LIQUID NITROGEN PUMP
XBNCP-30-000

Installation, Operating, and Maintenance Manual

FEBRUARY 1996

20-25 Impeller Torque
40+80 Torque on Motor

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INSTALLATION, OPERATING, AND MAINTENANCE MANUAL

1.0 INTRODUCTION

The liquid nitrogen pump is a partial emission centrifugal pump with a hermetically sealed motor. The motor is a 220 volt, 3-phase, 2-pole motor that provides .78 hp at 90 Hz. The motor is cooled by natural convection. The motor is controlled by a variable frequency drive (VFD). This allows adjustment of the pump speed to produce any desired head and flow within the available power range. The pump is designed so that the pump housing and impeller are in the liquid nitrogen and the motor is at atmospheric conditions. The pump and motor are separated by a 31-inch, thin-walled shaft and housing. This minimizes heat input from the motor into the liquid nitrogen.

This manual describes the installation of the pump, the electrical hookup, operation of the pump, replacement of the pump, and maintenance of the pump.

2.0 INSTALLATION

2.1 GENERAL INSTALLATION GUIDELINES

The pump contains precision mechanical components and must be handled with care during installation. Excessive bumping, jolting or mishandling may result in damage to the pump. The pump should be handled and maneuvered using the mounting flanges only (as much as possible). Avoid putting any loads or moments on the pump inlet and discharge connections.

The outlet piping must be sufficiently flexible to transfer minimal piping loads or moments into the housing.

The pump is designed to run in a vertical position only with the motor on top. Running it in any other position will result in reduced bearing life, and possibly equipment failure.

The motor is cooled by natural convection. It should be installed in a cool, well ventilated area away from any heat source.

2.2 MECHANICAL INSTALLATION

Before installing the pump, ensure that the mounting flange is clean, dry, and free of any substance that could be detrimental to the O-ring seal.

1. Apply high vacuum O-ring grease to the mounting flange O-ring.

2. Install the mounting flange O-ring in the groove on the mating surface to the pump mounting flange. Apply enough grease to ensure the O-ring stays in the groove during installation.

3. Lower the pump into the mounting hole and secure with the mounting bolts provided.

4. Connect the inlet and discharge piping to the pump. The inlet is one-inch Swagelok and the discharge is 3/4-inch Swagelok.

5. Remove the vacuum port plug (located on the side of the pump just above the mounting flange) and replace with connection to vacuum line as required.

2.3 ELECTRICAL INSTALLATION

- W A R N I N G -

NATIONAL OR LOCAL ELECTRICAL CODES OUTLINE PROVISIONS FOR SAFELY INSTALLING ELECTRICAL EQUIPMENT. INSTALLATION MUST COMPLY WITH SPECIFICATIONS REGARDING WIRE SIZE, TYPE, CONDUCTOR SIZE, BRANCH CIRCUIT PROTECTION AND DISCONNECT DEVICES. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY AND/OR EQUIPMENT DAMAGE.

The electrical installation is to be accomplished using relevant electrical codes (NEC-1996) and VFD manufacturer furnished technical manuals as a guideline. Basic wiring is per section 430-22 and table 310-16 of the US NEC-1996.

1. Remove VFD cover by removing the cover screws located at the bottom of the cover. Lift up on the cover, pull it down and remove it. See Figure 1 for the location of the Main Circuit Terminal Block and the Control Circuit Terminal Block.

2. Wire the VFD to the power supply as shown in Figure 2. Refer to the VFD manual for additional information on installing and wiring the VFD to the power source.

3. Remove the cover from the electrical enclosure on the pump motor. Attach conduit or liquid tight flexible conduit to the electrical enclosure.

4. Wire the VFD to the motor as shown in Figure 2. Refer to the VFD manual for additional information on wiring the VFD to the motor.

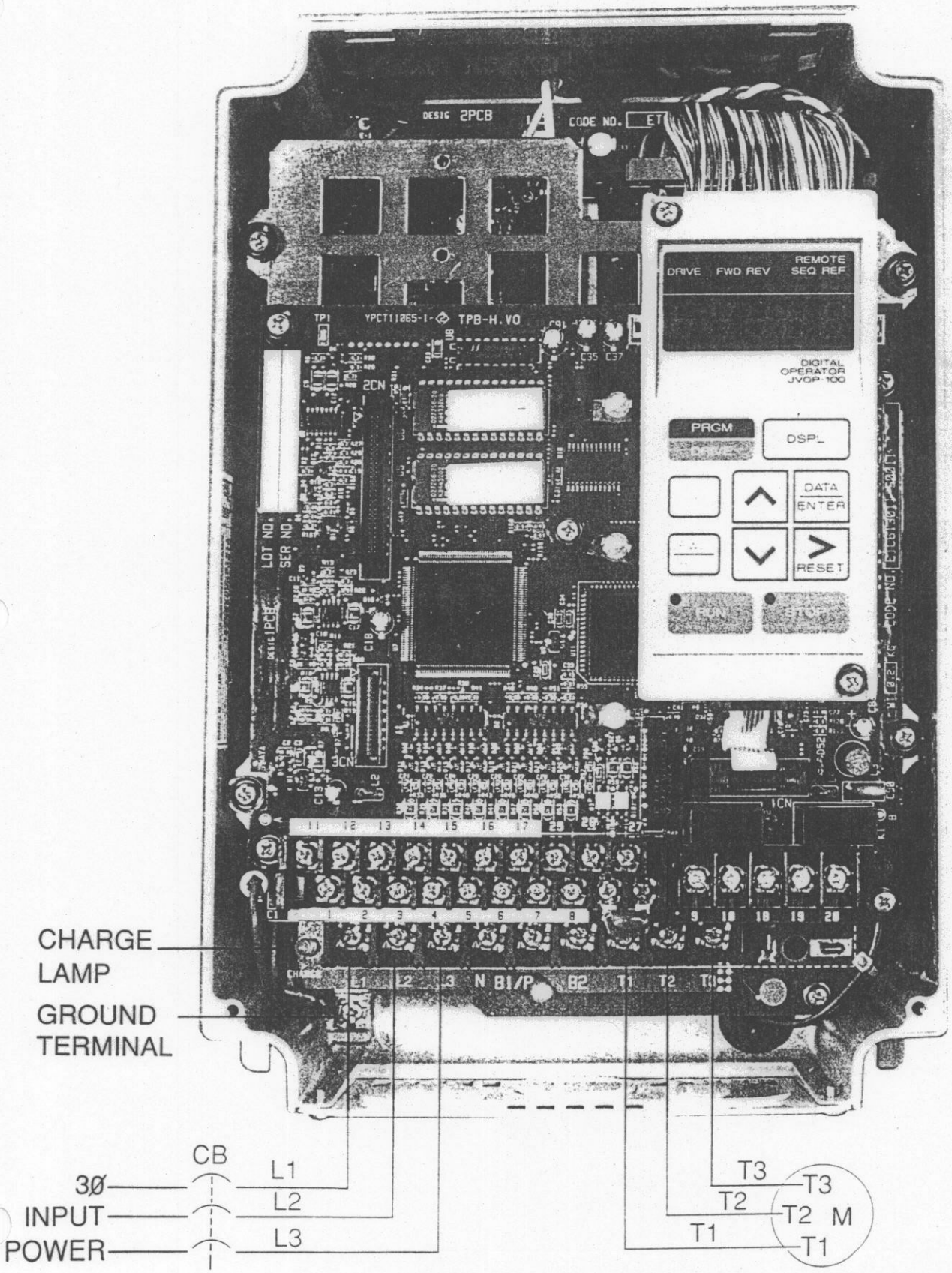
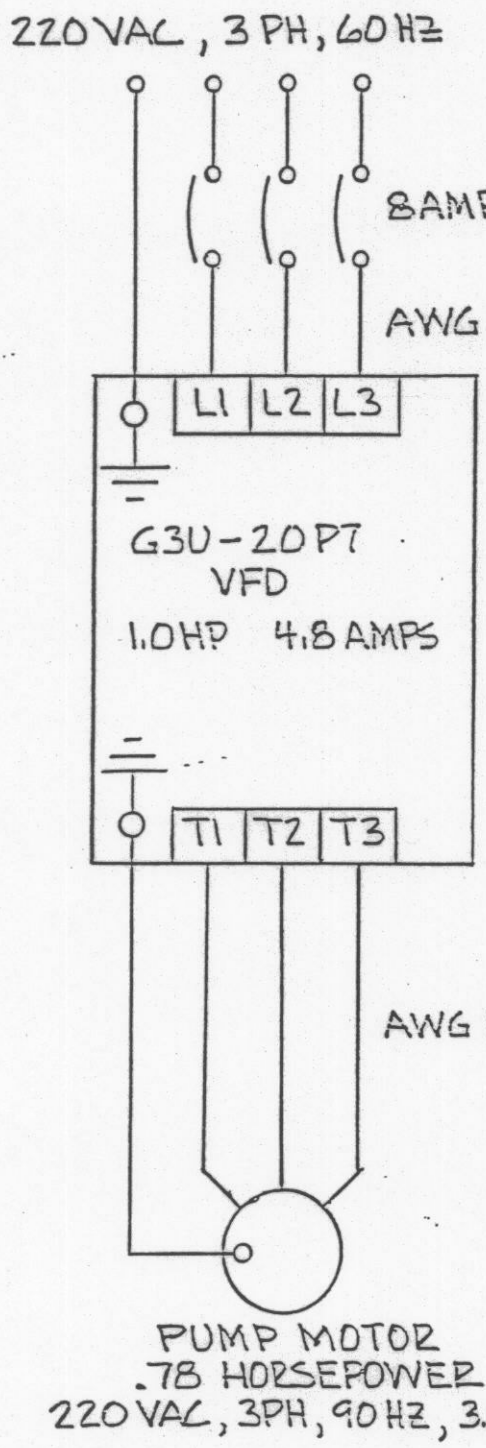


FIGURE 1. VFD TERMINAL LOCATIONS

BARBER NICHOLS

PROJECT		SUBJECT
	BY / DATE	VFD 220 VAC WIRING DIAGRAM FIGURE 2



NOTE: GROUND MOTOR HOUSING TO VFD GROUND LUG. DO NOT GROUND MOTOR NEUTRAL WHEN USING A VFD.

5. After wiring the VFD to the motor, the unit is ready for operation. However, the direction of motor rotation must be checked prior to functional operation. To check motor rotation, apply electrical power to the VFD. Remove the vacuum fitting on the side of the pump. Depress and hold the JOG button on the VFD digital keypad and visually observe the direction of shaft rotation through the vacuum port. Rotation should be clockwise when viewed from the top of the pump. If pump rotation is incorrect, interchange any two of the three wires between the pump and the VFD. DO NOT interchange any of the wires between the VFD and the power source. This will have no affect on motor rotational direction. Stop the pump, replace the vacuum fitting and set the VFD to the desired operating frequency (design frequency is 90 Hz).

6. Install the electrical enclosure cover on the motor and the VFD terminal cover on the VFD.

3.0 OPERATION

3.1 PUMP DESIGN POINT OPERATING CONDITIONS

The pump design point operating conditions are:

Fluid	Liquid nitrogen
Inlet pressure	150 psig
Inlet temperature	-320°F
Flow rate	5 gpm
Differential pressure	50 psid
Approx. operating speed	5272 rpm

Figure 3 shows the head-flow curve for the liquid nitrogen pump at its operating speed of 5272 rpm.

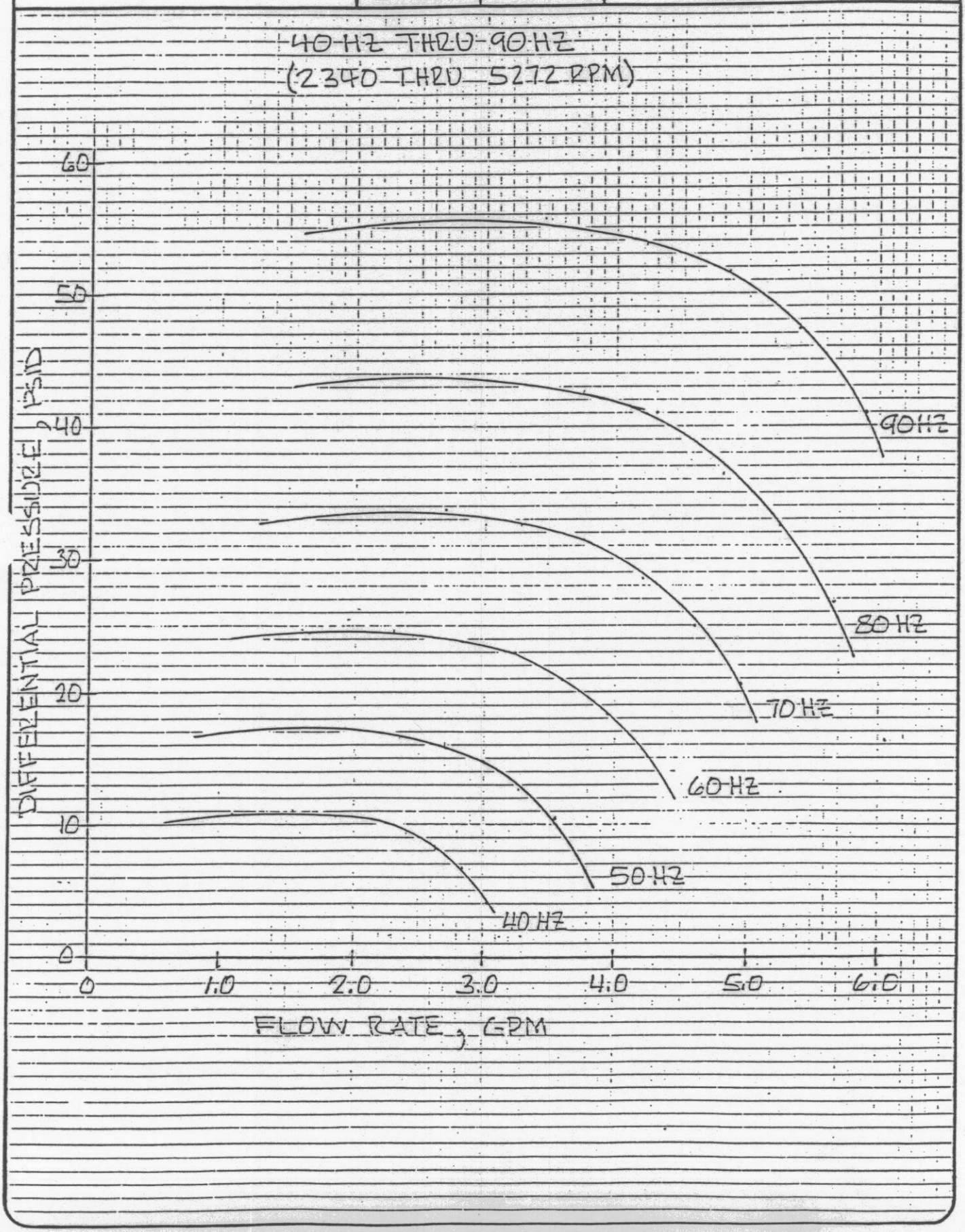
3.2 MOTOR NAMEPLATE DATA

The pump motor is a 220 VAC, 3-phase, high speed, inverter duty motor. The nameplate data for the motor is as follows:

Frame size	354-831
Volts	220
Amps	3.0
Phase	3
Hertz (Base freq.)	90
Horsepower	.78
Speed	5272 rpm
Ambient temp.	40°C
Duty	Continuous
Insulation class	F
Enclosure	Totally enclosed non-ventilated

BARBER-NICHOLS ENGINEERING CO.

PROJECT		SUBJECT
		HEAD - FLOW CURVE VS PUMP SPEED FIGURE: 3
BY JWH	DATE 2-01-95	



The motor has a maximum operating speed of 5520 rpm because of the critical speed with the long shaft.

3.3 PUMP CHECKS AND OPERATION

Before operating the pump, perform the following checks and operations:

1. The pump should always be evacuated before charging with nitrogen to prevent the formation of solid crystals (ice or other foreign material) which could damage the cold end bearing.

2. Be sure there are no loose objects or large particles in the dewar which could get caught in the impeller clearances and cause damage to the pump.

3. Ensure that all pump mounting bolts are securely fastened.

4. The pump was <u>not</u> designed to operate under shock loading. Ensure that heavy shock loads are not encountered in service.

5. The motor maximum speed is 92 Hz. Exceeding this speed could overload or damage the motor. Ensure that the VFD is set up to limit motor speed at or below 92 Hz. Setting the speed limit on the VFD will ensure overspeed protection of the pump. The pump speed cannot exceed the speed of the VFD even if the impeller is suddenly unloaded. Normal operating speed for the pump is 5272 rpm (90 Hertz).

The pump is operated by controlling the frequency of the variable frequency drive (VFD). The motor is a 2-pole induction type motor. Consequently, the synchronous speed of the rotor and shaft corresponds directly with the frequency of the VFD (60 Hz = 3600 rpm synchronous). The true speed of the rotor and shaft will be slightly less than the synchronous speed due to rotor slip. Under normal operation, the difference between the synchronous speed and true shaft speed depends on the load, but is typically about 2% to 4%.

The VFD has been programmed to run at speeds ranging up to 92 Hz (5520 rpm) using 3-phase power at 220 VAC. The design speed is 5272 rpm. The pump was tested at Barber-Nichols and meets the design performance requirements. Operating at speeds in excess of design speed will reduce bearing life and is not recommended. Operating at speeds less than 5272 will extend the life of the bearings.

Basic operation of the VFD is described below. For further information, refer to the Power Master G3U-20P7 VFD manual.

Figure 4 shows the VFD display. The RUN and STOP keys are used to start and stop the motor. The DISPLAY displays set frequency, running frequency, current, shutdown errors, etc. The DISPLAY key is used to sequence the display through various functions and parameters. The JOG key is used to run the motor about 6 Hertz to check motor direction of rotation. The FWD/REV key has been disabled by the program so the pump cannot be run backwards once direction of rotation has been correctly set. The DATA ENTER key is used to display data in memory and to enter new data to memory. The RESET key is used to reset operation after a fault. The STOP key is used to stop the motor. The PRGM DRIVE key switches between the program and drive modes.

When AC power is applied to the VFD, the DISPLAY will display the reference frequency. By depressing the DISPLAY key once, the output frequency will be displayed. When the RUN key is depressed, the output frequency will increased on the DISPLAY to the reference frequency plus slip compensation, if any. Thus, the output frequency can be slightly higher than the reference frequency (62.6 Hertz vs. 60 Hertz). The STOP key halts operation of the compressor.

When the PRG key is depressed, the Program Setting Mode is selected. Each time the DISPL key is depressed, the display toggles between An-xx, Bn-xx, Sn-xx, and Cn-xx. The UP/DOWN arrows can then be used to select a particular Constant Number such as Sn-04. The DATA/ENTER key is then depressed to read the value in memory. If the number in memory is to be changed, the UP/DOWN and RESET keys (arrow to the right) are used to change the value. The DATA/ENTER key is then depressed and the DISPLAY will display END. The DSPL key is then depressed to display the Constant Number and the UP/DOWN arrows or the DISPL key is used to toggle to the next Constant Number. The PRGM/DRIVE key is depressed to exit the program mode.

The G3U-20P7 Technical Manual further describes the Digital Key Pad and the Program and Drive modes of operation.

During startup, the Power Master VFD is programmed to ramp the pump up to set speed in 15 seconds. Ramp speed lower than 15 seconds can be programmed into the VFD, if desired. However, a ramp speed of less than 5 seconds could cause an overcurrent shutdown during initial acceleration and should not be used. The set speed and ramp rate are programmed into the VFD and can be changed as necessary. Refer to the Power Master VFD manual for information to reprogram the VFD.

Appendix A summarizes the VFD settings as recommended for the unit as shipped to Argonne National Laboratory.

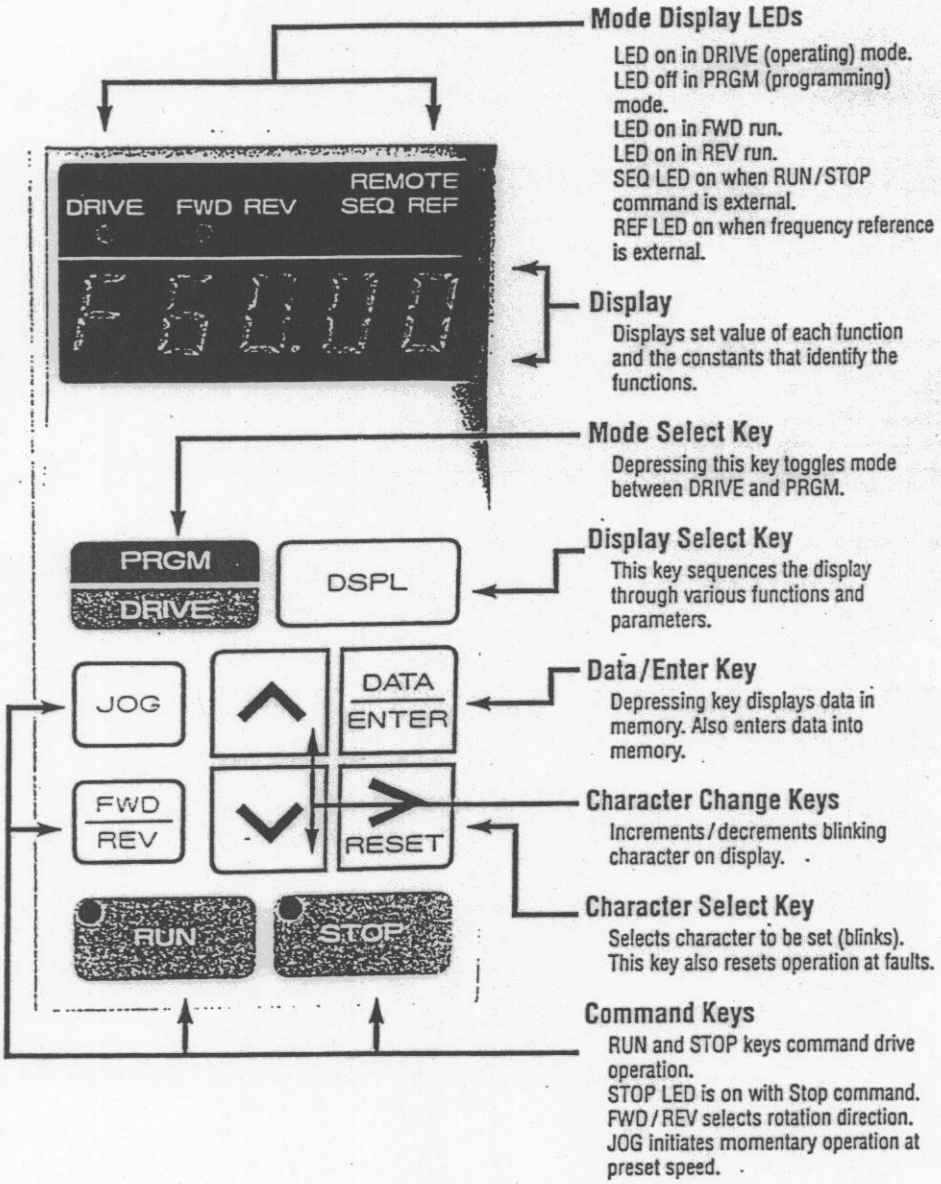


FIGURE 4. VFD DIGITAL KEYPAD

4.0 MAINTENANCE

4.1 VFD MAINTENANCE

The variable frequency drive was manufactured by Power Master. Under normal circumstances, it requires no maintenance. If problems arise with the VFD, refer to the Power Master G3U-20P7 manual for maintenance and troubleshooting or contact the Power Master representative in your area.

4.2 REPLACING THE PUMP ASSEMBLY

- W A R N I N G -

BEFORE PERFORMING ANY MAINTENANCE ON THE PUMP, ENSURE THAT ALL ELECTRICAL POWER TO THE UNIT IS TURNED OFF, LOCKED OUT AND TAGGED. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR EQUIPMENT DAMAGE.

The pump is designed so that all fluid and electrical connections can be external to the dewar. The pump can be replaced with a spare pump without draining the dewar. The following steps describe the removal and reinstallation of the liquid nitrogen pump.

Removal of the Pump

1. Ensure all electrical power is turned off.

2. Remove the electrical enclosure cover from the electrical box (item 50) on the side of the motor.

3. Make a note of the wire connections before removing the wires so they can be reconnected correctly to the leads on the new motor.

4. Disconnect the wires from the motor and remove the conduit from the terminal box.

5. Disconnect the pump inlet and discharge lines from the pump housing.

6. Remove the bolts connecting the pump mounting flange to the top of the dewar.

7. Pull the pump assembly straight up and out of the dewar without bumping the 35-inch long shaft, housing, and inlet tube against the side of the dewar.

Installation of a Reconditioned Pump

1. Using a new O-ring, install the pump assembly into the dewar. Tighten the bolts securely.

2. Install the pump inlet and discharge lines at the pump housing.

3. Install the conduit into the motor terminal box and attach the wires to the motor leads.

4. While viewing the motor shaft coupling through the port in the side of the pump shaft housing, check motor rotation. Rotation should be clockwise (coupling rotating to the left). If rotation is backwards, swap any two leads on the motor or on VFD terminals T1, T2 or T3.

5. Install the cover on the motor terminal box.

6. Pump air out of the LN2 loop if required.

4.3 REPLACING THE BEARINGS

The pump bearings have an estimated life of 5000 hours under normal use. If the pump has been operating for 5000 hours or longer or bearing replacement is required because of early bearing failure, follow the procedures in this section to service the motor and cold end bearings. Replace all bearings when service is required.

- W A R N I N G -

THE BEARINGS SHOULD ONLY BE REPLACED BY AN EXPERIENCED TECHNICIAN. IMPROPER REPLACEMENT AND REASSEMBLY COULD LEAVE THE UNIT INOPERABLE AND IN NEED OF MAJOR OVERHAUL. TECHNICIANS SHOULD REVIEW AND UNDERSTAND ALL STEPS PRIOR TO DISASSEMBLING THE ROTATING ASSEMBLY.

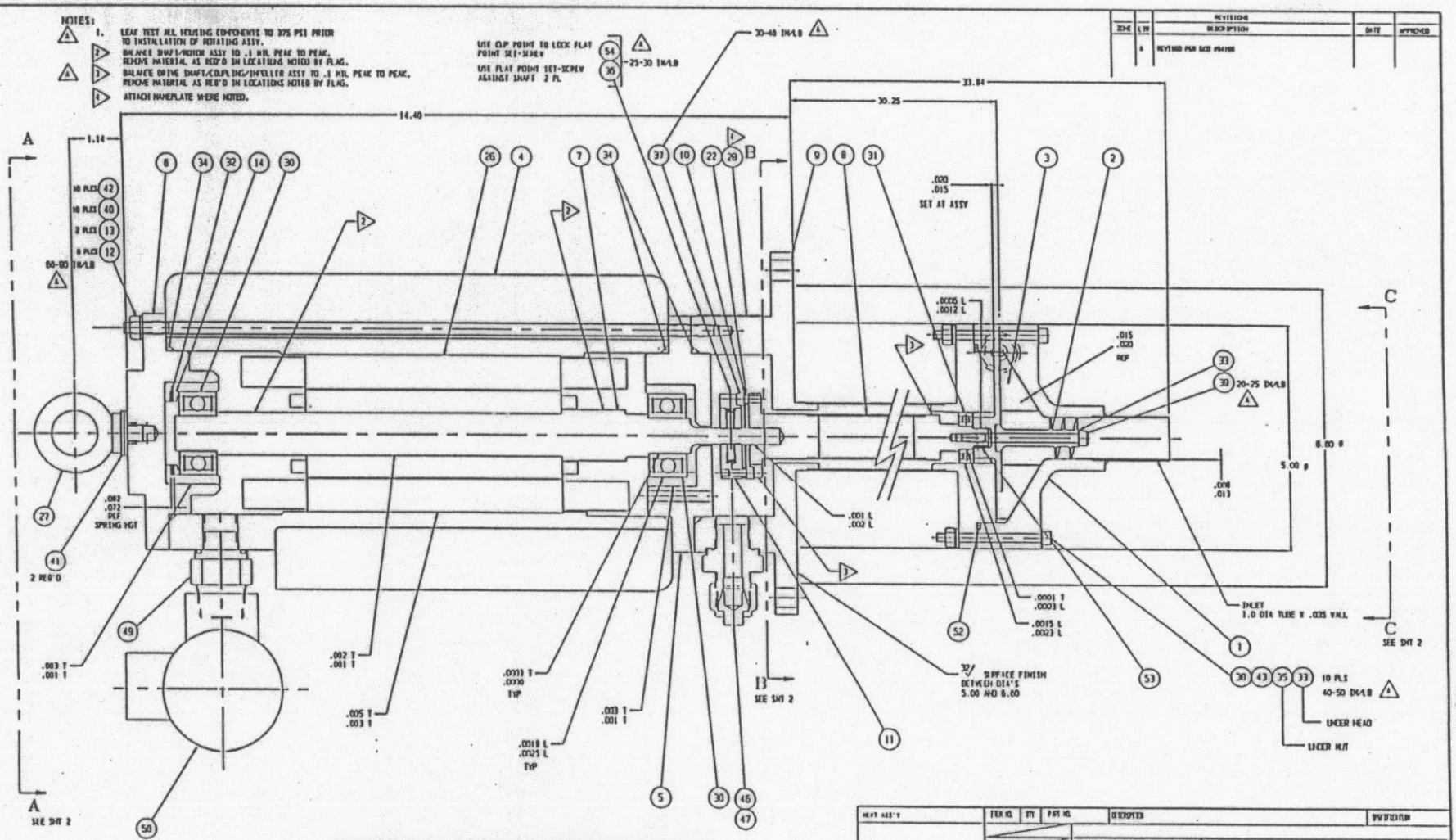
Removing the bearings from the pump assembly can damage them. Therefore, once the bearings have been removed, they should be replaced with new bearings.

The following steps outline the replacement of the bearings in the pump assembly (BNCP-30-000). See paragraph 4.2 for removal of the pump assembly from the dewar. Refer to the parts lists in Section 5.0 and the Assembly Drawing in Appendix B for identification of components.

1. Ensure that the pump assembly has been disconnected from all electrical loads, vacuum lines, etc.

NOTES:

1. LEAK TEST ALL HOUSING COMPONENTS TO 375 PSI PRIOR TO INSTALLATION OF ROTATING ASSY.
2. BALANCE SHAFT/ROTOR ASSY TO .1 MIL PEAK TO PEAK. REMOVE MATERIAL AS REQ'D IN LOCATIONS NOTED BY FLAG.
3. BALANCE DRIVE SHAFT/COUPLING/IMPELLER ASSY TO .1 MIL PEAK TO PEAK. REMOVE MATERIAL AS REQ'D IN LOCATIONS NOTED BY FLAG.
4. ATTACH NAMEPLATE WHERE NOTED.



PUMP		MOTOR		MOTOR BEARINGS		WET END BEARING	
FLUID	LN_2	MAX HP	.78	TYPE	[illegible]	TYPE	SRBSSTBS
FLOW RATE	5.0 GPM	VOLTAGE	220V	HSG FIT	0019/.0025 L	HSG FIT	0019/.0023
HEAD RISE	143 FT	BASE FREQ.	60	SHAFT FIT	0000/.0008	SHAFT FIT	.0001/.0003
DESIGN SPEED	5772 RPM	PHASE	3Ø	PRELOAD	20 lb		
MAX SPEED	5500 RPM	MFG	PERSAE	GREASE	SRI	LUBE	DRY FILM
TEMPER.	-[illegible]						
MAX PRES	250 PSI						
DESIGN POWER	.57 HP						

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
	A	REVISED PER ECO [illegible]		

NEXT ASS'Y	ITEM NO.	QTY	PART NO.	DESCRIPTION	SPECIFICATION

MATERIAL ----
HEAT TREATMENT ----
PROCESS ----

APPROVED	DATE
DWN P KERNE	10-10-04
CHK [illegible]	10-27-04
REJ [illegible]	11-04-04
G.P	11-10-04
APPD [illegible]	11-04-04

ENGINE: ANL-9444-1 CURRENT UPDATE. 30-000-1 12-15-04

TITLE: LN_2 PUMP

SIZE D | DRAWING NO. XBNCP-30-000 | A

SCALE FULL | WT | ACT CALC | SHEET 1 OF 1

ANL-9444

2. Position the pump assembly securely in a padded vise or stand with the impeller end down.

3. Remove the impeller housing (item 1) from the pump support tube (item 9). Discard the C-seal (item 52).

4. While holding the impeller (item 3), loosen and remove the socket head cap screw (item 39), the belleville washer (item 33), and the inducer (item 2).

5. While holding the shaft from below, reach in the vacuum port with an Allen wrench and loosen and remove the 10-24 socket head screws (item 36 and 54) (two set screws per hole) that secure the motor shaft (item 7) to the motor coupling (item 11). It will be necessary to rotate the shaft into position to access the screws.

6. Loosen and remove the eight nuts (item 42) and flat washers (item 40) from the 12-3/4 inch long studs (item 12) that secure the motor housing (item 4) to the pump support tube (item 9).

7. Pull the motor (item 4) and motor shaft assembly (item 7) off the pump support tube (item 9).

8. Pull the drive shaft (item 8), cold end bearing (item 31) and motor coupling assembly (item 11) out of the pump support tube (item 9).

9. Remove the remaining two nuts (item 42) and flat washers (item 40) from the motor housing (item 4).

10. Remove the motor rear plate (item 6) from the motor housing (item 4). Discard the O-ring (item 34).

11. Reach into the motor housing (item 4) and remove the rotor shaft assembly (item 7).

12. Slide the motor housing (item 4) and motor front plate (item 5) off the eight 12.75 inch long studs (item 12).

13. With the rotor shaft assembly (item 7) securely held, remove the motor bearings (item 30) from the shaft. (It may be necessary to make a special tool that reaches behind the bearing inner races to pull them off.

- N O T E -

PULLING THE BEARINGS OFF THE SHAFT MAY DAMAGE THEM. THEREFORE, IT IS RECOMMENDED THAT ONCE THE BEARINGS HAVE BEEN PULLED, THEY SHOULD BE REPLACED.

14. With the drive shaft (item 8) securely held, remove the cold end bearing (item 31) from the drive shaft (item 8).

15. Remove the motor front plate (item 5) from the motor housing (item 4). Discard the O-ring (item 34).

16. Clean the interior of the motor housing (item 4), the motor front plate (item 5), the motor rear plate (item 6), the rotor shaft assembly (item 7) and the drive shaft (item 8).

17. Press a new, dry, ungreased cold end bearing (item 31) onto the drive shaft (item 8). Use an arbor press and apply steady even force to the inner race only.

18. Press new motor bearings (item 30) onto the rotor shaft assembly (item 7). Insure the bearings have been packed 25 to 33% full with Chevron SRI-2 grease. Again, use an arbor press and apply steady even force to the inner races only.

19. Examine and replace, if necessary, the preload washer (item 32).

20. Reinstall the motor front plate (item 5) onto the motor housing (item 4). Use a new 2-239 O-ring (item 34).

21. Slide the rotor shaft assembly (item 7) into the motor housing (item 4) and engage the lower bearing (item 30) into the bearing carrier in the motor front plate (item 5).

22. Install a new 2-239 O-ring (item 34) on the motor rear plate (item 6) and install the rear plate onto the motor housing (item 4).

23. Secure the motor assembly with two nuts (item 42) and two flat washers (item 40) on the two 12.15 inch long studs (item 13). torque to 60-80 in-lbs.

24. Install a new 2-239 O-ring (item 34) on the motor front plate (item 5).

25. Slide the motor assembly over the eight 12.75 long studs (item 12) in the pump support tube (item 9).

26. Install eight nuts (item 42) and eight flat washers (item 40) onto the eight long studs (item 12). Torque to 60-80 in-lbs.

27. Reinstall the drive shaft (item 8) into the pump support tube (item 9) and engage the rotor shaft (item 7) with the motor coupling (item 11).

28. While holding the drive shaft (item 8) to prevent it from sliding out of the pump support tube (item 9), turn the entire assembly upside down (impeller end up) and place it back into the padded vise or stand.

29. Install the impeller (item 3), the inducer (item 2), the belleville washer (item 33), and the retaining screw (item 39) onto the end of the drive shaft (item 8). Torque to 20-25 in-lbs.

30. Reinstall two of the 10-24 set screws (item 36) in the motor coupling (item 11), but do not tighten.

31. Using a .015 inch (.40 mm) feeler gage, set the clearance between the impeller (item 3) and the pump support tube (item 9) (see clearance callout on layout drawing XBNCP-30-000). Tighten the set screws (item 36) in the motor coupling (item 11) to lock in the clearance. Torque to 25-30 in-lbs.

32. Install the remaining two set screws (item 54) into the holes in the coupling to lock the first two set screws in place. Torque to 25-30 in-lbs.

33. Install the impeller housing (item 1) with a new C-seal (item 52) onto the pump support tube (item 9) with ten socket head cap screws (item 38), ten belleville washers (item 33), ten flat washers (item 35) and ten nuts (item 43). Item 33 goes under the head of the screw and item 35 goes under the nut. Torque to 40-50 in-lbs.

After completion of step 33, the pump assembly is complete. To reinstall the pump assembly into the dewar, see paragraph 4.2.

4.4 BEARING REPACK AND RUN-IN PROCEDURE

During initial run-in of new or repacked bearings in the nitrogen pump, when the lubricating film is being established, excess lubricant will be expelled from the rotational surface region of the bearing. It is important that this excess lubricant is not restricted from exiting the rotational surface region so as not to increase the internal friction of the bearing during operation. If there is insufficient void area inside the bearing between the balls and the shields, excessive internal friction will cause the bearing outer race to be dragged around at a rotational speed high enough to wear the outer bearing retainer. This wear will cause shaft displacement either radially or axially with subsequent damage to the rotor, stator and impeller.

To insure there is sufficient void area, the proper lubricant quantity for high speed ball bearings is 25 to 30% of the bearing free space. When packing or repacking ball bearings, they should

be packed with no more than enough SRI-II grease that the excess grease can exit the rotational surface region and bearing internal friction can be held to a minimum.

After the bearings have been repacked and installed into the pump, the bearings need to be run in so a lubricating film and a ball track can be established. This run-in procedure needs to be done only the first time the pump is run with new or repacked bearings.

Bearing Run-in Procedure

Use the following procedure to run-in the ball bearings in the liquid nitrogen pump.

1) Start at a low speed, typically 50,000 DN or 30 Hertz (1800 rpm) and run the pump at 30 Hertz for 30 minutes.

2) After 30 minutes, increase the rotational speed to 60 Hertz and run at 60 Hertz for 15 minutes.

3) Every 15 minutes, increase the speed by 30 Hertz (90, 120, etc.) until normal operational speed (90 Hertz) is reached.

4) Once the pump has reached operational speed, let it run there for 45 minutes. After 45 minutes, remove the motor rear end cap and measure the stator and rotor temperatures. With an unloaded motor, the rotor temperature should be about 125 $\pm 10^{\circ}$F and the stator temperature should be about 90 $\pm 10^{\circ}$F. Full load and rotor and bearing temperatures should not exceed 250°F.

5) While the end cap is removed, check that excess grease has not been ejected from the bearing. A few very small grease spots are normal.

4.5 OTHER MAINTENANCE

The rotating assembly should be returned to Barber-Nichols for any maintenance beyond changing the bearings and O-ring seals.

5.0 PARTS LISTS

5.1 PARTS LIST FOR LIQUID NITROGEN PUMP XBNCP-30-000

Item	Qty	Part No.	Description
1	1	XBNCP-30-001	Impeller housing
2	1	XBNCP-30-002	Inducer
3	1	XBNCP-30-003	Impeller
4	1	XBNCP-28-004	Motor housing
5	1	XBNCP-28-005	Front plate
6	1	XBNCP-28-006	Rear plate
7	1	XBNCP-28-007	Shaft
8	1	XBNCP-30-008	Drive shaft
9	1	XBNCP-30-009	Pump support tube
10	1	XBNCP-20-010	Coupling disc
11	1	XBNCP-20-011	Motor coupling
12	8	XBNCP-28-012	Stud, 12.75 long
13	2	XBNCP-28-013	Stud, 12.15 long
14	1	XBNCP-28-014	Shim, rear bearing
22	4	XBNCP-20-022	Spacer
26	1	XBNCP-28-026	Motor, .78 hp
27	1	XBNCP-28-027	Eyebolt, modified
28	1	XBNCP-30-028	Nameplate
30	2	9204FFTX4K6	Ball bearing
31	1	SR8SSTB5	Ball bearing
32	1	W1819-020	Wave spring washer
33	11	B0375-020-S	Belleville washer
34	3	2-239	O-ring, viton
35	10	98017A140	Flat washer
36	2	#10-24 UNC	Socket head set screw .25" long, flat point
37	4	#8-32 UNC	Socket head cap screw .50" long
38	10	#10-24 UNC	Socket head cap screw 2.25" long
39	1	#10-24 UNC	Button head cap screw 2.50" long
40	10	98017A160	Flat washer
41	2	98017A200	Flat washer
42	10	#1/4-20 UNC	Hex nut
43	10	#10-24 UNC	Hex nut
46	1	SS-810-1-OR	O-seal fitting
47	1	SS-810-P	Swagelok plug
49	1	29409	Electric feed-through
50	1	GUAL 24	Conduit outlet with cover
52	1	614A5P-0062-2	C-seal/Series 61 face type internal pressure
53	1		Dowel pin 1/16" dia x .25" long, SS
54	2	#10-24 UNC	Socket head set screw .25" long, cup point

5.2 PARTS LIST FOR PUMP REBUILD KIT XBNCP-30-055

Item	Qty	Part No.	Description
14	1	XBNCP-28-014	Shim, rear bearing
30	2	9204FFTX4K6	Ball bearing
31	1	SR8SSTB5	Ball bearing
32	1	W1819-020	Wave spring washer
33	11	B0375-020-S	Belleville washer
34	3	2-239	O-ring
36	2	#10-24 UNC	Socket head set screw .25" long, flat point
52	1	614A5P-0062-2	C-seal/Series 61 face type internal pressure
54	2	#10-24 UNC	Socket heat set screw .25" long, cup point

APPENDIX A: VFD PARAMETER SETTINGS

The VFD has been programmed to run the XBNCP-30-000 Liquid Nitrogen Pump at a design speed of 5272 rpm at a maximum voltage of 220 VAC, 3-phase. The following table summarizes the settings of the Power Master G3U-20P7 VFD.

QUICK REFERENCE FOR GPD 503 CONSTANTS (FACTORY SET)

CONSTANT NUMBER	FACTORY SETTING	USER SETTING
An-01	0.00	90
An-02	0.00	
An-03	0.00	
An-04	0.00	
An-05	0.00	
An-06	0.00	
An-07	0.00	
An-08	0.00	
An-09	6.00	
bn-01	10.0	15.0
bn-02	10.0	15.0
bn-03	10.0	
bn-04	10.0	
bn-05	100.0	
bn-06	0	
bn-07	1.0	
bn-08	0.0	3.0
bn-09	80	
bn-10	1	
bn-11	1.00	
bn-12	0.50	
Sn-01	*(1)*	01
Sn-02	01	OF
Sn-03	0000	
Sn-04	0011	
Sn-05	0000	0010
Sn-06	0000	0001
Sn-07	0000	
Sn-08	0100	
Sn-09	0000	
Sn-10	0000	
Sn-11	0000	0100
Sn-12	0100	
Sn-13	0100	
Sn-14	0000	0110
Sn-15	03	
Sn-16	04	
Sn-17	06	
Sn-18	08	
Sn-19	00	
Sn-20	00	
Sn-21	01	

CONSTANT NUMBER	FACTORY SETTING	USER SETTING
Sn-22	02	
Sn-23	00	
Sn-24	00	
Sn-25	0000	
Sn-26	0000	
Sn-27	0010	
Sn-28	0100	
Cn-01	230.0 (230V) or 460.0 (460V) or 575.0 (575V)	220
Cn-02	*(2)*	92
Cn-03	*(2)*	220
Cn-04	*(2)*	90
Cn-05	*(2)*	45
Cn-06	*(2)*	110
Cn-07	*(2)*	.5
Cn-08	*(2)*	11
Cn-09	*(1)*	3.0
Cn-10	1.5 *(2)*	.5
Cn-11	50	
Cn-12	0.0	
Cn-13	0.0	
Cn-14	100	
Cn-15	0	
Cn-16	0.0	
Cn-17	0.0	
Cn-18	0.0	
Cn-19	1.0	
Cn-20	0	
Cn-21	0.0	
Cn-22	2.0	
Cn-23	*(4)*	15.0
Cn-24	*(4)*	15.0
Cn-25	00	
Cn-26	160	
Cn-27	0.1	
Cn-28	170	

CONSTANT NUMBER	FACTORY SETTING	USER SETTING
Cn-29	50	
Cn-30	160	
Cn-31	*(4)*	5.604
Cn-32	*(4)*	00026
Cn-33	*(4)*	050
Cn-34	30 *(3)*	28
Cn-35	2.0	
Cn-36	0	
Cn-37	*(4)*	1.0
Cn-38	150	
Cn-39	2.0 *(4)*	
Cn-40	*(4)*	0.5
Cn-41	100	
Cn-42	0.3	
Un-01	N/A	N/A
Un-02	N/A	N/A
Un-03	N/A	N/A
Un-04	N/A	N/A
Un-05	N/A	N/A
Un-06	N/A	N/A
Un-07	N/A	N/A
Un-08	N/A	N/A
Un-09	N/A	N/A
Un-10	N/A	N/A

APPENDIX B ASSEMBLY DRAWING FOR LIQUID NITROGEN PUMP, XBNCP-30-000