TURBINE TERMINOLOGY

1. **DATUM OR GRADE** — The elevation of the surface from which the pump is supported.
2. **STATIC WATER LEVEL** — The vertical distance from grade to the water level when no water is being drawn from the well.
3. **DRAWDOWN** — The distance between the static water level and the water level when pumping at required capacity.
4. **PUMPING WATER LEVEL** — The vertical distance from grade to water level when pumping at required capacity. Pumping water level equals static Water Level plus Drawdown.
5. **SETTING** — The distance from grade to the top of the pump bowl assembly.
6. **FIELD PUMPING HEAD** — Lift below discharge plus head above discharge plus friction losses in discharge line. This is the head for which the customer is responsible and does not include any losses within the pump.
7. **COLUMN FRICTION LOSS** — Head loss in the pump due to friction in the column assembly. Friction loss is measured in feet and is dependent upon column and shaft size and setting. Values given in chart, page 200.B1.
8. **TDH (LAB. HEAD)** — Total head which the pump bowl assembly must deliver at the given capacity. TDH equals Field Pumping Head plus Column Friction Loss.
9. **LABORATORY EFFICIENCY** — The efficiency of the bowl unit only. This value is read directly from the performance curve.
10. **LABORATORY HORSEPOWER** — The horsepower required by the bowls only to deliver a given capacity against Laboratory Head.

$$\text{LAB. HP} = \frac{\text{TDH x Capacity}}{\text{3960 x Laboratory Efficiency}}$$

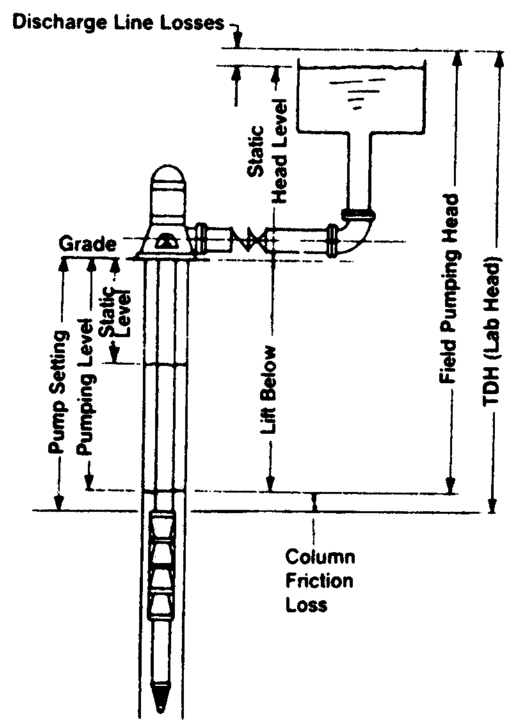
11. **SHAFT FRICTION LOSS** — The horsepower required to turn the lineshaft in the bearings. These values are given in chart, page 200.B3.
12. **FIELD HORSEPOWER OR BRAKE HORSEPOWER** — Sum of laboratory horsepower plus shaft loss (and the driver thrust bearing loss under certain conditions.)
13. **PUMP FIELD EFFICIENCY (WATER TO WATER)** — The efficiency of the complete pump less the driver, with all losses between laboratory and field performance being taken into account.

$$\text{Field Efficiency} = \frac{\text{Field Pumping Head x Capacity}}{\text{3960 x Brake Horsepower}}$$

14. **TOTAL PUMP THRUST** — The sum of the weight of the shaft plus hydraulic thrust of the liquid being pumped. Chart, page 200.B2 gives shaft weight per foot. Performance curves give hydraulic "K" factor. Total thrust equals:

    Shaft Wt. Per Foot x Setting in Feet + "K" x TDH

15. **OVERALL EFFICIENCY (WIRE TO WATER)** — The efficiency of the pump and motor complete. Overall efficiency = Pump Field Efficiency x Motor Efficiency.



DWT TURBINE PUMP SELECTION PROCEDURE

1. TENTATIVE BOWL SELECTION — Select best bowl assembly for capacity and head, pumping conditions and well size. Curves are drawn per stage so head per stage must be multiplied by the number of stages required.

(a) Add 5 ft. column friction loss per 100 ft. of column to field pumping head to determine approximate TDH. Choose best pump, keeping well diameter and Engineering limitations in mind. To determine number of stages required, divide TDH by head per stage of selected turbine bowl.

(b) Record efficiency for number of stages used. Note that up to 4 or 5 stages, efficiency may have to be reduced per chart on right hand side of curve.

(c) Calculate lab. horsepower from curve or by formula:

$$HP = \frac{\text{Capacity x TDH}}{\text{3960 x Corrected Laboratory Efficiency}}$$

(d) Calculate approximate thrust = TDH x "K" (from performance curve) x specific. gravity for liquids other than fresh water.

2. LINESHAFT SELECTION

(e) Size lineshaft for horsepower under (c) from Horsepower chart, page 200.B3.

(f) Calculate thrust due to lineshaft weight from Horsepower chart, page 200.B2. Thrust due to shaft weight equals weight per foot x setting in feet.

(g) Add (f) and (d) for total thrust. Check that lineshaft will take thrust load from Horsepower chart, page 200.B3.

3. COLUMN SELECTION

(h) Select column size for required capacity from Column Friction Loss chart, page 200.B1. Choose column with losses in the bold figures, unless setting is very short, making column friction negligible.

4. FINAL BOWL SELECTION

(i) Calculate column friction loss by multiplying loss per 100 ft. under (h) x number of 100 ft. lengths.

(j) Add (i) to Field Pumping Head. This gives final TDH.

(k) Re-select number of stages and head per stage for new head under (j).

(l) Calculate new Laboratory Horsepower from curve or formula:

$$HP = \frac{\text{Capacity x Final TDH}}{\text{3960 x Corrected Laboratory Efficiency}}$$

5. CHECK LINESHAFT SIZE

(m) Check that lineshaft can carry new horsepower under (l).

(n) Check lineshaft stretch, page 200.B4. If stretch is greater than lateral adjustment, consult factory or choose next larger shaft size, use "K" Factor Thrust only.

6. BRAKE HORSEPOWER CALCULATION

(o) Calculate shaft friction loss from Table, page 200.B2 number of 100 ft. lengths. Add this to (l) for brake horsepower required.

7. DRIVER SIZE

(p) Select the driver size based on the brake horsepower speed and total thrust (g). Record driver B.D.

8. DISCHARGE HEAD

(q) Select discharge head for column and shaft size and driver B.D. dimension. Check setting, total weight and thrust values Section 3A.2B4W to be sure values are not exceeded.

GOULDS PUMPS, INC.
TEXAS DIVISION-STD. PRODUCTS GROUP

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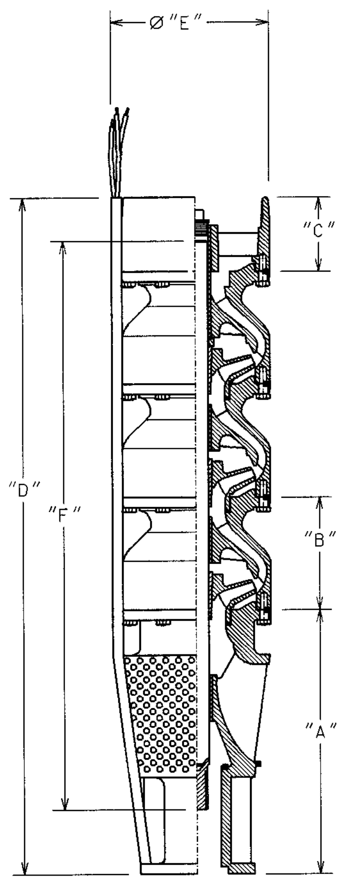
Submersible Turbine Pumps Engineering Data

Effective January 1, 2000

Submersible Pump Data

Model	NEMA	"A"	"B"	"C"	"D"	"E"	"F"	Disch. Size	First Stage Wt.	Add'l Stage Wt.
5C	4	8.25	4.63	3.06	15.94	5.64	12.88	3,4	44	13
	6	10.56	4.63	3.06	18.25	5.64	13.63	3,4	49	13
5T	4	8.25	4.81	3.06	16.13	5.64	13.06	3,4	44	13
	6	10.56	4.81	3.06	18.44	5.64	13.81	3,4	49	13
5WA	4	8.38	4.00	3.06	15.44	5.64	13.25	3,4	44	13
	6	10.56	4.00	3.06	17.63	5.64	13.75	3,4	49	13
6C	4	8.44	5.13	3.75	17.31	6.28	13.63	3,4,5	50	17
	6	10.56	5.13	3.75	19.44	6.28	14.25	3,4,5	55	17
	8	12.50	5.13	3.75	21.38	6.28	15.38	3,4,5	60	17
6DH	4	4.94	5.50	3.75	14.19	5.94	10.63	3,4,5	41	16
	6	9.75	5.50	3.75	19.00	5.94	13.75	3,4,5	53	16
6RA	6	10.56	3.75	3.75	18.06	5.94	12.88	3,4	90	20
7C	6	12.88	6.38	3.63	22.88	7.50	18.50	5,6	75	28
	8	14.56	6.38	3.63	24.56	7.50	19.25	5,6	87	28
7RA	6	8.44	4.50	3.63	16.56	7.90	11.50	3,4	105	28
7T	6	12.88	7.09	3.63	23.59	7.50	19.06	5,6	78	31
	8	14.56	7.09	3.63	25.28	7.50	19.94	5,6	90	31
7WA	6	12.88	5.50	3.63	22.00	7.50	17.75	5,6	68	30
	8	14.56	5.50	3.63	23.69	7.50	18.50	5,6	80	30
8DH	6	12.88	7.38	3.63	23.88	7.90	19.25	5,6	125	34
	8	14.56	7.38	3.63	25.56	7.90	20.13	5,6	137	34
8I	6	12.88	6.38	3.63	22.88	7.90	18.13	5,6	90	33
	8	14.56	6.38	3.63	24.56	7.90	18.88	5,6	102	33
8RA	6	12.88	5.00	3.63	21.50	7.90	17.25	4,5,6	165	36
	8	14.56	5.00	3.63	23.19	7.90	18.13	4,5,6	177	36
8RJ	6	12.88	6.50	3.63	23.00	7.90	17.50	5,6	90	34
	8	14.56	6.50	3.63	24.69	7.90	18.88	5,6	102	34
9RA	6	12.88	5.50	3.63	22.00	7.90	17.50	4,5,6	185	46
	8	14.56	5.50	3.63	23.69	7.90	18.50	4,5,6	197	46
9RC	6	15.13	8.50	4.50	28.13	9.81	24.25	5,6,8	194	64
	8	13.25	8.50	4.50	26.25	9.81	21.50	5,6,8	206	64
	10	13.25	8.50	4.50	26.25	9.81	20.50	5,6,8	206	64
9T	6	15.13	9.25	4.50	28.88	9.81	25.00	5,6,8	200	70
9RT	8	13.25	9.25	4.50	27.00	9.81	22.25	5,6,8	212	70
	10	13.25	9.25	4.50	27.00	9.81	21.25	5,6,8	212	70
9WA	6	15.13	6.63	4.50	26.25	9.81	22.38	5,6,8	158	58
	8	13.25	6.63	4.50	24.38	9.81	19.63	5,6,8	170	58
	10	13.25	6.63	4.50	24.38	9.81	18.63	5,6,8	170	58
10DH	8	13.25	9.25	4.50	27.00	10.00	22.00	6,8	185	65
	10	13.25	9.25	4.50	27.00	10.00	22.00	6,8	190	65
	12	13.25	9.25	4.50	27.00	10.00	21.00	6,8	190	65
10RA	6	15.13	6.63	4.50	26.25	10.00	22.38	4,6,8	280	76
	8	13.25	6.63	4.50	24.38	10.00	19.63	4,6,8	285	76
	10	13.25	6.63	4.50	24.38	10.00	18.63	4,6,8	285	76
10RJ	6	15.13	8.40	4.50	28.03	10.00	23.38	6,8	187	60
	8	13.25	8.40	4.50	26.15	10.00	20.75	6,8	192	60
	10	13.25	8.40	4.50	26.15	10.00	19.75	6,8	192	60
10WA	6	15.13	7.63	4.50	27.25	10.00	23.38	4,6,8	183	56
	8	13.25	7.63	4.50	25.38	10.00	20.63	4,6,8	188	56
	10	13.25	7.63	4.50	25.38	10.00	19.63	4,6,8	188	56

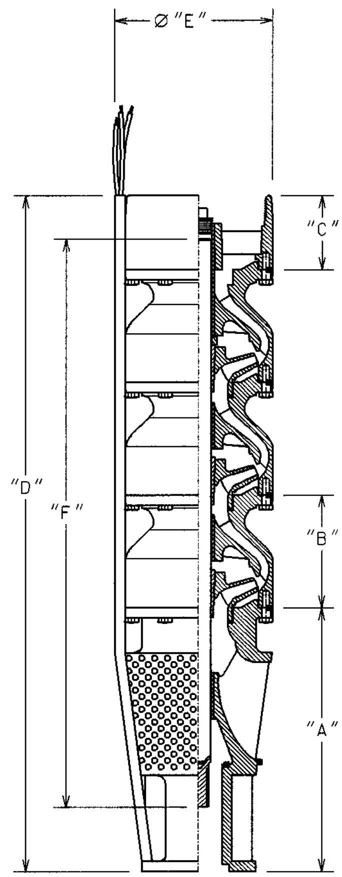


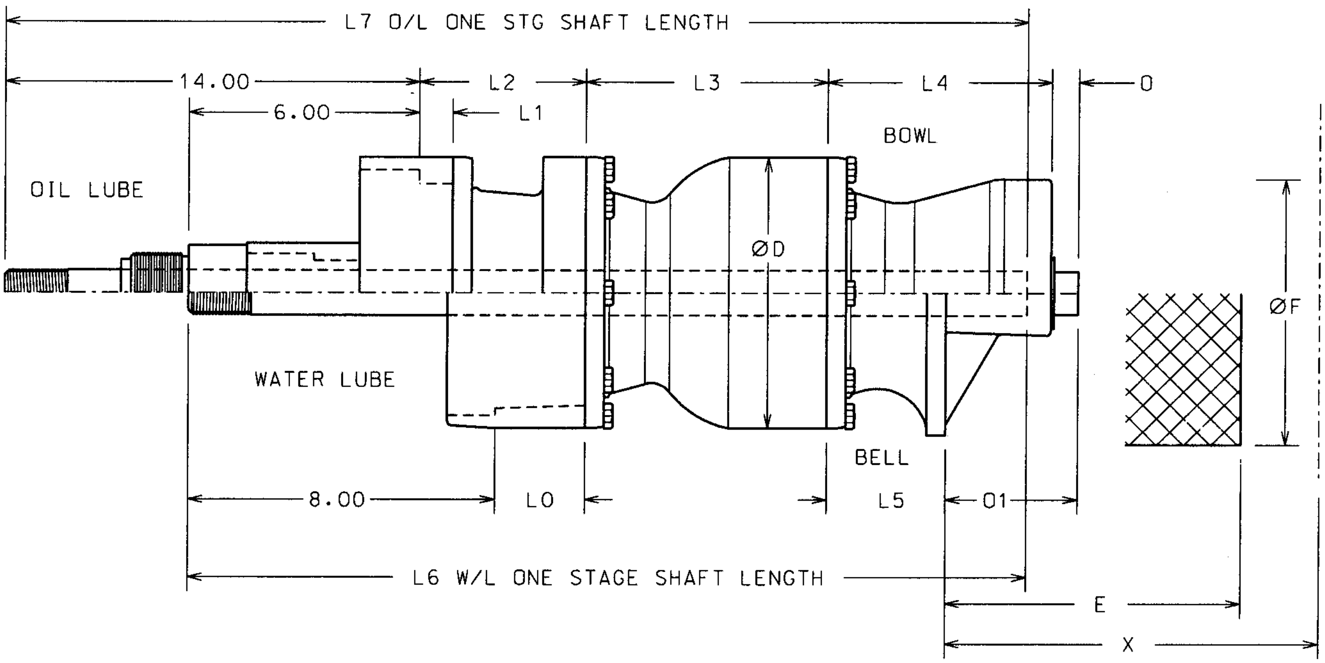
Goulds Pumps

ITT Industries

Submersible Pump Data

Model	NEMA	"A"	"B"	"C"	"D"	"E"	"F"	Disch. Size	First Stage Wt.	Add'l Stage Wt.
11C	8	13.25	9.88	5.13	28.25	11.50	23.75	6,8,10	285	97
	10	13.25	9.88	5.13	28.25	11.50	23.75	6,8,10	285	97
	12	13.25	9.88	5.13	28.25	11.50	22.75	6,8,10	285	97
11RA	6	14.44	8.00	5.88	28.31	12.10	24.25	6,8,10	415	103
	8	13.25	8.00	5.88	27.13	12.10	22.25	6,8,10	415	103
	10	13.25	8.00	5.88	27.13	12.10	21.25	6,8,10	415	103
11WA	8	13.25	8.75	5.13	27.13	11.50	23.00	5,6,8	275	90
	10	13.25	8.75	5.13	27.13	11.50	23.00	5,6,8	275	90
	12	13.25	8.75	5.13	27.13	11.50	22.00	5,6,8	275	90
12C	8	19.00	11.00	6.25	36.25	12.10	30.25	6,8,10	345	124
	10	19.00	11.00	6.25	36.25	12.10	30.25	6,8,10	345	124
	12	19.00	11.00	6.25	36.25	12.10	29.25	6,8,10	345	124
12DH	8	19.00	11.25	6.25	36.50	12.10	31.25	6,8,10	360	129
	10	19.00	11.25	6.25	36.50	12.10	31.25	6,8,10	360	129
	12	19.00	11.25	6.25	36.50	12.10	30.25	6,8,10	360	129
12FR	8	16.50	12.50	6.25	35.25	12.10	30.00	10	350	129
	10	16.50	12.50	6.25	35.25	12.10	30.00	10.00	350	129
	12	16.50	12.50	6.25	35.25	12.10	29.00	10.00	350	129
12WA	8	13.25	9.00	5.88	28.13	12.10	23.25	6,8,10	250	95
	10	13.25	9.00	5.88	28.13	12.10	23.25	6,8,10	250	95
	12	13.25	9.00	5.88	28.13	12.10	22.25	6,8,10	250	95
12RJ	8	19.00	9.60	5.88	34.48	12.10	29.63	6,8,10	310	95
	10	19.00	9.60	5.88	34.48	12.10	29.63	6,8,10	310	95
	12	19.00	9.60	5.88	34.48	12.10	28.63	6,8,10	310	95
13C	8	20.00	11.13	6.25	37.38	13.75	32.50	8,10	425	150
	10	20.00	11.13	6.25	37.38	13.75	32.50	8,10	425	150
	12	20.00	11.13	6.25	37.38	13.75	31.50	8,10	425	150
13RA	8	20.00	9.50	5.25	34.75	13.75	29.50	8,10	505	164
	10	20.00	9.50	5.25	34.75	13.75	29.50	8,10	505	164
	12	20.00	9.50	5.25	34.75	13.75	28.50	8,10	505	164
14F	10	21.00	13.63	8.63	43.25	14.50	37.38	10,12	680	195
	12	21.00	13.63	8.63	43.25	14.50	36.38	10,12	680	195
	14	21.00	13.63	8.63	43.25	14.50	36.38	10,12	680	195
14H	10	21.00	13.63	8.63	43.25	14.50	37.38	10,12	680	195
	12	21.00	13.63	8.63	43.25	14.50	36.38	10,12	680	195
	14	21.00	13.63	8.63	43.25	14.50	36.38	10,12	680	195
14RJ	10	20.00	11.50	5.25	36.75	14.00	31.50	10,12	445	155
	12	20.00	11.50	5.25	36.75	14.00	30.50	10,12	445	155
	14	21.00	11.50	5.25	37.75	14.00	31.50	10,12	445	155





Turbine Mechanical Bowl Data

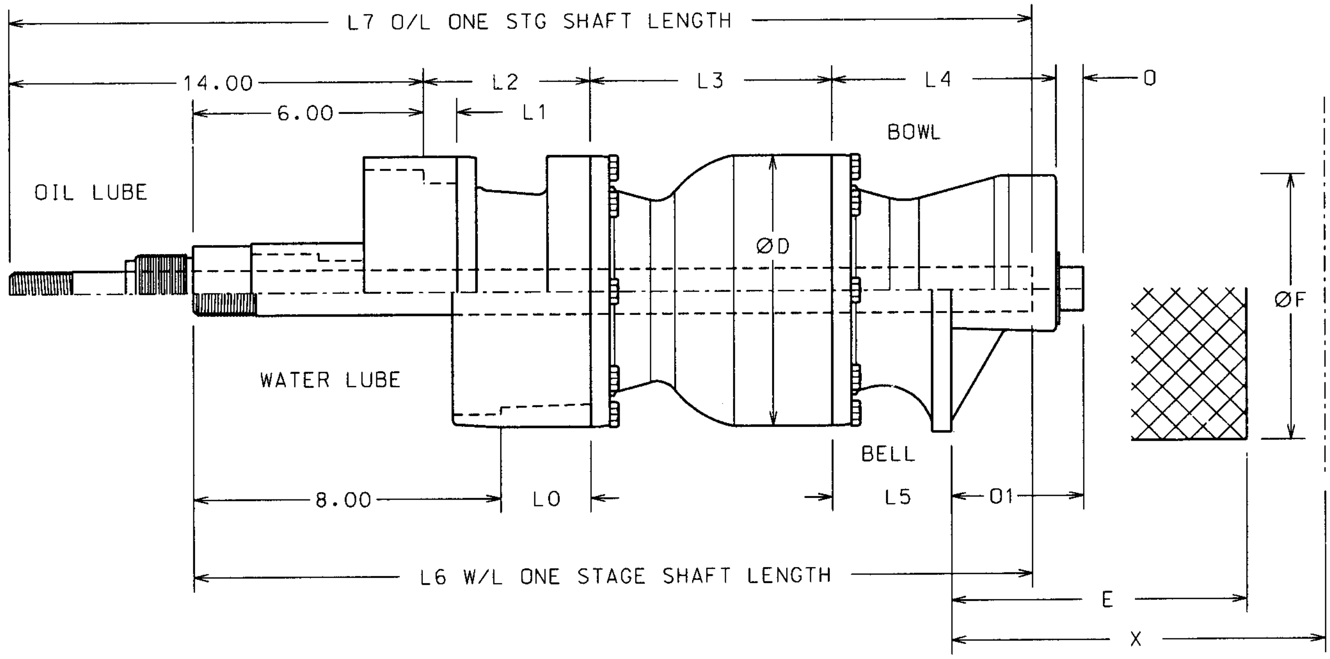
Model and Size	Bowl Assembly Length										Basket Strainer (Optional)		Floor Clearance	Bowl O.D.	Bowl Shaft Dia.	Available Lineshaft Sizes	Column Pipe Size	Suction Pipe Size	1st Stage Bowl Assembly Wt.		Add'l Stage Wt.
	L_0	L_1	L_2	L_3	L_4	L_5	L_6	L_7	O	O1	E	F	X	D					Open Shaft	Encl. Shaft	
5C	1.81	N/A	4.75	4.63	5.00	N/A	18.50	N/A	0.63	N/A	N/A	N/A	2.00	5.20	1.00	1.00	3,4	4	42	N/A	13
5T	1.81	N/A	4.75	4.81	5.00	N/A	18.63	N/A	0.63	N/A	N/A	N/A	2.00	5.20	1.00	1.00	3,4	4	43	N/A	13
5WA	1.81	N/A	4.75	4.00	5.00	3.00	17.88	26.81	0.63	2.63	5.50	7.00	6.00	5.20	1.00	1	3,4	4	40	N/A	13
6C	2.50	N/A	4.75	5.13	5.00	3.94	19.88	28.13	0.63	1.69	4.63	7.00	2.00	5.88	1.00	1.00	3,4	4	47	55	17
6DH	2.06	N/A	5.13	5.50	5.38	5.38	21.06	30.13	1.75	1.75	4.00	7.31	4.63	5.50	1.00	1.00	3,4	4,5	48	57	16
6RA	2.06	N/A	5.13	3.75	N/A	3.00	19.19	28.25	N/A	4.00	4.63	7.00	6.00	5.50	1.00	1.00	3,4	N/A	42	52	20
7C	2.38	0.88	4.38	6.38	5.88	3.13	22.00	30.00	1.00	3.75	5.25	9.25	4.50	7.13	1.19	1.00-1.19	5,6	5	50	72	28
7RA	2.38	1.19	4.38	4.50	N/A	3.75	20.38	28.38	N/A	3.38	4.63	7.00	5.38	7.50	1.00	1.00	3,4	N/A	51	69	28
7T	2.38	0.88	4.38	7.09	5.88	3.13	22.81	30.81	1.00	3.75	5.25	9.25	5.50	7.13	1.19	1.00-1.19	5,6	5	53	71	31
7WA	2.38	0.88	4.38	5.50	6.13	3.25	21.25	29.25	1.00	3.75	5.25	9.25	8.00	7.13	1.19	1.00-1.19	4,5,6	4	54	76	30
8DH	2.38	1.19	4.38	7.38	6.00	6.00	24.75	32.75	2.88	2.88	8.25	8.38	9.00	7.50	1.19	1.00-1.19	5,6	6	80	95	34
8I	2.38	1.19	4.38	6.38	6.88	3.75	23.00	31.00	0.75	4.13	5.25	9.25	6.50	7.50	1.19	1.00-1.19	5,6	5	75	90	33
8RA	2.38	1.19	4.38	5.00	N/A	3.19	20.63	28.63	N/A	3.69	5.63	8.00	5.88	7.50	1.19	1.00-1.19	4,5,6	N/A	67	82	36
8RJ	2.38	1.19	4.38	6.50	6.25	3.50	22.53	30.53	1.00	3.75	5.25	9.25	6.50	7.50	1.19	1.00-1.19	5,6	5	77	92	34
9RA	2.38	1.19	4.38	5.50	N/A	3.25	21.88	29.88	N/A	4.13	5.63	8.00	7.25	7.50	1.19	1.00-1.19	4,5,6	N/A	66	126	46
9RC	3.00	1.25	5.25	8.50	9.25	5.00	28.00	36.25	0.88	5.13	5.25	9.25	7.13	9.25	1.50	1.00-1.50	5,6,8	6	144	182	64
9T	3.00	1.25	5.25	9.25	9.25	5.00	28.75	37.00	0.88	5.13	6.88	11.25	7.13	9.25	1.50	1.00-1.50	5,6,8	6	150	188	70
9WA	3.00	1.25	5.25	6.63	9.25	5.00	26.13	34.38	0.88	5.13	6.88	11.25	7.13	9.25	1.50	1.00-1.50	5,6,8	6	138	176	58

(All dimensions are in inches and weights in lbs.)

Continued on next page.

Vertical Turbine Pumps Engineering Data

Effective January 1, 2000



Turbine Mechanical Bowl Data

Model and Size	Bowl Assembly Length										Basket Strainer (Optional)		Floor Clearance	Bowl O.D.	Bowl Shaft Dia.	Available Lineshaft Sizes	Column Pipe Size	Suction Pipe Size	1st Stage Bowl Assembly Wt.		Add'l Stage Wt.
	L_0	L_1	L_2	L_3	L_4	L_5	L_6	L_7	0	01	E	F	X	D					Open Shaft	Encl. Shaft	
10DH	2.94	1.25	5.19	9.25	8.38	5.75	30.63	38.88	4.44	7.06	11.38	14.75	14.00	9.50	1.69	1.00-1.69	6,8	8	140	170	64
10L	2.94	1.25	7.63	8.75	9.38	9.38	30.81	41.50	4.00	4.00	6.63	12.75	6.50	9.50	1.69	1.00-1.69	8,10	8	195	225	64
10RA	2.94	1.25	5.19	6.63	N/A	3.94	25.06	33.31	N/A	5.69	7.25	8.50	7.88	9.50	1.50	1.00-1.50	4,6,8	N/A	141	176	76
10RJ	2.94	1.25	5.19	8.40	9.69	5.88	28.13	36.44	0.94	4.75	6.25	12.75	7.50	9.50	1.50	1.00-1.50	6,8	6	130	165	60
10WA	2.94	1.25	5.19	7.63	9.19	5.06	27.13	35.38	1.00	5.13	6.63	11.25	9.00	9.50	1.50	1.00-1.50	4,6,8	6	126	160	56
11C	3.50	1.00	5.75	9.88	10.13	5.63	30.25	38.50	0.88	5.38	6.25	12.13	8.00	11.00	1.69	1.00-1.69	6,8,10	8,10	240	265	97
11RA	4.13	2.13	5.75	8.00	N/A	4.63	28.63	36.25	N/A	6.00	6.63	10.63	8.13	11.60	1.69	1.00-1.69	6,8,10	N/A	216	231	103
11WA	3.50	1.00	5.75	8.75	10.13	5.63	29.38	37.63	0.88	5.38	6.25	12.13	9.50	11.00	1.69	1.00-1.69	5,6,8	8	229	254	90
12C	4.13	2.13	5.75	11.00	10.38	6.88	32.63	40.25	0.88	4.38	6.25	12.13	8.00	11.75	1.69	1.00-1.69	6,8,10	8,10	263	295	124
12DH	4.13	2.13	5.75	11.25	9.50	8.00	33.25	40.88	2.50	4.00	6.25	12.13	13.00	11.60	1.94	1.00-1.94	6,8,10	10	275	300	129
12FR	4.13	N/A	8.25	12.50	9.13	8.00	33.75	43.88	2.88	4.00	6.25	12.13	13.00	11.75	1.94	1.00-1.94	10	10	255	320	129
12WA	4.13	2.13	5.75	9.00	9.75	6.88	29.88	37.50	1.00	3.88	6.25	12.13	8.00	11.60	1.69	1.00-1.69	6,8,10	6	240	265	95
12RJ	4.13	2.13	5.75	9.60	10.38	6.88	30.81	38.50	0.88	4.38	6.25	12.13	8.00	11.60	1.69	1.00-1.69	6,8,10	8	250	275	95
13C	4.13	N/A	5.75	11.13	10.13	5.56	32.00	39.63	1.00	5.56	6.25	12.13	8.00	12.38	1.94	1.00-1.94	8,10	10	315	380	150
13RA	3.13	3.00	9.00	9.50	N/A	7.00	31.38	43.25	N/A	5.50	11.50	14.75	7.63	13.38	1.94	1.00-1.94	8,10,12	N/A	374	459	164
14DH	3.13	3.00	9.00	13.25	10.75	10.75	37.00	49.88	5.88	5.88	13.25	15.50	18.00	13.25	2.19	1.19-2.19	10,12	12	405	490	169
14F	6.50	N/A	13.50	13.63	11.00	11.00	40.25	53.25	3.75	3.75	11.38	13.75	12.00	14.00	2.19	1.19-2.19	10,12	10	493	568	195
14H	6.50	N/A	13.50	13.63	11.00	11.00	40.25	53.25	3.75	3.75	11.38	13.75	12.00	14.00	2.19	1.19-2.19	10,12	10	493	568	195
14RJ	3.13	3.00	9.00	11.50	10.38	6.25	31.75	43.63	1.13	5.25	9.63	14.00	10.00	13.63	1.94	1.00-1.94	8,10,12	10	390	475	155

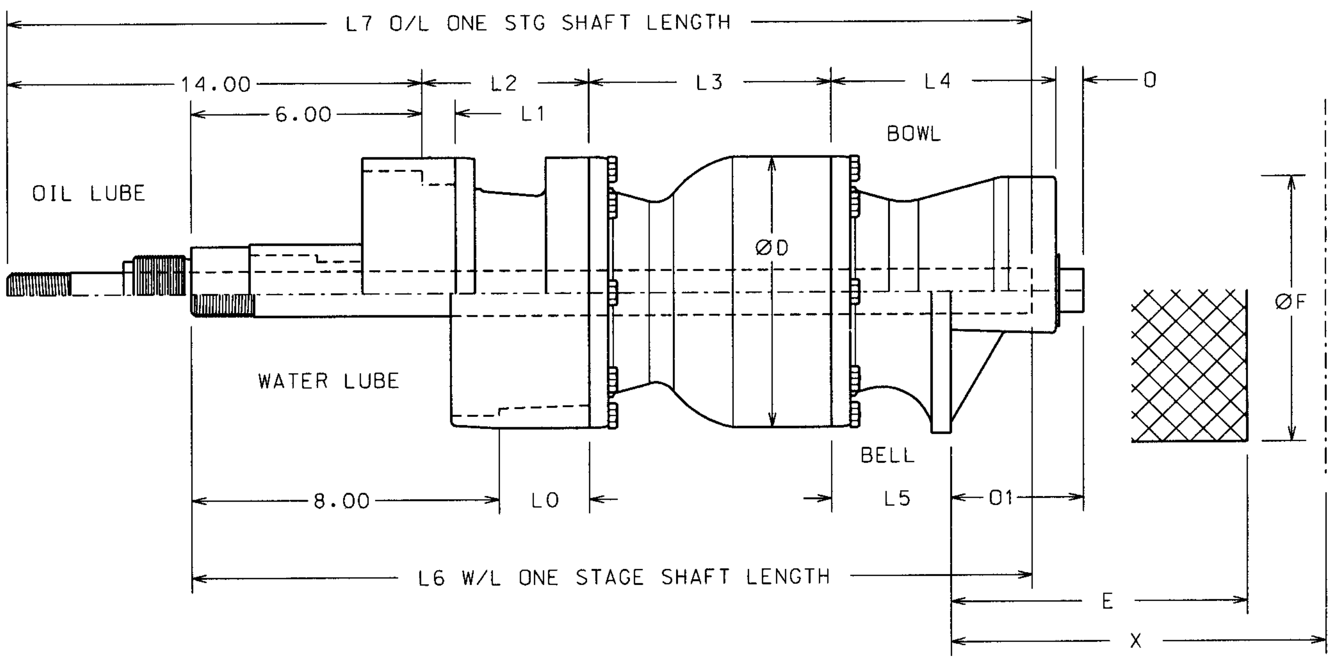
(All dimensions are in inches and weights in lbs.)

Continued on next page.

GOULDS PUMPS

Vertical Turbine Pumps Engineering Data

Effective January 1, 2000



Turbine Mechanical Bowl Data

Model and Size	Bowl Assembly Length										Basket Strainer (Optional)		Floor Clearance	Bowl O.D.	Bowl Shaft Dia.	Available Lineshaft Sizes	Column Pipe Size	Suction Pipe Size	1st Stage Bowl Assembly Wt.		Add'l Stage Wt.
	L_0	L_1	L_2	L_3	L_4	L_5	L_6	L_7	O	O1	E	F	X	D					Open Shaft	Encl. Shaft	
15F BELL	5.75	N/A	13.00	16.00	N/A	8.00	38.50	51.75	N/A	4.75	12.00	17.50	16.00	14.75	2.19	1.19-2.19	12,14	N/A	535	620	222
15F BOWL	5.75	N/A	13.00	16.00	12.63	N/A	45.25	58.50	5.38	N/A	N/A	N/A	16.00	14.75	2.19	1.19-2.19	12,14	12,14	535	620	222
16B	N/A	N/A	10.00	14.00	N/A	10.25	C/F	C/F	N/A	4.75	19.00	17.50	8.00	16.13	2.44	1.19-2.44	8,10,12	N/A	465	680	300
16DH BELL	4.25	N/A	12.75	15.25	N/A	8.00	37.50	52.00	N/A	4.75	12.00	17.50	17.00	15.25	2.44	1.19-2.44	12,14	N/A	660	764	281
16DH BOWL	4.25	N/A	12.75	15.25	12.63	N/A	42.25	56.75	5.38	N/A	N/A	N/A	17.00	15.25	2.44	1.19-2.44	12,14	12,14	660	764	281
16DM	10.25	N/A	9.88	15.25	12.75	10.75	46.25	51.88	2.50	4.50	16.00	17.50	9.25	16.13	2.44	1.19-2.44	12,14	12,14	490	710	320
18B	N/A	N/A	11.25	13.00	N/A	8.63	C/F	C/F	N/A	3.50	16.88	19.50	15.06	17.50	2.44	1.19-2.44	12,14,16	N/A	514	742	354
18D	N/A	N/A	9.88	16.75	N/A	12.00	C/F	C/F	N/A	4.25	16.75	19.50	10.50	17.75	2.69	1.19-2.69	12,14,16	N/A	661	905	482
18H	N/A	N/A	9.88	17.63	N/A	8.88	C/F	C/F	N/A	7.81	16.75	21.00	13.25	18.00	2.69	1.19-2.69	12,14,16	N/A	648	886	371
18L	N/A	N/A	9.88	18.63	N/A	12.75	C/F	C/F	N/A	2.31	26.00	26.25	11.75	18.00	2.44	1.19-2.44	16,18	N/A	616	1020	456
20B	N/A	N/A	N/A	16.31	N/A	12.25	C/F	C/F	N/A	4.75	26.00	22.00	12.06	19.75	2.44	1.19-2.44	10,12	N/A	730	N/A	395
20E	N/A	N/A	9.88	18.00	N/A	12.50	C/F	C/F	N/A	3.38	20.75	24.13	12.50	18.94	2.44	1.19-2.44	12,14,16	N/A	600	896	392
20G	N/A	N/A	15.00	21.50	N/A	12.50	C/F	C/F	N/A	3.38	20.75	24.13	15.56	20.75	2.44	1.19-2.44	16	N/A	714	1150	519
20H	N/A	N/A	13.13	14.50	N/A	12.63	C/F	C/F	N/A	1.88	19.00	24.13	11.38	19.75	2.69	1.19-2.69	12,14,16	N/A	665	965	462

(All dimensions are in inches and weights in lbs.)
CF = Consult Factory

Goulds Pumps

ITT Industries

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

PRINTED IN U.S.A.

Lubbock, Texas 79417
DATAPG6A

Performance Correction Factors

"Use the multipliers listed below to de-rate head, capacity and efficiency for special materials" bowls and impellers. Apply both multipliers listed if both bowl and impeller are of special construction.

Bowl Size & Model	Bowl Multiplier		Impeller Multiplier	
	C.I. CL30 without Enamel	D.I. and other Materials without Enamel	C.I. CL30 Al-BRZ	D.I. and other Materials
5C,5T,	1.00	0.99	0.98	0.98
5WA,6C,6D,6RA	0.98	0.97	0.98	0.97
7C,7RA,7T,7WA	0.98	0.97	0.98	0.97
8DH	0.98	0.97	0.99	0.97
8RA,8RJ,8I	0.98	0.97	0.98	0.97
9RA,9WA,9RC,9T	0.98	0.97	0.98	0.97
10DH	0.99	0.98	0.99	0.98
10RA,10WA	0.98	0.97	0.99	0.97
10RJ	0.98	0.98	0.99	0.98
10L	0.99	0.98	0.99	0.98
11C,11WA	0.99	0.98	0.99	0.98
11RA	0.98	0.97	0.99	0.97
12C,12DH,12FR	0.99	0.98	0.99	0.98
12WA,12RJ	0.99	0.98	0.99	0.98
13C,13RA	0.98	0.97	0.99	0.97
14DH, 14F,14H,14RJ	0.99	0.98	0.99	0.98
15F	0.99	0.99	0.99	0.97
16B	0.99	0.98	0.99	0.97
16DH	1.00	0.99	1.00	0.99
18B,18H,18L	0.99	0.99	0.99	0.97
18D	1.00	1.00	0.99	0.97
20B,20G,20H	0.99	0.99	0.99	0.97
20E	0.98	0.98	0.99	0.97

Example:
Customer's rating is 1000 GPM at 50 ft. head with a 316 SS bowl and impeller construction. A 12RJMO at 1760 RPM was selected. From the table, both the bowl and impeller correction is 0.98. To determine pump efficiency, the rating must be corrected:

Corrected capacity $= \frac{1000 \text{ GPM}}{.98 \times .98} = 1041 \text{ GPM}$

Corrected head $= \frac{50 \text{ ft.}}{.98 \times .98} = 52 \text{ ft.}$

Referring to the bowl assembly performance curve, the efficiency at the corrected rating is 85% minus 3 points de-rate for one stage which equals 82%. This efficiency must now be derated:

The pump efficiency = 82% x .98 x .98 = 78.8%

Therefore, the pump performance is 1000 GPM, 50 ft. and 78.8% efficiency.

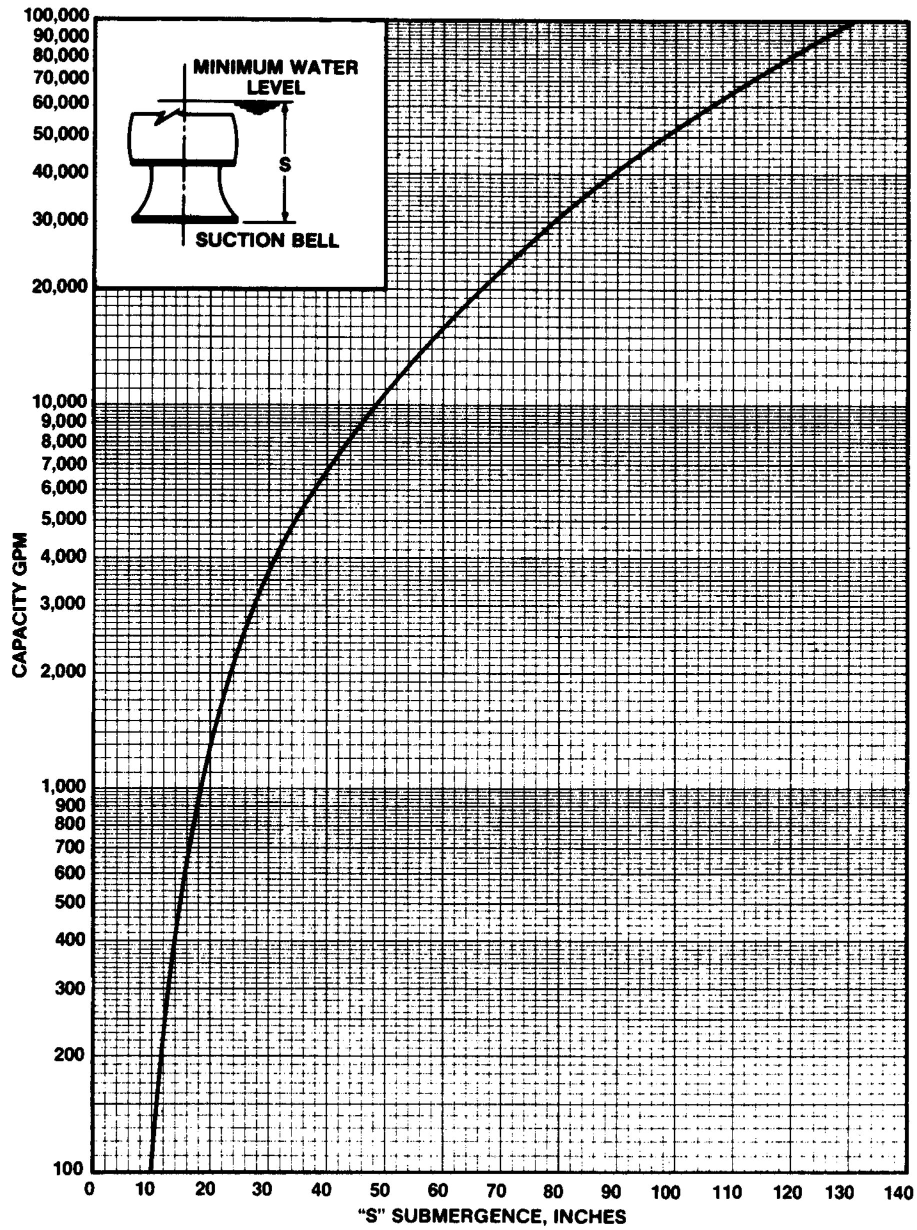
BHP $= \frac{1000 \times 50}{3960 \times .788} = 16.02 \text{ HP}$

Bowl Assembly Pressure Limits

Bowl Size & Model	Maximum Bowl Working Pressure (PSIG) *1	
	Cast Iron CL 30	Ductile Iron *3 Double Bolting
	Std Bolts (Grade 8)	Std Bolts (Grade 8)
5C	480	720
5T,5WA	480	720
6C	420	720
6DH *2	200	-
6RA	430	790
7C	415	720
7RA	430	790
7T	310	720
7WA	364	680
8DHC	364	600
8DHO *2	300	-
8I	364	720
8RA	430	790
8RJ	425	790
9RA	450	850
9WA	530	920
9RC	400	860
9T	530	920
10DH	322	600
10LC	244	500
10RA	450	850
10RJ	430	790
10WA	375	790
11C,11WA	380	680
11RA	400	632
12C	340	680
12DH	327	600
12FR	300	600
12WA	390	720
12RJ	340	632
13C	327	632
13RA	430	680
14DH	327	680
14F	327	680
14H	327	680
14RJ	340	720
15F	260	410
16DH	240	480
16DM	335	620
16B	322	643
18B	348	656
18D	308	562
18H	373	537
18L	160	-
20B	327	636
20E	380	650
20G	300	534
20H	307	524

NOTES:
1. Pressure units based on maximum operating pressure of pump at any point on performance curve, normally occuring at shutoff.
2. Threaded bowl connection.
3. To insure proper sealing at bowl mating surfaces: Either O-ring or liquid gasket material recommended on all ductile iron, double-bolted bowl assemblies.

MINIMUM SUBMERGENCE REQUIRED FOR VORTEX SUPPRESSION



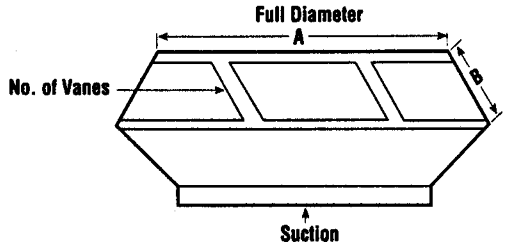
NOTE: 1. Submergence values above are for Vortex free operation. Check performance curves for NPSH required. Submergence to satisfy NPSH requirements may be greater than "S".

2. Minimum submergence is based on 2 times the bell diameter distance between pump centerlines and other ideal flow conditions. Refer to Figure 69 and 70 in Hydraulic Institute or refer to factory for more information regarding your particular installation, as less than ideal conditions will require additional submergence.

GOULDS PUMPS

Vertical Turbine Pumps Engineering Data

Effective January 1, 2000



Turbine Impeller Mechanical Data

Bowl Size and Model	Allowable Lateral (inches) Bearing Type		Eye Area (square inches)	Wet WR2 lbs.-ft. 2	Impeller Identifications									Impeller Weight (lbs.)	
					A (inches)			B (inches)			Number of Vanes				
	Bronze	Rubber			Low Capacity	Medium Capacity	High Capacity	Low Capacity	Medium Capacity	High Capacity	Low Capacity	Medium Capacity	High Capacity	Closed	Open
5C	0.25	NA	3.08	0.03	3.76	-	3.76	0.43	-	0.43	5	-	8	2.00	NA
5T	0.25	NA	5.02	0.03	3.54	-	3.54	0.62	-	0.62	4	-	7	2.40	NA
5WA	0.50	0.50	1.62	0.05	4.00		4.00	0.21		0.21	5		8	2.40	NA
6C	0.25	0.25	4.05	0.07	4.22	-	4.22	0.46	-	0.46	5	-	8	2.30	NA
6D	0.44	0.44	6.86	0.05	3.56	-	3.56	1.00	-	1.06	4	-	7	1.50	2.20
6RA	0.25	NA	1.62	0.05	4.00	-	4.00	0.21	-	0.21	5	-	8	2.40	NA
7C	0.50	0.50	7.54	0.14	5.25	-	5.25	0.60	-	0.60	5	-	8	3.10	NA
7RA	0.25	NA	2.65	0.08	4.75	-	4.75	0.25	-	0.25	5	-	8	3.30	NA
7T	0.38	0.38	10.40	0.18	4.96	-	4.96	1.26	-	1.26	4	-	7	5.10	NA
7WA	0.50	0.31	5.04	0.25	5.40	-	5.40	0.49	-	0.49	5	-	8	4.20	NA
8D	0.56	0.56	13.48	0.21	5.06	-	5.06	1.31	-	1.31	4	-	7	6.80	4.50
8I	0.62	0.44	6.10	0.22	6.03	-	6.03	0.44	-	0.44	5	-	8	5.70	NA
8RA	0.25	0.25	3.08	0.16	5.50	-	5.50	0.28	-	0.28	5	-	8	3.60	NA
8RJ	0.62	0.44	8.51	0.29	5.25	-	5.25	0.71	-	0.71	5	-	8	5.70	4.20
9RA	0.31	0.31	5.05	0.25	5.56	-	5.56	0.38	-	0.38	5	-	8	6.20	NA
9WA	0.56	0.56	6.84	0.45	6.69	-	6.69	0.46	-	0.46	5	-	8	11.50	NA
9RC	0.88	0.88	12.56	0.33	6.88	-	6.88	1.00	-	1.00	5	-	8	7.00	NA
9T	0.75	0.75	16.94	0.50	6.44	-	6.44	1.44	-	1.44	4	-	7	10.00	NA
10DH	0.75	0.75	20.92	0.97	6.37	-	6.37	1.62	-	1.62	4	-	7	14.00	NA
10L	0.50	0.50	27.18	0.94	-	-	5.81	-	-	1.68	-	-	7	10.50	NA
10RA	0.37	0.37	6.84	0.45	6.68	-	6.68	0.46	-	0.46	5	-	8	11.50	NA
10RJ	0.75	0.50	13.40	0.77	6.62	6.62	6.62	0.90	0.90	0.90	5	6	8	10.50	6.50
10WA	0.63	0.44	8.60	0.58	7.31	-	7.31	0.73	-	0.73	5	-	9	7.90	NA
11C	0.75	0.75	15.60	0.89	8.12	8.12	8.12	0.90	0.90	0.90	5	7	8	13.00	10.00
11RA	0.37	0.37	9.90	1.00	8.00	-	8.00	0.55	-	0.55	5	-	8	13.00	NA
11WA	0.75	0.75	11.20	0.93	8.38	-	8.38	0.82	-	0.82	5	-	9	11.60	NA
12C	1.00	0.88	20.43	1.65	-	-	8.69	-	-	1.20	-	-	8	18.00	14.50
12DH	0.68	0.68	31.47	2.36	7.75	-	7.75	2.00	-	2.12	4	-	7	19.50	19.50
12FR	0.88	0.88	38.30	2.42	-	-	7.25	-	-	2.12	-	-	8	19.00	16.00
12WA	0.75	0.68	13.70	1.65	8.94	8.94	8.94	0.75	0.75	0.75	5	8	9	14.00	NA
12RJ	1.00	0.88	19.91	1.63	8.00	8.00	8.12	1.09	1.09	1.09	5	6	8	18.00	11.00
13C	0.88	0.75	19.78	1.69	9.20	9.20	9.20	1.00	1.00	1.00	5	7	8	22.00	NA
13RA	0.50	0.50	20.21	1.69	9.62	-	9.62	0.66	-	0.66	5	-	5	18.00	NA
14DH	1.00	1.00	43.42	3.72	9.06	-	9.06	2.31	-	2.31	4	-	7	NA	26.50
14F	1.00	1.00	49.00	5.10	-	-	9.88	-	-	2.31	-	-	7	29.00	NA
14H	0.75	0.75	36.06	5.05	-	9.88	-	-	1.62	-	-	5	-	29.00	29.00
14RJ	1.00	1.00	30.24	3.12	9.81	9.81	9.81	1.34	1.34	1.34	5	6	8	27.00	27.00
15F	1.25	1.25	70.00	8.70	-	-	9.75	-	-	3.00	-	-	7	30.00	NA
16B	0.88	0.88	29.50	11.44	12.25	-	12.25	1.03	-	1.03	5	-	7	60.00	NA
16DH	0.88	0.88	57.96	9.33	10.44	-	10.44	2.68	-	2.68	4	-	7	48.50	48.50
16DM	0.75	0.75	40.37	9.65	-	11.62	-	-	1.41	-	-	7	-	62.00	NA
18B	0.75	0.75	46.90	13.96	12.94	-	12.94	1.28	-	1.28	7	-	7	88.00	NA
18D	0.75	0.75	49.00	13.30	-	12.75	-	-	1.56	-	-	7	-	60.70	NA
18H	0.75	0.75	68.40	21.68	-	12.63	-	-	2.50	-	-	5	-	65.00	NA
18L	1.12	1.12	78.40	8.04	-	-	10.41	-	-	2.78	-	-	6	87.50	NA
20B	0.81	0.81	38.25	19.32	-	-	14.25	-	-	1.26	-	-	7	95.00	NA
20E	0.88	0.88	80.70	17.16	-	-	13.25	-	-	1.97	-	-	7	68.00	NA
20G	1.41	1.41	99.90	15.80	13.50	-	13.50	3.00	-	3.00	5	-	5	77.00	NA
20H	0.87	0.88	72.40	21.68	14.00	14.00	14.00	1.75	1.75	1.75	7	7	7	74.00	NA

NOTE: WR2 are for enclosed impellers only.

Goulds Pumps

ITT Industries

Goulds Vertical Turbine Pumps

Engineering Data

200.A5
July 1985
(New)

CALCULATING AXIAL THRUST

Under normal circumstances Vertical Turbine Pumps have a thrust load acting parallel to the pump shaft. This load is due to unbalanced pressure, dead weight and liquid direction change. Optimum selection of the motor bearing and correct determination of required bowl lateral for deep setting pumps require accurate knowledge of both the magnitude and direction (usually down) of the resultant of these forces. In addition, but with a less significant role thrust influences shaft H.P. rating and shaft critical speeds.

IMPELLER THRUST

Impeller Thrust in the downward direction is due to the unbalanced discharge pressure across the eye area of the impeller. See diagram A.

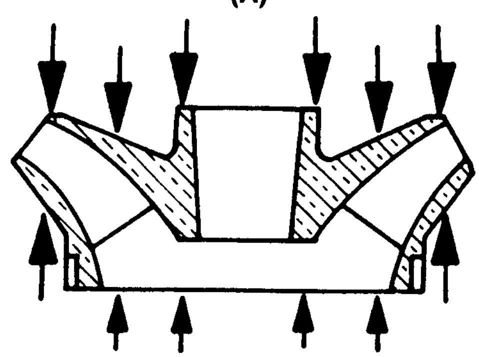
Counteracting this load is an upward force primarily due to the change in direction of the the liquid passing through the impeller. The resultant of these two forces constitutes impeller thrust. Calculating this thrust using a thrust constant (K) will often produce only an approximate thrust value because a single constant cannot express the upthrust component which varies with capacity.

To accurately determine impeller thrust, thrust-capacity curves based on actual tests are required. Such curves now exist for the "A" Line. To determine thrust, the thrust factor "K" is read from the thrust-capacity curve at the required capacity and given RPM. "K" is then multiplied by the Total Pump Head (Final Lab Head) times Specific Gravity of the pumped liquid.

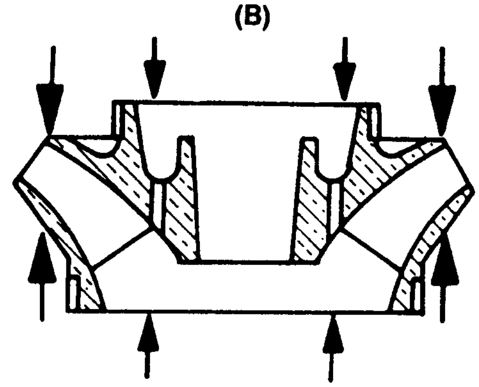
If impeller thrust is excessively high, the impeller can usually be hydraulically balanced. This reduces the value of "K". Balancing is achieved by reducing the discharge pressure above the impeller eye area by use of balancing holes and rings. See diagram B.

Although hydraulic balancing reduces impeller thrust, it also decreases efficiency by 1 to 5 points by providing an additional path for liquid recirculation.

(A)



(B)



Suction Pressure

Discharge Pressure

GOULDS PUMPS, INC.
TEXAS DIVISION-STD. PRODUCTS GROUP

CALCULATING AXIAL THRUST (CON'T.)

DEAD WEIGHT

In addition to the impeller force, dead weight (shaft plus impeller weight less the weight of the liquid displaced) acts downward. On pumps with settings less than 50 feet, dead weight may be neglected on all but the most critical applications as it represents only a small part of the total force. On deeper setting pumps, dead weight becomes significant and must be taken into account.

NOTE: We normally only take shaft weight into consideration as dead weight, the reason being that impeller weight less its liquid displacement weight is usually a small part of the total.

SHAFT SLEEVES

Finally, there can be an upward force across a head shaft sleeve or mechanical seal sleeve. In the case of can pumps with suction pressure there can be an additional upward force across the impeller shaft area. Again for most applications, these forces are small and can be neglected; however, when there is a danger of upthrusts or when there is high discharge pressure (above 600 psi) or high suction pressure (above 400 psi) these forces should be considered.

MOTOR BEARING SIZING

Generally speaking a motor for a normal thrust application has as standard, a bearing adequate for shutoff thrust. When practical, motor bearings rated for shutoff conditions are preferred.

For high thrust applications (when shutoff thrust exceeds the standard motor bearing rating) the motor bearing may be sized for the maximum anticipated operating range of the pump.

Should the pump operate to the left of this range for a short period of time, anti-friction bearings such as angular contact or spherical roller can handle the overload. It should be remembered, however, that bearing life is approximately inversely proportional to the cube of the load. Should the load double, motor bearing life will be cut to ⅛ of its original value. Although down thrust overloading is possible, the pump must never be allowed to operate in a continuous up thrust condition even for a short interval without a special motor bearing equipped to handle it. Such up thrust will fail the motor bearing.

MOTOR BEARING SIZING

CALCULATING MOTOR BEARING LOAD

As previously stated, for short setting non-hydraulic balanced pumps below 50 feet with discharge pressures below 600 psi and can pumps with suction pressures below 100 psi, only impeller thrust need be considered.

Under these conditions:

Motor Bearing Load (lbs.) $T_{imp} = K \times H_L \times SG$

Where:

Impeller Thrust (lbs.)
K = Thrust factors (lbs./ft.)
H_L = Lab Head (ft.)
SG = Specific Gravity

For more demanding applications, the forces which should be considered are impeller thrust plus dead weight minus any sleeve or shaft area force.

In equation form:

Motor Bearing Load = T_{imp} + Wt(1) — sleeve force(2) — shaft area force(3)

Shaft Dia. (in.)	Shaft Dead Wt. (lbs./ft.)		Shaft Area (in²)	Sleeve Area (in)
	Open Lineshaft	Closed Lineshaft		
1	2.3	2.6	.78	1.0
1 3/16	3.3	3.8	1.1	1.1
1 1/2	5.3	6.0	1.8	1.1
1 11/16	6.7	7.6	2.2	1.5
1 15/16	8.8	10.0	2.9	1.8
2 3/16	11.2	12.8	3.7	2.0

(1) Wt. = Shaft Dead Wt. x Setting In Ft.
(2) Sleeve Force = Sleeve area x Discharge pressure
(3) Shaft Area Force = Shaft area x Suction pressure

NOTE: Also see complete weight chart on Page 200.B2

*Oil Lube shaft does not displace liquid above the pumping water level and therefore has a greater net weight.

CALCULATING BOWL LATERAL REQUIREMENT

When determining the bowl lateral required, shaft and impeller weight are not considered. When the impeller is correctly positioned prior to start up, any stretch due to the shaft and impeller weight has already occurred. Also, Head Shaft or Mechanical Seal Sleeve force is not considered as this force affects only the elongation of the line shaft above the sleeve. Impeller thrust then is the only force normally affecting lateral.

Bowl lateral requirement may be calculated by determining impeller thrust and then referring to Shaft Elongation Charts 2 or 2a. The impeller thrust equation is:

$$T_{imp} = K \times H_L \times SG$$

NOTE: For bowl lateral calculations, Lab Head and "K" value selected should be the maximum anticipated (example: if unit operates near shut-off, the Lab Head and "K" value corresponding to this flow should be selected.)

EXAMPLE

What is the load carried by the motor bearing at design conditions when:

Capacity	400 GPM	Bowl Model	10 AHC
Head	1800 ft.	Speed	3550 RPM
SpGr	1.03	Head Shaft Dia.	$1\,^{11}/_{16}$
Discharge Pressure	803 PSI	Setting (Product Lube)	100′
Suction Pressure	Flooded		

From the 10 AHC thrust capacity curve, Pg. 2J.3, the "K" factor at design is 2.6.

Impeller Thrust: $T_{imp} = K \times H_L \times SG$
= 2.6 x 1800 x 1.03
= 4820 lbs.

Dead Weight: Wt. = Shaft wt. per ft. x Setting
= 6.7 x 100
= 670 lbs.

Shaft Area Force: S.A.F. = Shaft area x Suction Pressure
= 2.2 x 0.0
= 0

Seal Sleeve Force: S.F. = Sleeve area x Discharge Pressure
= 1.5 x 803
= 1204 lbs.

Motor Bearing Load = T_{imp} + wt. — shaft area force — sleeve force
= 4820 + 670 — 0 — 1204
= 4286 lbs.

NOTE: In addition to the design point, the motor bearing load should be calculated at shutoff and runout. Should these points indicate excessive down thrust or any upthrust, a simple plot of shutoff, design and runout thrust against capacity will establish the maximum allowable operating range of the pump.