

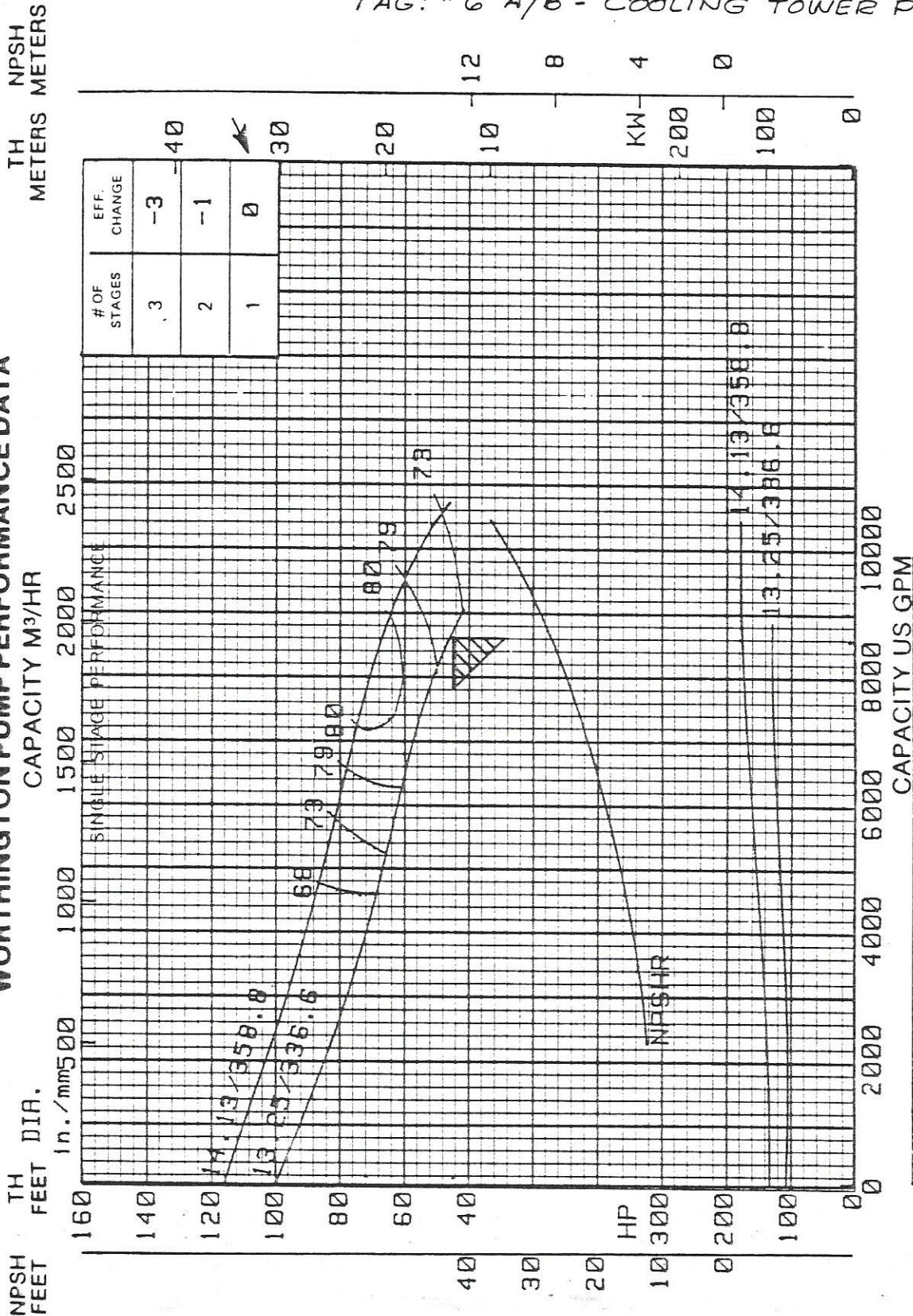
Customer FLUOR ENGINEERS, INC. Worthington S.O. CHICAGO/156-70028  
 Project LOWELL Co. GEN Co. Proposal/Order No. TVU-60321  
 Cust. Proposal/Order No. 814101-4-6001 Certified By R. SHEEDY  
 Customer Item No. \_\_\_\_\_ Date 9.14.87

2400-8 Page 109  
 May 1986  
 22HH780  
 1175 RPM

Liquid/Service WATER Sp. Gr. 1.0 Visc. \_\_\_\_\_ SSU  
 Capacity 8600 Head 45 Temp. 80 °F Consistency \_\_\_\_\_ %

TAG: # 6 A/B - COOLING TOWER PUMP

# WORTHINGTON PUMP PERFORMANCE DATA



CURVE NO.	SIZE	RPM
ER4472	22HH780-1	1175



# NAMEPLATE DATA

CUSTOMER WORTHINGTON ENG. PUMP  
CUSTOMER P.O. TVU60321  
USEM ORDER  
NUMBER P1950015

Type/Description

TU/TEFC

Frame Number

447TPA

Horsepower Output

150

Service  
Factor

1.15

Continuous Rating

40° C

Insulation Class

F

RPM at Full Load

1185

Frequency (Hertz)

60

Number of Phases

3

Voltage

460

Full Load Amperes

181

NEMA Code Letter

G

NEMA Design Letter

B

Special Notes

DF #291





HEAVY DUTY VERTICAL PUMP DATA

Project No. 814101 SELLER: Worthington

Client Lowell Cogeneration Company No. Req'd 2

Project Lowell Cogeneration Project Tag(s): P-6A/B

Service Cooling Tower Pumps

1.0 DESIGN CONDITIONS

1.1	Capacity, gpm - - - - -	<u>8600</u>
1.2	Discharge head, ft - - - - -	<u>-</u>
1.3	Suction head, ft - - - - -	<u>-</u>
1.4	NPSH available, normal/minimum, ft - - - - -	<u>Flooded</u>
1.5	Submergence available, normal/minimum, ft - - - - -	<u>-</u>
1.6	Total head, ft - - - - -	<u>45</u>
1.7	Fluid pumped - - - - -	<u>Cooling Tower Water</u>
1.8	Suction temperature, °F - - - - -	<u>40-90</u>
1.9	Specific gravity - - - - -	<u>1.0</u>
1.10	Fluid condition - - - - -	<u>Liquid</u>
1.11	Pump floor elevation, ft - - - - -	<u>-</u>
1.12	Suction elevation, ft - - - - -	<u>-</u>
1.13	Discharge elbow location - - - - -	<u>-</u>
1.14	Cooling water available - - - - -	<u>-</u>
1.15	Maximum acceptable speed, rpm - - - - -	<u>+ 1200</u>

2.0 GUARANTEED PERFORMANCE AT DESIGN CONDITIONS

		Base	Alt.
2.1	Capacity, gpm - - - - -	<u>+ 8600</u>	<u>8600</u>
2.2	NPSH required, ft - - - - -	<u>+ 30</u>	<u>10</u>
2.3	Submergence required, ft - - - - -	<u>+ 1</u>	<u>above imp.</u>
2.4	Total head, ft - - - - -	<u>+ 45</u>	<u>45</u>
2.5	Efficiency, % - - - - -	<u>+ 77</u>	<u>85</u>
2.6	Brake horsepower required at pump coupling - - - - -	<u>+ 134</u>	<u>115</u>
2.7	Speed, rpm - - - - -	<u>+ 1150</u>	<u>1175</u>
2.8	Guaranteed maximum (not to exceed) shut-off head, ft - - - - -	<u>+ 100</u>	<u>90</u>
2.9	Pump Head/Flow Tolerance:		
2.9.1	Maximum head/flow limit, ft/gpm- - - - -	<u>+ 78/3000</u>	<u>60/5000</u>
2.9.2	Minimum head/flow limit, ft/gpm- - - - -	<u>+ 33/10,000</u>	<u>13/11,000</u>

3.0 DESIGN AND CONSTRUCTION

3.1	Pump type - - - - -	<u>+ Vert. Wet Pit</u>
3.2	Pump casing type - - - - -	<u>+ diffuser <del>straight</del></u>

SELLER: Worthington

		Base	Alt.
3.3	Impeller:		
3.3.1	Class - - - - -	+ Francis Vane	<del>Propeller</del>
3.3.2	Type/number - - - - -	+ Encl/one	<del>open/1</del>
3.3.3	Diameter, in. - - - - -	+ 13.1	<del>47.2</del>
3.4	Shaft sleeves - - - - -	+ Included	
3.5	Column:		
3.5.1	Length, ft - - - - -	+ 4.6	<del>7.5</del>
3.5.2	Sections, number/length each - - - - -	+ 1/4.6	<del>1/7.5</del>
3.5.3	External corrosion protection, type - - - - -	+ None	
3.6	Shaft Seals:		
3.6.1	Type (packed or mechanical) - - - - -	+ Packing	
3.6.2	Injection or lubricating water required? - - - - -	+ No	
3.7	Shaft Bearings:		
3.7.1	Type/No. required - - - - -	+ One	
3.7.2	Span, in. - - - - -	+ 60	
3.8	Pump suction, type/size, in. - - - - -	+ Flaired/22	
3.9	Pump Discharge:		
3.9.1	Type/size, in. - - - - -	+ 16" Flanged	<del>18"</del>
3.9.2	ANSI pressure rating, psig - - - - -	+ 150	
3.10	Shaft Coupling:		
3.10.1	Manufacturer/Model No. - - - - -	+ None	
3.10.2	Rotation, CW or CCW (looking from coupling toward pump) - - - - -	+ CW	
3.11	Materials, ASTM:		
3.11.1	Casing - - - - -	+ CI-30	<del>CI-30</del>
3.11.2	Casing wearing rings - - - - -	+ SAE40 Brz.	<del>None</del>
3.11.3	Impeller - - - - -	+ SAE40 Brz.	<del>Bronze</del>
3.11.4	Impeller wearing rings - - - - -	+ Bronze	<del>None</del>
3.11.5	Stage bushings - - - - -	+ None	<del>None</del>
3.11.6	Shaft - - - - -	+ 416SS	<del>416SS</del>
3.11.7	Shaft sleeves - - - - -	+ 304SS	<del>None</del>
3.11.8	Packing - - - - -	+ Non-Asbestos	<del>None</del>
3.11.9	Inner column - - - - -	+ None	<del>Steel</del>
3.11.10	Outer column - - - - -	+ Steel	<del>Steel</del>
3.11.11	Guide bearings - - - - -	+ Rubber	<del>Bronze</del>
3.11.12	Suction bell - - - - -	+ CI-30	<del>CI-30</del>
3.11.13	Discharge head - - - - -	+ CI-30	<del>Steel</del>
3.11.14	Other - - - - -	+	

#### 4.0 OPERATING INFORMATION

4.1	Critical speeds, first/second, rpm - - - - -	+ 2200 / N/A	
4.2	Impeller speed, peripheral, fps - - - - -	+ 71.5	Will advise
4.3	Pump specific speed at design conditions - - - - -	+ 6271	Will advise
4.4	Pump suction specific speed at design conditions - - - - -	+ 8950	Will advise



SELLER: Worthington

		Base	Alt.
4.5	Number of stages - - - - -	+	1
4.6	Developed head per stage, ft - - - - -	+	45
4.7	Shut-off head, ft - - - - -	+	100
4.8	Minimum continuous flow required to prevent excessive temperature rise and to achieve dynamically stable operation, gpm - - - - -	+	3000
4.9	Recommended height of bell above the bottom of the sump, ft-in - - - - -	+	1'
4.10	Maximum flow at reduced head, gpm - - - - -	+	10,000
4.11	Power required at coupling, rated load - - - - -	+	134
4.12	Power required at coupling, max @ 150% flow and rated speed - - - - -	+	134
4.13	Lubrication:		
4.13.1	Shaft bearing, type - - - - -	+	SLEEVE Water-LUBE
4.13.2	Tail bearing, type - - - - -	+	SLEEVE Grease-LUBE
4.14	WR <sup>2</sup> of pump, lb/ft <sup>2</sup> - - - - -	+	36
4.15	Maximum axial/radial thrust, lb - - - - -	+	2836/N.A.
4.16	Maximum torque required at startup, ft-lb - - - - -	+	89.8 AT 0 RPM
4.17	Alarm and trip data - - - - -		Will advise
4.18	Sound power levels - - - - -		Less than 80dBA

5.0 WEIGHTS

5.1	Weight of assembled pump, lb - - - - -	+	3000 pump
5.2	Weight of heaviest piece as shipped, lb - - - - -	+	3000 pump
5.3	Number of pieces - - - - -	+	Two = pump and motor

PRODUCT



SECTION: 505

PAGE: 11 & 17

CUSTOMER NAME WORTHINGTON ENG. PUMP

CUSTOMER ORDER NO. TVU60321

USEM NO. P1950015

MARKS: P081401 4 6001, TVU 60321 COOLING TOWER PUMP TAG NOS. 6 A/B

DESCRIPTION

QUANTITY 2 HP 150 FRAME 447TPA TYPE TU  
PHASE 3 HERTZ 60 RPM 1200 VOLTS 460 ASSY.POS.

FEATURES: 1.15 SERVICE FACTOR, SRC, 115 DEGREE C RISE AT 1.15 SERVICE  
FACTOR, BD=20", BX-1.69 WITH STEADY BUSHING 5-3/8 X 3/16 KEYWAY, COUNTER  
CLOCKWISE LOOKING DOWN ON TOP OF MOTOR.

RECEIVED  
SEP 08 1987  
WORTHINGTON  
TRAFFIC

RECEIVED  
SEP 08 1987  
Engineering

EXCEPTIONS & CLARIFICATIONS (IF ANY):

WHEN SIGNED BELOW, THE PRINT(S) AND/OR  
DATA ATTACHED IS(ARE) CERTIFIED  
CORRECT FOR MOTOR(S) DESCRIBED ABOVE.

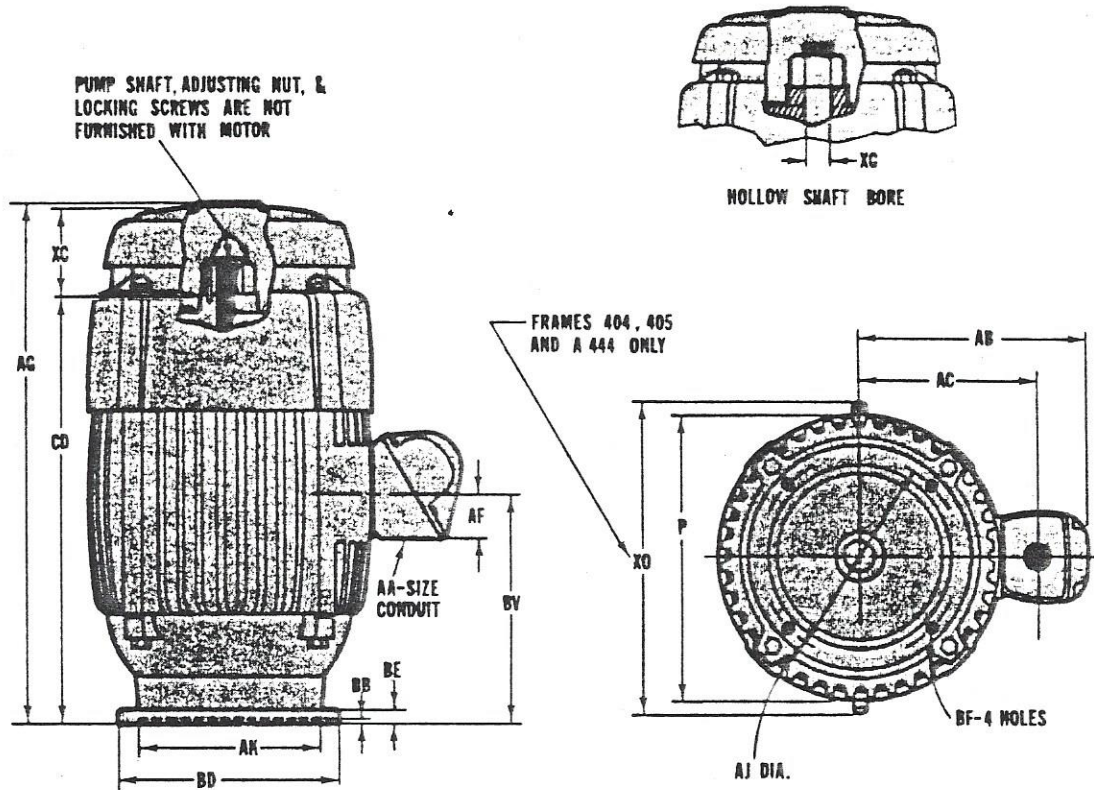
BY CRB DATE 9/1/87

# VERTICAL MOTORS



# DIMENSIONS

FRAMES 444TP THRU 447TPA -- TYPES LU (EXPLOSIONPROOF), TU (TOTALLY ENCLOSED)



ALL DIMENSIONS ARE IN INCHES

FRAME	P*	AA	AG	AJ	AK +.005	BB	BE	BF	BV	CD	XC	XG	XO
444, 445TP, TPA	23-1/4	3	48-1/8	14-3/4	13-1/2	5/16	1	11/16	17-1/8	43-1/16	4-5/8	2	26-3/8
447TP, TPA	23-1/4	3	51-5/8	14-3/4	13-1/2	5/16	1	11/16	18-7/8	46-9/16	4-5/8	2	26-3/8

FRAME	TYPE	AB	AC	AF	BD
444, 445, 447TP	LU	19-5/8	14-5/8	4-9/16	16-1/2
	TU	18-9/16	14-3/8	4-7/8	16-1/2

FRAME	TYPE	AB	AC	AF	BD
444, 445, 447TPA	LU	19-5/8	14-5/8	4-9/16	20
	TU	18-9/16	14-3/8	4-7/8	20

\* Largest motor width.

All rough casting dimensions may vary by 1/4" due to casting variations.

Conduit box opening may be located in steps of 90 degrees. Standard as shown with conduit opening down.

TOLERANCES	
Face runout	.007 F.I.R.
Permissible eccentricity of mounting rabbet	.007 F.I.R.



U.S. ELECTRICAL MOTORS DIVISION EMERSON ELECTRIC CO.

Printed in U.S.A.

EFFECTIVE: MAY 1, 1986  
SUPERSEDES: SEPTEMBER 30, 1984

SECTION : 505  
PAGE : 11

DO NOT USE FOR CONSTRUCTION  
PURPOSES UNLESS CERTIFIED





6001-4-814101  
DE-800-5  
Sheet 1 of 1  
Date: 9-17-86

SQUIRREL CAGE INDUCTION MOTOR DATA

Project No.	<u>814101</u>	SELLER:	<u>Worthington</u>
Client	<u>Lowell Cogeneration Company</u>	Service: P-6A/B	No. Reqd <u>2</u>
Project	<u>Lowell Cogeneration Project</u>	<u>Cooling Tower Pumps</u>	

01	Enclosure - - - - -	<u>TEFC</u>
02	Shaft orientation - - - - -	<u>Vertical</u>
03	Rated horsepower - - - - - +	<u>150</u>
04	Service factor - - - - - +	<u>1.15</u>
05	Rated voltage, Hz/phase - - - - - +	<u>3/60/460 or 4000</u>
06	Rated speed - - - - - +	<u>1200</u>
07	Driven load, horsepower - - - - - +	<u>115</u>
08	NEMA locked rotor code - - - - - +	<u>F</u>
09	Temperature rise at service factor - +	<u>115°C *</u>
10	Insulation class - - - - - +	<u>F</u>
11	Bearings, type - - - - - +	<u>Z, Anti Friction</u>
12	Bearings, location - - - - - +	<u>Motor Brackets</u>
13	Shaft, (solid/hollow) - - - - - +	<u>Hollow</u>
14	Vertical thrust capacity, up/down, lbs - - - - - +	<u>7,100 down **</u>
15	Lubrication - - - - - +	<u>Oil</u>
16	Bearing cooling requirements - - - - +	<u>None</u>

\* If 90° rise at Service Factor is required, add + \$3,085

\*\* 30% of down thrust - momentary for up thrust.

~~\*\*\*for alternate bid - 200HP may be required (due to high HP at shut-off), add + \$10,101.~~



# MATERIALS LIST

WORKS NO. TVU-60321 D.O. NO. 156-70028 CUST. P.O. 814101-4-6001  
QUANTITY TWO (2) SIZE & TYPE 22HH780-1 STAGE  
C IFIED BY R. GROFT DATE 10/09/87  
CUSTOMER : FLUOR ENGINEERS, INC. PAGE 1

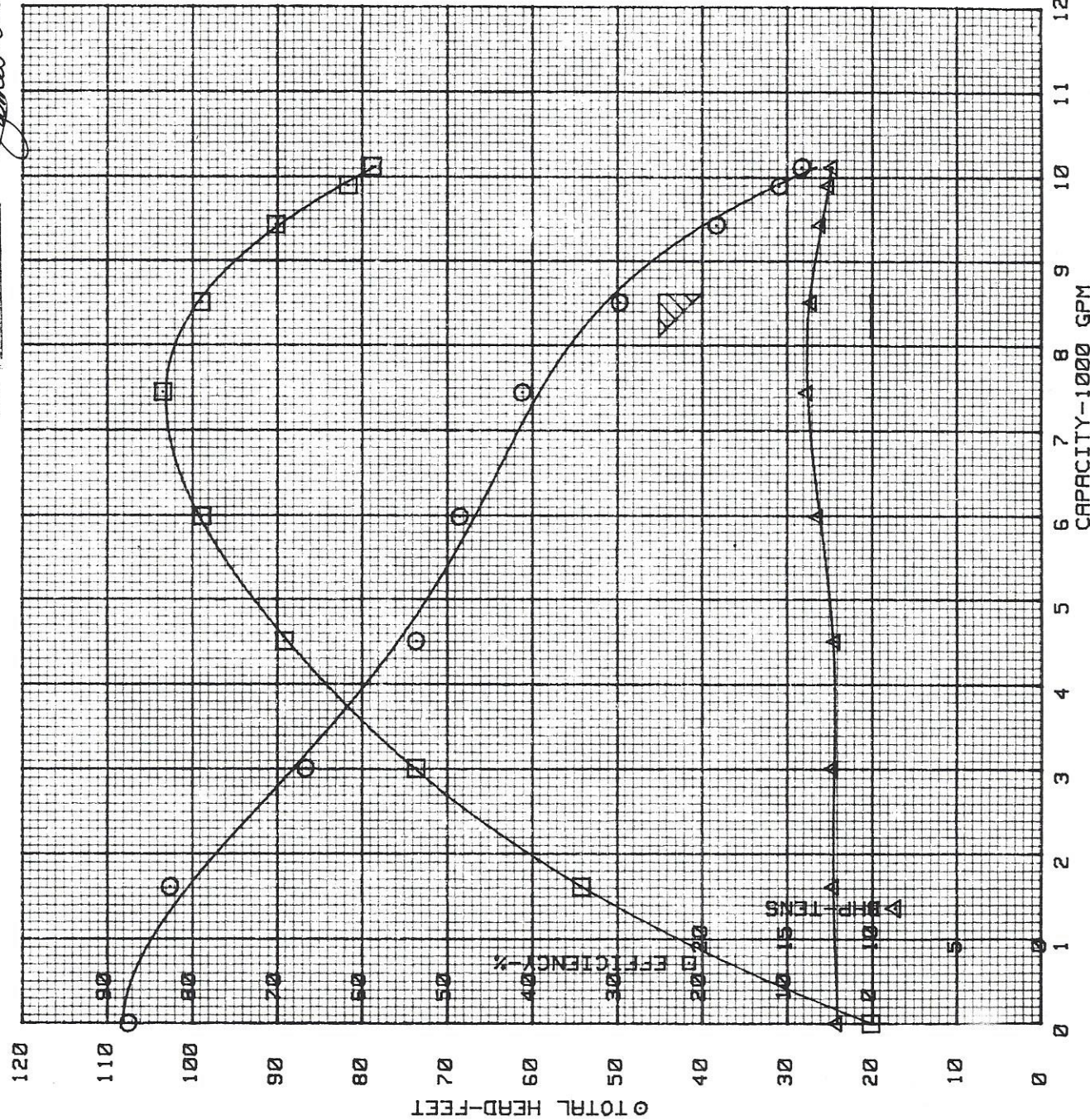
SECTIONAL DRAWING NO. VX-45251

<u>REF.</u> <u>NO.</u>	<u>NO. OF</u> <u>PIECES</u>	<u>NAME OF PART</u>	<u>MATERIAL</u>
1	1	MOTOR	
2	1	LOCK SCREW	STEEL
3	1	GIB KEY	STEEL/ASTM-A-322
4	1	DISCH HEAD	CAST IRON/ASTM-A-48
6	1	TOP COLUMN PIPE	STEEL/ASTM-A-36
7	16	TOP COLUMN BOLTS	STEEL
8	1	STUFFING BOX BEARING	BRONZE/ASTM-B-584
9	1	STFG. BOX GASKET	ANKORITE 425
10	8	STFG. BOX BOLTS	STEEL
11	1	GLAND	BRONZE/ASTM-B-584
12	2	GLAND STUDS/NUTS	STEEL/BRONZE
13	1	WATER SLINGER	RUBBER
14	1	HEAD SHAFT	416 ST STL/ASTM-A-582
15	1	GREASE CUP	STEEL
16	1	PACKING	GRAPHITE ASBESTOS
17	1	STUFFING BOX	CAST IRON/ASTM-A-48
18	4	BOLTS/NUTS MOTOR TO HEAD	STEEL
22	1	DISCHARGE CASE	CAST IRON/ASTM-A-48
23	1	TOP BOWL	CAST IRON/ASTM-A-48
25	32	BOWL BOLTS	STEEL
28	1	ADJUSTING NUT	CARBON STL/ASTM-A-108
30	1	SHAFT COUPLING	CARBON STL/ASTM-A-108
31	1	DISCH. CASE CAP	CAST IRON/ASTM-A-48
32	1	TOP BOWL BEARING	BRONZE/ASTM-B-584
33	1	SEAL CAGE	BRONZE/ASTM-B-584
35	1	IMPELLER	BRONZE/ASTM-B-584
37	1	IMPELLER SHAFT	416 ST STL/ASTM-A-582
38	2	SET SCREW	ST STL
39	1	SAND COLLAR	CAST IRON/ASTM-A-48
40	1	GREASE SEAL	RUBBER
41	1	SUCTION CASE/BELL BRG.	BRONZE/ASTM-B-584
42	1	SUCTION BELL PLUG	CAST IRON/ASTM-A-48
45	1	SUCTION BELL	CAST IRON/ASTM-A-48
**	1	BELL/BOWL WEARING RING	BRONZE/ASTM-B-584
**	1	IMPELLER WEARING RING	BRONZE/ASTM-B-584
**	2	IMPELLER SNAP RING	ST STL
**	1	IMPELLER KEY	STEEL/ASTM-A-434
**	1	TOP PIPE GASKET	ANKORITE 425
**	1	COLUMN/DISCH CASE GSKT	ARAMID FIBER
**	16	DISCH CASE BOLTS	STEEL

\*\* NOT SHOWN



I CERTIFY THAT WITHIN THE ACCURACY  
OF TEST DOCUMENTATION THIS TEST  
REPRESENTS THE PERFORMANCE OF 22HH780-1  
PUMP #87 TVU-60321-1 *Jameo-Bio*



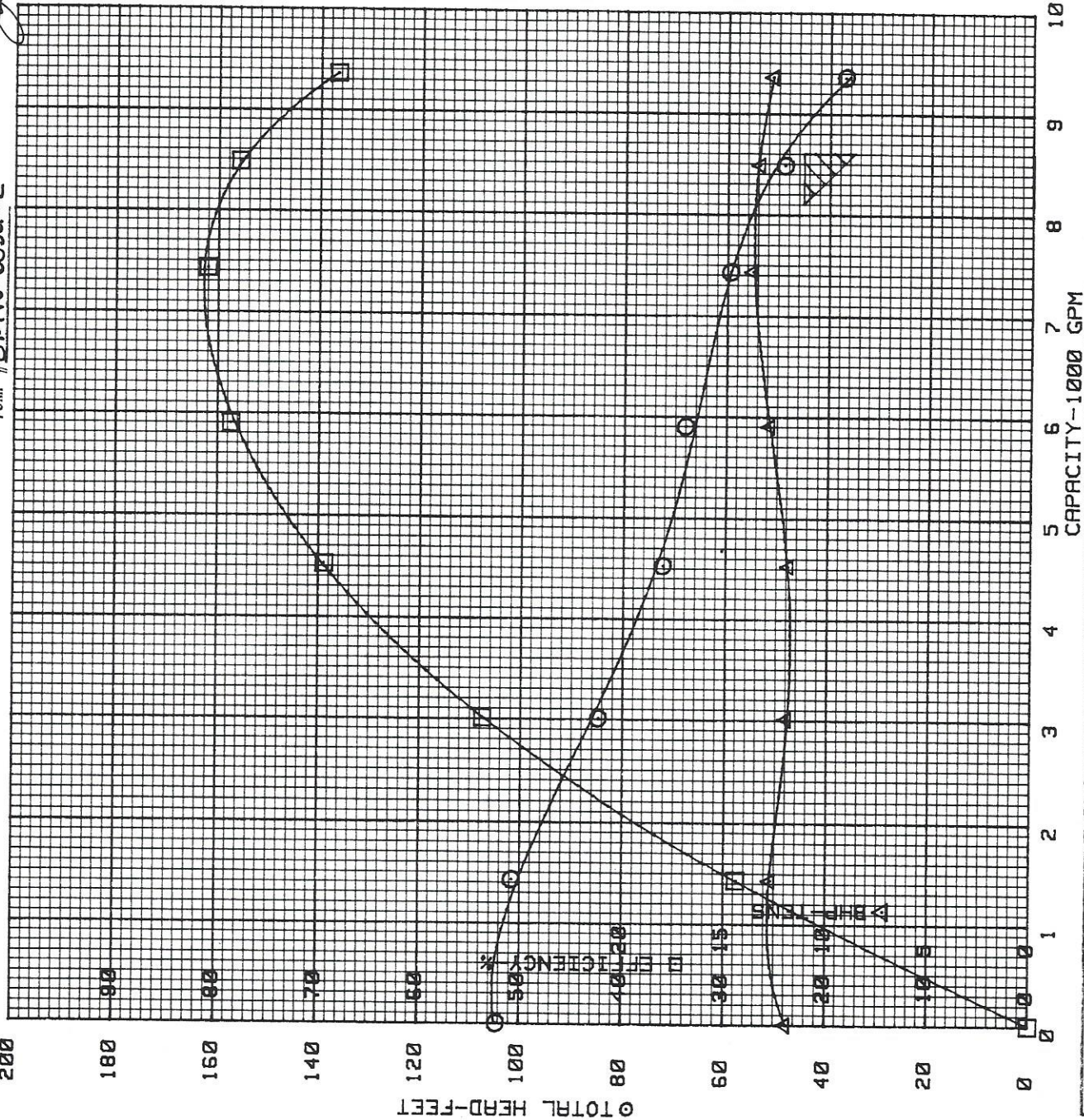
DRESSER PUMP DIVISION DRESSER INDUSTRIES INC. PUMP TEST DATA				
RPM	GPM	HD.	BHP	EFF.
1191.0	8617	51.0	140.7	78.8
1191.0	9555	39.2	135.2	70.1
1192.0	10039	31.6	130.4	61.5
1192.0	10263	29.0	128.0	58.7
1190.0	7538	62.7	143.1	83.4
1191.0	6062	70.3	136.8	78.7
1192.0	4565	75.7	126.4	69.0
1192.0	3047	89.1	120.0	53.5
1191.0	1628	105.3	127.2	34.1
1192.0	0	110.6	125.6	0.0
SP GR:1				
CASING DATA				
C.I.	-	-		
MATERIAL	FINISH	TONGUE		
IMPELLER DATA				
Bez	# 2	1/6		
MATERIAL	FINISH	DISC.TIPS		
RW 127816		135/6		
PATT.NO.	COMB.NO.	DIA.		
x9	1175	E. 219993		
TURI	PLOTTED RPM	CURVE NO.		

NORTHINGTON 22HH780-1	TVU60321	TVU60321-1	10/29/87 STA	J.B.	200HP / 1200RPM TEST MOTOR	12x9	1175	E. 219993
PUMP	STAGES	ORDER NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	PLOTTED RPM	CURVE NO.



1 GPM  
OF TEST INSTRUMENTATION THIS TEST  
REPRESENTS THE PERFORMANCE OF 22HH780-1  
PUMP #81-TVU-60321-2

*James R. Davis*



DRESSER PUMP DIVISION DRESSER INDUSTRIES INC. PUMP TEST DATA				
RPM	GPM	HD.	BHP	EFF.
1190.0	8584	50.0	139.1	77.9
1190.0	9476	37.9	132.8	68.3
1189.0	7513	60.8	142.3	81.0
1190.0	5968	69.7	133.6	78.6
1192.0	4585	74.4	124.0	69.4
1192.0	3047	87.2	124.8	53.8
1191.0	1443	104.3	132.0	28.8
1191.0	0	107.3	124.0	0.0
SP GR:1				
CASING DATA				
C.I.				
MATERIAL	FINISH	TONGUE		
IMPELLER DATA				
B22	# 2		1/16	
MATERIAL	FINISH	DISC.TIPS		
RW 127B1/6			13 5/16	
PATT.NO.	COMB.NO.	DIA.		
12 x 9	1175	E-219994		
TURI	PLOTTED RPM	CURVE NO.		

NORTHINGTON 22HH780-1		TVU60321		TVU60321-2		10/30/87 STB		J.B.		200HP 1200 RPM TEST MOTOR	
PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO.	