1964.79	56.97	382.61	6.52
6	2019.74	60.49	6.65	419.64	1957.64	56.83	382.11	6.25
7	2024.14	60.38	6.37	418.30	1960.59	56.65	380.13	5.98
8	2027.77	60.11	6.14	417.63	1965.42	56.47	380.28	5.77
9	2019.24	59.65	5.87	416.54	1957.15	56.03	379.28	5.51
10	1976.98	57.83	5.61	411.05	1916.19	54.33	374.29	5.27
11	1952.28	55.75	5.48	405.40	1892.25	52.37	369.14	5.14
12	1887.66	52.29	5.27	391.07	1828.39	49.06	355.38	4.95
Note	Flow Coefficient: 250.0000 1/L Potential difference between inl. and out. 0 m Diameter, of the outlet Pipe: 0.400 m Diameter, of the inlet Pipe: 0.350 m Test Date: 2009. 6.20 Test Time: 02:00 am							



PUMP DATA SHEET						
Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.400-350-510
1	Customer	El Concorde Construction Ltd.		Station No.	High Lift to BS2	
2	Location	Mosul - Iraq		Req. Qty.	4 Set + 1 Set Spare	
3	Project	Mosul Water Scheme		Duty	2 Set	
4	Ref. No.	MSL		Stand By	2 Set	
PUMP SPECIFICATIONS						
5	Pump Type	Horizontal Split Case		Capacity	2000 M ³ /Hr	
6	Stages	1		TDH	60 mtr	
7	Liquid	Water		Eff.	81%	
8	Temp.	Ambient		Shaft P.	450 Kw	
9	NPSHA	Flooded		Motor P.	500 Kw	
10	NPSHR	6.70 mtr		Speed	1450 RPM	
11	Suction	400 mm (PN-16)		Rotation	CW	
12	Discharge	300 mm (PN-16)		Duty Imp.	467 mm	
13	Weight	App. 1680 Kg		Max Imp.	517 mm	
MATERIALS				ACCESSORIES		
14	Casing	Ductile GGG60		Base Plate	Included	
15	Impeller	Alum Bronze		Flex Coplg	Included	
16	Shaft	SS420		O&M	Included	
17	Sh. Sleeve	SS 1.4300		Docs.	1.Layout Dimensional	
18	Sh. Couplg	CS TPD6-2100		Docs.	Ref: MXT-131F	
19	Bearing	SKF		Docs.	3.Performance Curve	
20	Seal	Stuffing		Docs.	4.Data Sheet	
DRIVER SPECIFICATIONS						
21	Driver	Electric Motor		Voltage	400V/50Hz/3Ph	
22	Mfg.	EC / USA		Protection	IP-55	
23	Type	Squirrel Cage Induction		Insulation	Class F	
24	Rated	500 Kw		Starting	Star Delta	
25	Speed	1450 RPM		Weight	App. 3300 Kg	
FINISHING & PAINT						
26	Prep.	Gritt Blasting		Test	Hydostatic 24 Bars	
27	Primer	100 micron		Test	Dimensional Tolerances	
28	Final	Epoxy Blue 200 micron		Test	DFT (Dry Film Thickness)	
Revisions						
29	Rev O	21-Aug-08		Rev B		
30	Rev A	25-Jan-09		Rev C		

1450 r/min

No: 9046



Process Systems, inc
A RUTHMAN COMPANY

23633 Elmwood - Warren, MI 48091
Phone: (586) 757-5711 Fax: (586) 758-6996

drawn				signature	date
checked					
approved					
scale	NTS			date	August 2008

drg. no.

MXT-9046

CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS

PROJECT MOSUL WATER SCHEME RIGHT BANK
HIGH LIFT PUMPING STATION TO BS2

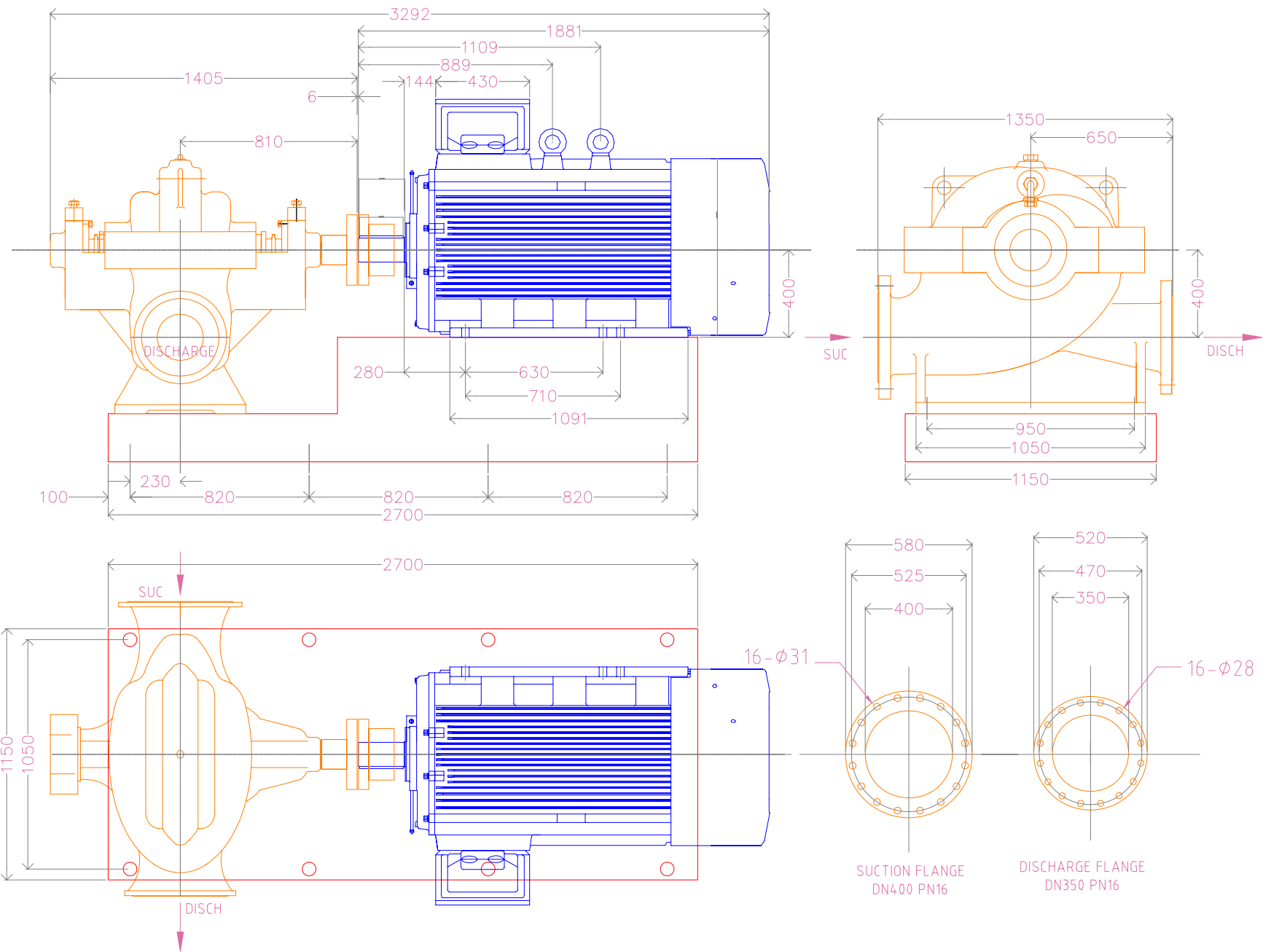
Drg. title

PUMP PERFORMANCE CURVE

MODEL PSI-400-350-510

sheet no.

8



QTY = 5

drawn			
checked			
approved			
name	signature	date	
scale	NTS	date	January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT	MOSUL WATER SCHEME RIGHT BANK HLP-BS2 PUMPING STATION
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-400-350-510

drg. no.	MXT-131F
sheet no.	

Pumps Calculations

High Lift Pump to B.S.2

TOTAL HEAD =60m
CAPACITY/PUMP=2000m3/hr

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH)\gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

LOW LIFT PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =263.8m
FLOOR LEVEL OF PUMP STATION=267.3m
SUCTION WELL MAXIMUM WATER LEVEL=269.8m
SUCTION WELL MINIMUM WATER LEVEL=265.8m
HIGHEST POINT LEVEL POINT C @STATION 3+513 m=307.55m
TEMPERATURE=30°C
VAPOR PRESSURE=0.0428bar
AVERAGE FLOW=1.1111111m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.22222222		0.44444444		0.6666667		0.8888889		1.1111111		1.3333333		1.55555554		1.77777776		1.99999998	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BUTTERFLY VALVE	3	0.46	0.9		0.34948843	0.008591039	0.698976866	0.034364156	1.0484653	0.077319352	1.3979537	0.137456626	1.747442164	0.21477598	2.0969306	0.309277408	2.44641903	0.420960916	2.795907462	0.549826503	3.1453959	0.695874167
2	HEADER TO LINE	1	1	0.9		0.34948843	0.006225391	0.698976866	0.024901563	1.0484653	0.056028516	1.3979537	0.09960625	1.747442164	0.15563477	2.0969306	0.224114064	2.44641903	0.305044142	2.795907462	0.398425002	3.1453959	0.504256643
3	90° BEND	3	0.3	0.9		0.34948843	0.005602852	0.698976866	0.022411406	1.0484653	0.050425664	1.3979537	0.089645625	1.747442164	0.14007129	2.0969306	0.201702657	2.44641903	0.274539728	2.795907462	0.358582502	3.1453959	0.453830979
4	REDUCER	2	0.5	0.8		0.4423213	0.009971872	0.884642596	0.039887488	1.3269639	0.089746849	1.7692852	0.159549953	2.211606489	0.2492968	2.6539278	0.358987395	3.09624908	0.488621733	3.538570382	0.638199814	3.98089168	0.80772164
5	FLOW METER	1	0.5	0.8		0.4423213	0.004985936	0.884642596	0.019943744	1.3269639	0.044873424	1.7692852	0.079774977	2.211606489	0.1246484	2.6539278	0.179493698	3.09624908	0.244310866	3.538570382	0.319099907	3.98089168	0.40386082
6	BUTTERFLY VALVE	1	0.46	0.8		0.4423213	0.004587061	0.884642596	0.018348245	1.3269639	0.04128355	1.7692852	0.073392979	2.211606489	0.11467653	2.6539278	0.165134202	3.09624908	0.224765997	3.538570382	0.293571914	3.98089168	0.371551954
7	BUTTERFLY VALVE	1	0.46	0.8		0.4423213	0.004587061	0.884642596	0.018348245	1.3269639	0.04128355	1.7692852	0.073392979	2.211606489	0.11467653	2.6539278	0.165134202	3.09624908	0.224765997	3.538570382	0.293571914	3.98089168	0.371551954
8	INCREASER	1	0.5	0.9		0.34948843	0.003112695	0.698976866	0.012450781	1.0484653	0.028014258	1.3979537	0.049803125	1.747442164	0.07781738	2.0969306	0.112057032	2.44641903	0.152522071	2.795907462	0.199212501	3.1453959	0.252128322
9	22.5° BEND	5	0.075	0.9		0.34948843	0.002334521	0.698976866	0.009338086	1.0484653	0.021010693	1.3979537	0.037352344	1.747442164	0.05836304	2.0969306	0.084042774	2.44641903	0.114391553	2.795907462	0.149409376	3.1453959	0.189096241
10	45° BEND	5	0.22	0.9		0.34948843	0.00684793	0.698976866	0.027391719	1.0484653	0.061631367	1.3979537	0.109566876	1.747442164	0.17119824	2.0969306	0.24652547	2.44641903	0.335548556	2.795907462	0.438267502	3.1453959	0.554682307
11	exit	1	1	0.9		0.34948843	0.006225391	0.698976866	0.024901563	1.0484653	0.056028516	1.3979537	0.09960625	1.747442164	0.15563477	2.0969306	0.224114064	2.44641903	0.305044142	2.795907462	0.398425002	3.1453959	0.504256643
12	TEE CONNECTION	5	0.5	0.9		0.34948843	0.015563477	0.698976866	0.062253907	1.0484653	0.14007129	1.3979537	0.249015626	1.747442164	0.38908692	2.0969306	0.560285159	2.44641903	0.762610355	2.795907462	0.996062505	3.1453959	1.260641608
13	PIPE (C=120)		120	0.9	3513	0.34948843	0.551730385	0.698976866	1.98898906	1.0484653	4.211154969	1.3979537	7.17030924	1.747442164	10.8348128	2.0969306	15.18122145	2.44641903	20.19102081	2.795907462	25.84897808	3.1453959	32.14219598
14	PIPE (C=140)		140	0.9	3513	0.34948843	0.414834953	0.698976866	1.495480772	1.0484653	3.166282516	1.3979537	5.39121095	1.747442164	8.14647726	2.0969306	11.41445433	2.44641903	15.18122145	2.795907462	19.43532545	3.1453959	24.16706911
FRICTION LOSS (C=120)							0.630365611		2.303529962		4.918871999		8.428472851		12.8006934		18.01208958		24.04414686		30.88163252		38.51164926
FRICTION LOSS (C=140)							0.493470178		1.810021675		3.873999547		6.649374561		10.1123579		14.24532245		19.03434751		24.46797989		30.53652239

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=120	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=120	C=140	C=120	C=140
800.0	0.6	0.5	41.8	37.8		42.4	42.2	38.4	38.2
1600.0	2.3	1.8	41.8	37.8		44.1	43.6	40.1	39.6
2400.0	4.9	3.9	41.8	37.8		46.7	45.6	42.7	41.6
3200.0	8.4	6.6	41.8	37.8		50.2	48.4	46.2	44.4
4000.0	12.8	10.1	41.8	37.8		54.6	51.9	50.6	47.9
4800.0	18.0	14.2	41.8	37.8		59.8	56.0	55.8	52.0
5600.0	24.0	19.0	41.8	37.8		65.8	60.8	61.8	56.8
6400.0	30.9	24.5	41.8	37.8		72.6	66.2	68.6	62.2
7200.0	38.5	30.5	41.8	37.8		80.3	72.3	76.3	68.3

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.11111111		0.22222222		0.3333333		0.4444444		0.5555555		0.6666667		0.7777777		0.8888888		0.9999999	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.05	0.945		0.15849816	6.40206E-05	0.316996311	0.000256082	0.4754945	0.000576185	0.6339926	0.001024329	0.792490777	0.00160051	0.9509889	0.00230474	1.10948709	0.003137007	1.267985244	0.004097315	1.4264834	0.005185665
2	90° BEND	1	0.3	0.7		0.28886289	0.001275868	0.577725777	0.005103472	0.8665887	0.011482812	1.1554516	0.020413888	1.444314442	0.0318967	1.7331773	0.045931249	2.02204022	0.062517533	2.310903107	0.081655553	2.599766	0.103345309
3	REDUCER	1	0.25	0.5		0.56617126	0.004084479	1.132342522	0.016337915	1.6985138	0.036760309	2.264685	0.065351661	2.830856306	0.10211197	3.3970276	0.147041237	3.96319883	0.200139462	4.529370089	0.261406644	5.09554135	0.330842784
4	PIPE	1	120	0.7	11	0.28886289	0.001628329	0.577725777	0.005870128	0.8665887	0.012428434	1.1554516	0.021161822	1.444314442	0.03197692	1.7331773	0.044804526	2.02204022	0.059590009	2.310903107	0.076288408	2.599766	0.09486166
5	EXIT	1	1	0.5		0.56617126	0.016337915	1.132342522	0.065351661	1.6985138	0.147041237	2.264685	0.261406644	2.830856306	0.40844788	3.3970276	0.588164949	3.96319883	0.800557847	4.529370089	1.045626575	5.09554135	1.323371134
6	90° BEND	1	0.3	0.5		0.56617126	0.004901375	1.132342522	0.019605498	1.6985138	0.044112371	2.264685	0.078421993	2.830856306	0.12253436	3.3970276	0.176449485	3.96319883	0.240167354	4.529370089	0.313687973	5.09554135	0.39701134
7	CHECK VALVE	1	2.2	0.5		0.56617126	0.035943414	1.132342522	0.143773654	1.6985138	0.323490722	2.264685	0.575094616	2.830856306	0.89858534	3.3970276	1.293962887	3.96319883	1.761227263	4.529370089	2.300378465	5.09554135	2.911416495
8	CONTROL VALVE	1	0.3	0.5		0.56617126	0.004901375	1.132342522	0.019605498	1.6985138	0.044112371	2.264685	0.078421993	2.830856306	0.12253436	3.3970276	0.176449485	3.96319883	0.240167354	4.529370089	0.313687973	5.09554135	0.39701134
9	BUTTERFLY VALVE	1	0.46	0.5		0.56617126	0.007515441	1.132342522	0.030061764	1.6985138	0.067638969	2.264685	0.120247056	2.830856306	0.18788603	3.3970276	0.270555876	3.96319883	0.368256609	4.529370089	0.480988225	5.09554135	0.608750722
10	PIPE	1	120	0.5	6	0.56617126	0.004567786	1.132342522	0.016466879	1.6985138	0.034864233	2.264685	0.059363128	2.830856306	0.08970162	3.3970276	0.125685624	3.96319883	0.167161849	4.529370089	0.214004186	5.09554135	0.266105858
11	TEE-BRANCH TO LINE	1	1	0.5		0.56617126	0.016337915	1.132342522	0.065351661	1.6985138	0.147041237	2.264685	0.261406644	2.830856306	0.40844788	3.3970276	0.588164949	3.96319883	0.800557847	4.529370089	1.045626575	5.09554135	1.323371134
TOTAL							0.097557917		0.387784213		0.86954888		1.542313775		2.40572358		3.459515006		4.703480133		6.137447892		7.761273442

PUMP SUCTION LINE PRESSURE LOSS = 0.57603398

PUMP CHARACTERISTIC HEAD-CAPACITY CURVE		INDIVIDUAL PUMP HEAD LOSS (m)		PUMP MODIFIED HEAD (m)		PUMP CAPACITY PARALLEL COMBINATION	
Capacity (m3/hr)	Total Head (m)					2 PUMPS	
400.0	75.1	0.1		75.0		800.0	
800.0	72.8	0.4		72.4		1600.0	
1200.0	69.8	0.9		68.9		2400.0	
1600.0	65.6	1.5		64.1		3200.0	
2000.0	60.0	2.4		57.6		4000.0	
2400.0	52.8	3.5		49.3		4800.0	
2800.0	44.0	4.7		39.3		5600.0	
3200.0	34.2	6.137448		28.0		6400.0	

Pumps Calculations

High Lift Pump to B.S.2

TOTAL HEAD =60m
CAPACITY/PUMP=2000m3/hr

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH)\gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

LOW LIFT PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =	263.8	m
FLOOR LEVEL OF PUMP STATION=	267.3	m
SUCTION WELL AVERAGE WATER LEVEL=	267.8	m
SUCTION WELL MINIMUM WATER LEVEL=	265.8	m
HIGHEST POINT LEVEL POINT C @ STATION 3+513 m	307.55	m
TEMPERATURE=	30	°C
VAPOR PRESSURE=	0.0428	bar
AVERAGE FLOW=	1.11111111	m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.22222222		0.44444444		0.6666667		0.8888889		1.1111111		1.3333333		1.55555554		1.77777776		1.99999998			
ITEM	VALVES &FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BUTTERFLY VALVE	4	0.46	0.9		0.34948843	0.011454719	0.698976866	0.045818875	1.0484653	0.103092469	1.3979537	0.183275501	1.747442164	0.28636797	2.0969306	0.412369877	2.44641903	0.561281222	2.795907462	0.733102004	3.1453959	0.927832223		
2	HEADER TO LINE	1	1	0.9		0.34948843	0.006225391	0.698976866	0.024901563	1.0484653	0.056028516	1.3979537	0.09960625	1.747442164	0.15563477	2.0969306	0.224114064	2.44641903	0.305044142	2.795907462	0.398425002	3.1453959	0.504256643		
3	90° BEND	3	0.3	0.8		0.4423213	0.008974685	0.884642596	0.03589874	1.3269639	0.080772164	1.7692852	0.143594958	2.211606489	0.22436712	2.6539278	0.323088656	3.09624908	0.439759559	3.538570382	0.574379833	3.98089168	0.726949476		
4	REDUCER	2	0.5	0.8		0.4423213	0.009971872	0.884642596	0.039887488	1.3269639	0.089746849	1.7692852	0.159549953	2.211606489	0.2492968	2.6539278	0.358987395	3.09624908	0.488621733	3.538570382	0.638199814	3.98089168	0.80772164		
5	FLOW METER	1	0.5	0.8		0.4423213	0.004985936	0.884642596	0.019943744	1.3269639	0.044873424	1.7692852	0.079774977	2.211606489	0.1246484	2.6539278	0.179493698	3.09624908	0.244310866	3.538570382	0.319099907	3.98089168	0.40386082		
6	BUTTERFLY VALVE	1	0.46	0.8		0.4423213	0.004587061	0.884642596	0.018348245	1.3269639	0.04128355	1.7692852	0.073392979	2.211606489	0.11467653	2.6539278	0.165134202	3.09624908	0.224765997	3.538570382	0.293571914	3.98089168	0.371551954		
7	BUTTERFLY VALVE	1	0.46	0.8		0.4423213	0.004587061	0.884642596	0.018348245	1.3269639	0.04128355	1.7692852	0.073392979	2.211606489	0.11467653	2.6539278	0.165134202	3.09624908	0.224765997	3.538570382	0.293571914	3.98089168	0.371551954		
8	INCREASER	1	0.5	0.9		0.34948843	0.003112695	0.698976866	0.012450781	1.0484653	0.028014258	1.3979537	0.049803125	1.747442164	0.07781738	2.0969306	0.112057032	2.44641903	0.152522071	2.795907462	0.199212501	3.1453959	0.252128322		
9	22.5° BEND	2	0.075	0.9		0.34948843	0.000933809	0.698976866	0.003735234	1.0484653	0.008404277	1.3979537	0.014940938	1.747442164	0.02334521	2.0969306	0.03361711	2.44641903	0.045756621	2.795907462	0.05976375	3.1453959	0.075638496		
10	45° BEND	1	0.22	0.9		0.34948843	0.001369586	0.698976866	0.005478344	1.0484653	0.012326273	1.3979537	0.021913375	1.747442164	0.03423965	2.0969306	0.049305094	2.44641903	0.067109711	2.795907462	0.0876535	3.1453959	0.110936461		
11	exit	1	1	0.9		0.34948843	0.006225391	0.698976866	0.024901563	1.0484653	0.056028516	1.3979537	0.09960625	1.747442164	0.15563477	2.0969306	0.224114064	2.44641903	0.305044142	2.795907462	0.398425002	3.1453959	0.504256643		
12	TEE CONNECTION	2	0.5	0.9		0.34948843	0.006225391	0.698976866	0.024901563	1.0484653	0.056028516	1.3979537	0.09960625	1.747442164	0.15563477	2.0969306	0.224114064	2.44641903	0.305044142	2.795907462	0.398425002	3.1453959	0.504256643		
13	PIPE (C=120)		120	0.9	3513	0.34948843	0.551730385	0.698976866	1.98898906	1.0484653	4.211154969	1.3979537	7.17030924	1.747442164	10.8348128	2.0969306	15.18122145	2.44641903	20.19102081	2.795907462	25.84897808	3.1453959	32.14219598		
14	PIPE (C=140)		140	0.9	3513	0.34948843	0.414834953	0.698976866	1.495480772	1.0484653	3.166282516	1.3979537	5.39121095	1.747442164	8.14647726	2.0969306	11.41445433	2.44641903	15.18122145	2.795907462	19.43532545	3.1453959	24.16706911		
FRICTION LOSS (C=120)							0.620383981		2.263603444		4.829037333		8.268766776		12.5511527		17.65275091		23.55504701		30.24280822		37.70313726		
FRICTION LOSS (C=140)							0.483488549		1.770095156		3.78416488		6.489668486		9.86281716		13.88598378		18.54524766		23.82915559		29.72801038		

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=120	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=120	C=140	C=120	C=140
800.0	0.6	0.5	41.8	39.8		42.4	42.2	40.4	40.2
1600.0	2.3	1.8	41.8	39.8		44.0	43.5	42.0	41.5
2400.0	4.8	3.8	41.8	39.8		46.6	45.5	44.6	43.5
3200.0	8.3	6.5	41.8	39.8		50.0	48.2	48.0	46.2
4000.0	12.6	9.9	41.8	39.8		54.3	51.6	52.3	49.6
4800.0	17.7	13.9	41.8	39.8		59.4	55.6	57.4	53.6
5600.0	23.6	18.5	41.8	39.8		65.3	60.3	63.3	58.3
6400.0	30.2	23.8	41.8	39.8		72.0	65.6	70.0	63.6
7200.0	37.7	29.7	41.8	39.8		79.5	71.5	77.5	69.5

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.11111111		0.22222222		0.3333333		0.4444444		0.55555555		0.6666667		0.77777777		0.88888888		0.99999999	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.05	1.055		0.12716948	4.12132E-05	0.254338969	0.000164853	0.3815085	0.000370919	0.5086779	0.000659412	0.635847422	0.00103033	0.7630169	0.001483677	0.89018639	0.002019449	1.017355875	0.002637648	1.14452536	0.003338273
2	90° BEND	1	0.3	0.7		0.28886289	0.001275868	0.577725777	0.005103472	0.8665887	0.011482812	1.1554516	0.020413888	1.444314442	0.0318967	1.7331773	0.045931249	2.02204022	0.062517533	2.310903107	0.081655553	2.599766	0.103345309
3	REDUCER	1	0.25	0.5		0.56617126	0.004084479	1.132342522	0.016337915	1.6985138	0.036760309	2.264685	0.065351661	2.830856306	0.10211197	3.3970276	0.147041237	3.96319883	0.200139462	4.529370089	0.261406644	5.09554135	0.330842784
4	PIPE	1	120	0.5	0	0.56617126	0	1.132342522	0	1.6985138	0	2.264685	0	2.830856306	0	3.3970276	0	3.96319883	0	4.529370089	0	5.09554135	0
5	PIPE	1	120	0.7	10	0.28886289	0.001480299	0.577725777	0.00533648	0.8665887	0.011298576	1.1554516	0.01923802	1.444314442	0.02906992	1.7331773	0.040731388	2.02204022	0.054172736	2.310903107	0.069353099	2.599766	0.086237873
7	EXIT	1	1	0.5		0.56617126	0.016337915	1.132342522	0.065351661	1.6985138	0.147041237	2.264685	0.261406644	2.830856306	0.40844788	3.3970276	0.588164949	3.96319883	0.800557847	4.529370089	1.045626575	5.09554135	1.323371134
8	90° BEND	1	0.3	0.5		0.56617126	0.004901375	1.132342522	0.019605498	1.6985138	0.044112371	2.264685	0.078421993	2.830856306	0.12253436	3.3970276	0.176449485	3.96319883	0.240167354	4.529370089	0.313687973	5.09554135	0.39701134
9	CHECK VALVE	1	2.2	0.5		0.56617126	0.035943414	1.132342522	0.143773654	1.6985138	0.323490722	2.264685	0.575094616	2.830856306	0.89858534	3.3970276	1.293962887	3.96319883	1.761227263	4.529370089	2.300378465	5.09554135	2.911416495
10	CONTROL VALVE	1	0.3	0.5		0.56617126	0.004901375	1.132342522	0.019605498	1.6985138	0.044112371	2.264685	0.078421993	2.830856306	0.12253436	3.3970276	0.176449485	3.96319883	0.240167354	4.529370089	0.313687973	5.09554135	0.39701134
11	BUTTERFLY VALVE	1	0.46	0.5		0.56617126	0.007515441	1.132342522	0.030061764	1.6985138	0.067638969	2.264685	0.120247056	2.830856306	0.18788603	3.3970276	0.270555876	3.96319883	0.368256609	4.529370089	0.480988225	5.09554135	0.608750722
12	PIPE	1	120	0.5	7.5	0.56617126	0.005709733	1.132342522	0.020583598	1.6985138	0.043580291	2.264685	0.07420391	2.830856306	0.11212703	3.3970276	0.15710703	3.96319883	0.208952312	4.529370089	0.267505233	5.09554135	0.332632323
13	TEE-BRANCH TO LINE	1	1	0.5		0.56617126	0.016337915	1.132342522	0.065351661	1.6985138	0.147041237	2.264685	0.261406644	2.830856306	0.40844788	3.3970276	0.588164949	3.96319883	0.800557847	4.529370089	1.045626575	5.09554135	1.323371134
	TOTAL						0.098529026		0.391276055		0.876929815		1.554865838		2.42467181		3.48604221		4.738735764		6.182553961		7.817328727

PUMP CHARACTERISTIC HEAD- CAPACITY CURVE		INDIVIDUAL PUMP HEAD LOSS (m)	PUMP MODIFIED HEAD (m)	PUMP CAPACITY PARALLEL COMBINATION
Capacity (m3/hr)	Total Head (m)			2 PUMPS
400.0	83.2	0.1	83.1	800.0
800.0	81.5	0.4	81.1	1600.0
1200.0	77.9	0.9	77.0	2400.0
1600.0	73.1	1.6	71.6	3200.0
2000.0	67.7	2.4	65.3	4000.0
2400.0	61.2	3.5	57.7	4800.0
2800.0	53.3	4.7	48.5	5600.0
3200.0	44.1	6.182554	37.9	6400.0

TOATL DYNAMIC HEAD

POINTS	DISTANCE(m)	TDH (m)
POINT A	0	325.1
POINT C	3513.5	309.55

Pumps Calculations

High Lift Pump to B.S.2

TOTAL HEAD =60m

CAPACITY/PUMP=2000m3/hr

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH)\gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

LOW LIFT PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

MAXIMUM WATER LEVEL POINT C @STATION 3+351 m= 309.6 m

MAX WATER LEVEL IN THE RECEIVING CHAMBER= 265 m

MIN WATER LEVEL IN THE RECEIVING CHAMBER = 261 m

TEMPERATURE= 30 °C

VAPOR PRESSURE= 0.0428 bar

AVERAGE FLOW= 1.11111111 m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.22222222		0.44444444		0.66666667		0.88888889		1.11111111		1.33333333		1.55555554		1.77777776		1.99999998	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCIT Y (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)
1	BUTTERFLY VALVE	1	0.46	0.9		0.34948843	0.00286368	0.698976866	0.011454719	1.0484653	0.025773117	1.3979537	0.045818875	1.747442164	0.07159199	2.0969306	0.103092469	2.44641903	0.140320305	2.795907462	0.183275501	3.1453959	0.231958056
2	90° BEND	3	0.3	0.9		0.34948843	0.005602852	0.698976866	0.022411406	1.0484653	0.050425664	1.3979537	0.089645625	1.747442164	0.14007129	2.0969306	0.201702657	2.44641903	0.274539728	2.795907462	0.358582502	3.1453959	0.453830979
3	BUTTERFLY VALVE	6	0.46	0.9		0.34948843	0.017182078	0.698976866	0.068728313	1.0484653	0.154638704	1.3979537	0.274913251	1.747442164	0.42955196	2.0969306	0.618554816	2.44641903	0.841921832	2.795907462	1.099653005	3.1453959	1.391748335
4	22.5° BEND	2	0.075	0.9		0.34948843	0.000933809	0.698976866	0.003735234	1.0484653	0.008404277	1.3979537	0.014940938	1.747442164	0.02334521	2.0969306	0.03361711	2.44641903	0.045756621	2.795907462	0.05976375	3.1453959	0.075638496
5	45° BEND	1	0.22	0.9		0.34948843	0.001369586	0.698976866	0.005478344	1.0484653	0.012326273	1.3979537	0.021913375	1.747442164	0.03423965	2.0969306	0.049305094	2.44641903	0.067109711	2.795907462	0.0876535	3.1453959	0.110936461
6	exit	1	1	0.9		0.34948843	0.006225391	0.698976866	0.024901563	1.0484653	0.056028516	1.3979537	0.09960625	1.747442164	0.15563477	2.0969306	0.224114064	2.44641903	0.305044142	2.795907462	0.398425002	3.1453959	0.504256643
7	PIPE (C=120)		120	0.9	7693	0.34948843	1.208215728	0.698976866	4.355619936	1.0484653	9.221865976	1.3979537	15.70201793	1.747442164	23.7267904	2.0969306	33.24484391	2.44641903	44.21563424	2.795907462	56.60580369	3.1453959	70.38710893
8	PIPE (C=140)		140	0.9	7693	0.34948843	0.908433046	0.698976866	3.274902812	1.0484653	6.933735096	1.3979537	11.8060307	1.747442164	17.8396953	2.0969306	24.99612785	2.44641903	33.24484391	2.795907462	42.56076251	3.1453959	52.92264806
FRICTION LOSS (C=120)							1.242393123		4.492329515		9.529462528		16.24885624		24.5812252		34.47523012		45.89032658		58.79315695		73.1554779
FRICTION LOSS (C=140)							0.942610441		3.411612391		7.241331648		12.35286901		18.6941302		26.22651406		34.91953625		44.74811577		55.69101703

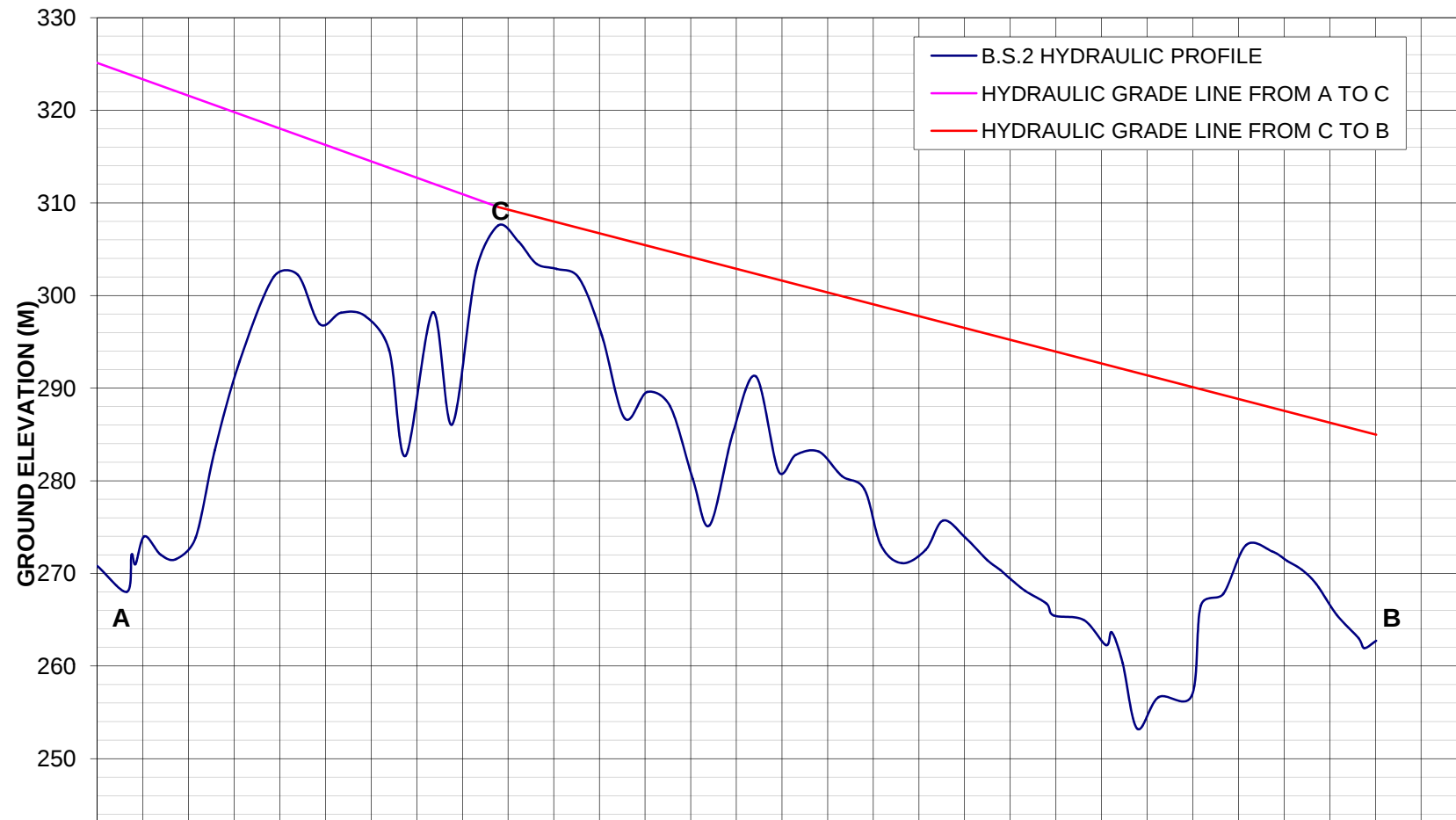
SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDH) (m)			
	C=120	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=120	C=140	C=120	C=140
800.0	1.2	0.9	44.6	48.6		43.4	43.7	47.4	47.7
1600.0	4.5	3.4	44.6	48.6		40.1	41.2	44.1	45.2
2400.0	9.5	7.2	44.6	48.6		35.1	37.4	39.1	41.4
3200.0	16.2	12.4	44.6	48.6		28.4	32.2	32.4	36.2
4000.0	24.6	18.7	44.6	48.6		20.0	25.9	24.0	29.9
4800.0	34.5	26.2	44.6	48.6		10.1	18.4	14.1	22.4
5600.0	45.9	34.9	44.6	48.6		-1.3	9.7	2.7	13.7
6400.0	58.8	44.7	44.6	48.6		-14.2	-0.1	-10.2	3.9
7200.0	73.2	55.7	44.6	48.6		-28.6	-11.1	-24.6	-7.1

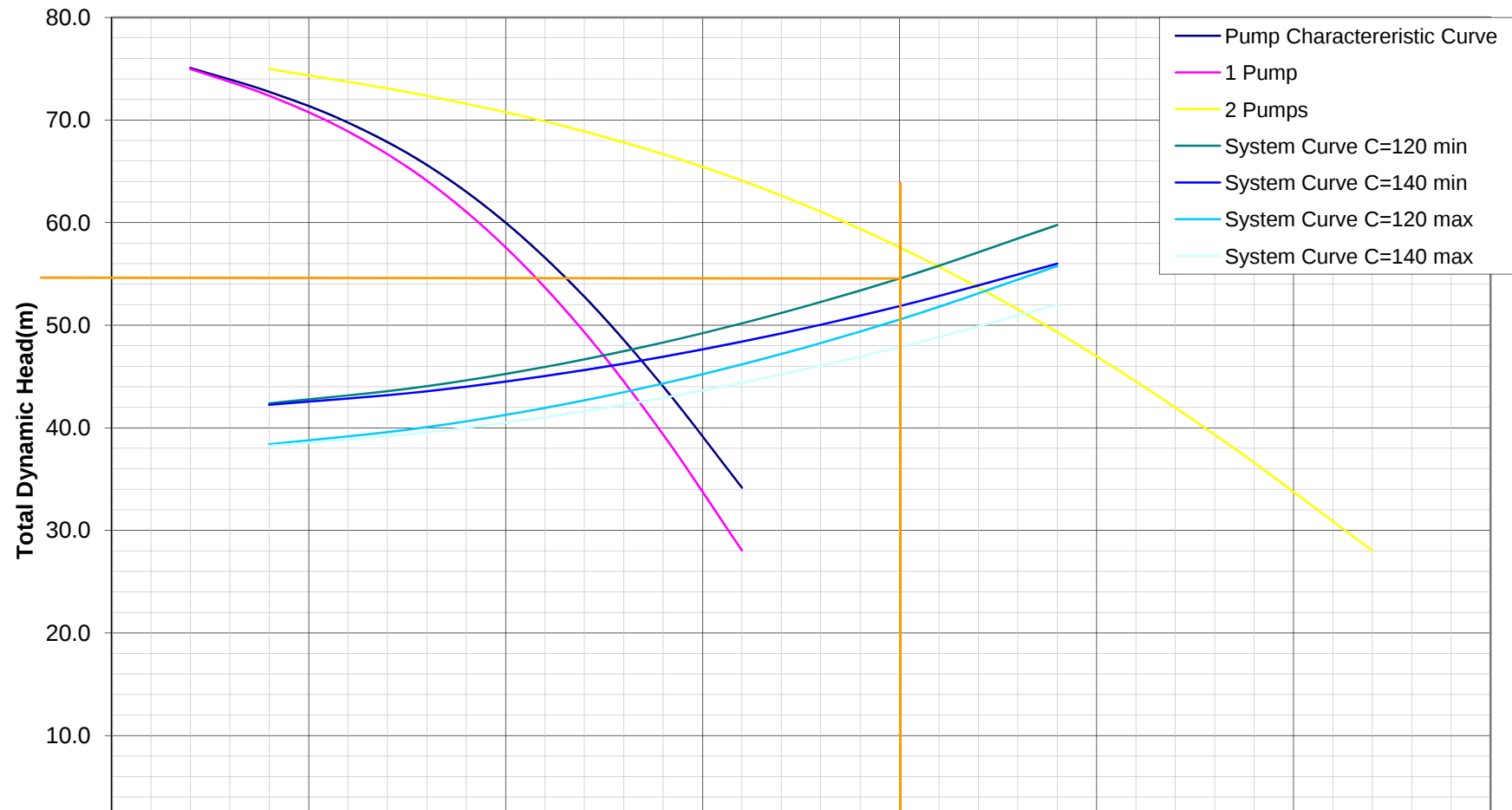
TOATL DYNAMIC HEAD

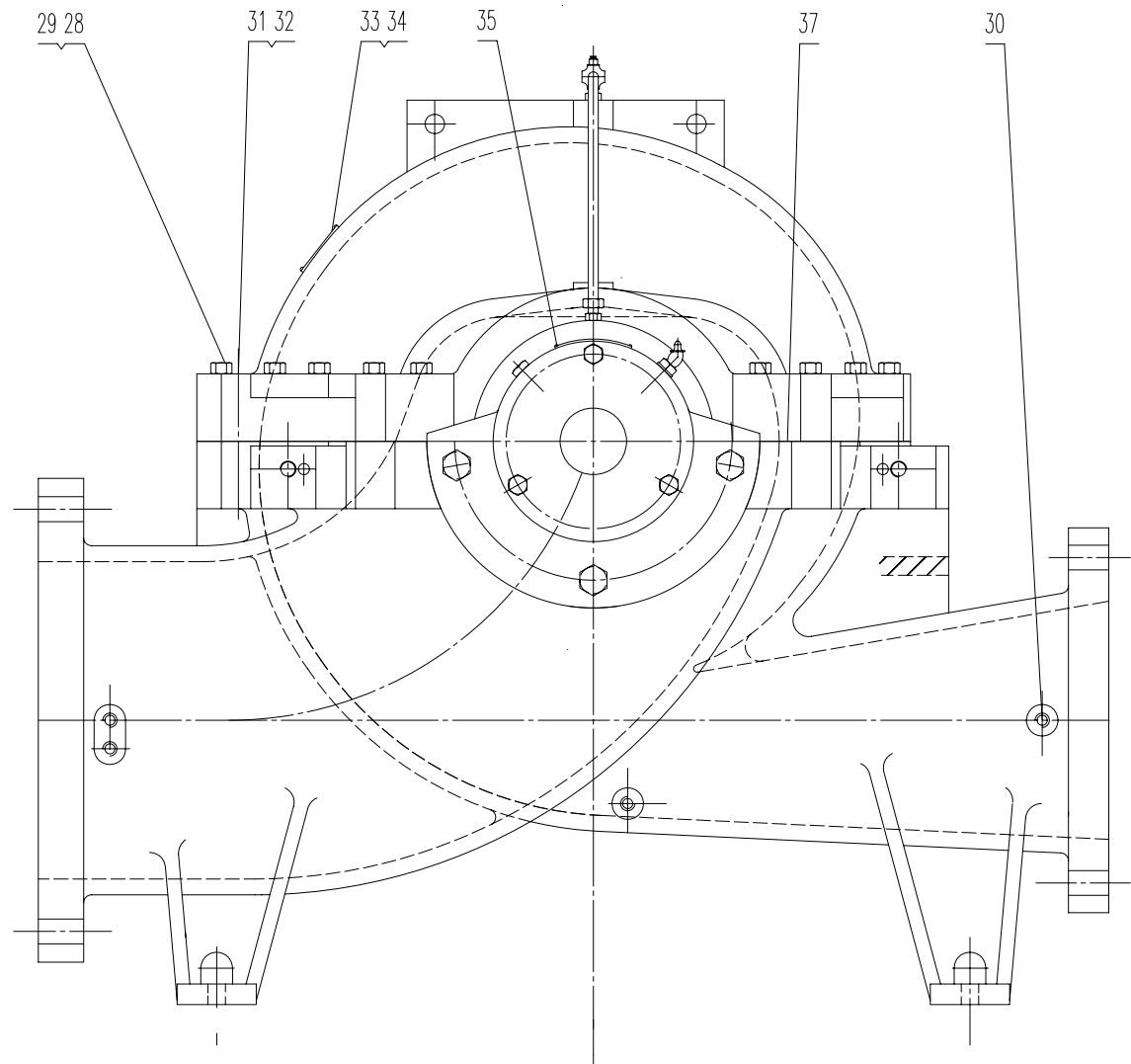
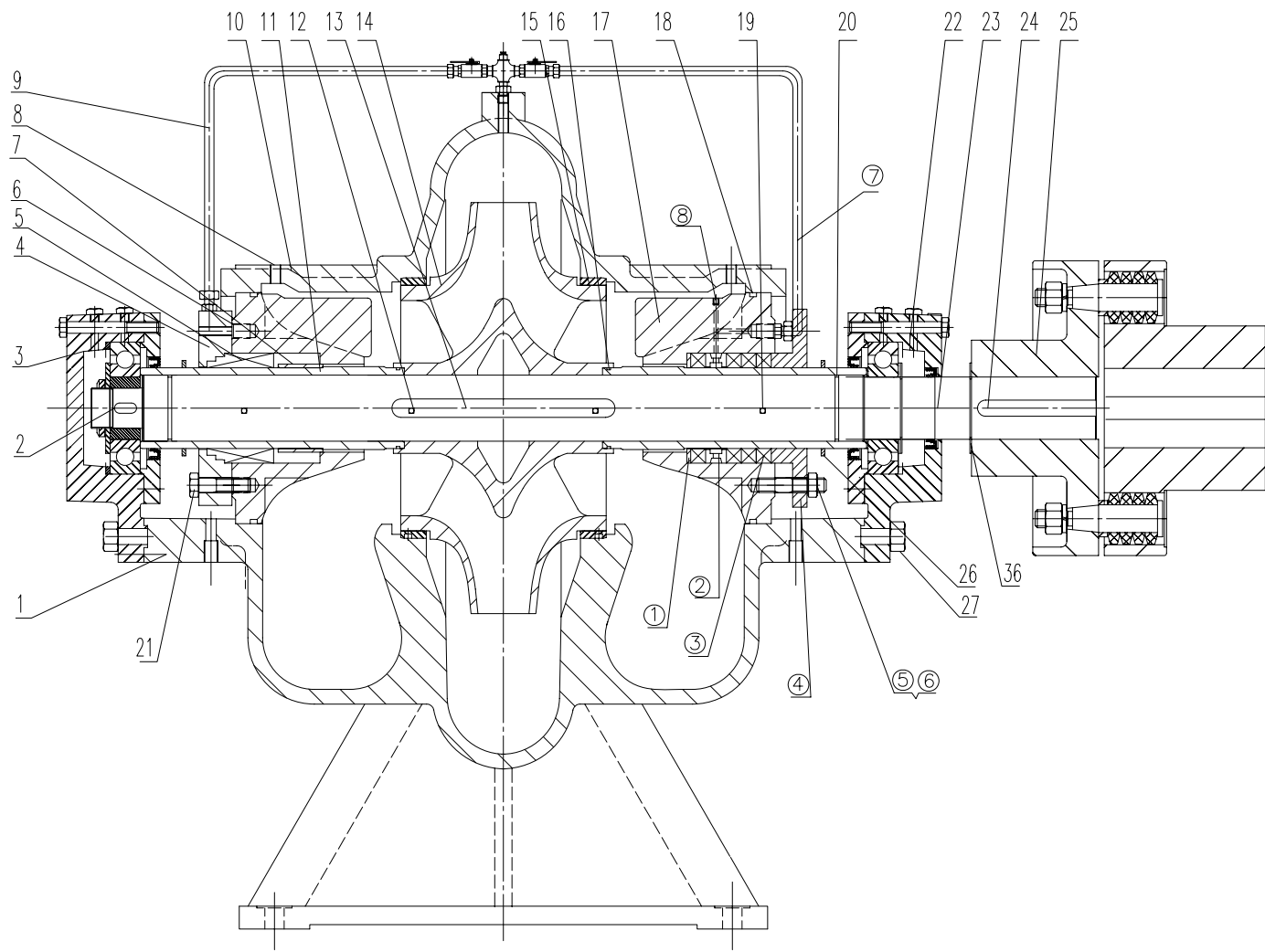
POINTS	DISTANCE (m)	TDH (m)
POINT C	3513.5	309.6
POINT B	11206.5	285.0

B.S.2 HYDRAULIC PROFILE



High Lift Pump Model 500-400-620





9	Flush pipe	1	18	O-ring 300X5.3	2	27	Bolt M20X55	6	36	Neck 85	1	⑧	Screw M10x12	2
8	Plug 1/2	2	17	Seal housing	2	26	Neck 110	2	35	Rotation plate22x100	1	⑦	Pipe assembly	1
7	Sleeve	2	16	O-ring 103X3.55	2	25	Coupling assembly	1	34	Screw 2x6	6	⑥	Nut M16	4
6	Washer Ø240XØ150X1.2	2	15	Wearing ring	2	24	Key C22X168	1	33	Nameplate 80x125	1	⑤	Stud M16x60	4
5	Seal	2	14	Impeller	1	23	Shaft	1	32	Nut M16	2	④	Gland packing	2
4	Cover	2	13	Key B25X276	1	22	Drive end bearing assembly	1	31	Bole 16x160	2	③	Packing 20x20x409	8
3	Non-drive end bearing assembly	1	12	Bolt 10X14	4	21	Bolt M16X60	8	30	1/2 Plug	8	②	Lantern ring	2
2	Key 14X30	1	11	Shaft sleeve	2	20	O-ring 82.5X3.55	2	29	M24	18	①	Packing ring	2
1	Lower casing	1	10	Upper casing	1	19	Bolt 10X22	4	28	Stud M24X95	18	37	Washer 965X860X0.25	1
Part No.	Part Name	Qty	Part No.	Part Name	Qty	Part No.	Part Name	Qty	Part No.	Part Name	Qty	Part No.	Part Name	Qty

drawn			
checked			
approved			
	name	signature	date
scale	NTS		date
			January 2009

Process Systems, inc
A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK HLP - BS2 PUMPING STATION	
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-400-350-510	sheet no.

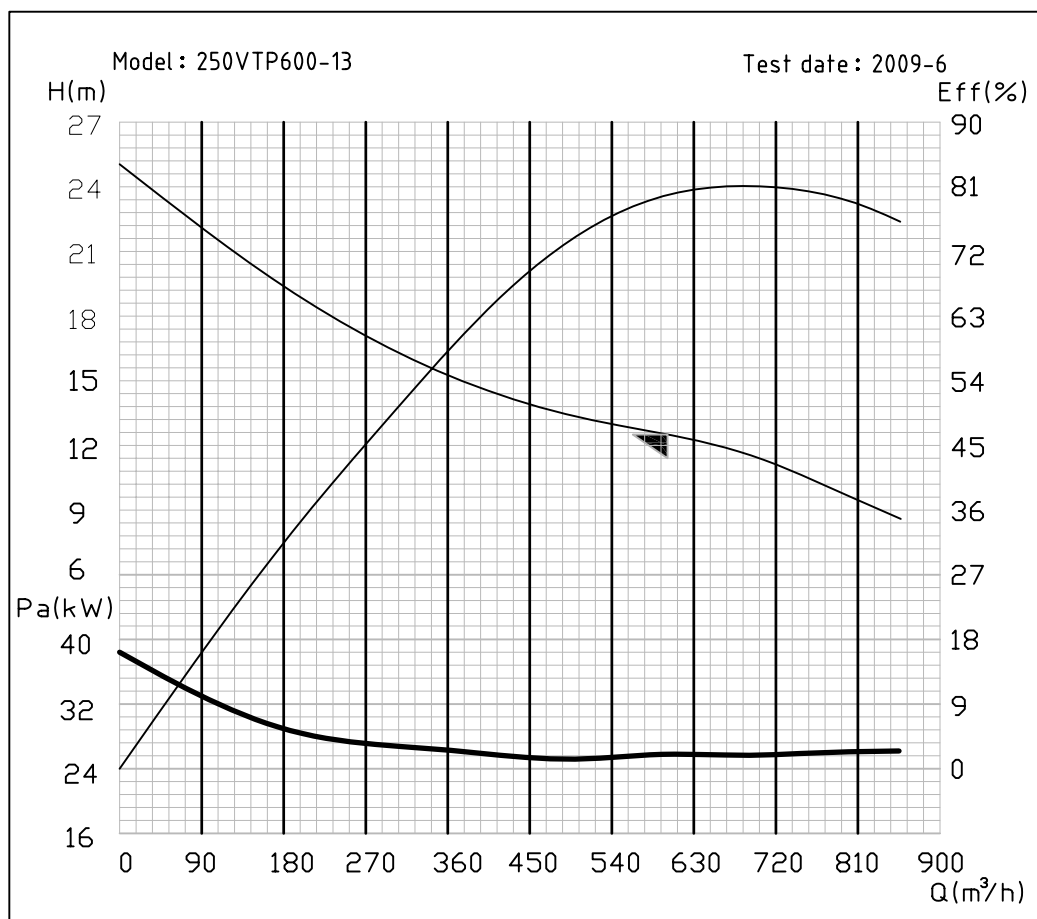
Process Systems, inc

A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL



Pump Test Data

Impeller: $\phi 282$

No	Q(m³/h)	H(m)	n(r/Min)	Pa(kW)	Eff(%)
1	0.00	25.07	1450	38.02	0.00
2	204.56	18.71	1450	28.63	36.39
3	302.11	16.43	1450	27.36	49.39
4	360.37	15.10	1450	26.32	56.43
5	425.88	13.69	1450	25.51	62.95
6	503.38	13.12	1450	25.23	71.24
7	567.91	12.53	1450	25.72	75.30
8	606.89	12.30	1450	25.40	79.90
9	629.94	12.27	1450	25.9	81.04
10	682.48	11.28	1450	25.7	80.54
11	731.11	10.34	1450	24.8	79.80
12	772.58	9.59	1450	25.6	78.50
13	851.04	8.60	1450	26.1	76.40

drawn	checked	approved	signature	date	scale	NTS	date	June 2009	sheet no.
Process Systems, inc A RUTHMAR COMPANY 23533 Pleasant - Warren, NJ 08091 Phone: (609) 757-5711 Fax: (609) 756-6996							CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	Drg. no.	
							PROJECT MOSUL WATER SCHEME RIGHT BANK	Drg. title PERFORMANCE TEST PUMP ARRANGEMENT PUMP MODEL 250VTP-600-13 / FILTERS BACKWASH	sheet no.



PUMP DATA SHEET

Spec No.: Quote No.: G08TC-2880 Order No.: IRQ-P15-01-2008 Pump No.250VTP-600-13

1	Customer	El Concorde Construction Ltd.		Station No.	Filters Backwash
2	Location	Mosul - Iraq		Req. Qty.	12 Set + 1 Set Spare
3	Project	Mosul Water Scheme		Duty	(4) X 2 Set
4	Ref. No.	MSL		Stand By	(4) X 1 Set

PUMP SPECIFICATIONS

5	Pump Type	Vertical Mixed Flow VTP		Capacity	600 M ³ /Hr
6	Stages	1		TDH	12.0 mtr
7	Liquid	Treated Water		Eff.	80%
8	Temp.	Ambient		Shaft P.	26 Kw
9	NPSHA	Flooded		Motor P.	45 Kw
10	NPSHR	-----		Speed	1450 RPM
11	Suction	Suction Bell 390 mm		Rotation	CW
12	Discharge	250 mm (PN-10)		Duty Imp.	Standard
13	Weight	App. xxxx Kg		Max Imp.	

MATERIALS

ACCESSORIES

14	Casing	Close Grained Cast Iron		Base Plate	Included
15	Impeller	SS 304		Flex Coplg	Included
16	Shaft	SS420		O&M	Included
17	Sh. Sleeve	SS304		Docs.	1.Layout Dimensional
18	Wear Ring	Cast Iron		Docs.	Ref: MXT-132F
19	Bearing	Teflon		Docs.	3.Performance Curve
20	Seal	Stuffing		Docs.	4.Data Sheet

DRIVER SPECIFICATIONS

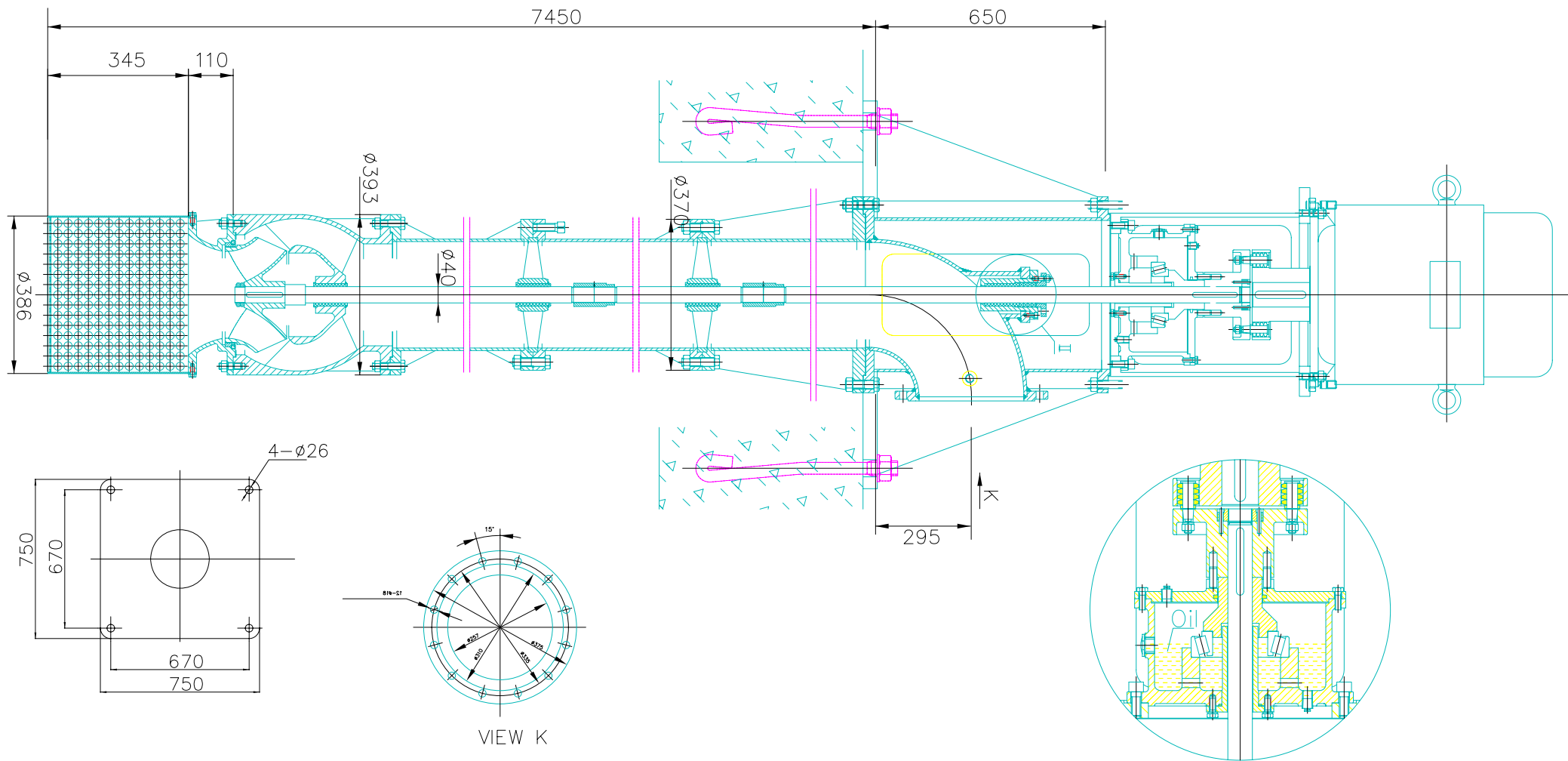
21	Driver	Electric Motor		Voltage	400V/50Hz/3Ph
22	Mfg.	EC / USA		Protection	IP-55
23	Type	Squirrel Cage Induction		Insulation	Class F
24	Rated	45 Kw		Starting	Star Delta
25	Speed	1450 RPM		Weight	App. 310 Kg

FINISHING & PAINT

26	Prep.	Gritt Blasting		Test	Hydostatic 15 Bars
27	Primer	100 micron		Test	Dimensional Tolerances
28	Final	Epoxy Blue 200 micron		Test	DFT (Dry Film Thickness)

Revisions

29	Rev O	21-Aug-08		Rev B	
30	Rev A	25-Jan-09		Rev C	



QTY = 13

drawn			
checked			
approved			
	name	signature	date
scale	NTS	date	January 2009

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CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK FILTERS BACKWASH PUMPING STATION	MXT-132F
Drg. title	PUMP LAYOUT DIMENSIONS MODEL PSI-250VTP-600-13	sheet no.

Pumps Calculations

Filter Backwash Pumps

TOTAL HEAD =12m
CAPACITY/PUMP=600m3/hr

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH) \gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

BACKWASH PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =	266.500	m
FLOOR LEVEL OF PUMP STATION=	274.300	m
SUCTION WELL AVERAGE WATER LEVEL=	269.000	m
SUCTION WELL MINIMUM WATER LEVEL=	268.000	m
MAX WATER LEVEL IN THE FILTER CELL=	274.165	m
TEMPERATURE=	30.000	°C
VAPOR PRESSURE=	0.043	bar
AVERAGE FLOW=	0.333	m3/sec
FILTER PRESSURE LOSS THROUGH MEDIA =	3.000	m

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.056		0.111		0.167		0.222		0.278		0.333		0.389	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCIT Y (m/sec)	HEAD LOSS (m)
1	HEADER TO LINE	1	1.000	0.400		0.442	0.010	0.885	0.040	1.327	0.090	1.769	0.160	2.212	0.249	2.654	0.359	3.096	0.489
2	BUTTERFLY VALVE	1	0.460	0.400		0.442	0.005	0.885	0.018	1.327	0.041	1.769	0.073	2.212	0.115	2.654	0.165	3.096	0.225
3	CONTROL VALVE	1	0.500	0.400		0.442	0.005	0.885	0.020	1.327	0.045	1.769	0.080	2.212	0.125	2.654	0.179	3.096	0.244
4	FLOW METER	1	0.500	0.400		0.442	0.005	0.885	0.020	1.327	0.045	0.000	0.000	2.212	0.125	2.654	0.179	3.096	0.244
5	REDUCER	1	0.400	0.400		0.442	0.004	0.885	0.016	1.327	0.036	1.769	0.064	2.212	0.100	2.654	0.144	3.096	0.195
6	ELBOW 90	3	0.300	0.600		0.197	0.002	0.393	0.007	0.590	0.016	0.786	0.028	0.983	0.044	1.180	0.064	1.376	0.087
7	TEE	12	0.500	0.600		0.197	0.012	0.393	0.047	0.590	0.106	0.786	0.189	0.983	0.295	1.180	0.425	1.376	0.579
8	BUTTERFLY VALVE	1	0.460	0.600		0.197	0.001	0.393	0.004	0.590	0.008	0.786	0.014	0.983	0.023	1.180	0.033	1.376	0.044
9	EXIST	1	1.000	0.600		0.197	0.002	0.393	0.008	0.590	0.018	0.786	0.032	0.983	0.049	1.180	0.071	1.376	0.097
10	FILTER MEDIA																		
	Subtotal						0.045		0.180		0.405		0.640		1.125		1.620		2.204
11	PIPE (C=100)		100.000	0.600	92.000	0.197	0.011	0.393	0.040	0.590	0.086	0.786	0.146	0.983	0.220	1.180	0.308	1.376	0.410
12	PIPE (C=140)		140.000	0.600	92.000	0.197	0.006	0.393	0.022	0.590	0.046	0.786	0.078	0.983	0.118	1.180	0.165	1.376	0.220

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

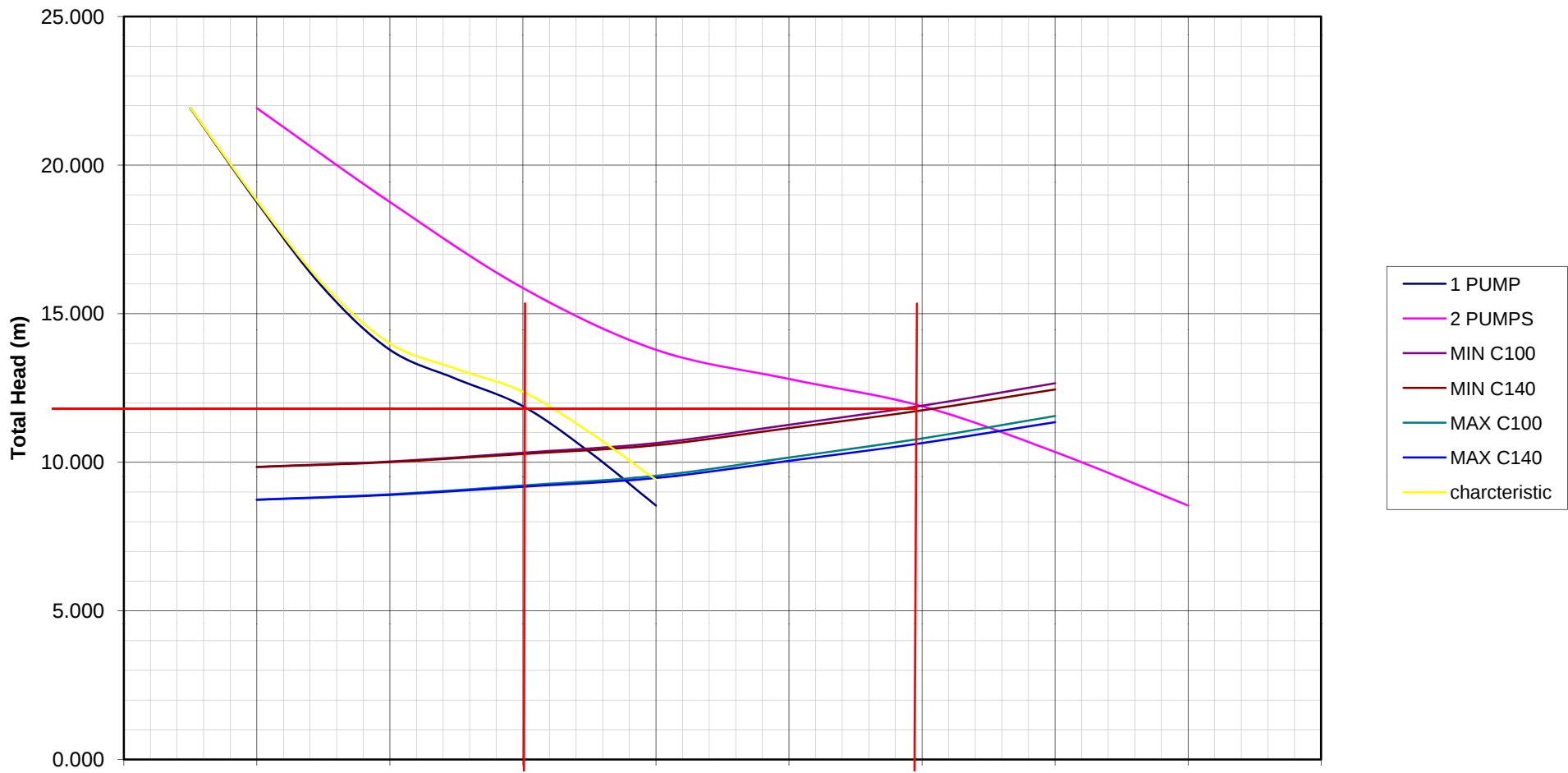
FLOW (m3/sec)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=100	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=100	C=140	C=100	C=140
200.000	0.056	0.051	6.165	5.165		9.843	9.838	8.743	8.738
400.000	0.220	0.202	6.165	5.165		10.024	10.003	8.924	8.903
600.000	0.490	0.451	6.165	5.165		10.321	10.277	9.221	9.177
800.000	0.786	0.718	6.165	5.165		10.646	10.571	9.546	9.471
1000.000	1.345	1.243	6.165	5.165		11.261	11.149	10.161	10.049
1200.000	1.928	1.785	6.165	5.165		11.902	11.745	10.802	10.645
1400.000	2.615	2.424	6.165	5.165		12.657	12.448	11.557	11.348

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.028		0.056		0.083		0.111		0.139		0.167		0.194		0.222	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCIT Y (m/sec)	HEAD LOSS (m)	VELOCIT Y (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.050	0.560		0.113	0.000	0.226	0.000	0.339	0.000	0.451	0.001	0.564	0.001	0.677	0.001	0.790	0.002	0.903	0.002
2	90° BEND	1	0.300	0.400		0.221	0.001	0.442	0.003	0.663	0.007	0.885	0.012	1.106	0.019	1.327	0.027	1.548	0.037	1.769	0.048
3	REDUCER	1	0.250	0.350		0.289	0.001	0.578	0.004	0.867	0.010	1.155	0.017	1.444	0.027	1.733	0.038	2.022	0.052	2.311	0.068
4	EXIT	1	1.000	0.400		0.221	0.002	0.442	0.010	0.663	0.022	0.885	0.040	1.106	0.062	1.327	0.090	1.548	0.122	1.769	0.160
5	CHECK VALVE	1	2.200	0.400		0.221	0.005	0.442	0.022	0.663	0.049	0.885	0.088	1.106	0.137	1.327	0.197	1.548	0.269	1.769	0.351
6	BUTTERFLY VALVE	1	0.460	0.400		0.221	0.001	0.442	0.005	0.663	0.010	0.885	0.018	1.106	0.029	1.327	0.041	1.548	0.056	1.769	0.073
7	PIPE	1	120.000	0.400	1.000	0.221	0.000	0.442	0.001	0.663	0.001	0.885	0.002	1.106	0.003	1.327	0.005	1.548	0.006	1.769	0.008
8	TEE-BRANCH TO LINE	1	1.000	0.400		0.221	0.002	0.442	0.010	0.663	0.022	0.885	0.040	1.106	0.062	1.327	0.090	1.548	0.122	1.769	0.160
TOTAL							0.014		0.054		0.122		0.218		0.340		0.489		0.666		0.870

PUMP CHARACTERISTIC HEAD- CAPACITY CURVE		Individual Pump Head Loss	Pump Modified Head (m) One Pump	PUMP CAPACITY PARALLEL
Capacity (m3/sec)	Total Head (m)	(m)	(m)	2 PUMPS
100.000	21.926	0.014	21.912	200.000
200.000	18.808	0.054	18.754	400.000
300.000	15.985	0.122	15.862	600.000
400.000	14.001	0.218	13.783	800.000
500.000	13.141	0.340	12.801	1000.000
600.000	12.375	0.489	11.885	1200.000
700.000	11.011	0.666	10.345	1400.000
800.000	9.411	0.870	8.542	1600.000

BACKWASH PUMPS SYSTEM CURVE



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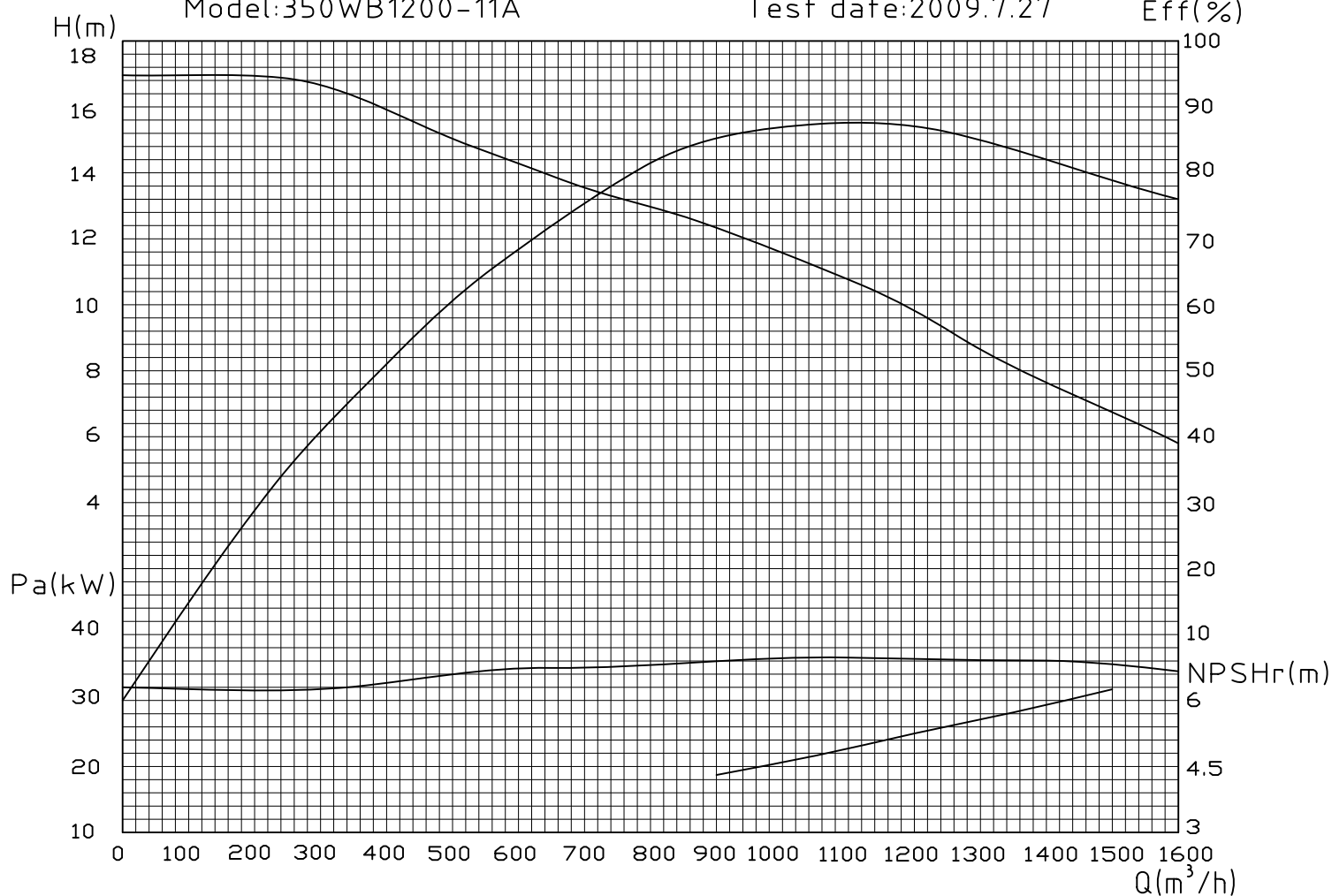
MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL

Series No.:0907019

Model:350WB1200-11A

Test date:2009.7.27

Eff(%)



Pump capability test data

Speed: 980rpm

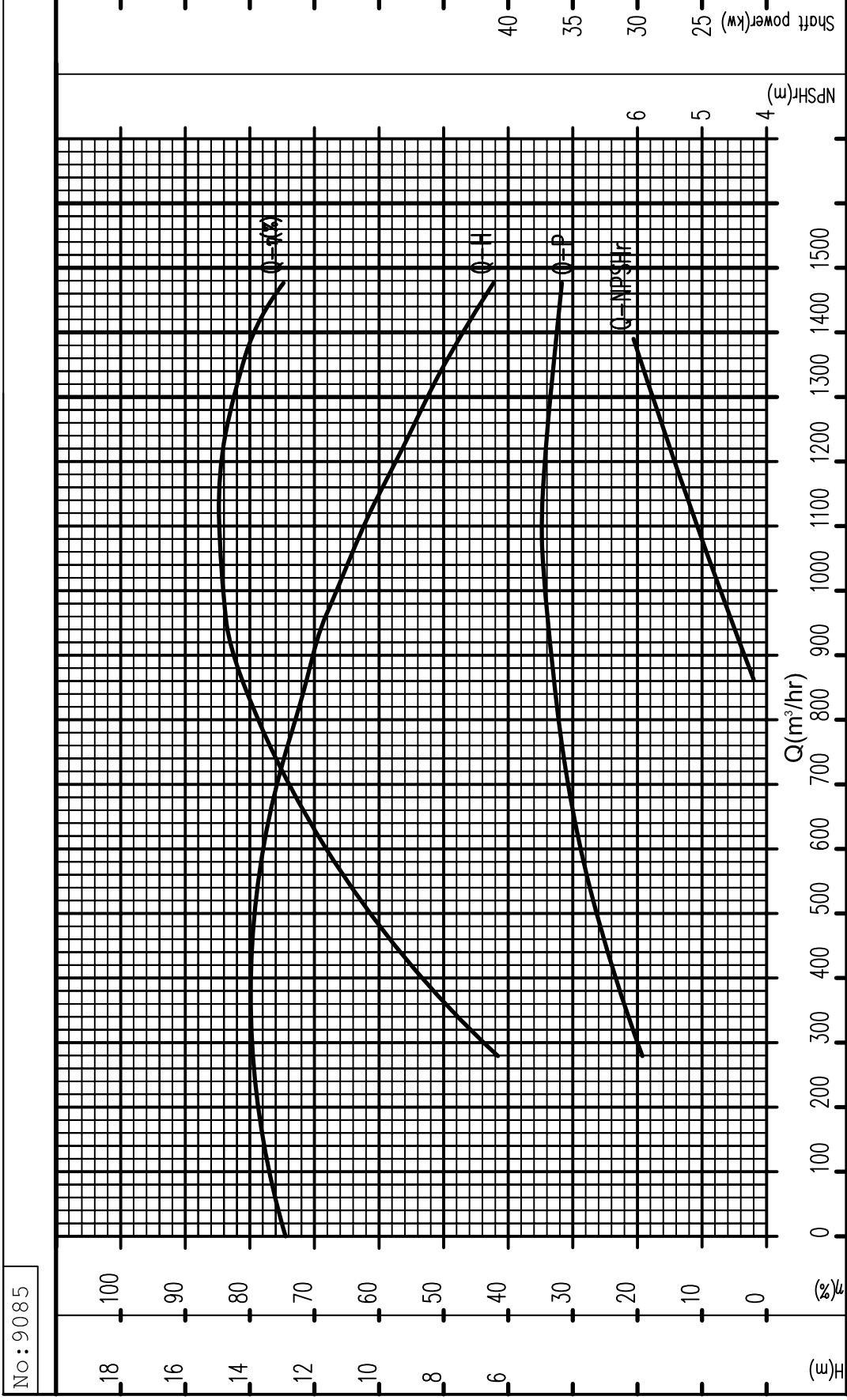
No.	Q(m³/h)	H(m)	Pa(kw)	Impeller dia	Eff(%)
1	0.00	16.96	31.92	ø389	0.00
2	151.05	16.96	31.56	ø389	22.11
3	268.91	16.76	31.56	ø389	38.90
4	386.86	15.97	32.46	ø389	51.83
5	498.70	15.30	34.62	ø389	60.02
6	607.76	14.18	34.70	ø389	67.62
7	712.97	13.48	35.06	ø389	74.66
8	830.08	12.91	35.25	ø389	82.78
9	1032.51	11.31	36.51	ø389	87.13
10	1195.18	10.07	37.59	ø389	87.17
11	1292.20	8.72	36.06	ø389	85.10
12	1337.78	8.42	36.15	ø389	84.87
13	1434.50	7.40	36.06	ø389	80.02
14	1560.10	6.20	34.19	ø389	77.01



PUMP DATA SHEET

Spec No.:		Quote No.:		Order No.:		Pump No.350WB-1200-11	
1	Customer	El Concorde Construction Ltd.			Station No.	Sludge Pumping Station	
2	Location	Mosul - Iraq			Req. Qty.	5 Set	
3	Project	Mosul Water Scheme			Duty	4 Set	
4	Ref. No.	MSL			Stand By	1 Set	
PUMP SPECIFICATIONS							
5	Pump Type	End Suction Mixed Flow			Capacity	1300 M ³ /Hr	
6	Stages	1			TDH	8.50 mtr	
7	Liquid	Clarifier Sludge			Eff.	82%	
8	Temp.	Ambient			Shaft P.	36 Kw	
9	NPSHA	Flooded			Motor P.	40 Kw	
10	NPSHR	5.76 mtr			Speed	980 RPM	
11	Suction	350 mm (PN-10)			Rotation	CW	
12	Discharge	350 mm (PN-10)			Duty Imp.	Standard	
13	Weight	App. xxxx Kg			Max Imp.		
MATERIALS				ACCESSORIES			
14	Casing	Close Grained Cast Iron			Base Plate	Included	
15	Impeller	SS 304			Flex Coplg	Included	
16	Shaft	SS420			O&M	Included	
17	Sh. Sleeve	SS304			Docs.	1.Layout Dimensional	
18	Sh. Couplg	CS TPD6-2100			Docs.	2.Cross Section	
19	Bearing	SKF			Docs.	3.Performance Curve	
20	Seal	Stuffing			Docs.	4.Data Sheet	
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor			Voltage	400V/50Hz/3Ph	
22	Mfg.	EC / USA			Protection	IP-55	
23	Type	Squirrel Cage Induction			Insulation	Class F	
24	Rated	40 Kw			Starting	Star Delta	
25	Speed	980 RPM			Weight	App. 250 Kg	
FINISHING & PAINT							
26	Prep.	Gritt Blasting			Test	Hydostatic 15 Bars	
27	Primer	100 micron			Test	Dimensional Tolerances	
28	Final	Epoxy Blue 200 micron			Test	DFT (Dry Film Thickness)	
Revisions							
29	Rev O	21-Aug-08			Rev B		
30	Rev A				Rev C		

980 r/min



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drawn				
checked				
approved				
scale	NTS	name	signature	date
				August 2008

CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS	drg. no.
PROJECT	MOSUL WATER SCHEME RIGHT BANK SLUDGE PUMPING STATION	MXT-9085
Drg. title	PUMP PERFORMANCE CURVE MODEL PSI-350WB-1200-11	sheet no.

Pumps Calculations

Sludge Pump Station
TOTAL HEAD =8.5m
CAPACITY/PUMP=1300m3/hr

TDH: TOATAL DYNAMIC HEAD

$$TDH = H_{stat} + h_f + h_m + h_v$$

HAZEN WILLIAM EQUATION : FRICTION LOSS IN SUCTION AND DISCHARGE PIPES

$$h_f = 6.82 \left(\frac{V}{C} \right)^{1.85} * \frac{L}{D^{1.167}}$$

MINOR LOSSES

$$h_m = K \frac{V^2}{2g}$$

VELOCITY HEAD

$$h_v = \frac{V^2}{2g}$$

POWER OUTPUT OF THE PUMP

$$P_w = Q(TDH) \gamma$$

PUMP EFFICIENCY

$$E_p = \frac{P_w}{P_p}$$

SPECIFIC SPEED

$$N_s = \frac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$$

NET POSITIVE SUCTION HEAD (NPSH)

$$NPSH_{av} = H_{abso} + H_s - h_L - H_{vp}$$

SLUDGE PUMP STATION HYDRAULIC DESIGN

DESIGN CRITERIA

FLOOR LEVEL OF SUCTION WELL =	260.425	m
FLOOR LEVEL OF PUMP STATION=	260.800	m
SUCTION WELL AVERAGE WATER LEVEL=	263.363	m
SUCTION WELL MINIMUM WATER LEVEL=	261.925	m
MAX WATER LEVEL IN THE VALLEY=	265.228	m
TEMPERATURE=	30.000	°C
VAPOR PRESSURE=	0.043	bar
AVERAGE FLOW=	1.444	m3/sec

SYSTEM HEAD LOSS CALCULATIONS:

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.241		0.481		0.722		0.963		1.204		1.444		1.685	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCIT Y (m/sec)	HEAD LOSS (m)
1	HEADER TO LINE	1	1.000	1.200		0.213	0.002	0.426	0.009	0.639	0.021	0.852	0.037	1.065	0.058	1.278	0.083	1.491	0.113
2	BUTTERFLY VALVE	1	0.460	1.200		0.213	0.001	0.426	0.004	0.639	0.010	0.852	0.017	1.065	0.027	1.278	0.038	1.491	0.052
3	90° BEND	1	0.300	1.200		0.213	0.001	0.426	0.003	0.639	0.006	0.852	0.011	1.065	0.017	1.278	0.025	1.491	0.034
4	exit	1	1.000	1.200		0.213	0.002	0.426	0.009	0.639	0.021	0.852	0.037	1.065	0.058	1.278	0.083	1.491	0.113
5	TEE CONNECTION	1	0.500	1.200		0.213	0.001	0.426	0.005	0.639	0.010	0.852	0.018	1.065	0.029	1.278	0.042	1.491	0.057
	Subtotal						0.008		0.030		0.068		0.121		0.188		0.271		0.369
6	PIPE (C=100)		100.000	1.200	250.000	0.213	0.016	0.426	0.057	0.639	0.120	0.852	0.204	1.065	0.309	1.278	0.433	1.491	0.576
7	PIPE (C=140)		140.000	1.200	250.000	0.213	0.008	0.426	0.030	0.639	0.064	0.852	0.110	1.065	0.166	1.278	0.232	1.491	0.309

TOTAL HEAD LOSS (C=100)						0.023		0.087		0.188		0.325		0.497		0.704		0.945
TOTAL HEAD LOSS (C=140)						0.016		0.061		0.132		0.230		0.354		0.504		0.678

SUMMARY COMPUTATIONS OF TOTAL DYNAMIC HEAD (SYSTEM CURVE)

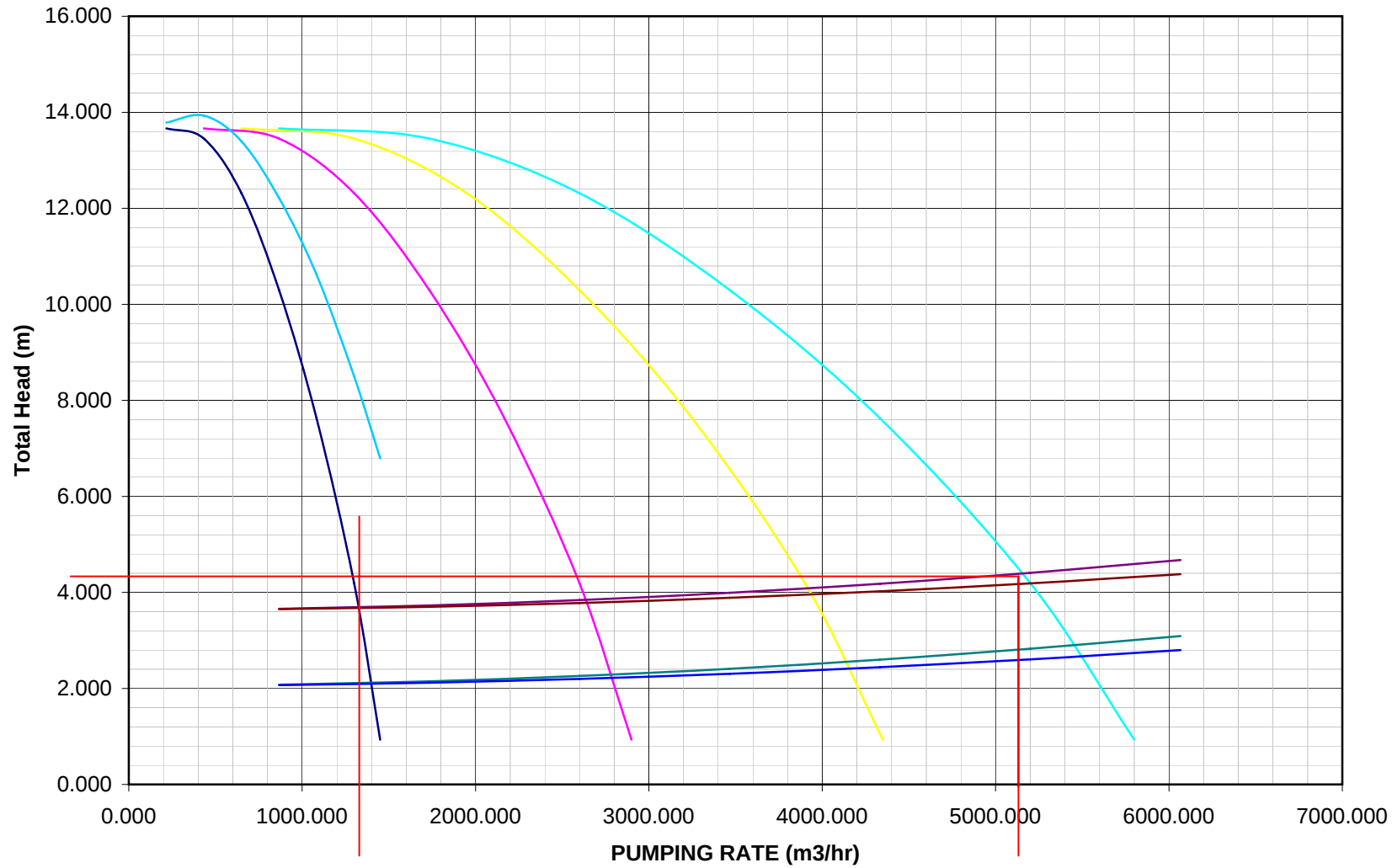
FLOW (m3/hr)	FRICTION LOSS		TOTAL DISCHARGE HEAD(m)			TOTAL DYNAMIC HEAD (TDM) (m)			
	C=100	C=140	MIN WET WELL	MAX WET WELL		MIN WET WELL		MAX. WET WELL	
						C=100	C=140	C=100	C=140
866.667	0.023	0.016	3.303	1.866		3.659	3.651	2.078	2.070
1733.333	0.087	0.061	3.303	1.866		3.729	3.700	2.148	2.119
2600.000	0.188	0.132	3.303	1.866		3.840	3.779	2.259	2.198
3466.667	0.325	0.230	3.303	1.866		3.991	3.887	2.410	2.305
4333.333	0.497	0.354	3.303	1.866		4.180	4.023	2.599	2.442
5200.000	0.704	0.504	3.303	1.866		4.408	4.187	2.827	2.606
6066.667	0.945	0.678	3.303	1.866		4.673	4.379	3.091	2.798

DETERMINATION OF INDIVIDUAL PUMP LOSSES FOR PREPARATION OF MODIFIED PUMP CURVE

						FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)		FLOW (m3/sec)	
						0.060		0.120		0.181		0.241		0.301		0.361		0.421	
ITEM	VALVES & FITTINGS	NO.	K VALUE	DIA.(m)	LENGTH(M)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCITY (m/sec)	HEAD LOSS (m)	VELOCIT Y (m/sec)	HEAD LOSS (m)
1	BELLMOUTH ENTRANCE	1	0.050	0.560		0.244	0.000	0.489	0.001	0.733	0.001	0.978	0.002	1.222	0.004	1.467	0.005	1.711	0.007
2	90° BEND	1	0.300	0.400		0.479	0.004	0.958	0.014	1.438	0.032	1.917	0.056	2.396	0.088	2.875	0.126	3.354	0.172
3	REDUCER	1	0.250	0.350		0.626	0.005	1.252	0.020	1.878	0.045	2.503	0.080	3.129	0.125	3.755	0.180	4.381	0.245
4	PIPE	1	120.000	0.400	2.250	0.479	0.002	0.958	0.006	1.438	0.012	1.917	0.021	2.396	0.032	2.875	0.045	3.354	0.060
5	EXIT	1	1.000	0.350		0.626	0.020	1.252	0.080	1.878	0.180	2.503	0.319	3.129	0.499	3.755	0.719	4.381	0.978
6	90° BEND	1	0.300	0.350		0.626	0.006	1.252	0.024	1.878	0.054	2.503	0.096	3.129	0.150	3.755	0.216	4.381	0.293
7	CHECK VALVE	1	2.200	0.350		0.626	0.044	1.252	0.176	1.878	0.395	2.503	0.703	3.129	1.098	3.755	1.581	4.381	2.152
8	BUTTERFLY VALVE	2	0.460	0.350		0.626	0.018	1.252	0.073	1.878	0.165	2.503	0.294	3.129	0.459	3.755	0.661	4.381	0.900
9	PIPE	1	120.000	0.350	1.500	0.626	0.002	1.252	0.008	1.878	0.016	2.503	0.027	3.129	0.041	3.755	0.057	4.381	0.076
10	TEE-BRANCH TO LINE	1	1.000	0.350		0.626	0.020	1.252	0.080	1.878	0.180	2.503	0.319	3.129	0.499	3.755	0.719	4.381	0.978
TOTAL							0.121		0.481		1.080		1.918		2.995		4.309		5.862

PUMP CHARACTERISTIC HEAD- CAPACITY CURVE		Individual Pump Head Loss	Pump Modified Head (m) One Pump	PUMP CAPACITY PARALLEL COMBINATION		
Capacity (m3/sec)	Total Head (m)	(m)	(m)	2 PUMPS	3 PUMPS	4 PUMPS
216.667	13.784	0.121	13.663	433.333	650.000	866.667
433.333	13.931	0.481	13.451	866.667	1300.000	1733.333
650.000	13.394	1.080	12.314	1300.000	1950.000	2600.000
866.667	12.214	1.918	10.296	1733.333	2600.000	3466.667
1083.333	10.620	2.995	7.625	2166.667	3250.000	4333.333
1300.000	8.500	4.309	4.191	2600.000	3900.000	5200.000
1450.000	6.794	5.862	0.932	2900.000	4350.000	5800.000

SLUDGE LIFT STATION SYSTEM CURVE



Process Systems, inc

A RUTHMAN COMPANY

23633 Pinewood - Warren, MI 48091
Phone: (586) 757-5711 Fax (586) 758-6996



MOSUL WATER TREATMENT PLANT PUMP PERFORMANCE TEST REPORT & OPERATION MANUAL

Pump Performance Test Report

Client: *Ministry of Municipalities & Public Works
General Directorate for Water*

Project: *Mosul Water Scheme – Right Bank*

Location: *Mosul – Iraq*

Contractor:

El Concorde Construction Ltd.
P.O. Box 926638, Jebel El Hussein
Amman 11190 Jordan
Tel:+962-6-5511691
Fax:+962-6-5511692
Contact: Mr. Khalid Eid

Manufacturer:

Process Systems, Inc.
23633 Pinewood
Warren, MI 48091 - USA
Phone: (586) 757-5711
Fax : (586) 758-6996
Contact: Mr. Mark Kostka

Project Ref: IRQ/P15/02/2008
Test Date: As shown on the individual Test Sheets.
Test Time: As shown on the individual Test Sheets.
Test Location: Manufacturing Facility.

Test Parameters: As shown on the individual Test Sheets.
Data Collection: Computerized.
Test Type: As shown on the individual Test Sheets.

TABLE OF CONTENTS

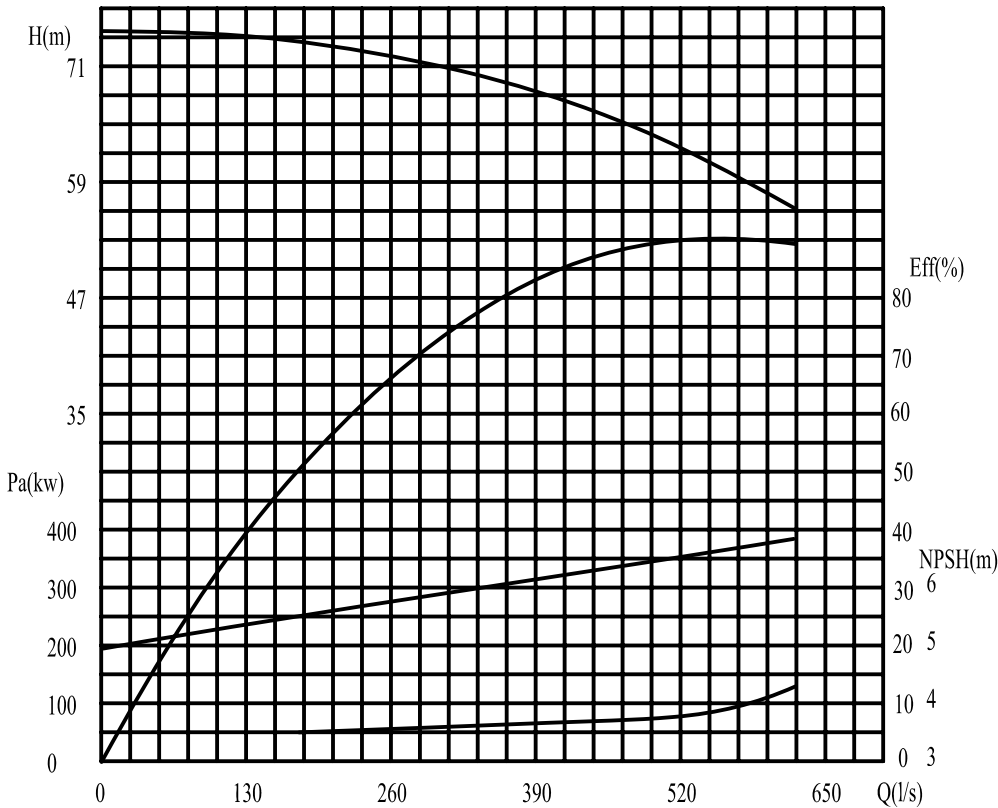
- 1. INTRODUCTION**
- 2. TEST STANDARD ISO 2548-C**
- 3. TEST RECORDS**
 - A. BS1 to EST1 PUMPING STATION**
 - I. H-Q-P & NPSH TEST RESULTS**
 - II. APPROVED DESIGN DATA**
 - B. BS1 TO NETWORK PUMPING STATION**
 - I. H-Q-P & NPSH TEST RESULTS**
 - II. APPROVED DESIGN DATA**
 - C. BS1 TO R&N NETWORK PUMPING STATION**
 - I. H-Q-P & NPSH TEST RESULTS**
 - II. APPROVED DESIGN DATA**
 - D. BS2 TO NETWORK 1 PUMPING STATION**
 - I. H-Q-P & NPSH TEST RESULTS**
 - II. APPROVED DESIGN DATA**
 - E. BS2 TO NETWORK 2 PUMPING STATION**
 - I. H-Q-P & NPSH TEST RESULTS**
 - II. APPROVED DESIGN DATA**
- 4. NOTES & RECOMMENDATIONS**

980 r/min

Series No.: 1006504

Model: PSI-500-400-675

Test date: 2010-07-26



Speed:980rpm

NO.	Q(l/s)	H(m)	Pa(kw)	Impeller dia	Eff(%)
1	0.00	74.61	197.45	Ø660mm	0.00
2	85.42	74.24	227.10		27.38
3	188.74	73.51	256.61		53.00
4	217.89	72.80	263.87		58.93
5	260.77	71.98	276.08		66.65
6	314.29	70.89	292.52		74.67
7	344.88	69.77	300.66		78.47
8	400.06	68.12	318.32		83.93
9	452.05	66.14	334.18		87.71
10	479.26	64.57	341.70		88.78
11	536.62	61.77	360.20		90.21
12	580.57	59.07	372.81		90.19
13	622.84	56.13	383.90		89.28

Process Systems, inc

23533 Pleasant - Warren, NJ 08091
Phone: (609) 757-5711 Fax (609) 756-6996

CLIENT: MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT: MOSUL WATER SCHEME RIGHT BANK
Booster Station (1) to EST.1
Drg. title: PUMP PERFORMANCE TEST CURVE
MODEL PSI-500-400-675

dra. no. MXT-140F
sheet no.

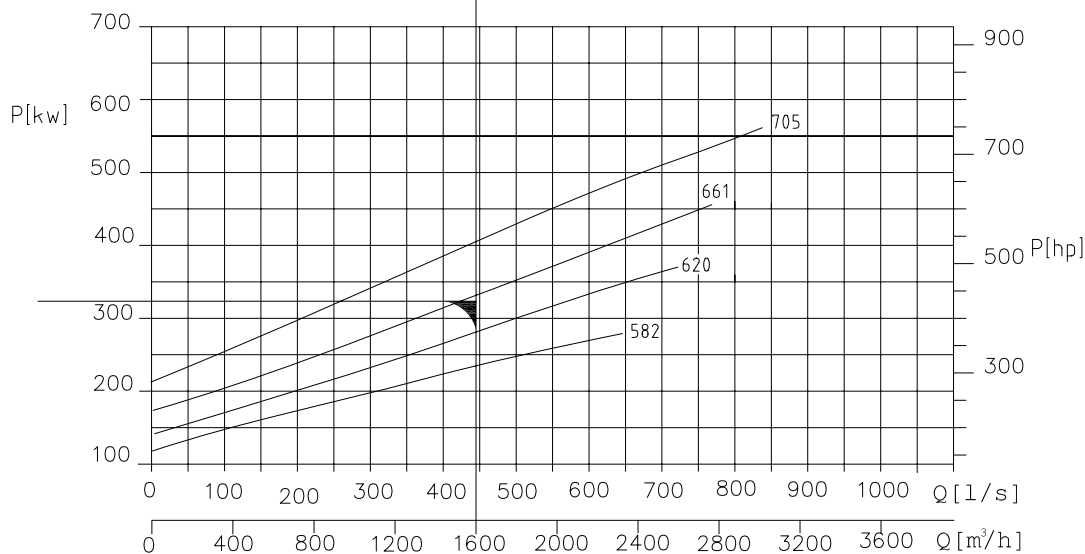
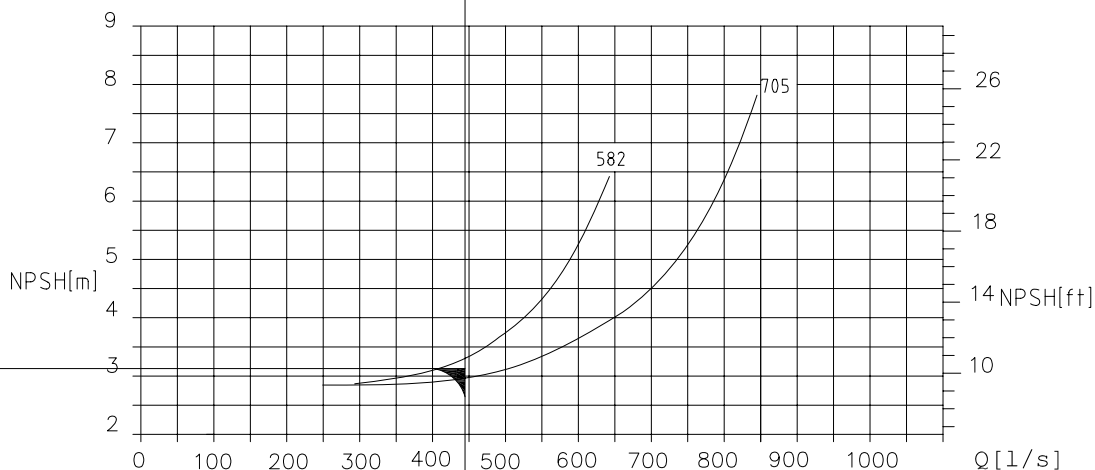
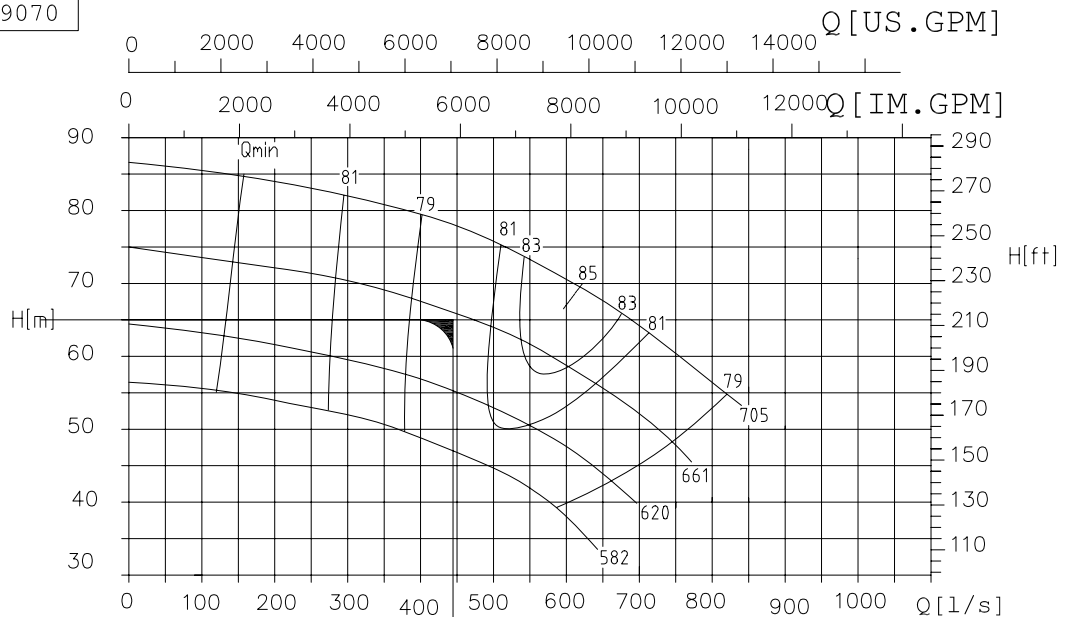
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approved: []
scale: NTS
name: []
signature: []
date: July 2010

PUMP DATA SHEET

Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.500-400-675	
1	Customer	El Concorde Construction Ltd.				Station No.	BS1 to EST.1
2	Location	Mosul - Iraq				Req. Qty.	5 Set + 1 Set Spare
3	Project	Mosul Water Scheme				Duty	3 Set
4	Ref. No.	MSL				Stand By	2 Set
PUMP SPECIFICATIONS							
5	Pump Type	Horizontal Split Case				Capacity	1600 M³/Hr
6	Stages	1				TDH	65 mtr
7	Liquid	Potable Water				Eff.	80%
8	Temp.	Ambient				Shaft P.	350 Kw
9	NPSHA	5.11 mtr				Motor P.	450 Kw
10	NPSHR	4.00 mtr				Speed	990 RPM
11	Suction	500 mm (PN-16)				Rotation	CW / NDE
12	Discharge	400 mm (PN-16)				Duty Imp.	655 mm
13	Weight	App. 2950 Kg				Max Imp.	705 mm
MATERIALS				ACCESSORIES			
14	Casing	Ductile GGG60				Base Plate	Included
15	Impeller	Stainless Steel 304				Flex Coplg	Included
16	Shaft	SS420				O&M	Included
17	Sh. Sleeve	SS304				Docs.	1.Layout Dimensional
18	Sh. Couplg	CS TPD6-2100				Docs.	Ref: MXT-140F
19	Bearing	SKF				Docs.	3.Performance Curve
20	Seal	Stuffing				Docs.	4.Data Sheet
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor				Voltage	400V/50Hz/3Ph
22	Mfg.	Dutchi Motors DM1-400-Lx6				Protection	IP-54
23	Type	Squirrel Cage Induction				Insulation	Class F
24	Rated	450 kW				Starting	Star/Delta
25	Speed	990 RPM				Weight	App. 3800 Kg
FINISHING & PAINT							
26	Prep.	Gritt Blasting				Test	Hydostatic 24 Bars
27	Primer	100 micron				Test	Dimensional Tolerances
28	Final	Epoxy Blue 200 micron				Test	DFT (Dry Film Thickness)
Revisions							
29	Rev O	04-Apr-10				Rev B	
30	Rev A	27-Jul-10				Rev C	

No: 9070

980 r/min



Process Systems, inc
A RUTHMAN COMPANY

23533 Pleasantwood - Warren, MI 48091
Phone: (586) 757-5711 Fax: (586) 756-6996

CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS

PROJECT MOSUL WATER SCHEME RIGHT BANK

Booster Station (1) to EST.1

Dwg. title PUMP PERFORMANCE CURVE

MODEL PSI-500-400-675

drg. no.

MXT-140F

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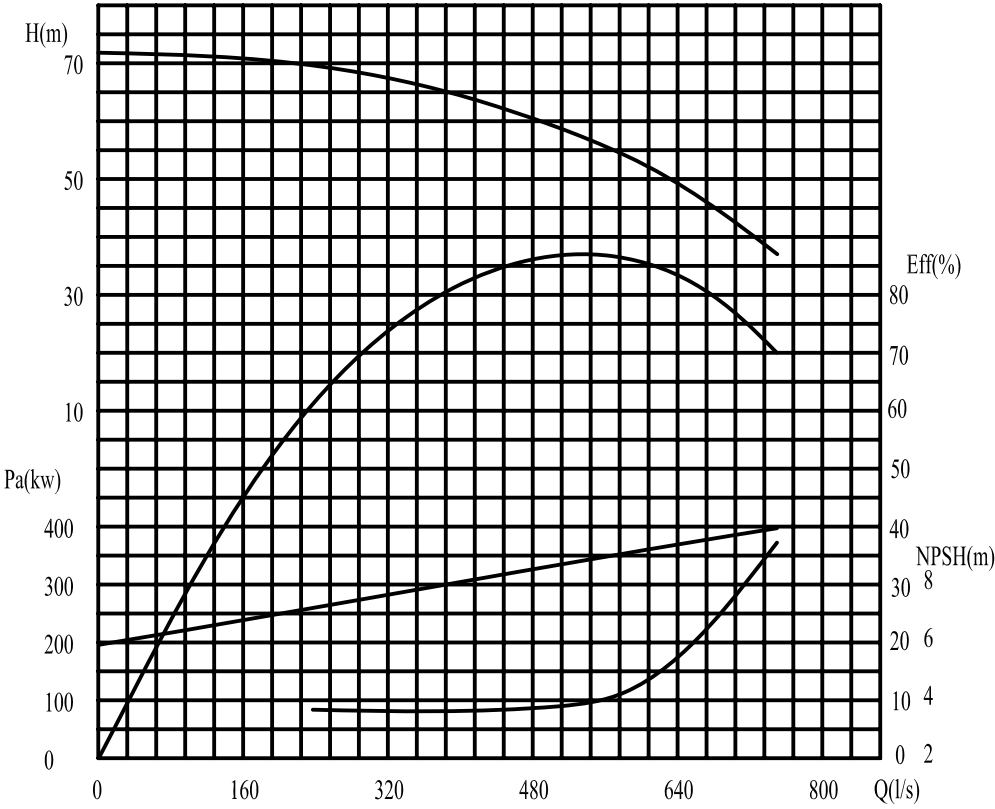
scale NTS date April 2010

980 r/min

Series No.: 1006500

Model: PSI-500-400-675

Test date: 2010-07-27



Speed:980rpm

NO.	Q(l/s)	H(m)	Pa(kw)	Impeller dia	Eff(%)
1	0.00	71.82	194.43	Ø645mm	0.00
2	122.89	71.35	235.57		36.49
3	228.28	69.76	262.22		59.54
4	270.55	68.63	272.63		66.77
5	330.03	67.00	288.91		75.03
6	398.23	64.65	308.63		81.79
7	452.65	62.11	323.84		85.12
8	499.95	59.41	336.41		86.55
9	566.24	55.25	354.52		86.52
10	621.24	51.03	369.48		84.12
11	671.67	46.03	376.27		80.56
12	711.11	41.62	381.79		76.00
13	750.00	36.94	392.01		69.29

Process Systems, inc
A RUTHMAN COMPANY

23533 Pleasant - Warren, NJ 08091
Phone: (609) 757-5711 Fax: (609) 756-6996

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approved					
scale	NTS	name	signature	date	July 2010

CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS

PROJECT MOSUL WATER SCHEME RIGHT BANK

Booster Station (1) to Network

Dwg. title PUMP PERFORMANCE TEST CURVE

MODEL PSI-500-400-675

dra. no.

MXT-140F

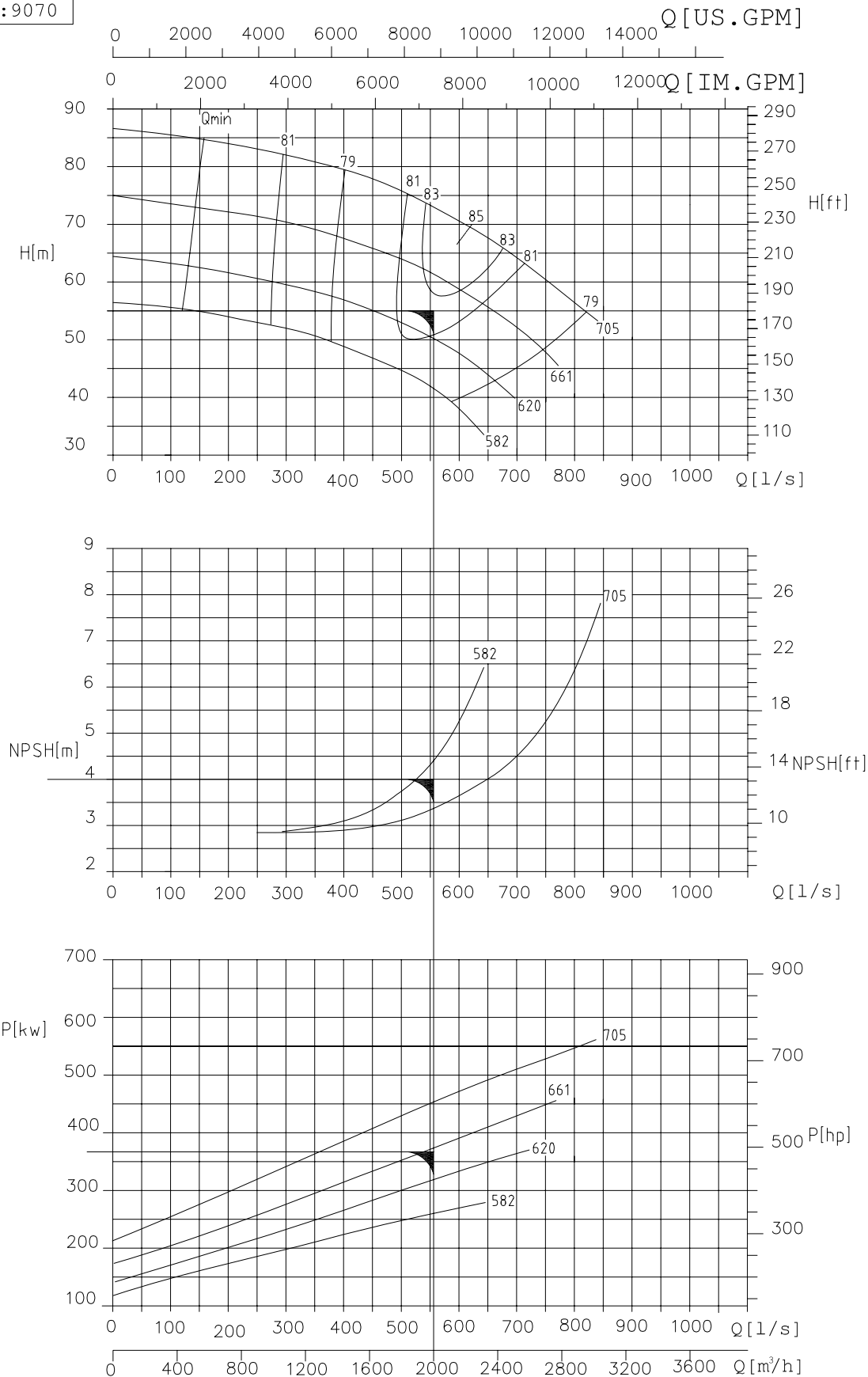
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PUMP DATA SHEET							
Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.500-400-675	
1	Customer	El Concorde Construction Ltd.			Station No.	BS1 to Network	
2	Location	Mosul - Iraq			Req. Qty.	3 Set + 1 Set Spare	
3	Project	Mosul Water Scheme			Duty	2 Set	
4	Ref. No.	MSL			Stand By	1 Set	
PUMP SPECIFICATIONS							
5	Pump Type	Horizontal Split Case			Capacity	2000 M ³ /Hr	
6	Stages	1			TDH	55 mtr	
7	Liquid	Potable Water			Eff.	82%	
8	Temp.	Ambient			Shaft P.	375 Kw	
9	NPSHA	Flooded			Motor P.	500 Kw	
10	NPSHR	4.00 mtr			Speed	990 RPM	
11	Suction	500 mm (PN-16)			Rotation	CW / NDE	
12	Discharge	400 mm (PN-16)			Duty Imp.	650 mm	
13	Weight	App. 2800 Kg			Max Imp.	705 mm	
MATERIALS				ACCESSORIES			
14	Casing	Ductile GGG60			Base Plate	Included	
15	Impeller	Stainless Steel 304			Flex Couplg	Included	
16	Shaft	SS420			O&M	Included	
17	Sh. Sleeve	SS304			Docs.	1.Layout Dimensional	
18	Sh. Couplg	CS TPD6-2100			Docs.	Ref: MXT-140F	
19	Bearing	SKF			Docs.	3.Performance Curve	
20	Seal	Stuffing			Docs.	4.Data Sheet	
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor			Voltage	400V/50Hz/3Ph	
22	Mfg.	Dutchi Motors DM1-400-Ly6			Protection	IP-55	
23	Type	Squirrel Cage Induction			Insulation	Class F	
24	Rated	500 Kw			Starting	Star Delta	
25	Speed	980 RPM			Weight	App. 3870 Kg	
FINISHING & PAINT							
26	Prep.	Gritt Blasting			Test	Hydostatic 24 Bars	
27	Primer	100 micron			Test	Dimensional Tolerances	
28	Final	Epoxy Blue 200 micron			Test	DFT (Dry Film Thickness)	
Revisions							
29	Rev O	04-Apr-10			Rev B		
30	Rev A	27-Jul-10			Rev C		

No:9070

980 r/min



Process Systems, inc
A RUTHMAR COMPANY

23533 Pleasantwood - Warren, MI 48091
Phone: (586) 757-5711 Fax: (586) 756-6996

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				April 2010

CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS

PROJECT MOSUL WATER SCHEME RIGHT BANK

Booster Station (1) to Network

Dwg. title PUMP PERFORMANCE CURVE

MODEL PSI-500-400-675

drg. no.

MXT-140F

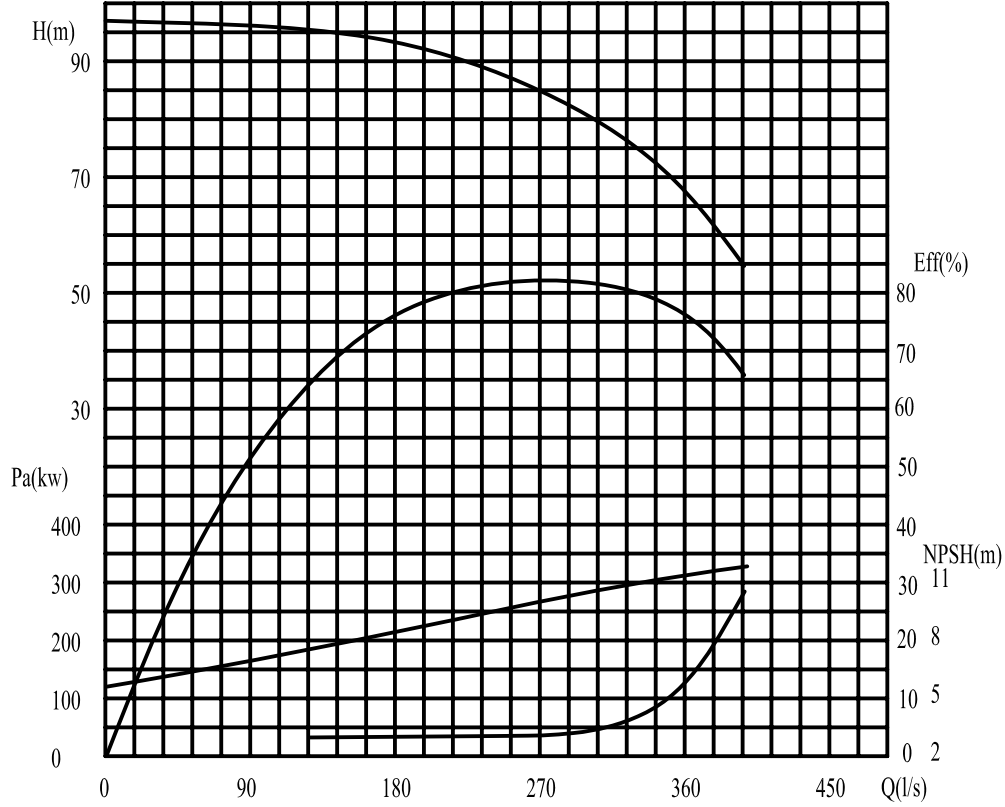
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1450 r/min

Series No.: 1005435

Model: PSI-300-250-600

Test date: 2010-07-26



NO.	Q(l/s)	H(m)	Pa(kw)	Impeller dia	Eff(%)
1	0.00	97.23	123.42	Ø510mm	0.00
2	56.12	96.60	150.58		35.30
3	127.39	95.35	186.35		63.90
4	158.65	94.11	203.89		71.79
5	189.82	92.34	222.46		77.25
6	217.39	90.16	239.26		80.31
7	248.33	87.11	258.50		82.05
8	277.92	83.38	276.14		82.27
9	312.49	78.03	293.90		81.34
10	326.94	75.17	300.28		80.24
11	351.39	70.05	310.86		77.63
12	375.83	62.89	318.50		72.75
13	397.22	53.44	327.88		63.48

Process Systems, inc
A RUTHMAR COMPANY
23533 Pleasant - Warren, NJ 08091
Phone: (609) 757-5711 Fax: (609) 756-6996

CLIENT: MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT: MOSUL WATER SCHEME RIGHT BANK
Booster Station (1) to Rafidin & Nahrawan
Drg. title: PUMP PERFORMANCE TEST CURVE
MODEL PSI-300-250-600

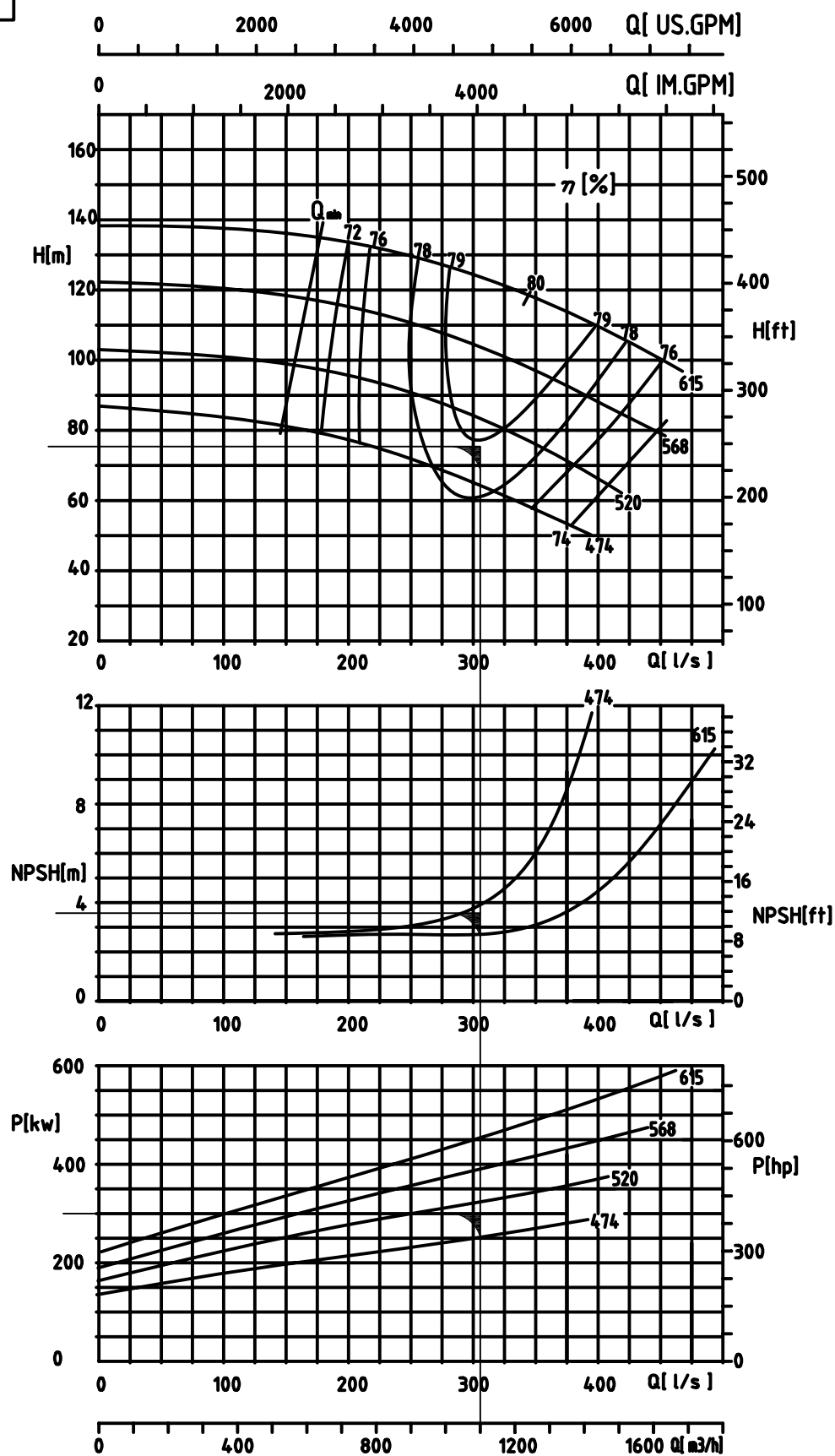
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PUMP DATA SHEET							
Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.300-250-600	
1	Customer	El Concorde Construction Ltd.			Station No.	BS1 ro R&N Network	
2	Location	Mosul - Iraq			Req. Qty.	3 Set + 1 Spare Set	
3	Project	Mosul Water Scheme			Duty	2 Set	
4	Ref. No.	MSL			Stand By	1 Set	
PUMP SPECIFICATIONS							
5	Pump Type	Horizontal Split Case			Capacity	1100 M ³ /Hr	
6	Stages	1			TDH	75 mtr	
7	Liquid	Potable Water			Eff.	79%	
8	Temp.	Ambient			Shaft P.	300 Kw	
9	NPSHA	Flooded			Motor P.	355 Kw	
10	NPSHR	3.50 mtr			Speed	1450 RPM	
11	Suction	300 mm (PN-16)			Rotation	CW / NDE	
12	Discharge	250 mm (PN-25)			Duty Imp.	510 mm	
13	Weight	App. 1400 Kg			Max Imp.	615 mm	
MATERIALS				ACCESSORIES			
14	Casing	Ductile GGG60			Base Plate	Included	
15	Impeller	Stainless Steel 304			Flex Coplg	Included	
16	Shaft	SS420			O&M	Included	
17	Sh. Sleeve	SS304			Docs.	1.Layout Dimensional	
18	Sh. Couplg	CS TPD6-2100			Docs.	Ref: MXT-140F	
19	Bearing	SKF			Docs.	3.Performance Curve	
20	Seal	Stuffing			Docs.	4.Data Sheet	
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor			Voltage	400V/50Hz/3Ph	
22	Mfg.	Dutchi Motors DM1-355XA4			Protection	IP-55	
23	Type	Squirrel Cage Induction			Insulation	Class F	
24	Rated	355 Kw			Starting	Star/Delta	
25	Speed	1450 RPM			Weight	App. 3000 Kg	
FINISHING & PAINT							
26	Prep.	Gritt Blasting			Test	Hydostatic 24 Bars	
27	Primer	100 micron			Test	Dimensional Tolerances	
28	Final	Epoxy Blue 200 micron			Test	DFT (Dry Film Thickness)	
Revisions							
29	Rev O	21-Aug-08			Rev B	27-Jul-10	
30	Rev A	25-Jan-09			Rev C		

No: 9070

1450 r/min



CLIENT	MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT	MOSUL WATER SCHEME RIGHT BANK Booster Station (1) to Rafidin & Nahrwan
Drp. title	PUMP PERFORMANCE CURVE MODEL PSI-300-250-600

Process Systems, inc
A RUTHMAR COMPANY

23533 Pleasant - Warren, NJ 08091
Phone: (609) 757-5711 Fax: (609) 756-6996

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approved					
scale	NTS	name	signature	date	date

drp. no.
MXT-140F

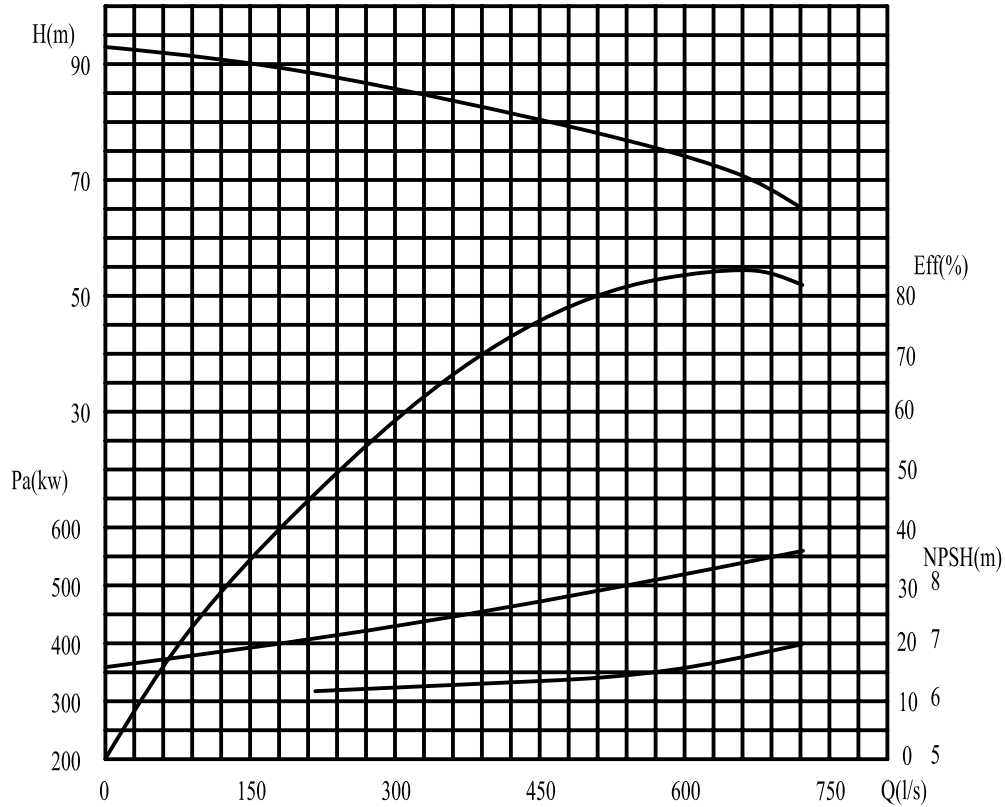
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1450 r/min

Series No.: 1005422

Model: PSI-400-350-510

Test date: 2010-07-26



Speed: 1450rpm

NO.	Q(l/s)	H(m)	Pa(kw)	Impeller dia	Eff(%)
1	0.00	93.14	357.22	Ø510mm	0.00
2	114.73	90.70	384.86		26.51
3	217.45	87.96	408.54		45.90
4	279.28	86.25	423.90		55.71
5	319.72	84.69	432.60		61.36
6	392.28	82.49	453.43		69.96
7	435.09	80.92	465.80		74.10
8	489.12	79.12	484.42		78.32
9	561.28	76.28	509.57		82.38
10	600.00	74.14	522.64		83.44
11	638.89	72.05	536.70		84.09
12	677.78	69.24	546.78		84.14
13	722.22	64.20	558.68		81.36

Process Systems, inc
A RUTHMAR COMPANY
23533 Pleasant - Warren, MI 48091
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CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS

PROJECT MOSUL WATER SCHEME RIGHT BANK

Booster Station (2) to Network (1)

Dwg. title PUMP PERFORMANCE TEST CURVE

MODEL PSI-400-350-510

dwg. no.

MXT-140F

sheet no.

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name

signature

date

July 2010

date

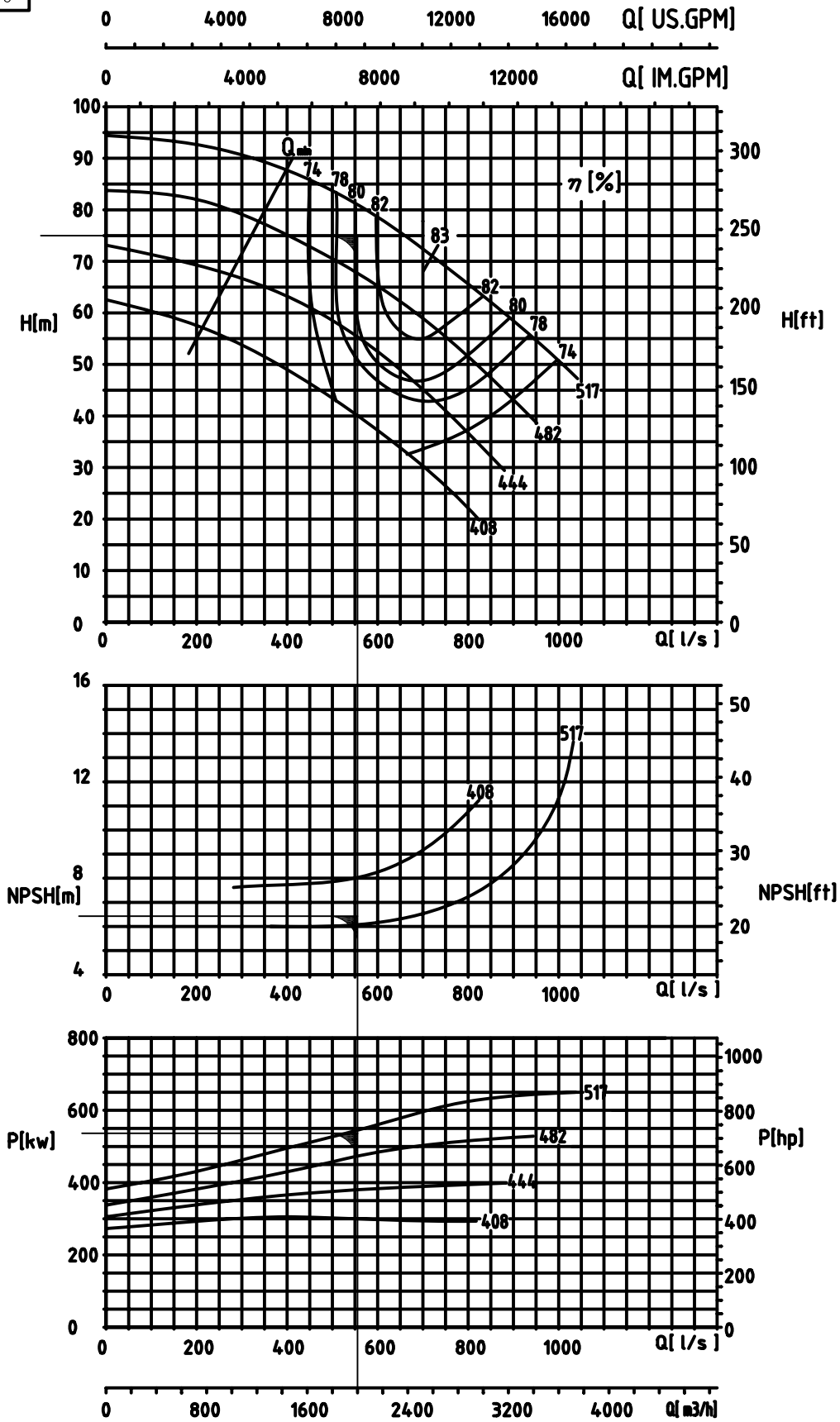
July 2010



PUMP DATA SHEET							
Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.400-350-510	
1	Customer	El Concorde Construction Ltd.			Station No.	BS2 to Network 1	
2	Location	Mosul - Iraq			Req. Qty.	2 Set + 1 Set Spare	
3	Project	Mosul Water Scheme			Duty	1 Set	
4	Ref. No.	MSL			Stand By	1 Set	
PUMP SPECIFICATIONS							
5	Pump Type	Horizontal Split Case			Capacity	2000 M ³ /Hr	
6	Stages	1			TDH	75 mtr	
7	Liquid	Water			Eff.	80%	
8	Temp.	Ambient			Shaft P.	540 Kw	
9	NPSHA	Flooded			Motor P.	630 Kw	
10	NPSHR	6.50 mtr			Speed	1450 RPM	
11	Suction	400 mm (PN-16)			Rotation	CW / NDE	
12	Discharge	350 mm (PN-16)			Duty Imp.	500 mm	
13	Weight	App. 1700 Kg			Max Imp.	517 mm	
MATERIALS				ACCESSORIES			
14	Casing	Ductile GGG60			Base Plate	Included	
15	Impeller	Stainless Steel 304			Flex Coplg	Included	
16	Shaft	SS420			O&M	Included	
17	Sh. Sleeve	SS304			Docs.	1.Layout Dimensional	
18	Sh. Couplg	CS TPD6-2100			Docs.	Ref: MXT-140F	
19	Bearing	SKF			Docs.	3.Performance Curve	
20	Seal	Stuffing			Docs.	4.Data Sheet	
DRIVER SPECIFICATIONS							
21	Driver	Electric Motor			Voltage	11000V/50Hz/3Ph	
22	Mfg.	Dutchi Motors DM1-HV500M4			Protection	IP-55	
23	Type	Squirrel Cage Induction			Insulation	Class F	
24	Rated	630 Kw			Starting	DOL	
25	Speed	1450 RPM			Weight	App. 3450 Kg	
FINISHING & PAINT							
26	Prep.	Gritt Blasting			Test	Hydostatic 24 Bars	
27	Primer	100 micron			Test	Dimensional Tolerances	
28	Final	Epoxy Blue 200 micron			Test	DFT (Dry Film Thickness)	
Revisions							
29	Rev O	04-Apr-10			Rev B		
30	Rev A	27-Jul-10			Rev C		

1450 r/min

No: 9070



Process Systems, inc
A RUTHMAN COMPANY
23533 Pleasant - Warren, NJ 08091
Phone: (609) 757-5711 Fax: (609) 756-6996

CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT MOSUL WATER SCHEME RIGHT BANK
Booster Station (2) to Network (1)
Drp. title PUMP PERFORMANCE CURVE
MODEL PSI-400-350-510

drp. no.
MXT-140F

sheet no.

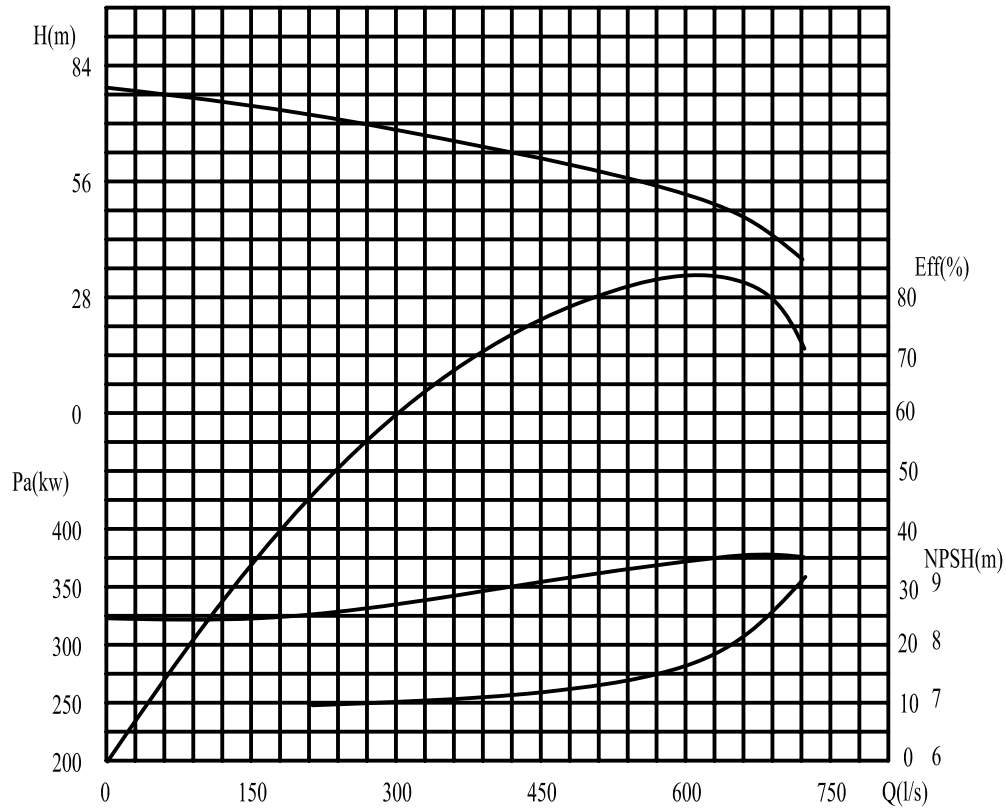
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			NTS			April 2000

1450 r/min

Series No.: 1005419

Model: PSI-400-350-510

Test date: 2010-07-26



Speed:1450rpm

NO.	Q(l/s)	H(m)	Pa(kw)	Impeller dia	Eff(%)
1	0.00	78.84	321.85	Ø453mm	0.00
2	106.95	75.15	322.09		24.46
3	210.79	71.45	326.57		45.22
4	273.25	69.19	334.63		55.39
5	328.22	66.93	338.31		63.66
6	376.67	64.69	344.68		69.31
7	446.23	61.54	355.11		75.82
8	502.96	58.54	361.99		79.74
9	561.15	55.18	367.19		82.68
10	600.00	52.71	370.69		83.64
11	638.89	50.23	375.48		83.78
12	683.33	45.31	378.99		80.08
13	722.22	32.28	366.40		62.39

Process Systems, inc
A RUTHMAR COMPANY
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CLIENT: MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT: MOSUL WATER SCHEME RIGHT BANK
Booster Station (2) to Network (2)
Dwg. title: PUMP PERFORMANCE TEST CURVE
MODEL PSI-400-350-510

dwg. no.: MXT-140F
sheet no.:

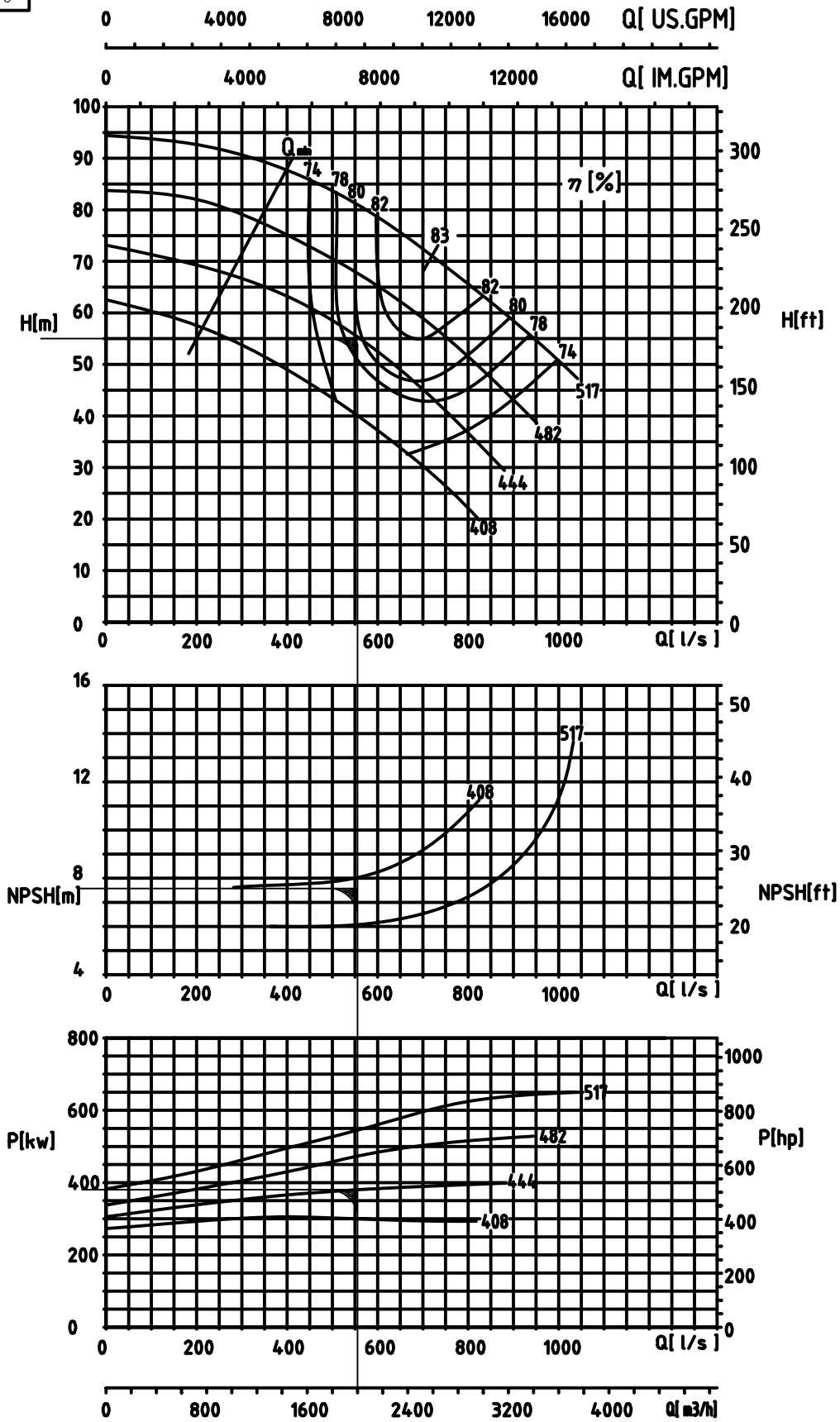
drawn					
checked					
approved					
scale	NTS	name	signature	date	July 2010



PUMP DATA SHEET						
Spec No.:		Quote No.: G08TC-2880		Order No.: IRQ-P15-01-2008		Pump No.400-350-510
1	Customer	El Concorde Construction Ltd.			Station No.	BS2 to Network 2
2	Location	Mosul - Iraq			Req. Qty.	2 Set + 1 Set Spare
3	Project	Mosul Water Scheme			Duty	1 Set
4	Ref. No.	MSL			Stand By	1 Set
PUMP SPECIFICATIONS						
5	Pump Type	Horizontal Split Case			Capacity	2000 M ³ /Hr
6	Stages	1			TDH	55 mtr
7	Liquid	Water			Eff.	79%
8	Temp.	Ambient			Shaft P.	375 Kw
9	NPSHA	Flooded			Motor P.	450 Kw
10	NPSHR	7.50 mtr			Speed	1450 RPM
11	Suction	400 mm (PN-16)			Rotation	CW / NDE
12	Discharge	350 mm (PN-16)			Duty Imp.	444 mm
13	Weight	App. 1700 Kg			Max Imp.	517 mm
MATERIALS				ACCESSORIES		
14	Casing	Ductile GGG60			Base Plate	Included
15	Impeller	Stainless Steel 304			Flex Coplg	Included
16	Shaft	SS420			O&M	Included
17	Sh. Sleeve	SS304			Docs.	1.Layout Dimensional
18	Sh. Couplg	CS TPD6-2100			Docs.	Ref: MXT-140F
19	Bearing	SKF			Docs.	3.Performance Curve
20	Seal	Stuffing			Docs.	4.Data Sheet
DRIVER SPECIFICATIONS						
21	Driver	Electric Motor			Voltage	400V/50Hz/3Ph
22	Mfg.	Dutchi Motors DM1-400-My4			Protection	IP-55
23	Type	Squirrel Cage Induction			Insulation	Class F
24	Rated	450 Kw			Starting	Star/Delta
25	Speed	1450 RPM			Weight	App. 3050 Kg
FINISHING & PAINT						
26	Prep.	Gritt Blasting			Test	Hydostatic 24 Bars
27	Primer	100 micron			Test	Dimensional Tolerances
28	Final	Epoxy Blue 200 micron			Test	DFT (Dry Film Thickness)
Revisions						
29	Rev O	04-Apr-10			Rev B	
30	Rev A				Rev C	

1450 r/min

No: 9070



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CLIENT MINISTRY OF MUNICIPALITIES & PUBLIC WORKS
PROJECT MOSUL WATER SCHEME RIGHT BANK
Booster Station (2) to Network (2)
Drp. title PUMP PERFORMANCE CURVE
MODEL PSI-400-350-510

drp. no.
MXT-140F

sheet no.

drawn	checked	approved	scale	name	signature	date
			NTS			April 2000

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0 General

This pump/unit has been developed in accordance with state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control.

These operating instructions are intended to facilitate familiarisation with the pump and its designated use.

The manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the pump and to avoid any risks.

These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation.

This pump/unit must not be operated beyond the limit values specified in the technical documentation for the medium handled, capacity, speed, density, pressure, temperature and motor rating. Make sure that operation is in accordance with the instructions laid down in this manual or in the contract documentation.

The name plate indicates the type series/size, main operating data and works/serial number; please quote this information in all queries, repeat orders and particularly when ordering spare parts.

If you need any additional information or instructions exceeding the scope of this manual or in case of damage please contact Ture's nearest customer service centre.

0.0 Safety

These operating instructions contain fundamental information which must be complied with during installation, operation and maintenance. Therefore this operating manual must be read and understood both by the installing personnel and the responsible trained personnel/operators prior to installation and commissioning, and it must always be kept close to the location of operation of the machine/unit for easy access.

Not only must the general safety instructions laid down in this chapter on "Safety" be complied with, but also the safety instructions outlined under specific headings.

0.1 Marking of Instructions in the Manual

The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the general hazard sign, namely



safety sign in accordance with DIN 4844 - W9. The electrical danger warning sign is



safety sign in accordance with DIN 4844 - W8. The word

Caution

is used to introduce safety instructions whose nonobservance may lead to damage to the machine and its functions.

Instructions attached directly to the machine, e.g.

- arrows indicating the direction of rotation
- markings for fluid connections

must always be complied with and be kept in perfectly legible condition at all times.

0.2 Personnel Qualification and Training

All personnel involved in the operation, maintenance, inspection and installation of the machine must be fully qualified to carry out the work involved.

Personnel responsibilities, competence and supervision must be clearly defined by the operator. If the personnel in question is not already in possession of the requisite know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer/supplier to take care of such training.

In addition, the operator is responsible for ensuring

ing that the contents of the operating instructions are fully understood by the responsible personnel.

0.3 Non-compliance with Safety Instructions

Non-compliance with safety instructions can jeopardise the safety of personnel, the environment and the machine itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages

In particular, non-compliance can, for example, result in:

- failure of important machine/unit functions
- failure of prescribed maintenance and servicing practices
- hazard to persons by electrical, mechanical and chemical effects
- hazard to the environment due to leakage of hazardous substances.

0.4 Safety Awareness

It is imperative to comply with the safety instructions contained in this manual, the relevant national health and safety regulations and the operator's own internal work, operation and safety regulations.

0.5 Safety Instructions for the Operator/User

- Any hot or cold components that could pose a hazard must be equipped with a guard by the operator.
- Guards which are fitted to prevent accidental contact with moving parts (e.g. coupling) must not be removed whilst the machine is operating.
- Leakages (e.g. at the shaft seal) of hazardous media handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons and the environment. Pertinent legal provisions must be adhered to.
- Electrical hazards must be eliminated. (In this respect refer to the relevant safety regulation applicable to different countries and/or the local energy supply companies.)

0.6 Safety Instructions for Maintenance, Inspection and Installation Work

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

Work on the machine must be carried out only during standstill. The shutdown procedure described in the manual for taking the machine out of service must be adhered to without fail.

Pumps or pump units handling media injurious to health must be decontaminated.

Immediately following completion of the work, all safety-relevant and protective devices must be reinstalled and/or re-activated.

Please observe all instructions set out in the chapter on "Commissioning" before returning the machine to service.

0.7 Unauthorised Modification and Manufacture of Spare Parts

Modifications or alterations of the machine are only permitted after consultation with the manufacturer. Original spare parts and accessories authorised by the manufacturer ensure safety. The use of other parts can invalidate any liability of the manufacturer for consequential damage.

0.8 Unauthorised Modes of Operation

The warranty relating to the operating reliability and safety of the pump/unit supplied is only valid if the machine is used in accordance with its designated use and if all operating instructions described in chapter 1 have been followed. The limits stated in the data sheet must not be exceeded under any circumstances.

1.0 Transport and interim storage

1.1 Safety instructions



Transport of the unit requires proper preparation and handling. Observe the following explanations and safety instructions.

1.2 Transport

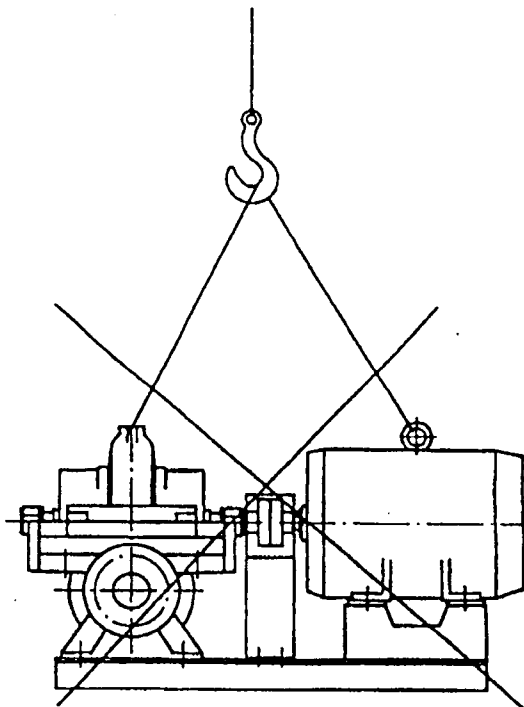
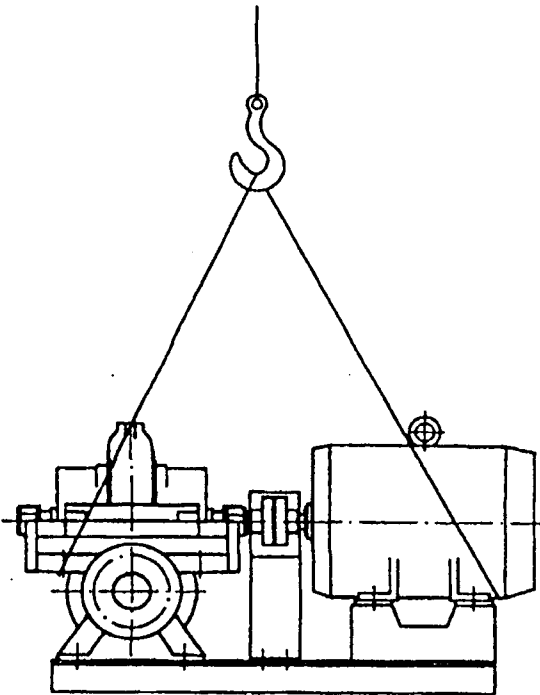
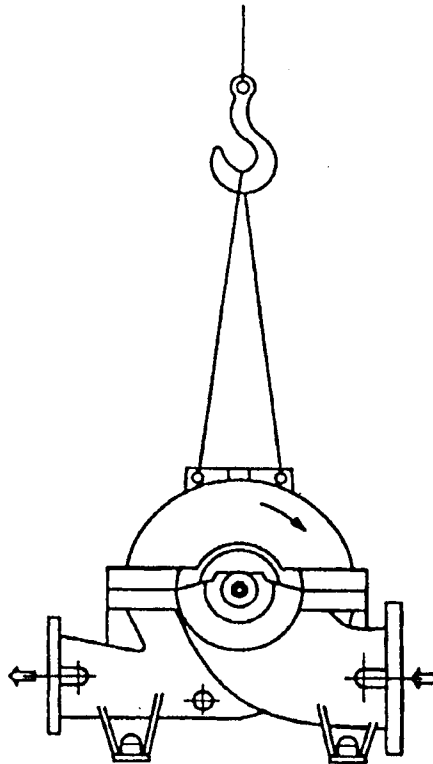
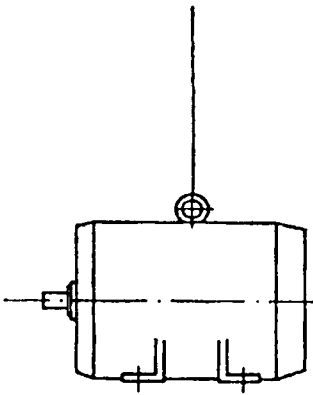
Transport in horizontal position is recommended in all cases, since this ensures stable positioning of the unit without any risk of accident, whatever the method of transport, e.g., road, rail or ship etc.

For transport purpose the unit should be secured on suitable pallets or sleds. All loose and movable parts must be secured.

1.2.1 Lifting the pump unit by crane



The motor lifting lugs must only be used for lifting the motor alone and never for lifting the complete unit.



When lifting the unit by crane, observe the directions of pull. Angles greater than 90° are forbidden.

Use separate belts on each side!

The drawings opposite show correct lifting by crane.

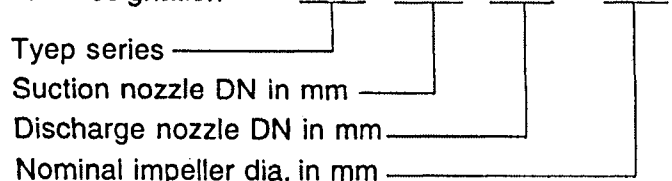
2.0 Description of the product and accessories

2.1 Technical specification

The pump of the TURE series is a horizontally installed, single – stage, axially split volute casing pump with double – entry radial impeller. Connection flanges are manufactured according to DIN, ISO, BS of ANSI, as preferred.

In waterworks, irrigation and drainage pumping plants, power stations, for industrial water supply, in air conditioning systems, dock installations, fire extinguishing systems and many other areas.

2.2 Designation



2.3 Design details

2.3.1 Pump casing

Axially split volute casing with replaceable wear rings. Suction and discharge nozzles in lower half of casing are at the same level (inline version).

2.3.2 Impeller

The double – entry radial impeller is manufactured for the operating data provided in each case. Also with wear rings, if requested.

In double – entry radial impellers the axial thrust is largely balanced.

2.3.3 Pump shaft

The shaft is fully sealed against the liquid being pumped. Shaft – protecting sleeves are fitted in the seal area.

2.3.4 Shaft seal

The shaft seal at the drive end of internal bearing end is designed as described in the " Shaft seal" operating instructions.

2.3.5 Bearings and lubrication

The pump is fitted with the bearing and lubrication

system stated in the design and operating data. The fixed bearing at the internal bearing end is located on a bush to permit rapid changing without removing the rotor or upper half.

2.4 Type of installation

The pump is installed in horizontal position. See "Installation" operating instructions.

2.5 Attachment

The accessories supplied with the pump are specified in the relevant individual operating instructions.

2.6 Dimensions and weights

For dimensions and weights please refer to the pump installation drawing.

3.0 Installation at site

3.1 Safety regulations



Electrical equipment operated in hazardous locations must comply with the explosion protection regulations. This is indicated on the motor rating plate.

If the equipment is installed in hazardous locations. The applicable local explosion protection regulations and the regulations of the test certificate supplied with the equipment and issued by the responsible approval authorities must be observed and complied with.

The test certificate must be kept close to the location of operation for easy access (e. g. foreman's office).

3.2 Checks to be carried out prior to installation

All structural work required must have been prepared in accordance with the dimensions stated in the dimension table/installation plan. The concrete foundations shall have sufficient strength (min. BN 150) to ensure safe and functional installation in accordance with DIN 1045 or equivalent standards. Make sure that the concrete foundation has set firmly before placing the unit on it. Its surface should be truly horizontal and even.

3.3 Installing the pump/unit

See Operating Instructions "Installation".

Caution Before setting up the pump, check the operating data. Ensure that the data on the maker's plate agrees with the data in the order and the system data, e.g. operating voltage, frequency, pumped liquid temperature etc...

3.3.1 Removal of pump rotor securing device

This is not necessary for a horizontally installed pump, since no securing device is fitted.

3.3.2 Aligning the pump/drive

To align the unit, refer to the sections, "Coupling" and "Installation".



Improper alignment of the unit can cause damage to both the coupling and the unit itself!

3.4 Connecting the piping

Caution Never use the pump itself as an anchorage point for the piping. Suction lift lines should be laid with a rising slope towards the pump and suction head lines with a downward slope towards the pump. The pipelines should be anchored in close proximity to the pump and should be connected without transmitting any stresses or strains. Their weight must not exert any load on the pump. With short pipelines, the nominal diameters should be at least equal to the nominal diameters of the pump hazzles. For long pipelines the most economical nominal diameter has to be determined from case to case.

Any additional loads on the discharge and suction nozzles, e.g. caused by:

Weight of the water-filled pipes, changes in the length of pipes owing to temperature fluctuations, reactive forces due to unbraced compensators must not exceed the stated values.



An excessive, impermissible increase in the pipeline forces may cause leaks on the pump where the medium handled can escape into the atmosphere.

Danger of life when hot media are handled!

The flange covers on the pump suction and discharge nozzles must be removed prior to installation in the piping.

3.4.1 Auxiliary connections

The dimensions and locations of the auxiliary connections (cooling, heating, sealing liquid, flushing liquid, etc.) are indicated on the installation plan or piping layout.

More detailed installation instructions are given in the respective operating instructions.

Caution These connections are required for proper functioning of the pump and are therefore of vital importance!

3.4.2 Coupling guard



In compliance with the accident prevention regulations the pump must not be operated without a coupling guard. If the customer specifically requests not to include a coupling guard in our delivery, then the operator must supply one.

3.5 Final check

Re-check the alignment as described in section.

3.3.2

It must be easy to rotate the shaft by hand at the coupling.

Caution Check the integrity and proper functioning of all connections.

4.0 Commissioning, start-up/shutdown

Caution Compliance with the following requirements is of paramount importance. Damage resulting from non-compliance shall not be covered by the scope of warranty.

4.1 Commissioning

Before starting up the pump make sure that the following requirements have been checked and fulfilled.

Has the pump been firmly bolted to the base/foundation?

Have the coupling and pump unit been aligned as specified?

Are the pipes properly fitted?

Has the motor been installed according to its operating instructions?

Can the unit be easily rotated by hand at the coupling?(Carry out at least one full rotation)

Has the coupling guard been fitted?

Have shaft been informed about sources of danger and measures taken to comply with the accident prevention regulations?

Is the unit protected against overload(appropriate safety valve)?

Have the seals been fitted according to their operating instructions?

Have any additional devices been prepared and fitted according to their operating instructions?

Has lubrication been provided for oil-lubricated bearings?

Has the pump been vented as specified in section 4.3?

4.2 Shaft seal

For putting the shaft into operation, refer to Operating instruction "Shaft seal".

If the pump has been out of operation for a prolonged period, the measures specified in section 4.6 must be carried out.

4.3 Venting

Before the pump is started up, it and the pipes must be vented and filled with the liquid to be pumped. In the case of both gravity feed and suction operation venting must be carried out via the hole on the upper suction elbow. In the case of suction operation the pump must additionally be evacuated (a vacuum must be created).

4.4 Commissioning

4.4.1 Checking the direction of rotation

Caution For trouble-free operation of the pump, the correct direction of rotation of the impeller is of paramount importance. If running in the wrong direction of rotation, the pump cannot

reach its duty point; vibrations and overheating will be the consequence. The unit or the shaft seal might be damaged.

Correct direction of rotation:

The direction of rotation must correspond to the direction indicated by the arrow on the pump. This can be verified by switching the pump on and then off again immediately.



Before checking the direction of rotation make sure that there is no foreign matter in the pump casing.

Never put your hands or any other objects into the pump!

4.4.2 Start-up

Caution Dry-running will result in increased wear and must be avoided

If a non-return valve is not fitted at the discharge end, close the delivery gate valve.

If a shut-off valve is fitted at the suction end, open it fully.

All additional connections for cooling, heating, lubrication, irrigation or sealing liquid etc, if fitted, must be opened fully or switched on and the flow must be checked.

Switch on the motor.

As soon as the pump starts to deliver this can be recognized by the rising gauge pressure slowly open the delivery gate valve fully.

Caution The pump may operate against the closed gate valve only during start-up and shutdown, as otherwise inadmissible temperature rise occurs resulting in damage.

4.4.3 Pump operating range

The flow rate "Q" adjusts itself automatically to the delivery head according to the Q-H characteristic. The pumps permitted operating range is subject to limits, which have separate causes.

1. Partial load operating limit with low flow rate

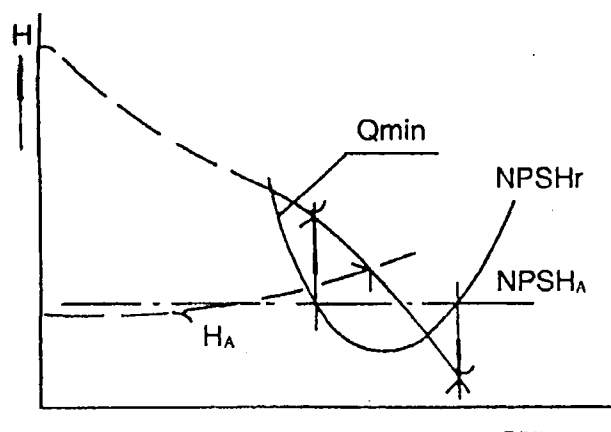
This limit is indicated in the Q-H characteristic by Q_{min} or by the continuation of the characteristic which is not depicted.

Caution It is not permissible to operate the pump in the range from $Q=0$ to Q_{min} ,

prolonged operation in this range causes greatly increased mechanical loads which the components cannot withstand. Brief passage through the critical range is permissible, e. g. during start – up.

2. NPSH – related limits in the partial load and overload ranges

These two limits are determined by the ratio of NPSHr to NPSHa. They are calculated as follows: The intersections of NPSHr and NPSHa are projected onto the Q – H characteristic, where they give the operating limits (refer to the diagram below). Checking of the NPSHr operating limit is not necessary for operating the pump under design conditions. If system – related changes occur, an NPSH check must be carried out. If necessary, consult the nearest Ture aftersales service centre.



4. 4. 4 Shutdown

Close the shut – off element in the discharge line. If the discharge line is equipped with a check valve, the shut – off element may remain open, provided there is back pressure in the line.



The shut – off element in the suction line must not be closed when switching off the pump. Switch off the motor, making sure that the unit runs smoothly down to a standstill. Depending on the system the pump should have an adequate after run period with the heat source switched off to allow the medium handled to cool down sufficiently to avoid any heat build – up within the pump.

In the case of prolonged shutdown, the shut – off

element in the suction line has to be closed. Close the auxiliary connections. The shaft seal in pumps where the liquid is fed in under vacuum must also be lubricated with sealing liquid during standstill.

In the event of frost and/or prolonged shutdowns, the pump and if applicable the cooling chambers must be drained or otherwise protected against freezing.

4. 5 Shutdown/storage/preservation

Each Ture pump leaves the factory carefully assembled. If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump storage.

4. 5. 1 Storage of new pumps

New pumps are supplied by our factory duly prepared for storage.

Maximum protection for up to 12 months, if the pump is properly stored indoors.

Store the pump in a dry location.

4. 5. 2 Measures to be taken for prolonged shutdown

1. The pump remains installed; periodic check of operation

In order to make sure that the pump is always ready for instant start – up and to prevent the formation of deposits within the pump and the pump intake area, start up the pump set regularly once a month or once every 3 month for a short time (approx. 5 minutes) during prolonged shutdown periods. Prior to an operation check run ensure that there is sufficient liquid available for operating the pump.

2. The pump is removed from the pipe and stored. Before putting the pump into storage carry out all checks specified in sections 5. 1 to 5. 4:

Spray – coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative. Spray the preservative through the suction and discharge nozzles. It is advisable to close the nozzles (for ex. with plastic caps or similar)

4.6 Returning to service after storage

Before returning the pump to service carry out all checks and maintenance work specified in sections 5.1 and 5.2.



In addition, the instructions laid down in section 4.1 "Commissioning" and section 4.4.3 Operating limits must be observed.



Upon completion of the work, all safety – related and protective equipment must be properly refitted and/or reactivated before starting the pump set.

5.0 Maintenance/repair

5.1 General Instructions

The operator is responsible for ensuring that all maintenance, inspection and installation work is carried out by authorised, duly qualified staff who are thoroughly familiar with these operating instructions.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble – free reliable operation of the pump with a minimum of maintenance expenditure and work.



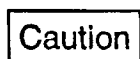
Work on the unit must only be carried out with the electrical connections disconnected. Make sure that the pump set cannot be switched on accidentally (danger of life!)



Pumps handling liquids posing health hazards must be decontaminated. When draining the medium see to it that there is no risk to persons or the environment. All relevant laws must be adhered to (danger of life!).

5.2 Maintenance/inspection

5.2.1 Supervision of operation



The pump should run quietly and free from vibrations at all times. The pump must never be allowed to run dry.



Prolonged operation against a closed shut – off element is not permitted in order to prevent the medium handled from heating up.

At room temperatures of up to 30°C (86°F) the

bearing temperature should not exceed 90°C (194°F). At higher room temperatures, the bearing temperature should be below 100°C (212°F). If the pump features oil – lubricated bearings, the correct oil level must be verified at regular intervals.



During pump operation the shut – off element in the inlet line must not be closed. Any stand – by pumps installed should be switched on and then immediately off again once a week to keep them operational.

Attention should be paid to the correct functioning of the auxiliary connections.

Caution

If the flexible coupling elements begin to show signs of wear, they should be replaced in due time. See Operating Instructions "Coupling".

If the liquid for sealing, cooling and lubricating is taken from an external source, the pressure must be 1.0 to 2.0 bar higher than at the suction nozzle. The gland packing (if the pump is fitted with one) should drip slightly during operation. The gland should only be gently tightened. See Operating Instructions "Shaft seal".

5.2.2 Maintenance of the shaft seal

Maintenance is effected as described in the "Shaft seal" Operating Instructions.

5.2.3 Maintenance of the bearings

The bearings are maintenance – free and are greased for life. No lubrication is required.

Maintenance of oil – lubricated bearings is to be effected as described in the "Oil – lubricated bearings" Operating instructions.

5.3 Dismantling



Before dismantling, secure the pump so as to make sure it cannot be switched on accidentally. The shut – off elements in the suction and discharge lines must be closed. The pump must have cooled down to ambient temperature, it must be drained and its pressure must be released.

Dismantling and reassembly must always be car-

ried out in accordance with the relevant sectional drawing.

5.3.1 Fundamental instructions and recommendations

Repair and maintenance work to the pump must only be carried out by specially trained personnel, using original spare parts.

Observe the safety regulations laid down. And work on the motor shall be governed by the specifications and regulations of the respective motor supplier.

Dismantling and reassembly must always be carried out in accordance with the relevant general drawing. The general drawing and other relevant documents are found in the annex. The dismantling sequence can be derived from the general drawing. In case of damage you can always contact our service departments.

5.3.2 Preparations for dismantling

Please observe the "Coupling" Operating Instructions.

The pump is designed so that the complete rotor can be removed in the sequence described below without removing the suction or discharge pipe or disturbing the alignment of the pump unit:

Close the suction and delivery gate valves and drain the pump by opening the drain plug and vent plug.

Remove any pipes between additional equipment and the pump.

Remove coupling guard.

Detach the pump – side coupling half as described in the Operating Instructions "Coupling".

Loosen and push back the seal cover.

Undo flange screws and release the upper casing half from the lower casing half with the aid of the forcing screws. remove with lifting gear and store in a safe place. The interior of the pump is then free (impeller with casing wear rings, shaft seals) for inspection and further disassembly.

In case of oil – lubricated pumps, drain off the oil.

Remove the screw connection between bearing housing and bearing brackets. Also undo the nuts

and bolts which secure the bearing cover.

Press the bearing housing out of the recesses and lift the rotor upwards out of the lower casing half. For further disassembly, place securely in horizontal position.

Pull off the bearing housing of the fixed bearing (opposite the drive end).

Undo and twist off the grooved nut. Remove the deep groove ball bearing with bush from the shaft.

Remove bearing cover.

Remove V – Ring from shaft – protecting sleeve.

Remove shaft seal housing.

Pull off shaft protecting sleeve.

The impeller is located with sliding fit on the shaft and can normally be removed easily. In case of difficulty, it can be loosened by gently tapping with a plastic hammer.

Remove second shaft protection sleeve complete with the shaft seal housing, if fitted.

Remove coupling half.

Pull off bearing housing.

Remove circlip and pull off deep groove ball bearing.

5.4 Reassembly

Reassembly is effected in reverse order to dismantling. For all work on the pump unit the general diagram, in conjunction with the individual parts list, serves as a guide.

The customary rules of mechanical engineering and also the installation instructions for removal and installation of shaft seal, bearing, impeller wear rings and casing wear rings sections must be observed. In the case of oil – lubricated bearings, the Operating Instructions "Oil – lubricated bearings" must be observed.

For the required tightening torques please refer to works standard ZN 192 unless otherwise specified. It is essential to use the correct tightening torques and the required screw locking devices. The relevant parts are specially indicated in the general drawing.

The symbols for screw locking devices and sealing elements are explained in BN 433.

O – rings and V – rings must be replaced and their

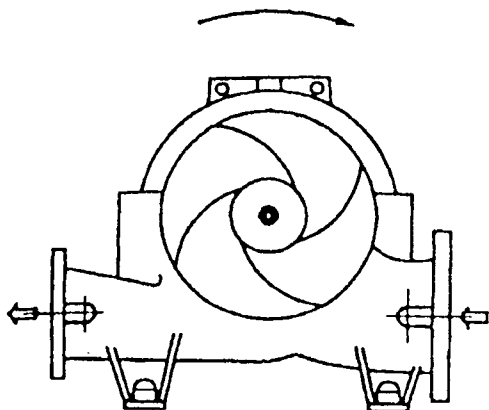
seats on the shaft must be cleaned. In addition, all the sealing elements must be fitted into the components provided for this purpose before installation.

For assembling the rotor, position the pump shaft securely. All fits, threads and sliding fits of the shaft must be cleaned and coated with assembly paste.

Insert the keys required for assembly into the pump shaft.

Mount the impeller, which has a sliding fit.

When fitting the impeller, observe the direction of rotation (see diagram below).



For assembling the casing wear rings, observe item 7.4.2 "Changing the casing wear rings".

Put the casing wear rings onto the running surfaces of the rotor. Ensure that the bezels of the rings are on the outside (towards the bearing). Insert the pins required for fixing the casing wear rings.

The remaining components are fitted first on the movable bearing side (i. e. the drive motor side) of the pump shaft.

Push the shaft protecting sleeve onto the pump shaft. Ensure that the groove provided engages in the key of the impeller.

Push the complete housing shaft seal see Operating Instructions "Shaft seals", V-Ring over the pump shaft.

Push the bearing cover over the shaft.

Heat the deep grooved ball bearing and fit it onto

the pump shaft. It is essential to avoid one sided pressure, e. g. hammer blows, on the outer rings. The bearing is secured by the disc and the securing ring.

To fit the shaft protecting sleeve, shaft seal housing, V-Ring and bearing cover at the interior bearing end, proceed as described above for the drive for the drive motor side.

Heat the deep groove ball bearing and fit it onto the sleeve.

Push the sleeve with deep groove ball bearing onto the pump shaft with key inserted.

Tension the rotor parts elastically with groove nut and disc spring. For this purpose tension the disc spring to blocking point and then undo the grooved nut again by half a turn.

Caution

This measure is essential to compensate for differences in thermal expansion between pump shaft and the components fitted on it.

Fitting of the rotor is then complete.

Insert the rotor into the pump casing.

Apply liquid sealant (refer to the appended list) to the surfaces of the casing wear rings and the sealing faces of the casing.

Insert the rotor, observing the direction of rotation.

The diagram on the previous page shows the correct method of installation.

Align the rotor and ensure that the fixing pins are correctly seated in the casing.

The pins must be positioned as shown in the diagram opposite.

The bearing housings must be fastened to the bearing brackets by means of the screw connections with the sealing cap inserted at the interior bearing end. The seating positions are determined by the recesses.

Fitting the bearing covers.

Before fitting the casing cover, apply liquid sealant to the joint surface of the lower casing half (refer to the appended list).

Tighten the flange screws diagonally from the inside towards the outside.

Insert the keys for fitting the coupling into the pump

shaft.

When fitting the coupling and accessories, refer to the individual operating instructions.

5.5 Note concerning replacement of assemblies/parts

5.5.1 Replacing the shaft seal

Refer to Operating Instructions "Shaft seals".

5.5.2 Replacing casing wear rings and/or impeller wear rings

The impeller clearance is given in the data sheets, "Design and operating data".

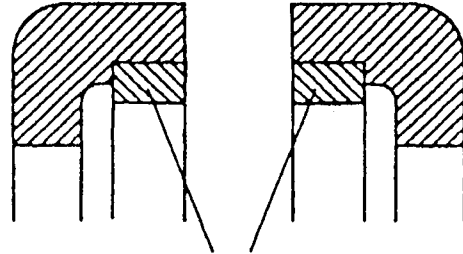
To remove the impeller, proceed as described in section 5.4 "Reassembly".

After reassembly section 5.3.2, the casing wear rings can be removed. When fitting the rings, ensure that their bezels are on the outside (towards the bearing). The pins must be positioned as shown in the following diagram.

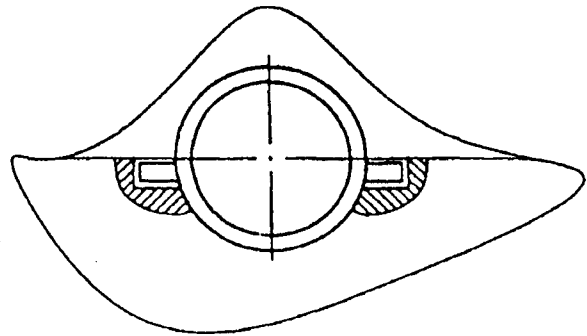
If the impeller has not been fitted with a wear ring at the factory, and changing the casing wear ring alone does not achieve anything close to the required impeller clearance (the impeller neck is

badly worn by split flows), the impeller neck must be turned off on a lathe and an impeller wear ring fitted in addition (available as spare part).

Alternatively, a new impeller can be supplied at short notice.



Casing wear rings



5.6 Spare parts

5.6.1 Purchasing of spares

The following information is required for ordering (see manufacturer's nameplate of refer to the information given in the design and operating data sheets):

Design series; serial number of pump; year of manufacture

The required parts should be specified as follows (see general drawing and spares list).

Example:

Quantity	Description	Material	Part No.
1	Bearing	ST	121

5.6.2 Proposal for spares

5.6.2.1 Recommended spare parts

Recommended spare parts stock for 2 years' operation to VDMA24296
(also for continuous operation)

Part - No.	Part description	Number of pumps (incl. stand - by pumps)						
		2	3	4	5	6	8	10 and more
		Number of spare parts						
117	Impeller	1	1	1	2	2	3	30%
118	Casing wear ring	4	4	4	6	6	8	50%
117.1	Impeller wear ring	4	4	4	6	6	8	50%
	Shaft with keys and shaft nuts	1	1	2	2	2	3	30%
121	Anti - friction bearing	2	2	4	4	6	8	100%
119	Shaft protecting sleeve	4	4	4	6	6	8	50%
128A	Packing ring	32	32	48	48	48	64	40%
	Set of seals	4	6	8	8	9	12	150%
128B	Mechanical Rotating seal ring	4	6	8	8	8	12	90%
	seal: Stationary seal ring	4	6	8	8	8	12	90%
	O - rings	4	6	12	16	16	20	150%
	Seals on stationary seal rings	4	6	12	16	16	20	150%
	Set of springs	1	2	2	2	2	4	20%

These figures already include those components required twice for replacement

5.6.2.2 Interchangeability of rotor components

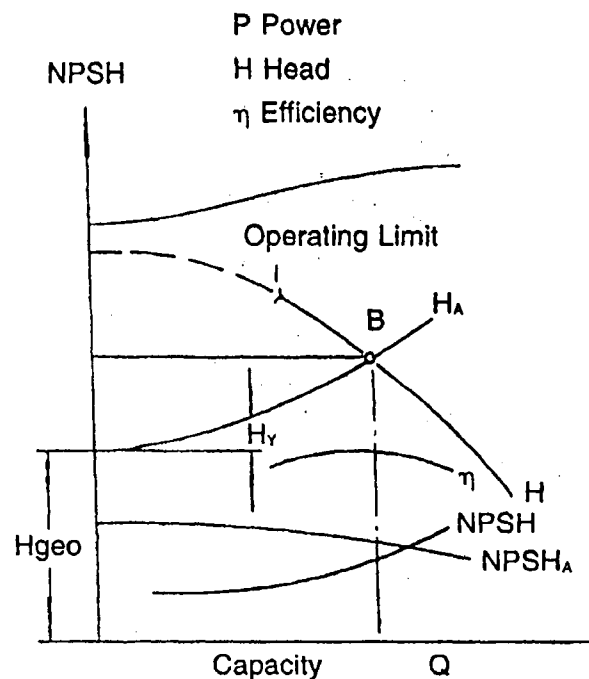
Pump sizes	Pump shaft dia.					
	40	50	60	70	80	90
125 - 80 - 210	*					
125 - 80 - 270	*					
125 - 80 - 370	*					
150 - 100 - 250	*					
150 - 100 - 310	*					
150 - 100 - 375	*					
200 - 125 - 230		*				
200 - 125 - 290		*				
200 - 125 - 365		*				
200 - 125 - 500		*				
200 - 150 - 290		*				
200 - 150 - 360		*				
200 - 150 - 460			*			
200 - 150 - 605			*			
250 - 200 - 320			*			
250 - 200 - 420			*			
250 - 200 - 520				*		
250 - 200 - 670				*		
300 - 250 - 370				*		
300 - 250 - 480					*	
300 - 250 - 600					*	
350 - 300 - 300				*		
400 - 300 - 435					*	
400 - 300 - 560						*
400 - 300 - 700						*
400 - 350 - 360					*	
450 - 350 - 430						*
400 - 350 - 510						*

6.0 Trouble - shooting

6.1 General

The diagram below is to facilitate understanding of the causes of faults and their remedies.

The cause of many operating faults on pumps is often hydraulic. The hydraulic behavior of a pump is illustrated by its characteristic curves H, P, Eta and NPSH in combination with the plant characteristic curves H_A and the pump curve H intersect. The duty point B is where the system curve H_A and the pump curve H intersect. The duty point B is where the system curve H_A and the characteristic curve H intersect. If it is not possible to determine the cause of the trouble, contact the Ture sole agent.



6.2 Causes of faults and their remedies

Faults

Pump pressure too low
 Pump pressure too high
 Flow capacity too high
 Flow capacity too low
 Power consumption too high
 Pump fails to pump liquid after being switched on
 Pump ceases to pump liquid
 Pump does not run smoothly (noise, vibrations)
 Inadmissible temperature increase at pump/seal casing
 Bearing temperature too high
 Excessive leakage at shaft seal
 Drive machine overloaded
 Leakage at pump

												Cause	Remedy
x	x	x	x	x	x			x	x			Duty point B does not lie at the calculated intersections of Q and H	- Re - adjust duty point
					x							Pump or piping incompletely vented or not primed	- Vent
x			x		x	x	x	x				Suction pipe or impeller blocked	- Clean impeller check - Check plant for impurities - Remove deposits in pump and /or piping - Check strainer/suction aperture
					x	x	x					Formation of air pockets in the piping	- Correct suction conditions - Alter piping
x			x		x	x	x					Suction head too high (NPSH available too low)/ water level too low	- Check mode of operation - Correct suction conditions - Increase positive suction head - Increase back pressure by throttling - Install pump at a lower level - Alter suction/intake pipe if resistances are too high
x			x		x	x						Air is drawn in at shaft seal	- Clean sealing liquid line, possibly introduce sealing liquid from an external source or increase pressure - Check level of liquid in feed tank - Renew shaft seal - Renew shaft protecting sleeve
x			x	x			x				x	Wrong direction of rotation	- Change over two phases of the power feed - Check electrical connections - Check impeller position, correct if necessary
x			x				x					Speed too low	- Increase speed - Check switchgear - Fit larger impeller 1)
x			x		x	x						Internals worn	- Check duty point/selection - Increase back pressure by throttling - Check medium handled for contamination by chemicals and the solid matter content - Renew worn components
					x						x	Pump pressure is lower than specified in the order	- Re - adjust duty point - Increase back pressure by throttling
					x						x	Higher density or viscosity of medium handled than specified in the order	- Reduce speed - If there is constant overloading possibly machine impeller 1)
	x	x		x			x				x	Speed too high	- Reduce speed - If there is constant overloading possibly machine impeller 1)
											x	Tie bolts/seals	- Check - Tighten tie bolts - Renew gaskets - Check pipe connections and pump mounting, if necessary improve mounting of piping
											x	Shaft seal worn	- Check flushing/sealing liquid pressure - Check sealing liquid line, possibly introduce sealing liquid from an external source or increase pressure - Renew shaft seal - Renew worn components
x			x				x		x			Unfavourable flow to suction to suction nozzle of pump	- Alter piping - If necessary, alter suction/intake pipe if resistances are too high. - Check whether pipe route has a twisted or irregular flow profile (e.g. downstream of an elbow)

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Faults

Pump pressure too low
 Pump pressure too high
 Flow capacity too high
 Flow capacity too low
 Power consumption too high
 Pump fails to pump liquid after being switched on
 Pump ceases to pump liquid
 Pump does not run smoothly (noise, vibrations)
 Inadmissible temperature increase at pump/seal casing
 Bearing temperature too high
 Excessive leakage at shaft seal
 Drive machine overloaded
 Leakage at pump

												Cause	Remedy
												Gland follower, seal cover (mech. seal) wrongly fitted, incorrect packing material	- Alter - Renew - Correct - Renew gland packing - Renew worn components
												Lack of cooling liquid or cooling liquid chamber contaminated	- Check flushing/sealing liquid pressure - Clean sealing liquid line, possibly introduce sealing liquid from an external source or increase its pressure - Increase flow cooling liquid - Clean cooling liquid
												Pump mis - aligned or there are resonance vibrations in the piping	- Re - align pump/drive machine - Check piping connections and pump mounting, if necessary improve mounting of piping - Apply vibration - damping measures
												Excessive axial thrust	- Check duty point/layout - Check mode of operation - Check suction flow
												Too little, too much or unsuitable lubricant	- Clean bearing - Renew lubricant - Top up reduce or change lubricant
x		x	x									Running on two phases	- Renew defective fuses - Check electrical connections - Check switchgear
												Rotor imbalance	- Clean rotor - Check rotation re - align necessary - Re - balance rotor
												Bearings damaged	- Renew/change
												Flow capacity too low	- Re - adjust duty point - Fully open shut - off valve in the suction/intake pipe - Fully open shut - off valve in the discharge pipe - Recalculate or measure the hydraulic losses H _v
x			x									In star/delta operation motor sticks at star stage	- Check electrical connections - Check switchgear
x			x									Inadmissible air or gas content in liquid	- Vent - Check integrity of suction pipe seal if necessary
x			x									Air drawn in at pump inlet	- Correct suction conditions - Reduce flow velocity at suction pipe entry - Increase suction head - Check integrity of suction pipe and seal if necessary - Renew defective pipes
												Cavitation (rattling noise)	- Correct suction conditions - Check mode of operation - Increase suction head - Install pump at a lower level
												Foundation not rigid enough	- Check - Alter
x			x									Inadmissible parallel operation	- Re - adjust duty point - Alter pump characteristic**
												Shaft is out of true	- Renew/change
												Impeller fouls casing components	- Check rotor - Check impeller position - Check that the piping is connected free of stress

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7.0 Routine maintenance and inspections intervals

Interval	Number of personnel required	Time(h)	Maintenance job
Daily	1	1/10	- Check leakage on mechanical seal or leakage of packed gland (see operating instructions "Shaft seal")
Weekly	1	1/4	- Check pump operation (positive suction pressure, total head, bearing temperature, noises and vibrations)
Monthly	1 1	1/4 1/4	- Check twist play of coupling (see operating instructions "Coupling") - If available, switch to stand - by pump or carry out a test run (for 5 min.)
every 20. 000 operating hours	2	3	- Renew deep - groove ball brgs. (see operating instruction)
every 4 years or if total head of pump drops	2	6	- General inspection and overhaul of pump in accordance with the operating instructions Check and renew, if required: - wear parts such as: bearings, casing wear rings (impeller wear rings, if provided), shaft sleeves - impeller and shaft