TEIKOKU USA INC
CHEMPUMP

CHEMPUMP™ G-SERIES

Sealless Canned Motor Pump
With Teikoku Rotary Guardian (TRG)

INSTRUCTION MANUAL

for Installation, Operation, and Maintenance

JUNE 2019

Introduction

Thank you for purchasing a Chempump™ G-Series pump.
Please carefully read this instruction manual and all Safety Warnings prior to use.

Safety Terms

Please pay close attention to these terms. When you see them in this manual, read the information thoroughly and follow the instructions given.

Attention!

Indicates careful attention is required. The instruction includes protective information for the device and product.

Caution!

Ignoring this warning can cause personal injury and/or damage to the device and product.

Hazard!

Ignoring this warning can cause serious injury or even death. It can also be used to alert against unsafe practices.

NOTE: *Information included in NOTES gives additional helpful information and recommendations.*

Applicable Standards and Regulations

The G-Series pump conforms to the following standards:

1. American Society of Mechanical Engineers (ASME) B-16.5
2. Canadian Standards Association (CSA): UL 778 CSA 22.2 No 108

Product Warranty Period

This product is warranted for two years from date of delivery. Please refer to Teikoku USA's Terms and Conditions of Sale for additional warranty coverage and restrictions.

Rights

Safety Warnings

Important:
Before operating the canned motor pump, read these Safety Warnings and this entire Instruction Manual to avoid improper operation.
It is essential for your safety and to avoid disaster.

Attention!

Do not run dry!

If the pump is allowed to run dry, the bearings, sleeves, and other components could be damaged and serious overheating of the motor windings can occur.

Attention!

Avoid rapid temperature changes!

Large changes in temperature must be avoided. Rapid changes can cause leaks to occur in gaskets. Published procedures for proper heating and cooling must be followed. If published procedures are not available, check with Teikoku before operating the equipment.

Caution!

Hot – Do not touch!

Motor and pump can be hot, even when pumping cold liquids.

Caution!

If motor trips, do not restart before determining the cause!

Restarting the motor before ascertaining the cause may result in excessive heat, causing pump or motor failure.

Hazard!

Do not remove internal bolts in terminal box.

If it is necessary to remove the terminal box for any reason, first loosen the bolts by 2 or 3 turns to check if any internal pressure or liquid is present. You must take measures if the possibility exists that the gas or liquid is toxic or hazardous to personnel or the environment.

Hazard!

Do not remove any bolts on pump, motor, or drain plugs!

The internal pressure can be higher than the atmosphere. Ensure that the pump and motor are properly de-pressurized and decontaminated prior to performing any work. Proper protective measures must be taken if the possibility exists that the gas or liquid is toxic or hazardous to personnel or the environment.

Hazard!

Always assume that there is liquid left in the pump!

There is always the possibility that residual liquid could remain in the pump and motor in spite of thorough decontamination. Pay particular attention to the clearance between the shaft and the impeller, bearings, sleeves, bearing housings, internal bolting and gaskets. You must take adequate precautions to protect personnel and the environment if the liquid could be considered hazardous.

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Overview

Teikoku USA's Chempump™ G-Series canned motor pump has been the workhorse of the North American sealless pump industry for over 50 years. G Series pumps feature automatic hydraulic thrust balance, replaceable thrust surface design, direction of rotation indication and precision front and rear bearings.

G-Series are capable of pumping fluids from -400ºF to 1000ºF and working pressures up to 5000 psi. As with all Teikoku products, no special tools, foundations, leveling or alignment are required for installation.

1. General Information

1.1 General Design and Operation

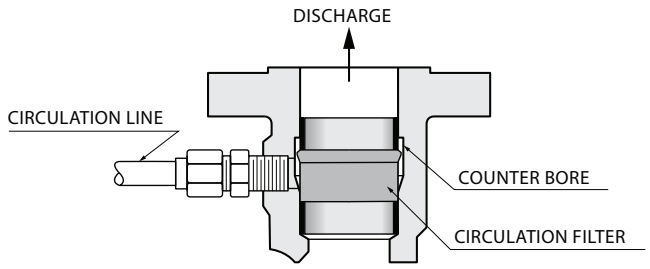
The Chempump™ Plan 11-S G-Series is a combined centrifugal pump and squirrel cage induction electric motor designed and produced as a single hermetically-sealed unit. The pump impeller is an enclosed type and mounted on one end of the rotor shaft, which extends from the motor section into the pump impeller casing.

The rotor is hermetically sealed or "canned" with a corrosion resistant, nonmagnetic, alloy shell to isolate it from contact with the pumped liquid being circulated through the liquid cooled motor assembly. The rotating rotor and shaft assembly and its supporting thin film liquid lubricated bearings, operate immersed in the circulating liquid, functioning as both a motor coolant and bearing lubricant.

The motor stator winding is also canned with a corrosion resistant, non-magnetic, alloy liner, to simultaneously isolate it from the same circulating liquid. Chempump™ Plan 11-S G-Series pumps are characterized by the use of an external circulation pipe to channel and control a portion of pump discharge flow into the rotor cavity through the rear bearing housing into the rotor cavity of the motor to effect motor cooling in this liquid cooled motor design. Through a combination of flow and pressure control mechanisms designed into the canned motor pump assembly, the circulating fluid is driven by pump discharge pressure into the rotor cavity to assure required motor cooling and the establishment of the bearing liquid film for rotating element support. The flow path of a Plan 11-S G-Series pump is shown in Figure 1-1. The circulating liquid is channeled from the discharge flange to the motor section through the circulation pipe. The circulating liquid first lubricates the rear bearing, then passes over the rotor, cooling the motor, moves forward to lubricate the front bearing and then exits the motor section through the front bearing housing. The fluid returns to the high-pressure region of the impeller for joining the pump discharge flow.

The discharge filter, Figure 1-2, located in the discharge nozzle of the pump casing, helps to extend motor and bearing life by keeping the circulating fluid free of damaging particles. Although this filter is open top and bottom, and is constantly washed by the discharge flow, certain types of solids are gummy and will adhere to the fine wire mesh, thus restricting flow to the bearings. If this type of solid is present, periodic inspection of the filter is recommended.

Figure 1-2. Discharge Filter Arrangement



The G-Series pump is a precision-built unit that, with proper care, provides years of trouble-free, leakproof service. This manual, containing basic instructions for installation, operation and maintenance of G-Series pumps, is designed to assist you in maintaining this service.

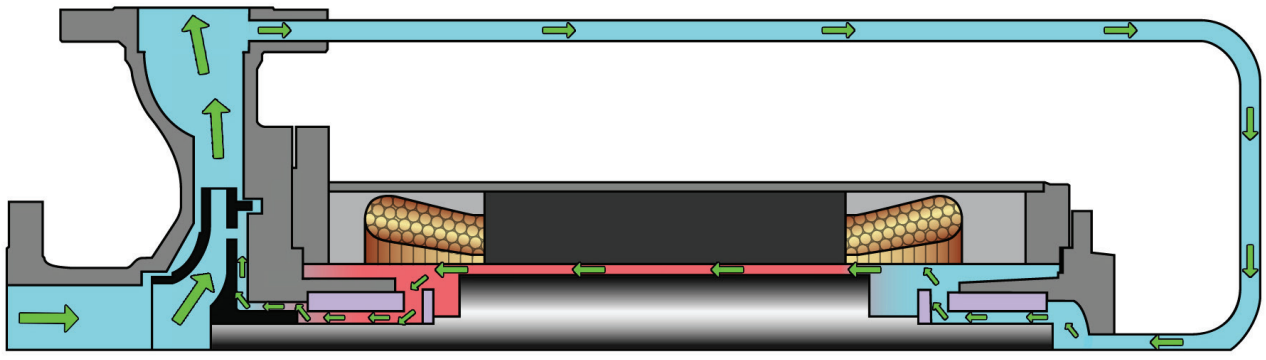
It is important that the persons responsible for the installation, operation and maintenance of the pump, read and understand this manual thoroughly. Trouble-free performance begins with proper pump selection and application. If the selected pump does not have the required performance characteristics, or if the materials of construction are not properly specified for the fluid being handled, unsatisfactory operation may result. **No amount of maintenance can compensate for this.**

If you doubt the pump selection or application, email or call your Teikoku application representative or the factory for assistance and advice. Additional copies of this manual are available from Teikoku field representatives or from the factory.

1.2 Stator Assembly

The stator assembly consists of a set of three-phase windings connected in a one circuit wye arrangement. Stator laminations

Figure 1-1. G-Series Schematic Diagram, Plan 11-S Standard Circulation Single Stage



are of low-silicon grade carbon steel. Laminations and windings are mounted inside the cylindrical stator band. End bells, welded to the stator band, close off the ends of the stator assembly. Back up sleeves are provided to strengthen those areas of the stator liner not supported by the stator laminations. The stator liner is, in effect, a cylindrical "can", placed under the stator bore and welded to the end bell shrouds to hermetically seal off the windings from contact with the liquid being pumped. Terminal leads from the windings are connected to a pressure tight terminal plate isolating the stator cavity from the customer's electrical connections in the Teikoku supplied connection box.

1.3 Rotor Assembly

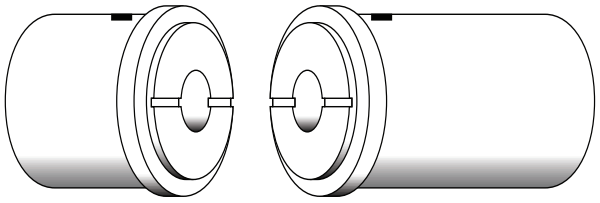
The rotor assembly is a squirrel cage induction rotor constructed and machined for use in the G-Series Pump. It consists of a machined corrosion-resistant shaft, laminated core with aluminum bars and end rings, two corrosion-resistant end covers, and a corrosion-resistant can. The shaft is provided with flats or with an impeller key arrangement at one end, to receive the impeller, and is threaded at the same end to receive the impeller nut which retains the impeller, or impellers in the case of two-stage models.

The two rotor end covers are welded to the shaft and also to the rotor can which surrounds the outside of the rotor, thus hermetically sealing off the rotor core from contact with the liquid being pumped.

1.4 Bearings

The bearings for the unit are metal sleeved or sleeveless and have a molded carbon/graphite insert as standard (other materials are furnished depending on the application), and are machined with a special helix groove through the bore to assure adequate fluid circulation at the journal area. Each bearing is manufactured to close tolerances for a high degree of concentricity, and is held in a bearing housing by a retaining screw and lock washer. Bearings are easily replaced by removing the retaining screw and sliding the bearing from its housing. See Figure 1-3. Single- stage models may be provided with two bearings in the motor end, while two-stage models may be provided with two bearings in the motor end plus another bearing (idler bearing) in the pump casing for additional shaft support.

Figure 1-3. Bearings – G-Series Sleeved Type

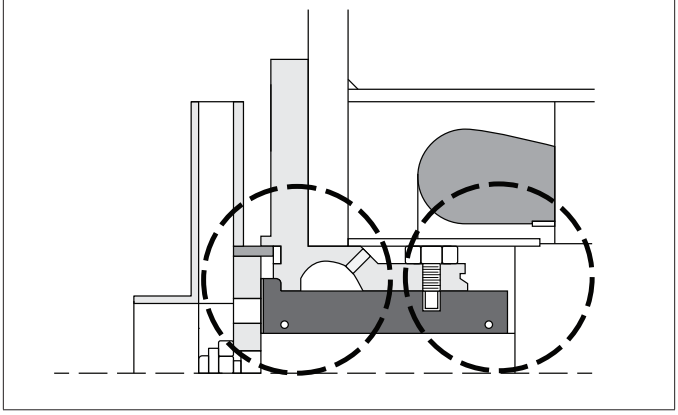


1.5 Thrust Surfaces

All Teikoku models equipped with thrust surfaces provide a replaceable bearing surface against which axial loads can be carried during upset conditions. This arrangement provides two thrust surfaces between the impeller and rotor assembly. These surfaces prevent metal to metal contact in the event of abnormal pump operation such as running dry or cavitation.

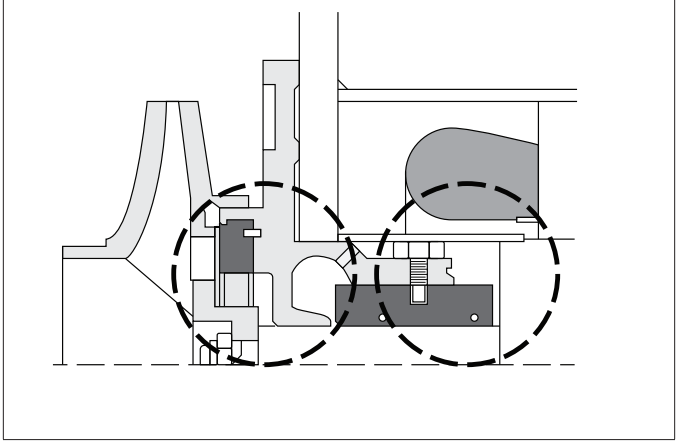
A) Single Stage Models GA, GB, & GC. See Figure 1-4.

Figure 1-4. Thrust Surfaces, Models GA, GB, & GC



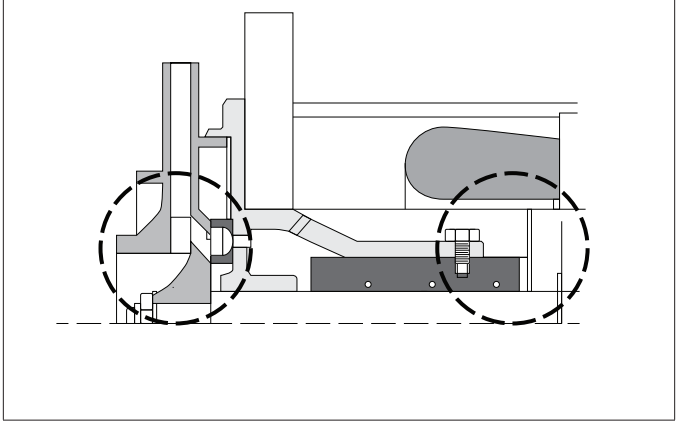
B) Single Stage GVBS. See Figure 1-5.

Figure 1-5. Thrust Surface Models GVBS



C) Single Stage Models GVD, GVE, and GVHS. See Figure 1-6.

Figure 1-6. Thrust Surfaces, Models GVD, GVE, & GVHS



1.6 External Cooling Flow (Standard Plan 11-S)

Cooling for stator, rotor, and bearings, as well as bearing lubrication, is provided by circulation of the pumped fluid. A small flow circulates through the circulation tube, through the rear bearing housing, across the rear journal, over and around the rotor, across the front journal and front bearing housing, through the eye of the impeller, and returns to the mainstream flow. See Figure 1-1, Page 6.

1.7 Automatic Thrust Balance

A) Single Stage Models GA, GB, GC, GVBS and GVD.

Based on hydraulic principles, G-Series automatic thrust balance is generated by the pressure of the internally circulated pumped fluid flowing into a balance chamber just to the rear of the impeller.

When a change in load tends to change the position of the impeller away from the balance condition, there is an equalizing change of hydraulic pressure in the balance chamber which immediately returns the impeller-rotor assembly to the balanced position. See Figure 1-7.

B) Single Stage Models GVE, GVHS, GG, and GVM.

Automatic thrust balance on these models operates on the same principle as noted above except that balance chambers are provided on the front as well as the rear of the impeller to absorb the additional axial thrust loading of these larger models. See Figure 1-8.

Figure 1-7. Automatic Thrust Balance, Single Ring

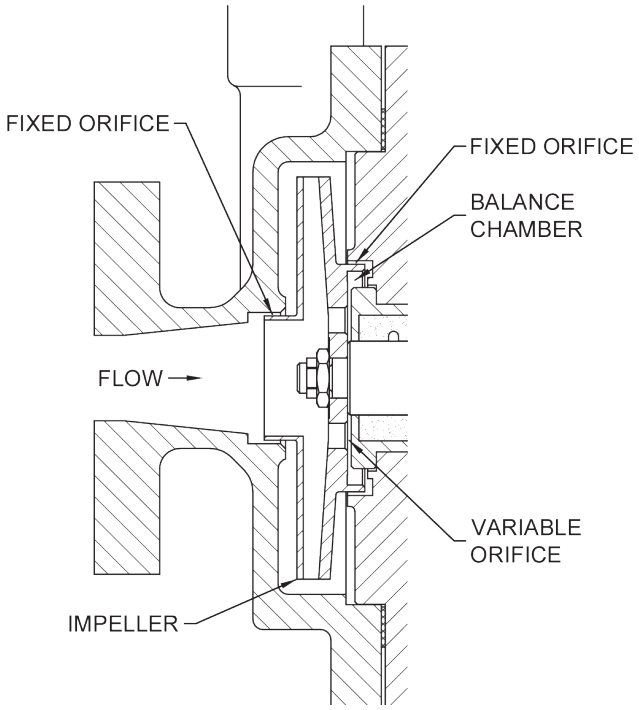
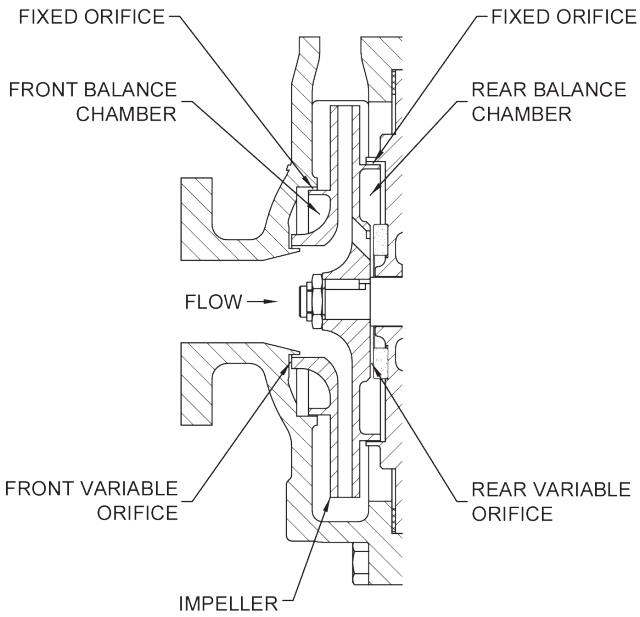


Figure 1-8. Automatic Thrust Balance, Double Ring



2. Installation

2.1 Receipt Inspection

1. Avoid rough handling during loading, transportation and unloading.
2. Visually inspect the shipping container for evidence of damage during shipment.
3. Check unit to see that suction, discharge, and any other connections are covered.
4. Inspect the suction, discharge and any other connections gasket seating surface to be certain that they are clean of foreign matter and free from nicks, gouges, and scratches.
5. Check phase resistance and megger resistance to ground of the motor windings. Refer to Table 4-9, page 27.
6. Check all nameplate data against shipping papers.
7. Caution should be observed during handling, so as not to bend the circulation line.

2.1.1 Storage Note

In situations where a pump is to be stored for a period of time prior to installation, and where the climate experiences wide temperature changes and high humidity, the terminal box must be sealed to prevent moisture from entering the motor winding area.

2.2 Structural

The pump design and construction eliminates the need to align the pump and motor. The pump should be supported using the mountings provided and mounted so that its weight is properly supported. Suction and discharge piping must be properly supported and aligned so that no strain is placed on the pump casing.

1. Remove burrs and sharp edges from flanges when making up joints.
2. When connecting flanged joints, be sure inside diameters match within 1/16" so as not to impose a strain on the pump casing.
3. Use pipe hangers or supports at intervals as necessary.

2.2.1 Pump Location

Locate the pump as close as possible to the fluid supply with a positive suction head. Installations with suction lift are possible but not recommended.

Since standard pumps are not self-priming, provide for initial priming and for maintaining a primed condition. Location of the pump and arrangement of the system should be such that sufficient NPSH (Net Positive Suction Head) is provided over vapor pressure of the fluid at the pump inlet. NPSH requirements at the design point are stated on the pump order copy. For additional design points, refer to the corresponding performance curves placed in the Appendix of this manual.

Note: *Experience has proven that most pump troubles result from poor suction conditions including insufficient NPSH. The suction line must have as few pressure drops as possible and available NPSH MUST be greater than required NPSH.*

Depending on job conditions, available NPSH can sometimes be increased to meet the NPSH required by the pump for satisfactory operation. NPSH can be tailored by changes in the piping, in liquid supply level, and by several other methods. Refer to Appx. B. Troubleshooting.

2.2.2 Mounting and Alignment

Canned motor pumps combine a pump and motor in a single hermetically sealed unit. No tedious coupling alignment is required as the pump has no external coupling between pump and motor. All models can be mounted in any position except the two-stage Model GLD, which must be mounted with suction and discharge "up" unless otherwise allowed. For mounting with suction and discharge on the side or in any other position, modifications must be made to the standard internal venting arrangement.

Standard Chempump™ Models GA, GB, GC and GVBS can be pipeline mounted. However, bases are offered on all models. You merely have to set the pumps on a foundation strong enough to support their weight. There is no need to bolt down or grout any canned motor pump.

Be sure that suction and discharge piping are properly aligned so that no strain is placed on the pump casing by out-of-line piping.

All G-Series models are provided with a specially made base designed to facilitate inspection and repair. See Figure 2-1.

2.2.3 Piping Data

Observe the standards of the Hydraulic Institute when sizing and making up suction and discharge piping. For Reverse Circulation, Pressurized Circulation, and Back-Flush installations, refer to Figure 2-4, 2-5, and 2-6. Follow these procedures below for all installations:

1. Remove burrs and sharp edges when making up joints.
2. When using flanged joints, be sure inside diameters match properly. When gasketing flanged joints, do not cut flow hole smaller than flange opening.
3. Use pipe hangers or supports at necessary intervals.
4. Provide for pipe expansion when required by liquid temperature.
5. When welding joints, avoid possibility of welding shot entering the suction or discharge line, and thereby entering the pump.

> **Caution!**
>
> Do not weld pipe when it is connected to pump.

6. Do not spring piping when making up any connections.

7. Make suction piping as straight as possible, avoiding unnecessary elbows. Where necessary, use 45-degree or long-sweep 90-degree fittings.
8. Make suction piping short, direct, and never smaller in diameter than suction opening of pump. Suction piping should be equal to or larger than pump suction port, depending on pipe length.
9. Ensure that all joints in suction piping are airtight.
10. When installing valves and other fittings, position them to avoid formation of air pockets.
11. Permanently mounted suction filters are not recommended.

It is extremely important to size and layout the suction system to minimize pressure losses and to be sure that the pump will not be "starved" for fluid during operation. NPSH problems are a result of improper suction systems.

If suction pipe length is short, pipe diameter can be the same size as the pump suction port diameter. If suction piping is long, the size should be one or two sizes larger than pump suction port, depending on piping length.

Use the largest pipe size practical on suction piping and keep piping short and free from elbows, tees or other sources of pressure drops. If elbows or tees must be used, locate them from 10 to 15 pipe diameters upstream from suction. When reducing to pump suction port diameter, use eccentric reducers with eccentric side down to avoid air pockets.

When operating under conditions where pump prime can be lost during off cycles, a foot valve should be provided in the suction line to avoid the necessity of priming each time the pump is started. This valve should be of the flapper type rather than the multiple spring type and of ample size to avoid undue friction in the suction line.

When foot valves are used, or when there are other possibilities of fluid hammer, it is important to close the discharge valve before shutting down the pump.

When necessary to connect two or more pumps to the same suction line, provide gate valves so that any pump can be isolated from the line. Install gate valves with stems horizontal to avoid air pockets. Globe valves should be avoided, particularly where NPSH is critical. If discharge pipe length is normal, pipe diameter can be the same size as the pump discharge port diameter. If discharge piping is of considerable length, use larger diameter pipe (one or two sizes larger).

If the pump is to discharge into a closed system or an elevated tank, place a gate valve or check valve in the discharge line close to the pump. The pump can then be opened for inspection without fluid loss or damage to the immediate area.

NOTE: *Install properly sized pressure gauges in suction and discharge lines between the pump and the first block and/or check valve so that operation of the pump and system can be easily observed. Should cavitation, vapor lock, or unstable operation occur, widely fluctuating discharge pressures will be observed. Such gauges provide a positive means of determining actual system conditions and can be used to great advantage in evaluating system problems.*

2.3 Electrical and Instrumentation

2.3.1 TRG Bearing Wear Monitor

The TRG is an electrical meter that continuously monitors the condition of the bearings. The TRG is mounted on the electrical junction box as standard.

The TRG meter operates on the principle of induced voltage. There are two TRG coils located inside the stator 180° apart. A magnetic field is created in the stator by current flowing through the stator windings. In addition, a magnetic field is created by induced currents in the rotor. When the rotor is perfectly centered in the stator, the two magnetic fields are essentially balanced. When bearing wear occurs and the gap between the rotor and stator decreases, an imbalance in the magnetic fields causes a differential induced voltage in the TRG coils. This differential voltage is indicated on the TRG voltmeter.

The initial display of the TRG meter is adjusted in the factory, but each meter will show subtle differences. To check bearing wear

Figure 2-1. Easy Maintenance Base

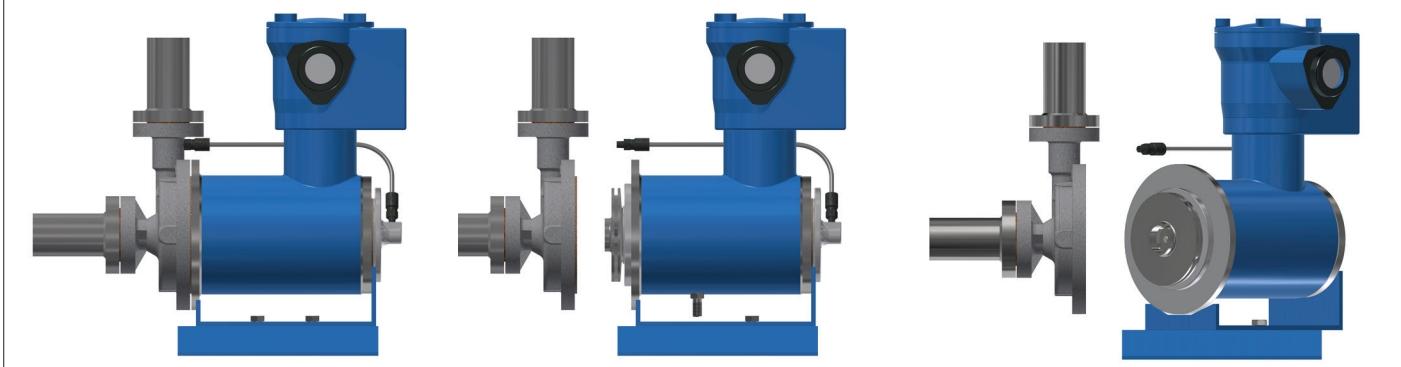


Table 2-1. Conditions Indicated on the TRG Meter					
The TRG meter has a colored scale which is divided into three zones: Green (0 to 0.5), Yellow (0.5 to 0.75), Red (0.75 to 1)					
AT TRIAL OPERATION			DURING OPERATION		
Indication	Condition	Solution	Indication	Diagnosis	User Actions
Full scale	incorrect wiring	change power cable connection	Green	Good	No action
Yellow to Red	phase failure	check connection of cables	Yellow or scale increase of > 0.3 from initial indication	Bearings worn to caution level	Plan routine maintenance
Green	normal	connection is correct	Red or scale increased of > 0.5 from initial indication	Immediate maintenance required	Shutdown immediately and replace worn parts

HAZARD **Hazard!** Do not operate if TRG meter condition is RED.

Figure 2-2. Teikoku TRG Bearing Wear Monitor

using the TRG meter, use the color change (Green, Yellow, Red) as a reference. If the increase of TRG readings is 0.3 or more, stop the pump and check bearings.

The Teikoku Rotary Guardian (TRG) signal is affected by motor load. Changes in operating frequency or hydraulic load may increase or decrease signal.

Keeping records of the TRG meter reading in conjunction with motor amp readings will provide a good indication of when the pump will require maintenance.

2.3.2 Thermal Cutout

Unless otherwise specified, all G-Series pumps are fitted with thermal cutouts. The cutout is a heat-sensitive bimetallic switch, mounted in intimate contact with the stator windings. It is to be wired in series with the holding coil in the starter box. Refer to Table 2-2 for TCO maximum holding coil currents.

Table 2-2. TCO Maximum Coil Currents	
115 Volt	3.1 Amps
230 Volt	1.6 Amps
460 Volt	0.8 Amps

CAUTION

Caution!

The thermal cutout switch does not provide protection against fast heat buildup resulting from locked rotor conditions, single phasing, or heavy overloads. This protection must be provided for by the current overload relay heaters in the magnetic starter. The rating of the heaters should be high enough to avoid nuisance cut outs under running loads, but must not be oversized. Refer to Table 2-3 for starting and running electrical characteristics. It is recommended that "quick trip", class 10 or less, type heaters be used.

2.3.3 Starting Equipment

Motor starters (normally not supplied with G-Series pumps) should be sized to handle the load required per the National Electrical Code (NEC). Start KVA, Full Load KW, Full Load amps and Full Load KVA data are listed in Table 2-3.

Thermal overload protective devices in the starters should be sized for the amperage shown on the product nameplate. DO NOT size the thermal overload protective device in excess of 10% of full load amp rating. In order to provide complete protection for G-Series motors under all conditions, it is recommended that "quick trip" (Class 10) type thermal overload protective devices be used in the starters where available. Standard type thermal overload protective devices can be used if these "quick trip" type thermal overload protective devices are not available. Standard thermal overload protective devices provide adequate protection for G-Series motors under starting or normal running conditions, but require a greater length of time than "quick trip" type thermal overload protective devices to cut out. This may not protect the meter if the motor is subject to locked rotor or overload conditions. Also, see Tables 2-3, 2-4, 2-5, or 2-6 for additional electrical wiring data for the most common G-Series motor sizes to assist in the electrical installation of the unit.

2.3.4 Variable Frequency Drive (VFD) Power Supply

G-Series pumps can be operated with a VFD power supply. The VFD should be a Pulse Width Modulated Drive selected for the appropriate voltage class of the motor, i.e. 400V class for 460V motors, and suitable to handle the full load current of the motor. The VFD should always be sized based on full load nameplate

current and not the listed horse power (hp). Sizing based on hp could lead to an undersized drive being selected. The drive should be programmed to ensure a linear relationship between voltage to frequency (V/F) and frequencies should be limited to the range of 25-65 Hz. Operation at 65 Hz assumes the motor will not operate in an overload condition. For frequencies beyond these limits please consult Teikoku Application and Engineering personnel.

Table 2-3. G-Series Electrical Data

G-Series Model	Motor Size	Start KVA	Full Load Ratings				
			KVA	KW	Amperes		
					230V	460V	575V
GA	1K	5.1	1.9	1.5	4.6	2.3	1.8
GA, GB, GC	1-1/2K	10.4	3.1	2.5	7.7	3.8	3.1
GB, GC, GVBS, GLD	3K	20.8	5.3	4.4	13.4	6.7	5.4
GB, GC, GVBS, GLD	5K	28.4	7.0	5.9	17.6	8.8	7.0
GVD, GVE, GVHS, GG	5K	34.6	9.9	8.5	24.8	12.4	9.9
GVD, GVE, GVHS, GG	7-1/2K	52.0	12.5	11.0	31.6	15.8	12.6
GVD, GVE, GVHS, GG, N2S	10K	69.2	17.5	15.5	44.0	22.0	17.6
GVD, GVE, GVHS, GG, N2S	15K	104.3	22.2	20.0	55.6	27.8	22.2
GVD, GVE, GVHS, GG, N2S	20K	138.8	30.8	27.0	77.6	38.8	30.9
GVM (1150 rpm)	5P	25.0	7.15	5.0	17.7	8.8	7.1
GVM (1750 rpm)	7-1/2L	38.5	10.7	7.5	27.0	13.5	10.8
	10L	48.5	13.1	10.0	33.4	16.7	13.4
	15L	62.7	16.5	13.5	41.2	20.6	16.5
N2S	30K	134.0	37.4	33.0	98.0	49.0	40.0
	40K	156.5	47.6	42.0	125.0	62.0	50.0
	50K	188.0	57.8	51.0	152.0	76.0	60.0

Table 2-4. Electrical Wiring Data for 230 Volt, 3 Phase, 60 Hz G-Series Pumps

G-Series Model	Motor Size	Full Load Speed (rpm)	Switch Size Amps	Breaker Size Amps	Starter NEMA Size	Conductor Suze for Motor Leads	Conduit Size for Motor Leads Only	Conduit Size for Motor PB & TRG Leads	Fuse Size Code & Current Limiting Amps	Fuse Size Dual Element Amps	Max Setting of Time Limit Overload Protection Amps
GA	1K	3450	30	15	0	14	1/2	3/4	15	7	5.3
GA, GB, GC	1-1/2K	3450	30	20	0	14	1/2	3/4	25	12	8.9
GB, GC, GV, BS, GLD	3K	3450	60 (30)	40	1	12	1/2	3/4	45	20	15.4
GB, GC, GV, BS, GLD	5K	3450	60 (30)	50	1	10	3/4	1	50	25	20.2
GVD, GVE, GVHS, GG	5K	3450	100 (60)	70	2	10	3/4	1	80	40	28.5
GVD, GVE, GVHS, GG	7-1/2K	3450	100 (60)	100	2	6	1	1-1/4	90	45	36.3
GVD, GVE, GVHS, GG, N2S	10K	3450	200 (100)	125	3	6	1	1-1/4	125	70	50.6
GVD, GVE, GVHS, GG, N2S	15K	3450	200 (100)	150	3	4	1-1/2	1-1/4	175	80	63.9
GVD, GVE, GVHS, GG, N2S	20K	3450	200 (150)	200	3	2	1-1/2	1-1/2	200	100	89.29
GVM (1150 rpm)	5P	1150	60 (30)	40	1	12	1/2	3/4	50	25	20.3
GVM (1750 rpm)	7-1/2L	1750	100 (60)	70	1	8	3/4	1	90	45	31.05
	10L	1750	100 (60)	100	1	8	3/4	1	100	50	38.41
	15L	1750	200 (60)	125	2	6	1	1-1/4	125	60	47.38
N2S	30K	3450	200	200	4	1/0	1-1/2	2	250	175	112.7
	40K	3450	200	200	4	3/0	1-1/2	2	200	200	143.8
	50K	3450	400	250	5	4/0	2	2-1/2	250	250	174.8

Table 2-5. Electrical Wiring Data for 460 Volt, 3 Phase, 60 Hz G-Series Pumps

G-Series Model	Motor Size	Full Load Speed (rpm)	Switch Size Amps	Breaker Size Amps	Starter NEMA Size	Conductor Suze for Motor Leads	Conduit Size for Motor Leads Only	Conduit Size for Motor PB & TRG Leads	Fuse Size Code & Current Limiting Amps	Fuse Size Dual Element Amps	Max Setting of Time Limit Overload Protection Amps
GA	1K	3450	30	15	0	14	1/2	3/4	15	3-1/2	2.75
GA, GB, GC	1-1/2K	3450	30	15	0	14	1/2	3/4	15	7	4.45
GB, GC, GV, BS, GLD	3K	3450	30	15	1	14	1/2	3/4	20	10	7.7
GB, GC, GV, BS, GLD	5K	3450	30 (15)	20	1	14	1/2	3/4	30	15	10.1
GVD, GVE, GVHS, GG	5K	3450	60 (30)	40	1	12	1/2	3/4	40	20	14.3
GVD, GVE, GVHS, GG	7-1/2K	3450	60 (30)	40	2	10	3/4	1	50	25	19.2
GVD, GVE, GVHS, GG, N2S	10K	3450	100 (60)	60	2	10	3/4	1	70	35	25.3
GVD, GVE, GVHS, GG, N2S	15K	3450	100 (60)	70	3	6	1	1-1/4	80	40	32.0
GVD, GVE, GVHS, GG, N2S	20K	3450	200 (100)	100	3	6	1	1-1/4	125	60	44.7
GVM (1150 rpm)	5P	1150	30	30	1	12	1/2	3/4	30	15	10.2
GVM (1750 rpm)	7-1/2L	1750	60 (30)	40	1	12	3/4	1	45	25	15.6
	10L	1750	60 (30)	50	1	10	3/4	1	60	30	19.2
	15L	1750	60 (30)	50	2	10	3/4	1	60	30	23.7
N2S	30K	3450	100	100	3	4	1	1-1/4	125	90	56.5
	40K	3450	100	100	3	2	1	1-1/4	100	100	71.3
	50K	3450	200	125	3	2	1	1-1/4	125	125	87.4

Table 2-6. Electrical Wiring Data for 575 Volt, 3 Phase, 60 Hz G-Series Pumps

G-Series Model	Motor Size	Full Load Speed (rpm)	Switch Size Amps	Breaker Size Amps	Starter NEMA Size	Conductor Suze for Motor Leads	Conduit Size for Motor Leads Only	Conduit Size for Motor PB & TRG Leads	Fuse Size Code & Current Limiting Amps	Fuse Size Dual Element Amps	Max Setting of Time Limit Overload Protection Amps
GA	1K	3450	30	15	0	14	1/2	3/4	15	3	2.2
GA, GB, GC	1-1/2K	3450	30	15	0	14	1/2	3/4	15	7	3.6
GB, GC, GV, BS, GLD	3K	3450	30	20	1	14	1/2	3/4	20	15	6.2
GB, GC, GV, BS, GLD	5K	3450	30 (15)	20	1	14	1/2	3/4	25	12	8.1
GVD, GVE, GVHS, GG	5K	3450	30	30	2	12	1/2	3/4	30	15	11.5
GVD, GVE, GVHS, GG	7-1/2K	3450	60 (30)	40	2	12	1/2	3/4	40	20	15.4
GVD, GVE, GVHS, GG, N2S	10K	3450	100	50	3	10	3/4	1	60	35	20.3
GVD, GVE, GVHS, GG, N2S	15K	3450	100 (60)	70	3	6	1	1-1/4	80	40	25.6
GVD, GVE, GVHS, GG, N2S	20K	3450	200 (100)	100	3	6	1	1-1/4	90	45	35.8
GVM (1150 rpm)	5P	1150	30	20	1	12	1/2	3/4	25	15	8.2
GVM (1750 rpm)	7-1/2L	1750	30	30	1	12	1/2	3/4	30	15	8.2
	10L	1750	60 (30)	40	1	12	1/2	3/4	45	20	15.4
	15L	1750	60 (30)	50	2	10	3/4	1	60	30	20.2
N2S	30K	3450	60	80	3	6	1	1-1/4	100	70	46.0
	40K	3450	100	80	3	4	1	1-1/4	80	80	57.5
	50K	3450	100	90	3	4	1	1-1/4	90	90	69.0

2.3.5 Oil Filled Stator

G-Series pumps are designed to provide long, trouble free service with oil filled stator cavities provided as standard. Solid filled or dry stator options are available for many applications. In order to facilitate even dissipation of heat from the motor section, eliminate operating hot spots on the motor winding and promote longer motor life, the stator cavity on standard G-Series pumps is factory filled with a heat conductive dielectric oil. Inert oils are also available. Oil filling provides enhanced conductivity and allows the heat generated in the motor to be conducted to the outside of the unit, thereby maintaining a lower temperature in the motor section than would be possible with a dry stator. When storing or installing oil filled stators, be sure that the motor lead or connection box nipple is maintained in an upright vertical position. Refer to Table 2-7 for oil volume in G Series stators.

Table 2-7. Oil Volume in G-Series Stators

G-Series Model	Motor Size	Volume of Oil (Fluid Ounces)
GA	1K	41.5
GA, GB, GC	1-1/2K	42
GB, GC, GVBS, GLD	3K	44
GB, GC, GVBS, GLD	5K	45
GVD, GVE, GVHS, GG	5K	90
GVD, GVE, GVHS, GG	7-1/2K	90.5
GVD, GVE, GVHS, GG, N2S	10K	91
GVD, GVE, GVHS, GG, N2S	15K	92
GVD, GVE, GVHS, GG, N2S	20K	93
GVM	5P, 7-1/2L	95
	10L	95
	15	95
N2S	30K	130
	40K	130
	50K	130

2.4 Special Conditions and Features

2.4.1 Back-Flushing (Plan 32-S)

For normal, clean fluid applications, G-Series pumps are cooled and lubricated by the fluid being pumped (Plan 11-S). For slurry and other "dirty" applications, a system of back-flushing is recommended.

Back-flushing is noted on the order when recommended. See Figure 2-3 for a typical back flush installation.

Pumps to be used with back-flush are normally supplied without circulating tubes. Clean fluid is brought to the fitting at the rear bearing housing using the customer's piping as shown in Figure 2-3. The amount of clean base fluid introduced in this manner should approximate the standard flow rates listed in Table 2-8, below.

Figure 2-3. Back-Flush System

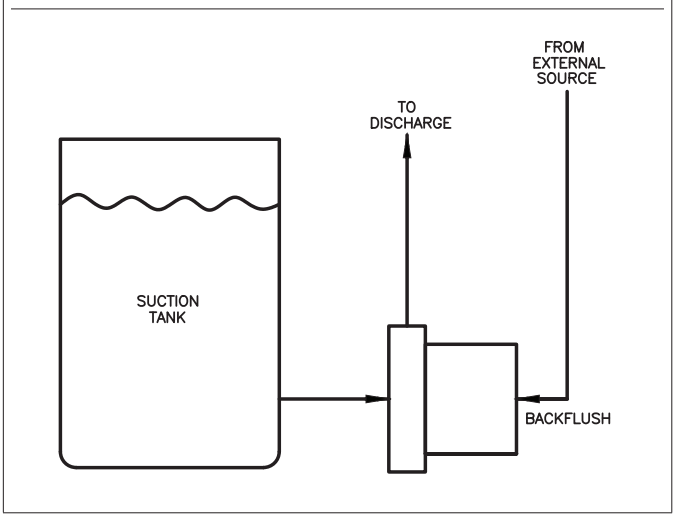


Table 2-8. Standard Recirculation Flow Rates

Model	Recirculation Flow Rate (gpm)
GA GB GC GVBS	1 to 2 1-1/2 to 2-1/2 1-1/2 to 2-1/2 1-1/2 to 2-1/2
GVD, GVE, GVHS GG	2 to 4 1-1/2 to 3
GVM GLD	1 to 3 4 to 5

Back-flush pressure should be suction pressure plus 20-30% of the pressure developed by the pump itself for single stage Models GA, GB, GC, GVBS, GVD, GVE, GVHS, GG and GVM, and suction pressure plus 60-80% of the pressure developed by the pump itself for two stage Model GLD. Excessive back-flush pressure will destroy the thrust balanced operation built into G-Series pumps by causing excessive forward thrust.

Procedure:

1. Remove the circulation tube and plug the port in the discharge neck of the pump casing used for the circulating tube front fitting. (This is done at the factory).
2. Pipe in the clean liquid to the port in the rear bearing housing used for the circulating tube rear fitting. See Table 2-9 below for proper circulating tube sizes.
3. If the back-flushing liquid is hot, auxiliary cooling methods, such as water jacketing the stator must be employed. The temperature of the back-flush fluid should not be close to its boiling point and should not exceed 300˚ Fahrenheit.

Table 2-9. Circulating Tube Sizes

Model	Tube Size
GA, GB, GC,GVBS, GLD	1/4" O.D. x 0.035 Wall
GVD, GVE, GVHS, GG, GVM, N2S	3/8" O.D. x 0.035 Wall

2.4.2 Reverse Circulation (Plan 13-SE)

For normal clean fluid applications, G-Series pumps are cooled and lubricated by the fluid being pumped; which flows through the circulating tube; into the rear of the rotor chamber; across the rear bearing, rotor, and front bearing; and then back into the main pumped stream through small holes provided in the rear of the impeller in the suction area. However, when the fluid being pumped is at or near its boiling point, plus the additional heat picked up from the motor, combined with the low pressure at the impeller suction, the recirculated fluid may vaporize. The reverse circulation method of lubricating the bearings and cooling the motor should be used. Flow rates should duplicate those shown in Table 2-8.

With reverse circulation, the rotor chamber will be under discharge pressure, with cooling fluid circulating from the pump end, through the rotor chamber, out the rear bearing housing, and back to the vapor space of the suction vessel. Flow through stator-rotor cavity must be controlled to allow for a good balance of pressure and temperature without excessive flow, typically through the use of an orifice. See Figure 2-4, for a typical reverse circulation installation. When provided, the reverse circulation modification is noted on the order.

Procedure:

1. Connect tubing or flanged piping (preferably 1/2" tubing at least) to the circulating tube port in the rear bearing housing.
2. Run the tubing from the connection port fitting in the rear bearing housing back to the vapor space of the suction receiver, preferably above the liquid level.
3. Use large size suction line and gate valve for a low pressure drop and thus improve available NPSH.

2.4.3 Pressurized Circulation (Plan 1-SD)

As an option to reverse circulation when pumping fluids close to their vapor pressure, pressurized circulation may be used. Fluid to cool the motor flows from the pump discharge to an auxiliary impeller (See Figure 2-5) in the back of the pump that adds pressure to the flow through the motor and returns the flow to the main stream at discharge pressure. With this recirculation system, the fluid heated by the motor is at sufficient pressure so the heat added by the motor will not cause the fluid to vaporize.

2.4.4 Electrical Isolation

To eliminate electrolytic corrosion when handling solutions during an electrolysis or plating operation, the G-Series pump should be electrically isolated. Insulated couplings or nonconductive plastic piping must be used in the primary suction and discharge lines. The pump must be isolated electrically from the tank, and separately grounded as shown in Figure 2-6.

Figure 2-4. Reverse Circulation

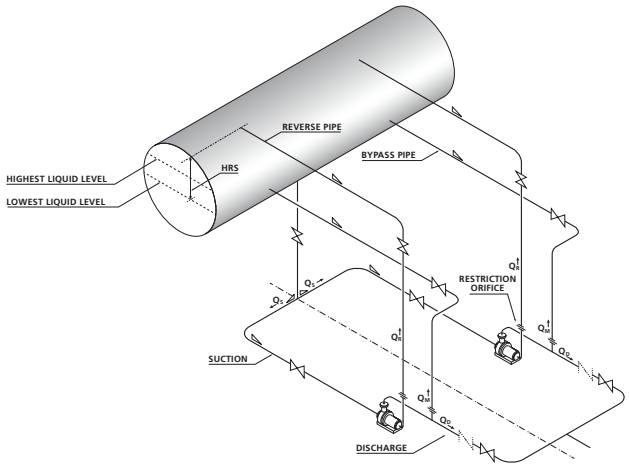


Figure 2-5. Pressurized Circulation

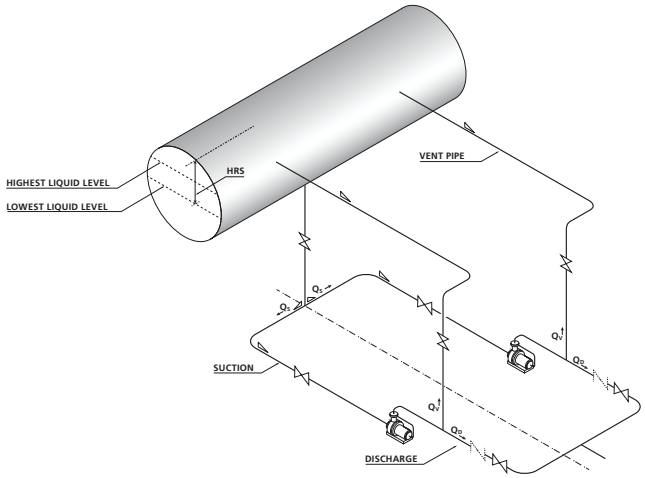
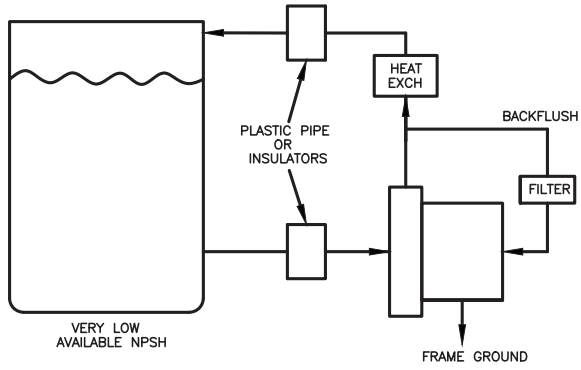


Figure 2-6. Back-Flush Installation with Electrical Isolation



2.4.5 Water and Steam Jackets

When handling fluids at controlled temperatures, additional motor cooling or heating must be provided. For temperature control, jackets are provided for water, steam, or other heat transfer media. In addition, the pump can be submerged into the pumped fluid, thus providing an additional means of temperature control.

All G-Series pumps can be provided with removable type water jackets (See Figure 2-8). This type jacket is easily removable from the stator band to allow for inspection and replacement. Removable-type water jacket kits are available from the factory for provision or already installed in the field when additional stator cooling is required. These jackets are suitable only for heating mediums compatible with the gasket and jacket material, with maximum inlet pressure of 50 psi and with maximum temperature of 150° F. They should not be used as steam jackets. Jackets welded to the stator band are available for use as steam jackets and for liquid mediums which exceed the temperatures and pressures noted above. Normally welded type jackets are suitable for steam pressures to 50 psi and liquid medium pressures to 100 psi. However, welded type jackets specially fabricated are also available for higher pressures.

2.4.6 Heat Exchanger

Similar to the water jacket in every respect except for the provision of corrosion-resistant tubing, heat exchangers, whether removable, or welded-on, are provided on Teikoku applications that require heating or cooling the fluid before it enters the rotor chamber. Heat exchangers are especially recommended for liquids with low specific heat characteristics.

All G-Series pumps can be provided with removable wrap around heat exchangers when specified. This type jacket is easily removed from the stator band to allow for inspection and replacement. These heat exchangers are suitable for maximum inlet pressure of 50 psi and maximum temperature of 150° F. See Figure 2-9.

Welded on heat exchangers are available on all G-Series pumps. These heat exchangers are suitable for steam pressure of 50 psi and liquid medium pressures to 100 psi, where maximum temperatures vary depending upon existing motor insulation and TCO setting as indicated on the pump nameplate.

2.4.7 Jacketed Circulation Tube

The jacketed circulation tube acts as a heat exchanger in that it permits a heat transfer medium to circulate around the tubing and heat or cool the fluid before it enters the rotor chamber. The jacketed circulation tube is suitable for maximum inlet pressures of 50 psi liquid, or 15 psi steam. Higher pressures are available on special models. See Figure 2-7.

Figure 2-7. Jacketed Circulation Tube

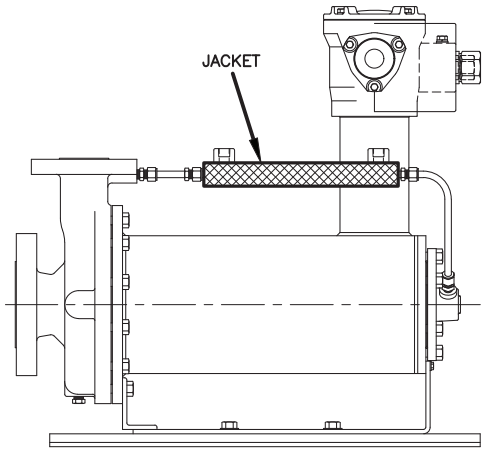


Figure 2-8. Removable Water Jacket

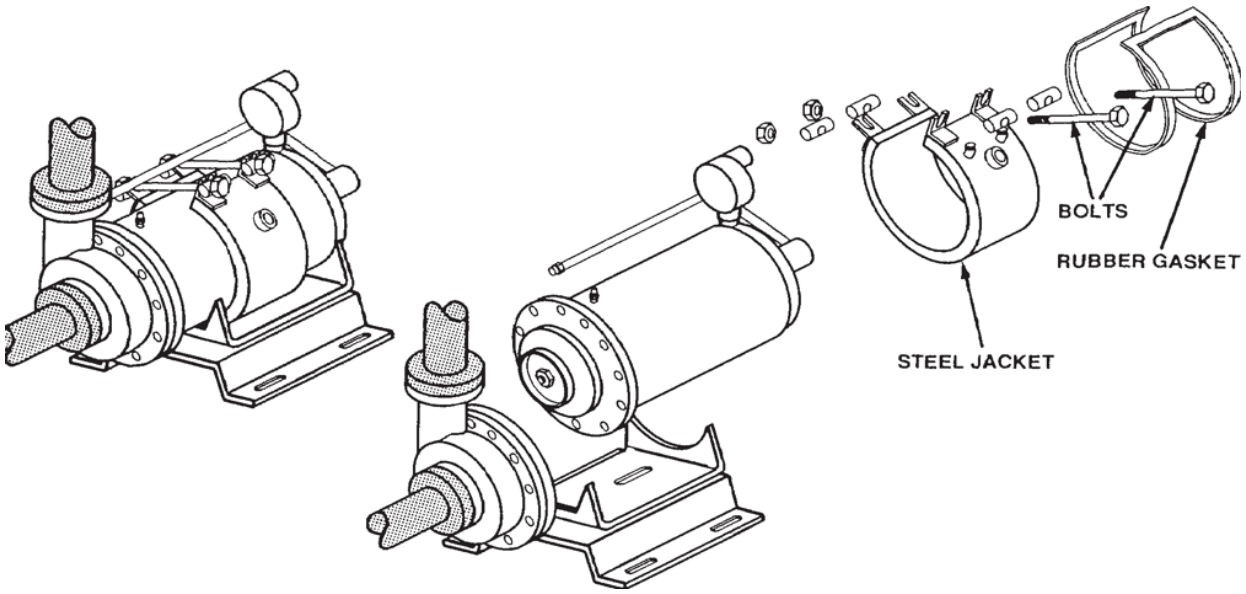
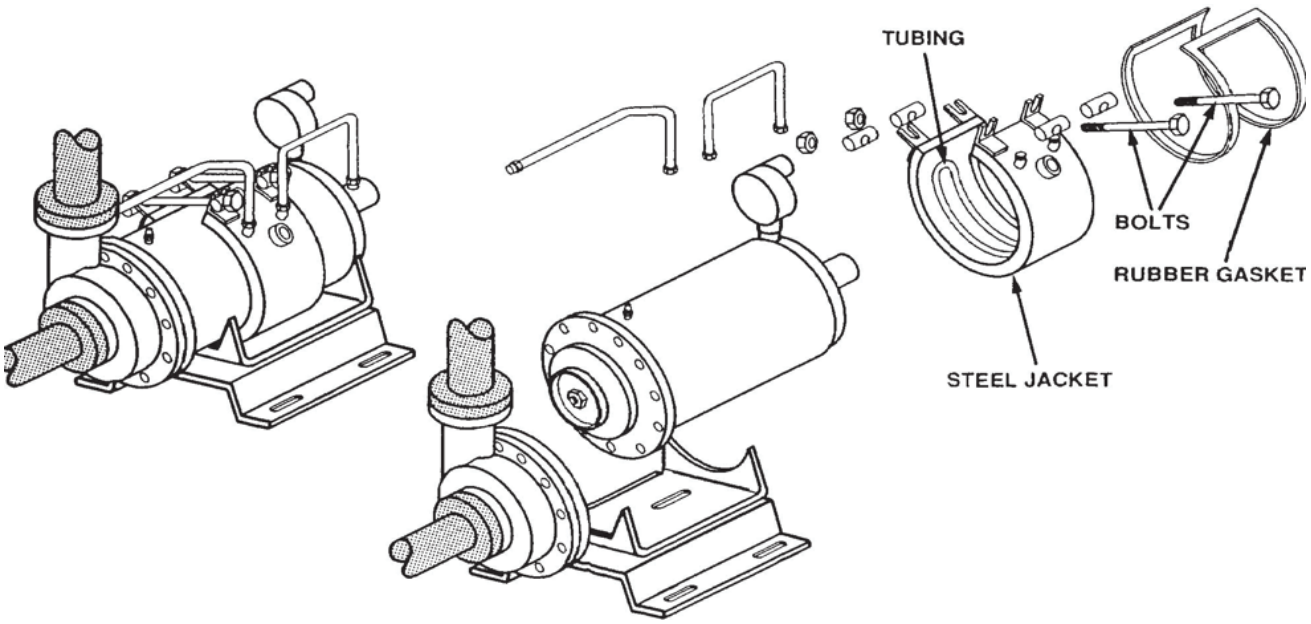


Figure 2-9. Removable Heat Exchanger



3. Operation

IMPORTANT! *NRTL certified per UL 778 & CAN/CSA C22.2 No. 108-14 for operation between 25 HZ to 65 HZ with Pulse Width Modulated (PWM) Variable Frequency Drive (VFD) power.*

3.1 Procedure Before Initial Start

Attention!

Before starting the pump for the first time, make sure suction and discharge piping are free of tools, nuts, bolts, or other foreign matter. Save time and money by checking before start-up.

Attention!

It is recommended to install a temporary cone-style strainer near the suction port to trap scale and other foreign particles. Suction strainer to be sized and designed per Teikoku recommendations. The screen can be installed for 24 hours of operation, but must be monitored closely so the pump does not become starved for liquid because of a clogged screen. Remove screen after 24 hours of running.

3.2 Preparation and Trial Operation

The following procedures are recommended for protection of canned motor pumps in industrial services.

Teikoku USA recommends monitoring the differential pressure and the power monitor for total protection of the pumps. Teikoku recommends using both as differential pressure works best for cavitation protection and the power monitor works best for no flow, loss of flow and excessive flow. If only one method is going to be applied then differential pressure would be the preferred method.

The preferred method for differential pressure monitoring is to install pressure transducers in the suction line between the pump and the block valve and in the discharge line between the pump and the first valve (either check or block). The signals from the pressure transducers are then sent to the control system and the pressure and time delay limits can be set within the control system program. Calibration of the transducers should always be checked as part of the installation process and startup of the system.

Recommended set points are:

- Differential Pressure (DP): 15 to 20 PSI below normal operating differential pressure
- Time Delay (TD): 20 seconds or less

When using an automatic control system, the following parameters are recommended:

A. Single pump:
- 20 Second Delay: Low differential pressure trip
- 60 Second Delay: Pump Restart

  Repeat above timing sequence for a maximum of 3 starts. If low differential continues after 3 starts a manual reset of the process controller is required.

B. Dual pumps:
- 20 Second Delay: "A" Pump low differential pressure trip
- 60 Second Delay: "B" Pump start
- 20 Second Delay: "B" Pump low differential pressure trip
- 60 Second Delay: "A" Pump start

  Repeat above timing sequence for a maximum of 3 starts per pump (6 starts combined total). If low differential continues after 3 starts per pump (6 starts combined total) a manual reset of the process controller is required.

Commercially available differential pressure switches are available with little to no adjustment. These switches will work but with no adjustment in the time frame or differential pressure set points they typically will not meet Teikoku's pressure and time delay recommendations.

The preferred method to monitor the input power to the pump would be to use a power monitor like the Load Controls PMP-25. The power monitor prevents failures due to loss of prime, no flow and excessive flow. The performance curve of the pump is used to set the low power and high power warnings and trip set point. Actual operating data can be used to make the final adjustments to the initial set points.

3.2.1 Setting of Thermal Overload Protective Device

Set the thermal overload protective device at the rated current indicated on the nameplate. It is effective as a protecting device for canned motors to set the thermal overload protective device at as low current as possible. When operating current is far lower than rated current, set the thermal overload protective device just above the operating current not the rated current. Generally, it is recommended to set the thermal overload protective device at the following values:

- Variation of voltage and load is small: operating current times 1.1
- Variation of voltage and load is big: operating current times 1.25

Attention!

Do not set the thermal overload protective device at more than the full load amps (FLA) listed on the name tag.

3.2.2 Priming and Venting

Complete priming should be carried out in the following order:

1. Open suction valve 100%
2. Open discharge valve 100%
3. If applicable: open reverse circulation line valve 100%
4. Open discharge pipe vent valve 100%
5. Open minimum flow valve (if required)

Caution!

CAUTION

All valves in the reverse circulation line must remain fully open while the pump is in operation. Verify that the correct restriction orifice is properly installed in the reverse circulation line.

3.2.3 Rotation Check

Centrifugal pump impellers must rotate in the proper direction to deliver rated head and capacity. The impeller must rotate in the same direction as the arrow cast on the pump casing.

Caution!

CAUTION

Pump and motor must be fully primed, vented, and liquid full prior to checking direction of rotation.

3.2.3.a Rotation Check using Type-M TRG Meter AM-45

The Type-M TRG Meter AM-45 is designed to provide a verification of direction of rotation. If the TRG Meter immediately pegs full scale, the direction of rotation is not correct.

1. Verify suction valve is 100% open.
2. Set discharge valve 10% to 20% open.
3. Check that valves in reverse circulation piping are open. Verify that the correct restriction orifice is installed in the reverse circulation line.
4. Switch on the pump for 3 to 5 seconds.

If applicable: Check indication of TRG meter. If TRG meter is pegged full scale red, the pump is rotating in the reverse direction. See Section 2.3.1 and Table 2-1.

5. If direction of rotation is not correct, swap any two of the electrical supply leads and repeat rotation check.
6. Once direction of rotation has been verified, stop the pump and leave it for several minutes.
7. Once you have determined correct rotation, tag correctly connected main power leads, in accordance with motor lead markings.

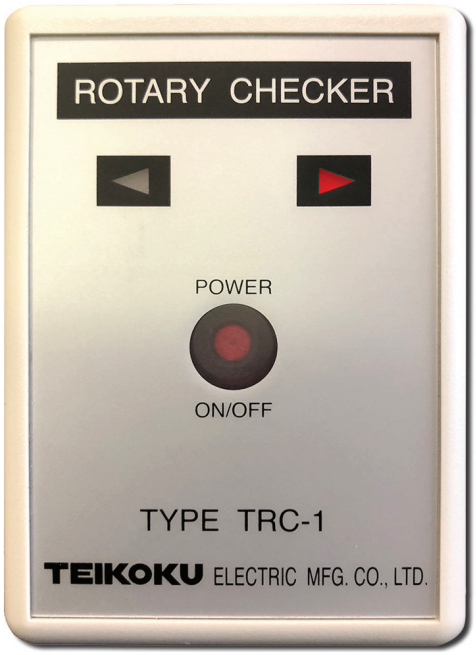
3.2.3.b Rotation Check using Type-L TRG Meter A45 C

The Type-L TRG Meter A45 C does not provide direction of rotation. The Teikoku TRC-1 hand-held direction of rotation indicator is available from Teikoku USA. This portable device can be used to confirm the rotation of any motor.

1. Verify suction valve is 100% open.
2. Set discharge valve 10% to 20% open.
3. If applicable: Check that valves in reverse circulation piping are open. Verify that the correct restriction orifice is installed in the reverse circulation line.
4. Switch on the pump for 3 to 5 seconds.

Check indication of TRC-1 hand-held rotation indicator. See Figure 3-1.

Figure 3-1. Teikoku Rotary Indicator TRC-1



5. If direction of rotation is not correct, swap any two of the electrical supply leads and repeat rotation check.
6. Once direction of rotation has been verified, stop the pump and leave it for several minutes.
7. Once you have determined correct rotation, tag correctly connected main power leads, in accordance with motor lead markings.

3.2.3.c Rotation Check using Pressure & Amps

1. Open suction valve 100%.
2. Set discharge valve 10% to 20% open.
3. If applicable: Check that valves in reverse circulation piping are open. Verify that the correct restriction orifice is installed in the reverse circulation line.
4. Switch on the pump for 3 to 5 seconds.
5. Note the motor amps and the discharge pressure at a pressure gauge, which should be installed between the pump casing and discharge valve.
6. Reverse any two of the three power leads and read the amps and the pressure gauge again. The higher amps and pressure is the correct direction of rotation.
7. Once direction of rotation has been verified, stop the pump and leave it for several minutes.
8. Once you have determined correct rotation, tag correctly connected main power leads, in accordance with motor lead markings.

Attention!

ATTENTION

It is recommended that the unit be run as little as possible with a closed discharge valve in order to prevent excessive overheating of the liquid circulating within the unit.

3.3 Starting Procedure

After priming and checking the direction of rotation, put the pump in operation as follows:

1. Set the valve in the suction line to 100% open.
2. Set the valve in the discharge line to 20% open.
3. Start the pump. Pump should operate with very low noise and vibrations. Excessive or abnormal noise or vibrations should be corrected immediately.
4. Open discharge valve to desired flow position.
5. Care should be taken in process design to assure there can be no operation at shutoff or deadhead conditions (zero flow). All canned motor pumps require a minimum flow that assures adequate motor cooling circulation. Minimum flow values by model from laboratory tests on water are provided in Appx. C., Page 31. Minimum flow requirements will very based on the fluid pumped and its pumping temperatures. Please consult the factory for any application specific guidance on minimum flow that may be required.

Once pump is operational, check the reading of the TRG meter. Record initial reading for comparison to future readings. See Table 2-1.

6. During any startup sequence, caution must be exercised not to exceed full load ampere rating indicated on the nameplate.
7. If the unit has not been run for a period of two weeks or more, the following inspections should precede its operation:

A. Check terminal box for moisture.

B. Upon starting, check for excessive noise, vibration, erratic speeds or excessive amp draw.

Caution!

CAUTION

The pump should not be allowed to run for more than one minute with the discharge valve fully closed.

NOTES:

1. *If the suction and discharge lines are completely filled with system fluid and adequate suction head is available the pump can be started without closing the discharge valve. During any startup sequence, caution must be exercised not to exceed full load amperage rating indicated on the nameplate.*

2. *If the unit has not been run for a period of two weeks or more, the following inspections shall precede its operation:*

a) *Check secureness of base hold down bolts if supplied.*

b) *Check terminal box for moisture and tightness of fittings.*

c) *Upon starting, check for excessive noise, vibration, or erratic speeds.*

Caution!

CAUTION

If the pump appears to be airbound as a result of the unit not being properly primed, do not continue operation. Locate and correct the conditions that prevent proper priming before attempting to start the unit.

3.4 Operation Details

TRG Meter should be checked periodically during operation. If the initial reading (TRG) was not recorded, then the color coding system shown in Table 2-1 may be used to determine bearing changing intervals.

Hazard!

HAZARD

Do not operate if TRG meter conditions is RED.

Discharge pressure should be checked frequently during operation. Pressure should be stable in a non-variable closed loop although the discharge pressure gauge needle may show small fluctuations. Check motor amps at normal operations. Verify motor amps are within the expected range. Pump should never be operating above the rated full load amps listed on the nameplate.

In some cases, the liquid supply may contain an excessive amount of air or gas, which will tend to separate from the liquid and remain in the passages of the pump. This results in the pump losing its prime and becoming air bound with marked reduction in capacity. The discharge pressure gauge will show large fluctuations if this occurs. Stop the pump and vent per Section 3.2.1.

If any abnormal noise or vibration is observed, stop the pump and check for the possible causes, see Appx B. Troubleshooting.

Table 3-1 Minimum Flow

Model	Minimum Flow (GPM)
GA	6
GB	7.5
GC	20
GVBS	20
GVD	25
GVE	45
GVHS	22
GG	65
GKS	55
GK	90
GVM	60
GN	75
GP	75
GS	140
GRS	250

3.5 Shutdown Procedure

Shutdown as follows:

1. Stop the pump (de-energize the motor).
2. If pump is to be removed from service, shut all valves.

Attention!

ATTENTION

If the pump is to be shut down for a long period of time or if there is danger of freezing, after stopping the pump, shut all valves and drain the entire pump and connected piping.

4. Maintenance

4.1 Recommended Tools for Disassembly, Reassembly, and Inspection

Table 4-1 Recommended Tools	
Size	**Description**
Dial Indicator	Dial Indicator (.200 travel) for determining end play
Verniers	
Telescopic gauges	5/16"-3"

4.2 Periodic Inspection

The TRG meter should be checked periodically during operation. If the initial reading (TRG) was not recorded, then the color coding system discussed in Table 2-1 may be used to determine bearing changing intervals.

4.2.1 Bearings

Since the bearings in this pump are lubricated by the process fluid, it is essential that bearing inspection and replacement periods be based on experience in each particular installation. Bearing life will depend, to some extent, on variable factors including lubrication quality, temperature, number of starts and stops, viscosity, and suspension content of the fluid being pumped, as well as ambient temperature and atmospheric conditions of the operational area. Each time one of these factors is changed, compensation must be applied in bearing inspection periods.

As noted above, the TRG meter should be checked periodically during operation. If the initial reading (TRG) was not recorded, then the color-coding system in Table 2-1 may be used to determine bearing changing intervals. This inspection is necessary to determine the rate of bearing wear, thereby enabling setup of a proper inspection and replacement schedule. See Table 4-2 for the maximum wear allowable.

If the inspection indicates that bearings are not wearing or are wearing very slightly, the next inspection may be put off for an additional 1,500 running hours, or three months of operation, whichever occurs first. If inspection indicates only slight wear, the interval may be lengthened.

If bearings must be changed at the initial inspection, they will need to be changed again in the time period which necessitated a change at the initial inspection, i.e., 1,500 running hours.

Frequency of periodic bearing inspection can best be determined by experience, and from these inspections, the time for replacement can best be indicated.

Bearings can be inspected and replaced without removing the pump casing from the line. No main piping connections need to be broken. Refer to 4.5.3, Disassembly and Reassembly, starting on page 23.

In the event the TRG bearing wear monitor indicates bearing wear on the wear indicator:

1. Measure the inside diameters of the front and rear bearings and compare to the diameter of the rotor shaft journal. If the difference in diameters is greater than that indicated in Table 4-2, replace the bearings.
2. Inspect the thrust faces of the front and rear bearings. If any scoring wear is visualized, measure the length of the bearings. Replace the bearing if the measured length is less than that indicated in Table 4-2.
3. Examine the bearings for any grooving or scoring, particularly on the inside diameter and thrust faces. The existence of grooving or scoring indicates the presence of solids or foreign matter in the system which should be eliminated prior to beginning operation again.

4.2.2 Rotor Assembly Inspection

The complete rotor assembly should be visually inspected for cracks, breaks, pitting, or corrosion which might destroy the effectiveness of the hermetically sealed rotor end covers and sleeve.

The rotor assembly shaft should also be visually inspected at the bearing contact area for general appearance and uniform wear. Excessive undercutting, pitting, or scoring is cause for rotor replacement. Minimum allowable shaft diameter is noted in Table 4-2.

4.2.3 Automatic Thrust Balance and End Play Inspection

The provision of automatic thrust balance design in the G-Series pump, with it close running seal faces and wearing rings to insure proper balance chamber pressures, requires that a close visual inspection be made of the impeller, front bearing housing, front bearing and front rotor end cover at the time bearing inspection is made.

During disassembly for bearing inspection, measure the unit end play as follows:

1. For all models, after removing the rear bearing housing from the unit and with all other parts in place, measure the total axial (front to back) movement of the shaft, or,
2. In the case of Models GA, GB, GC and GVBS or pumps equipped with thrust surfaces after the unit has been separated from the pump casing, measure the total axial (front to back) movement of the impeller assembly.

If the measured end play exceeds end play (new) noted in Table 4-3 or 4-4, then remove the impeller from the shaft and the bearings from within the rotor chamber. Visually examine the impeller seal faces, front bearing housing seal face, and the front rotor end cover for noticeable wear; also measure the length of the front bearing, See Table 4-2. (The rear bearing, because of its position, will not usually experience axial wear). Should the front bearing length be below the unit of when new dimension, replace with a

Table 4-2. Bearing and Journal Dimensions							
Motor*	**Shaft Outisde Dia. New**	**Bearings Inside Dia. New**	**Diametrical Clearnace Bearings to Journal**		**Bearing Lengths (inches)**		
			New	**Max. Allow.**	**Front Bearing**	**Rear Bearing**	**Thrust Surfaces**
GA, GB, GC GVBS, GLD	0.9143"-0.9150"	0.9175"-0.9185"	.0025"-.0042"	.013"	1-3/4"	1-3/4"	2.609" (frt brg)
GVE, GVD GVHS, GG	1.1833"-1.1840"	1.1888"-1.1890"	.0048"-.0057"	.014"	4"	2"	0.406"
GVM	1.4893"-1.4900"	1.4950"-1.4960"	.0050"-.0067"	.014"	4-3/8"	3-1/4"	-
N2S-30\40\50	Frt: 1.4893"-1.4900" Rear: 1.1833"-1.1840"	1.4950"-1.4960" 1.1888"-1.1890"	.0050"-.0067" .0048"-.0057"	.014" .014"	4-3/8" -	- 2	- -

new bearing and then calculate if the new bearing length will put end play back in tolerance. If end play still exceeds the maximum allowable, then the impeller or front bearing housing seal faces (and in the case of Models GVD, GVE, GVHS and GG the pump casing seal faces) must be worn beyond a tolerable limit and must be repaired or replaced. (It should be noted that under proper operating conditions, wear on these parts due to axial thrust forces will be negligible and will normally not require replacement.) At the time the impeller seal face is inspected for wear, also visually inspect the wearing rings and front impeller hub for any noticeable signs of wear. If excessive grooving or scoring of the wear rings or impeller hub is noticed, the impeller must be replaced.

Table 4-3. End Play	
Model*	**End-Play**
	Inch
GA, GB, GC	.084"-.104"
GVBS	.084"-.106"
GVE	.101"-.137"
GVD, GVHS	.032"-.068"
GG	.102"-.138"
GVM	.068"-.096"
GLD	.067"-.073"
N2S	.040"-.060"

On Teikoku pumps with thrust bearings, the end play tolerances are slightly different than new thrust bearing pumps. In GA, GB and GC models the thrust is taken from the large flange on the bearing and the gap between the rotor and front bearing. The remaining models take the thrust from the impeller to the front ring and the front bearing face to the rotor. Table 4-4 indicates end play tolerances for thrust bearing models.

Table 4-4. End Play on Thrust Bearing	
Model*	**End-Play New**
	Inch
GA, GB, GC	.086"-.140"
GVBS	.083"-.107"
GVE	.084"-.104"
GVD	.012"-.042"
GVHS	.022"-.042"
GG	.050"-.070"
GVM	.030"-.056"

4.2.4 Stator Assembly Inspection

The complete stator assembly should be visually inspected for cracks, breaks, pitting, or corrosion in the stator liner which might destroy the effectiveness of the barrier. Inspect the wiring of the stator assembly by checking the visible portion of the connector leads for cracked, broken, or frayed insulation, then check the condition of the motor windings by taking resistance readings with an ohmmeter and a megger. If the ohmmeter readings are not within 20% of the values shown in Table 4-9, the stator assembly must be replaced.

4.2.5 General Inspection

1. Inspect the impeller nut threads on the rotor shaft to insure they are not cut, pressed, or stripped. Models GA, GB, GC, GVBS and GLD have left-hand threads. Models GVD, GVE, GVHS, GG, GVM, and N2S have right-hand threads.
2. Be sure that all mating faces are free of nicks and burrs so that they will present a smooth face, insuring a good seal. Clean off any traces of old gasket material.
3. Make sure all parts are clean. Inaccessible areas may be cleaned with a small brush or suit ably pointed tool. The circulation line should be blown out with filtered, oil-free compressed air.

4.3 Lubrication

The G-Series pump requires no external lubrication. Bearing surfaces and other parts are lubricated and cooled by the fluid being pumped.

4.4 Cooling

The motor rear bearing housing temperature is a direct indication of the efficiency of the cooling and lubrication functions of the fluid circulation through the motor section of the pump. If at any time during operation the rear bearing housing appears overheated, check the temperature of the fluid being pumped. Check rear bearing housing temperature with a thermocouple to assure that it does not exceed the pumped fluid temperature (assuming that no auxiliary means of cooling the recirculation flow is used such as heat exchangers, jacketed circulation tubes, etc.). Rear bearing housing temperature can also be checked by using a pyrometer or a standard thermometer, held against the retainer by putty.

If the pumped fluid temperature is satisfactory, overheating is most probably caused by a restriction in the circulation tube.

Shutdown pump, drain unit, remove the circulation tube and clean it with clean, oil-free, compressed air. If the unit still runs hot, or if tube was clear, disassemble unit and inspect.

Caution!

Between cycles of pumping fluids which may solidify, such as caustic soda, flush the system with steam, water or the proper solvent to prevent the piping and internal passages of the pump from plugging up. Where the pump is fitted with a discharge filter, flush pump during off cycles and check discharge filter for plugging.

4.5 Disassembly and Reassembly

4.5.1 Models GA, GB, GC, and GVBS Recommended Tools for Disassembly

Table 4-5. Recommended Tools

Size	Description
1/2" and 9/16"	Open end, box end wrench for circulation tube fitting, pump casing and rear bearing retainer bolts.
5/8"	Socket for impeller nut.
5/32" and 3/16"	Allen wrench for front bearing retainer screws.
3/8"	Open end, box end wrench for stator assembly retaining screws (WHIZLOCK).
3/4"	Open end, box end wrench for base cradle retaining bolt (WHIZLOCK).
5/8"	Open end, box end wrench for relief valve top.
7/16"	Open end, box end wrench for pump casing drain plugs.

4.5.2 Models GVD, GVE, GVHS, GG and GVM Recommended Tools for Disassembly

Table 4-6. Recommended Tools

Size	Description
5/8" and 11/16"	Open end, box end wrench for circulation tube fitting.
3/4"	Open end, box end wrench for pump casing, rear bearing housing and base cradle retaining bolts (WHIZLOCK).
1-1/8"	Socket for impeller nut.
5/32" Hexwrench	Socket flat head cap screws for front bearing housing retaining screws.
3/8"	Open end, box end wrench for stator assembly retaining screws (WHIZLOCK).
5/8"	Open end, box end wrench for relief valve top.
9/16" and 5/8"	Open end, box end wrench for pump casing drain plugs.
7/16"	Open end, box end wrench for bearing assembly retainer screws

4.5.3 Models GA, GB, GC, GVBS, GVD, GVE, GVHS, GG, GVM Disassembly and Reassembly Procedures

1. Close discharge valve, shutdown pump, and then close the suction valve.
2. Disconnect the power cables from the connection box prior to disassembly (WARNING: PERSONNEL SAFETY HAZARD WILL EXIST IF THIS STEP IS NOT FOLLOWED.)
3. Drain pump.
4. Begin disassembly, carefully examining each part for corrosion or wear.
5. Remove circulating tube, back flush piping, or reverse circulation piping if so equipped.
6. Remove water jacket cooling inlet and drain connections, if used.
7. Remove bolts holding rear bearing housing to stator assembly and then remove the housing.
8. Remove the screw and lock washer holding the rear bearing to rear bearing housing, and then remove the rear bearing.
9. Check end play as indicated in 4.2.3.
10. Remove bolts holding motor section to pump casing.
11. a) If a base is provided, loosen one bolt and remove the other which holds together the upper and lower sections of the base assembly. Next, pull the motor section, resting on the upper half or cradle portion of the base assembly, away from the pump casing until the impeller hub is clear of the casing. Then, rotate the motor section and cradle to a point which will allow further disassembly of same. This specially constructed base, which is furnished as standard on all G-Series models, allows inspection or maintenance to be performed on the unit without it having to be moved to a workbench or without the motor section having to be set on the floor or ground. If desired, the motor section can be removed from the lower base section and taken to another area for inspection. In this case, the upper half of the base is used as a stand to protect the parts.

    b) If a base is not supplied, remove the motor section and if necessary, disconnect the power cable from the connection box if the unit is to be taken to a workbench.
12. Remove the impeller nut (Models GA, GB, GC and GVBS have left-hand threads; Models GVD, GVE, GVHS, GG, GVM, and N2S have right-hand threads.) Then remove the impeller.
13. Withdraw the rotor assembly from rear of motor section taking care not to allow rotor to drop, thereby allowing shaft to hit stator liner.
14. Remove the three screws retaining the front bearing housing to the stator assembly, and then remove the housing.
15. Remove the screw and lock washer holding the front bearing to the front bearing housing and then remove the front bearing.
16. A check for bearing wear can be made at this time. Refer to Table 4-2.

17. Reassemble pump by reversing the disassembly procedure, replacing old gaskets with new ones. BE SURE TO TAKE UP EVENLY ON BOLTS SECURING BEARING HOUSING. Otherwise, the housing may skew and misalignment will cause rapid bearing wear. Bolt torque values by model are provided in Appx. C., Page 31.
18. Complete reassembly. Before bolting the motor section to the pump casing, spin the rotor impeller assembly by hand to ensure that it does not bind. Check end play again as noted in Table 4-3 before reassembling the rear bearing housing to the stator assembly but after bolting the pump casing to motor section.
19. In reattaching the impeller nut to rotor assembly it is vital that the impeller nut be tightened to proper torque to lock the nut onto the threads. The Proper torque values are: Models GA, GB, GC, GVBS: 12 FT-LBS. Models GVD, GVE, GVHS, GG GM: 75 FT-LBS.

4.5.4 Models GLD Recommended Tools for Disassembly

Table 4-7. Recommended Tools

Size	Description
1/2" and 9/16"	Open end, box end wrench for circulation tube fitting.
3/4"	Open end, box end wrench for pump casing, rear bearing housing and base cradle retaining bolts (WHIZLOCK).
1/2" Drive, 1 Socket	For impeller nut.
5/32" Hexwrench	Socket flat head cap screws for front bearing housing retaining screws.
3/8"	Open end, box end wrench for stator assembly retaining screws (WHIZLOCK).
5/8"	Open end, box end wrench for relief valve top.
9/16" and 5/8"	Open end, box end wrench for pump casing drain plugs.
7/16"	Open end, box end wrench for bearing assembly retainer screws

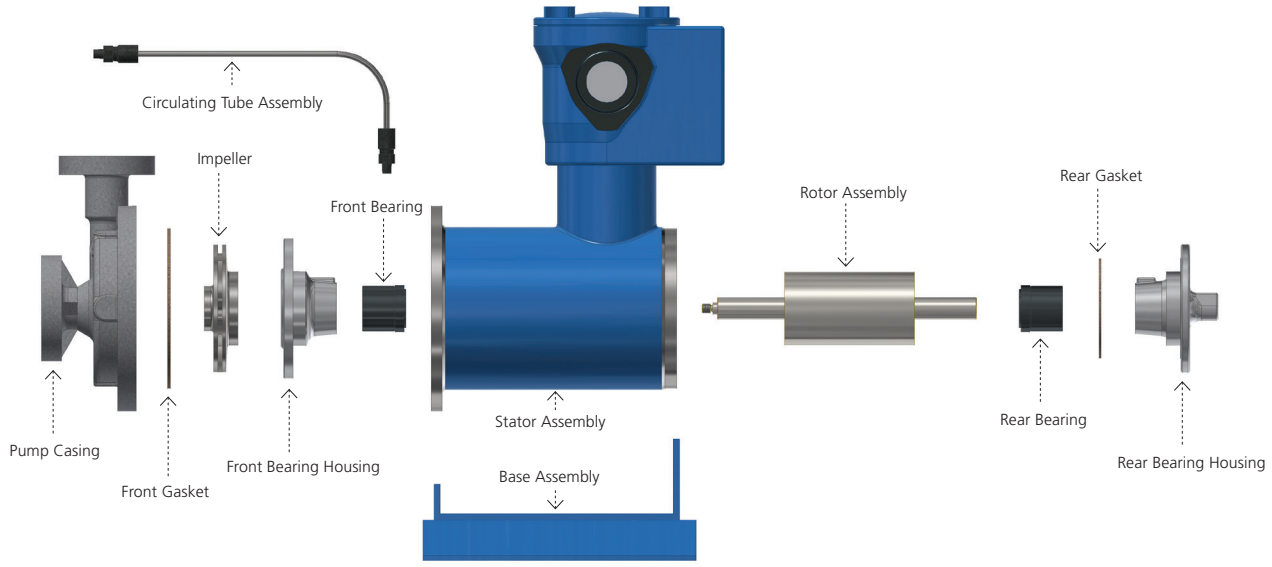
4.5.5 Models GLD Disassembly and Reassembly

Unlike the other G-Series models covered by this manual, the Model GLD is a two-stage model and as a result disassembly and reassembly instructions are a bit different. The step by step procedure is as follows:

1. Close discharge valve, shutdown pump, and then close the suction valve.
2. Disconnect the power cables from the connection box prior to disassembly (WARNING: PERSONNEL SAFETY HAZARD WILL EXIST IF THIS STEP IS NOT FOLLOWED).
3. Drain pump.
4. Begin disassembly, carefully examining each part for evidence of corrosion or wear.
5. Remove circulating tube, back-flush piping, or reverse circulation piping, if so equipped.
6. Remove water jacket cooling inlet and drain connections, if used.
7. Remove bolt s holding rear bearing housing and then remove the housing.
8. Remove the screw and lock washer holding the rear bearing to the rear bearing housing and then remove the rear bearing. If the pump is equipped with a bearing wear detector, please refer to Table 2-1 prior to removing the rear bearing.
9. Check end play as indicated in Table 4-3.
10. Then, moving to the front of the unit, remove bolts holding pump casing cover plate to pump casing, and then remove cover.
11. Remove the exposed impeller nut (left hand thread) and then the impeller, and key (second stage impeller). Second stage impeller has tapped pull holes for easy removal and for holding impeller when removing impeller nut.
12. Remove the spacer sleeve from the shaft.
13. Remove bolts holding motor section to pump casing.
14. a) If a base is provided, loosen one bolt and remove the other which holds together the upper and lower sections of the base assembly. Next, pull the motor section, resting on the upper half or cradle portion of the base assembly, away from the pump casing until the front end of the rotor shaft is clear of the casing. Then, rotate the motor section and cradle to a point which will allow further disassembly of the unit. This specially constructed base, which is furnished as standard on all G-Series models, allows inspection or maintenance to be performed on the unit without its having to be removed to a workbench or without the motor having to be set on the floor or ground. If desired, the motor section can be removed from the lower base section and taken to another area for inspection. In this case, the upper half of the base is used as a stand to protect the parts.

    b) If a base is not supplied, remove the motor section, and if necessary, disconnect the power cable from the connection box if the unit is to be taken to a workbench.
15. Slip off the first stage impeller and remove the key from the shaft.
16. Withdraw the rotor assembly from the rear of the motor section, taking care not to allow the rotor or shaft to hit the stator liner.
17. Remove the three screws retaining the front bearing housing to the stator assembly and then remove the housing.
18. Remove the screw and lock washer holding the front bearing to the front bearing housing and then remove the bearing.
19. Slip out the idler bearing from the pump casing.
20. A check for bearing wear can be made at this point. See Table 4-2.
21. Reassemble pump by reversing the disassembly procedure, replacing old gasket s with new ones. BE SURE TO TAKE UP EVENLY ON ALL BOLTS SECURING BEARING HOUSING. Otherwise, the housing may skew and misalignment may occur,

Figure 4-1. General Parts



which would cause rapid bearing wear. Bolt torque values by model are provided in Appx. C., Page 31.

22. Complete reassembly. However, before bolting the pump casing cover plate to the pump casing, spin the rotor-impeller assembly by hand to ensure that it does not bind. Also, check end play again as noted in Table 4-3 and 4-4, before reassembling the rear bearing housing to the stator assembly.
23. In reassembling the impeller nut, care must be taken to completely tighten the impeller lock nut against the impeller to ensure that it securely holds the impeller against the shaft shoulder

4.5.6 Models N2S Recommended Tools for Disassembly

Table 4-8. Recommended Tools

Size	Description
7/16"	Open end, box end wrench for circulation tube fitting.
5/8" and 11/16"	Open end, box end wrench for the circulation tube fitting on the pump casing.
11/16"	Open end, box end wrench for the circulation tube fitting on the rear bearing housing.
15/16"	Open end, box end wrench for the pump casing and front cover plate bolts.
1-1/8"	Drive socket for the impeller nut.
Screwdriver	For front balances plate and seal plate retaining screws.

4.5.7 Models N2S Disassembly and Reassembly

1. Close discharge valve, shutdown pump, and then close the suction valve.
2. Disconnect the power cables from the connection box prior to disassembly.

Hazard!

HAZARD

PERSONNEL SAFETY HAZARD WILL EXIST IF STEP 2 IS NOT FOLLOWED.

3. Drain pump.
4. Begin disassembly, carefully examining each part for evidence of corrosion or wear.
5. Remove water jacket or heat exchanger cooling inlet and drain connections, if used.
6. Remove circulation tube, back flush piping, or reverse circulation piping if so equipped.
7. Remove the bolts holding the rear bearing housing and then remove the housing.
8. Remove the screw and lockwasher holding the rear bearing to the rear bearing housing and then remove the rear bearing.
9. Check end play as indicated in Table 4-3 and 4-4.
10. Remove the nuts and bolts retaining the front cover plate and then remove the front cover plate.
11. If a base is provided, loosen one bolt and remove the other which holds together the upper and lower sections of the base assembly. Next, pull the pump assembly resting on the upper half, or cradle portion of the base assembly, away from the cover plate until the front impeller is clear of the cover plate. Then rotate the pump assembly and cradle to a point which will allow further disassembly of the unit. This specially constructed base allows inspection or maintenance to be performed on the unit without its having to be removed to a workbench or without the pump assembly having to be set on the floor or ground. If desired, the motor section can be removed from the lower base section and taken to another area for inspection. In this case, the upper half on the base is used as a stand to protect the parts.

12. Remove the impeller nut, then the first stage impeller and impeller key.
13. Remove the three screws retaining the front bearing housing to the pump casing assembly and then remove the front bearing housing.
14. Remove the screw and lock washer holding the front bearing to the front bearing housing and then remove the front bearing.
15. A check for bearing wear can be made at this point. See Table 4-2.
16. Remove the nut s and bolt s retaining the pump casing to the stator assembly, then remove the pump casing.
17. Remove the impeller space by pulling it towards the threaded part of the shaft then remove the second stage impeller and impeller key.
18. Remove the three retaining screws at the front balance plate and then remove the front balance plate.
19. Seal plates are located inside the front cover plate and pump casing assembly. These seal plates should be checked for wear and be replaced if required. They are held in place by three screws for each plate and can be removed by removing these screws.
20. Reassemble pump by reversing the disassembly procedure, replacing old gaskets with new ones. BE SURE TO TAKE UP EVENLY ON ALL BOLTS SECURING BEARING HOUSING. Otherwise, the housing may skew and misalignment may occur, which would cause rapid bearing wear. Bolt torque values by model are provided in Appx. C., Page 31.
21. Complete reassembly. Before bolting the front cover plate to the pump casing, spin the rotor-impeller assembly by hand to ensure that it does not bind. Also, check end play again as noted in Table 4-3 and 4-4 before reassembling the rear bearing housing to the stator assembly.
22. In reassembling the impeller nut, care must be taken to completely tighten the impeller lock nut against the impeller to ensure that is securely holds the impeller against the shaft shoulder.

4.6 Service Policy

Any pump, damaged or inoperative for any reason, will be repaired at the factory at minimum cost and returned to the customer as quickly as possible.

Caution!

CAUTION

Before returning units to the factory for examination or repair, **clean and decontaminate the pump or parts thoroughly to prevent corrosive attack during shipment or injury to personnel handling returned equipment. Tag pump with information regarding the fluid it was handling and operating conditions at the time of failure.** Proper service will be facilitated with the proper submittal of a Teikoku Field Service Report Form. These forms are available from the factory , from the Teikoku field representatives, and from this instruction manual Appendix.

4.7 Spare Parts

Any pump, damaged or inoperative for any reason, will be repaired at the factory at minimum cost and returned to the customer as quickly as possible.

Have on hand at least two extra sets of bearings, two extra sets of gaskets, and one extra rotor assembly for each G-Series that is installed. When ordering spare parts, give the serial number and model designation; then give the part name which is noted on the Exploded View Parts Diagram, Figure 4-1.

When ordering an impeller, include the diameter which can be noted from the pump order acknowledgment or from the pump nameplate.

It is recommended that the following parts be maintained as "on-hand" spare parts for each Teikoku model installed:

1. Models GA, GB, GC, GVBS	
Part	**Quantity**
Pump Casing Gasket	2
Rear Motor Gasket	2
Front & Rear Bearings	2 sets
Rotor Assembly	1
Bearing Housing Screw	4
Bearing Housing Screw lock washer	4

2. Models GVD, GVE, GVHS, GG, GVM, and N2S	
Part	**Quantity**
Pump Casing Gasket	2
Rear Motor Gasket	2
Front & Rear Bearings	1 set
Impeller Nut	1
Impeller Key	1
Rotor Assembly	1
Bearing Housing Screw	4
Bearing Housing Screw lock washer	4

3. Model GLD	
Part	**Quantity**
Coverplate Gasket	2
Pump Casing "O" Ring Gasket	2
Rear Motor Gasket	2
Front & Rear Bearings	1 set
Impeller Nut	1
Impeller Key	2
Idler Bearing	1
Impeller Spacer	1
Rotor Assembly	1
Bearing Housing Screw	4
Bearing Housing Screw lock washer	4

Table 4-9. Phase to Phase Resistance Values					
Model	**Motor Size**	**Electric Connection**	**Insulation Class**	***Resistance (OHMS)**	**Max OHM Var. Per Motor**
GA	1K	230	R	6.80	0.51
	1K	460	R	27.20	2.04
	1K	575	R	42.50	3.12
GA, GB, GC	1-1/2K	230	R	3.40	0.26
	1-1/2K	460	R	13.60	1.04
	1-1/2K	575	R	21.25	1.63
GB, GC, GVBS, GG	3K	230	R	1.73	0.04
	3K	460	R	6.92	0.26
	3K	575	R	10.80	0.26
	5K	230	R	1.02	0.03
	5K	460	R	4.08	0.12
	5K	575	R	6.38	0.19
GVD, GVE, GVHS, GG	10K	230	R	0.30	0.02
	10K	460	R	1.20	0.08
	10K	575	R	1.88	0.13
	15K	230	R	0.21	0.02
	15K	460	R	0.85	0.06
	15K	575	R	1.33	0.01
	20K	230	R	0.16	0.01
	20K	460	R	0.64	0.05
	20K	575	R	1.00	0.08
GVM	5P	230	R	0.80	0.06
	5P	460	R	3.20	0.24
	5P	575	R	5.00	0.38
	7-1/2L	230	R	0.58	0.06
	7-1/2L	460	R	2.31	0.25
	7-1/2L	575	R	3.61	0.38
	10L	230	R	0.05	0.06
	10L	460	R	2.03	0.24
	10L	575	R	3.17	0.38
	15L	230	R	0.04	0.06
	15L	460	R	1.40	0.20
	15L	575	R	2.20	0.30

*RESISTANCE VALUES AT 25˚ C

Appendix

TEIKOKU USA INC
CHEMPUMP

TRC-1

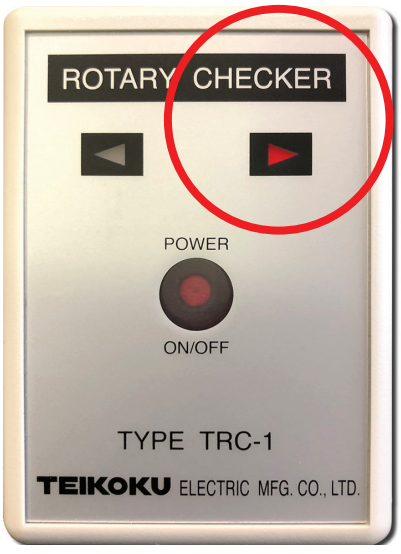
Teikoku Rotary Checker
Hand-held Direction of Rotation Indicator

The design of canned motor pumps is such that the rotating element cannot be seen while it is in operation. For this reason, Teikoku supplies an internal rotation indicator with a majority of our pumps. However, there are some instances where this device is not supplied, so we recommend purchasing the TRC-1. This simple device takes the guesswork out of confirming the correct rotation of the motor. It is light, compact, and easy to use. Not only can this be used on Teikoku canned motors, but other three-phase induction motors as well.

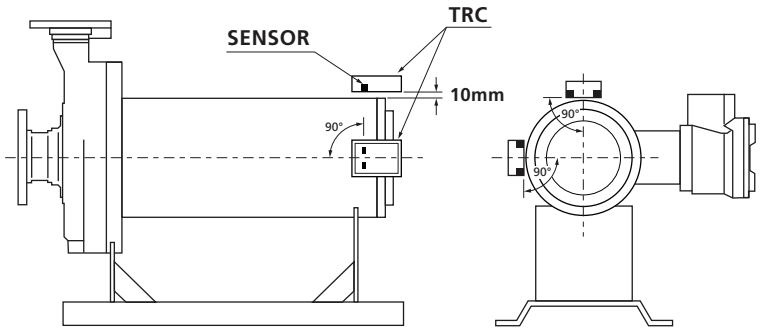
- **Place TRC-1 on an operating motor as illustrated below.**
- **The arrow that lights up indicates the direction of rotation.**
- **There is an arrow on the pump case that indicates the correct direction of rotation.**

Specifications:

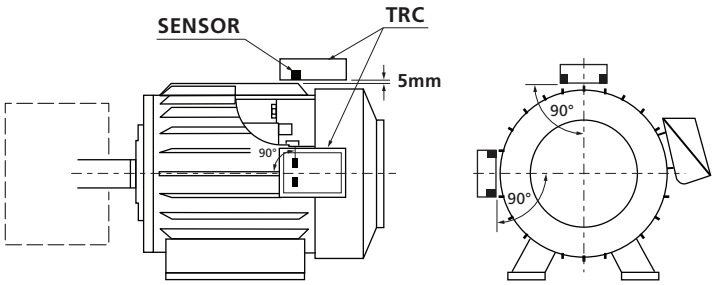
Size: 2.6"W x 3.6"L x 1.1" H (66.mm x 92mm x 28mm)
External Case : ABS plastic
Battery operated : 9V



TEIKOKU CANNED MOTOR PUMP



THREE-PHASE INDUCTION MOTOR



Appx. B. Troubleshooting

Teikoku G-Series Pump

Problem	Probable Cause	Suggested Solution
Failure to deliver required capacity	Pump not primed.	Reprime pump in accordance with Section 3.2.2.
	Air leaks in suction piping.	Locate leaks and eliminate.
	Motor not energized.	Check motor wiring. See Section 2.3.
	Motor windings burnt-out or grounded.	Check electrical continuity of windings and is negative response, stator assembly needs to be replaced.
	Low suction head.	Correct suction side of system to ensure availability of design NPSH.
	Discharge head too high.	Correct discharge side of system to ensure proper operating conditions.
	Discharge valve closed or partially opened.	Open discharge valve until rated discharge pressure is obtained.
	Impeller clogged.	Remove obstructions in impeller.
	Wrong direction of rotation.	Reverse any two motor leads and check with phase sequence meter. See Section 3.2.3.
	Damaged impeller	Impeller must be repaired or replaced.
Insufficient pressure	Pump not primed.	Reprime pump in accordance with Section 3.2.2.
	Air leaks in suction piping.	Locate leaks and eliminate.
	Motor not energized.	Check motor wiring. See Section 2.3.
	Motor windings burnt-out or grounded.	Check electrical continuity of windings and is negative response, stator assembly needs to be replaced.
	Low suction head.	Correct suction side of system to ensure availability of design NPSH.
	Discharge valve open too wide.	Close down discharge valve until rated discharge pressure is obtained.
	Impeller clogged.	Remove obstructions in impeller.
	Wrong direction of rotation.	Reverse any two motor leads
	Damaged impeller	Impeller must be repaired or replaced.
Pump loses prime after starting	Pump not properly primed at starting.	Reprime pump in accordance with Section 3.2.2.
	Excessive change in suction vessel pressure.	Locate source pressure fluctuations and correct as required.
	Air or gas in liquid.	Locate source of gas or air entrainment and correct.
	Low suction head.	Correct suction side of system to ensure availability of design NPSH.
Pump takes too much power	Shaft bent.	Replace rotor assembly or straighten shaft if bend not too great.
	Rotating element binds.	Replace bearings (see Section 4) as a result of excessive wear or check for presence of foreign material in rotor chamber
	Electrical short.	Check electrical continuity of all phases of the motor winding and replace stator assembly if necessary
Pump vibrates	Foundation not sufficiently rigid.	Tighten all bolts on the pump base and base supporting structure.
	Impeller partially clogged.	Remove obstructions in the impeller.
	Shaft bent.	Replace rotor assembly or straighten shaft if bend is not too great.
	Worn bearings.	Replace bearings (see Section 4). Check for presence of foreign material.
	Rotating element rubbing stator liner.	Replace bearings (see Section 4), Check stator liner and rotor can for wear. Repair and/or replace as required.
Motor running hot	Motor operating at overload condition.	Make sure pump is operating at design point and conditions specified when purchased.
	Pump is operating below minimum flow.	Increase flow through the pump.
	Pump is running dry.	Check suction line for obstructions and closed valves

TEIKOKU USA INC
CHEMPUMP

ENGINEERING DATA SHEET

Recommended Torque Values		
Date	Supersedes	No.
8/19/13	12/10/12	34E

Model	Torque Value	
	Pump Casing (in-lbs.)	Rear Bearing Housing (in-lbs.)
GA	250 – 260	120 – 130
GB	155 – 165	120 – 130
GC	250 – 260	120 – 130
GVBS	155 – 165	120 – 130
GVD	250 – 260	220 – 230
GVE	250 – 260	220 – 230
GVHS	400 – 420	220 – 230
GG	250 – 260	220 – 230
GKS	400 – 420	220 – 230
GK	400 – 420	220 – 230
GVM	220 – 230	220 – 230
GN	CONSULT FACTORY	
GP		
GPS		
GRS		

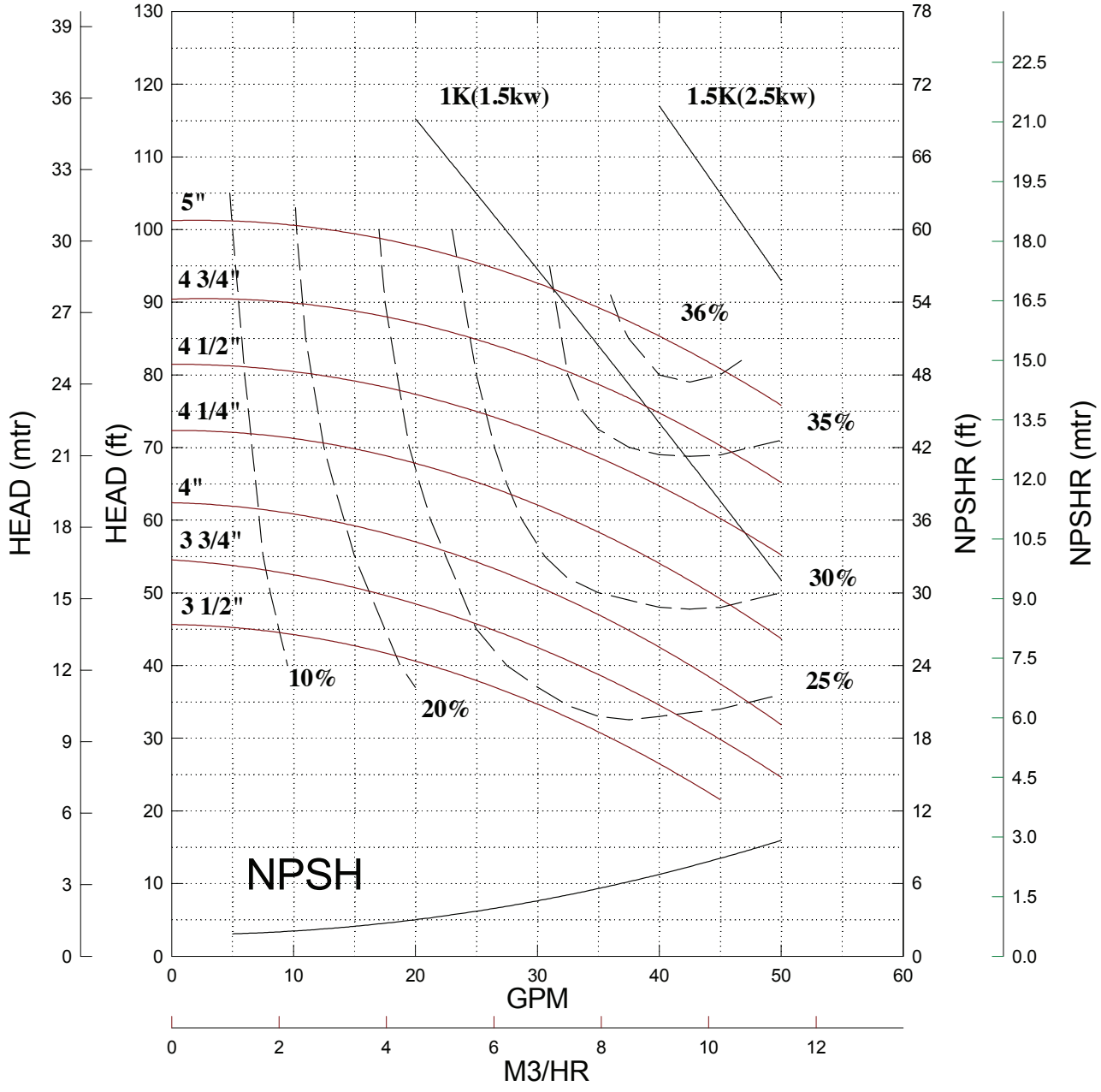
Torque Values: Torque should be applied to bolt sets in increasing increments until these values are reached, and in an evenly distributed "star" pattern. These values are for the standard Chempump product line using Teflon envelope gaskets, standard bolting and 150 or 300 psi design. For other configurations and applications, please consult the factory.

Impeller Nut Torque Values:		
	56 Frame	12 Ft-Lbs.
	180 Frame	75 Ft-Lbs.

Appx. D. Curve - GA(T) Model

PUMP CASING	**D-38205**	SIZE	**1 x 3/4 x 5**	MODEL	**GA(T)**
IMPELLER	**C-37670**	IMP. DIA.		RPM	**3450**
SERIAL #		REVISION DATED 9/92: COMPUTER GENERATED			

Curves are based on shop test while handling clean water at 20°C and at sea level. Performance guarantees apply at rating point only. Efficiencies shown are overall wire to water. Numbers beneath model designations indicate full load kilowatt ratings for the referenced motor load lines. When pumping fluids with specific gravities other than 1.0, select pump model (see load line) to handle load equivalent in feet of water. e.g, 40 feet of fluid of Sp. Gr.=1.5 is load equivalent of 60 feet (1.5x40) of water. Please note that this is merely a short cut method to estimate the model required. For proper model selection, especially when handling a fluid with a Sp. Gr. greater than 1.7, consult your Chempump representative or the factory.



	DRAWN	DATE	CURVE	REV.
	JFK	10-16-79	A-70059	3

Appx. E. Curve - GB(T) Model

PUMP CASING	D-38203	SIZE	1 x 3/4 x 6 1/2	MODEL	**GB(T)**
IMPELLER	C-37669	IMP. DIA		RPM	**3450**
SERIAL #		REVISION DATED 9/92: COMPUTER GENERATED			

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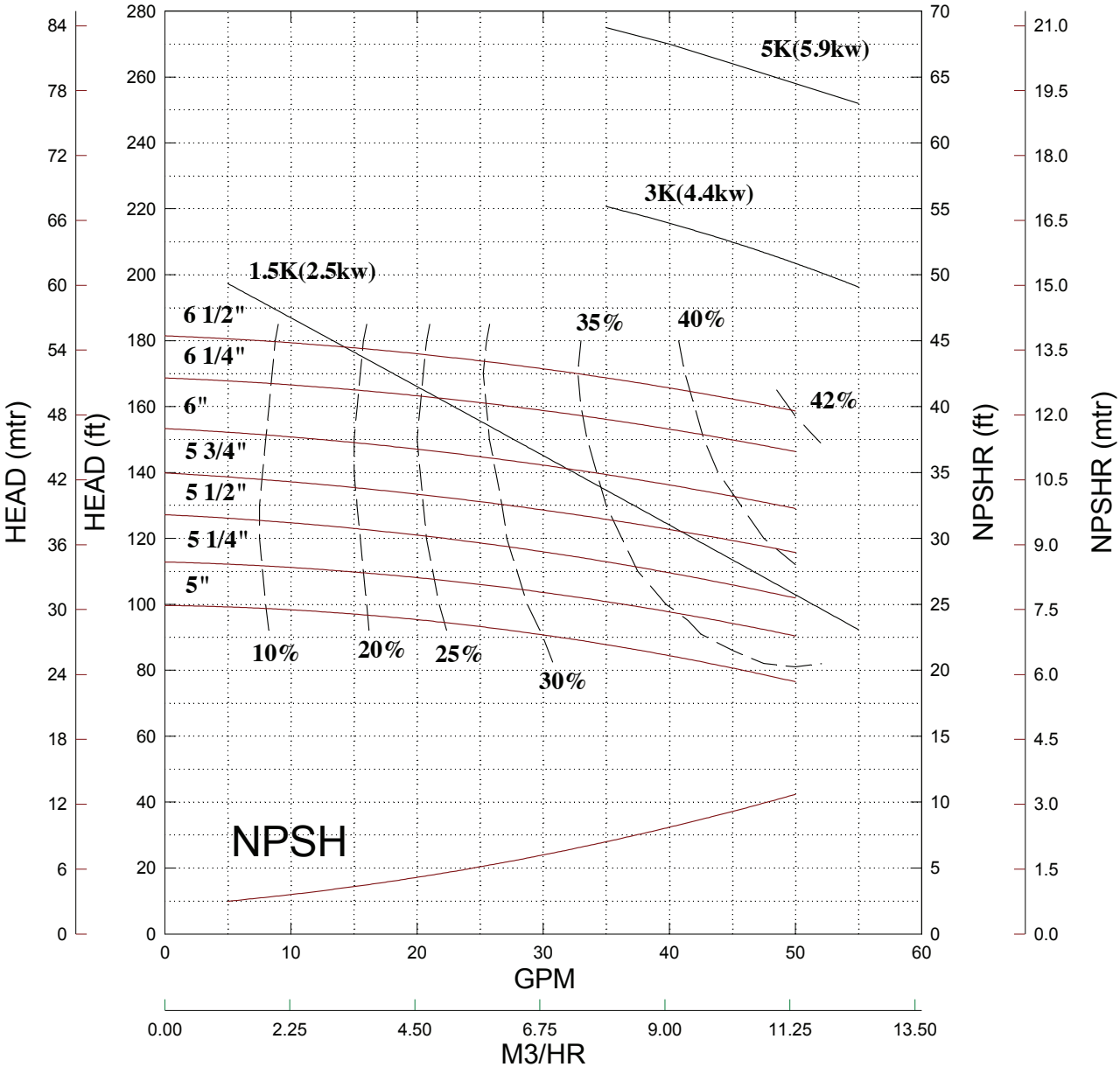
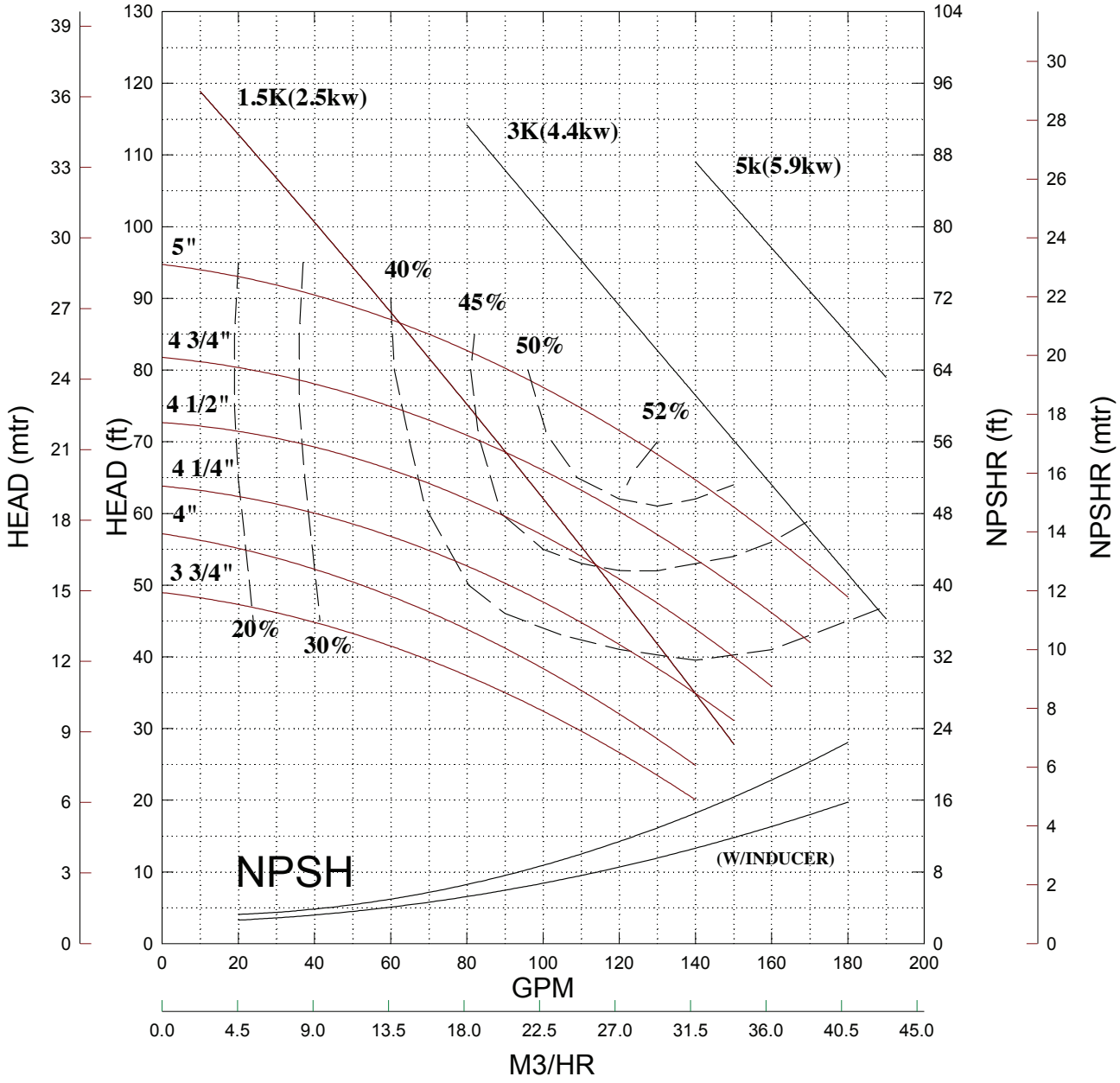


	DRAWN	DATE	CURVE	REV.
	JFK	09-26-79	A-70058	3

Appx. F. Curve - GC(T) Model

PUMP CASING	**D-38208**	SIZE	**2 x 1 1/2 x 5**	MODEL	**GC(T)**
IMPELLER	**C-39427**	IMP. DIA.		RPM	**3450**
SERIAL #		REVISION DATED 9/92: COMPUTER GENERATED			

Curves are based on shop test while handling clean water at 20°C and at sea level. Performance guarantees apply at rating point only. Efficiencies shown are overall wire to water. Numbers beneath model designations indicate full load kilowatt ratings for the referenced motor load lines. When pumping fluids with specific gravities other than 1.0, select pump model (see load line) to handle load equivalent in feet of water. e.g, 40 feet of fluid of Sp. Gr.=1.5 is load equivalent of 60 feet (1.5x40) of water. Please note that this is merely a short cut method to estimate the model required. For proper model selection, especially when handling a fluid with a Sp. Gr. greater than 1.7, consult your Chempump representative or the factory.



	DRAWN	DATE	CURVE	REV.
	JFK	12-12-79	A-70060	2

Appx. G. Curve - GVBS(T) Model

PUMP CASING **D-38201**	SIZE **3 x 1 1/2 x 6 1/4**	MODEL **GVBS(T)**
IMPELLER **C-24463**	IMP. DIA.	RPM **3450**
SERIAL #	REVISION DATED 9/92: COMPUTER GENERATED	

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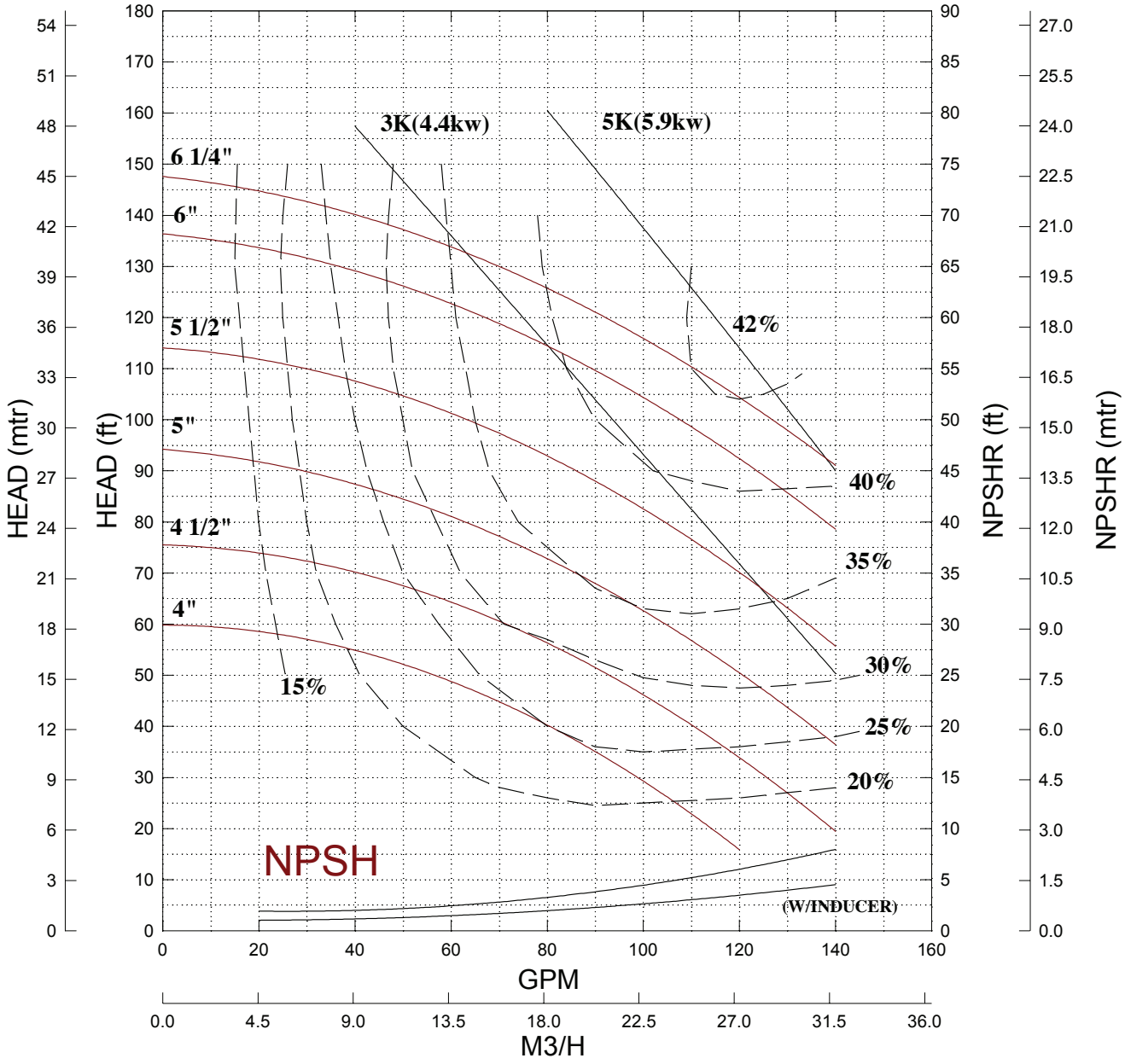
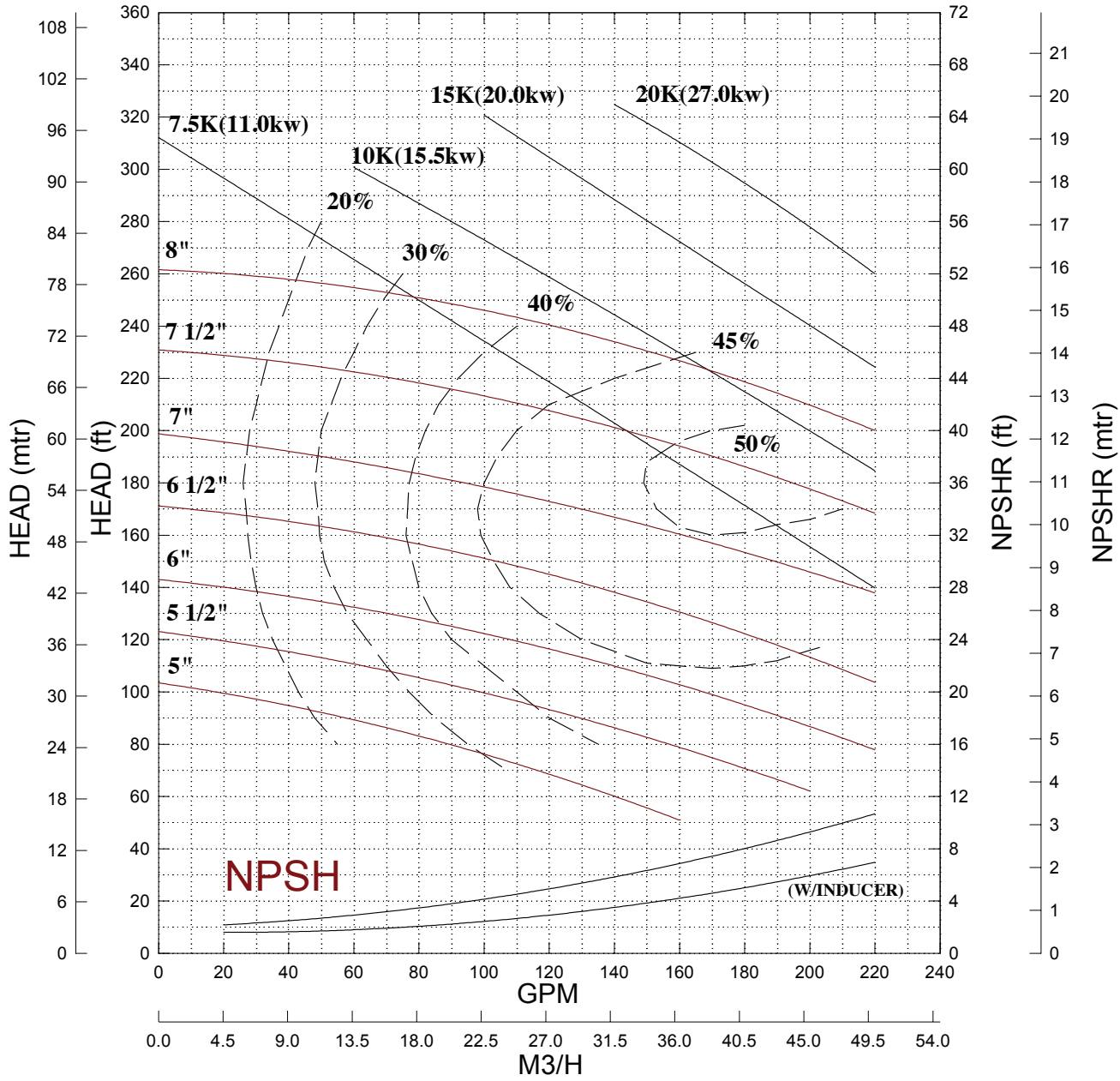


	DRAWN	DATE	CURVE	REV.
	WF	11-18-86	A-70066	2

Appx. H. Curve - GVD(T) Model

PUMP CASING	D-38197	SIZE	3 x 1 1/2 x 8	MODEL	GVD(T)
IMPELLER	C-38196	IMP. DIA		RPM	3450
SERIAL #		REVISION DATED 9/92: COMPUTER GENERATED			

Curves are based on shop test while handling clean water at 20°C and at sea level. Performance guarantees apply at rating point only. Efficiencies shown are overall wire to water. Numbers beneath model designations indicate full load kilowatt ratings for the referenced motor load lines. When pumping fluids with specific gravities other than 1.0, select pump model (see load line) to handle load equivalent in feet of water. e.g, 40 feet of fluid of Sp. Gr.=1.5 is load equivalent of 60 feet (1.5x40) of water. Please note that this is merely a short cut method to estimate the model required. For proper model selection, especially when handling a fluid with a Sp. Gr. greater than 1.7, consult your Chempump representative or the factory.

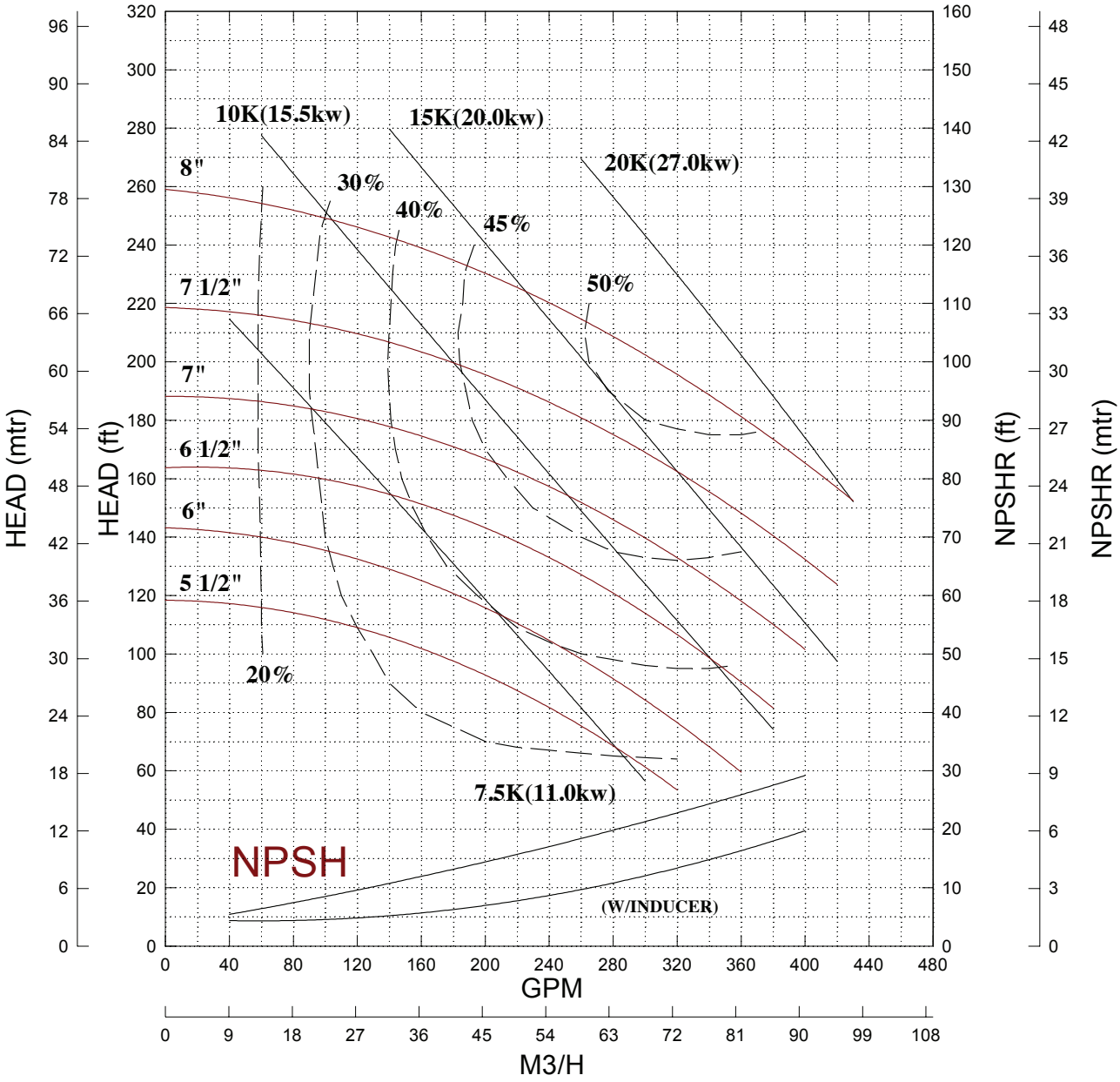


	DRAWN	DATE	CURVE	REV.
	JFK	12-16-80	A-70061	3

Appx. I. Curve - GVE(T) Model

PUMP CASING	**D-38783**	SIZE	**3 x 2 x 8**	MODEL	**GVE(T)**
IMPELLER	**C-39373**	IMP. DIA.		RPM	**3450**
SERIAL #		REVISION DATED 9/92: COMPUTER GENERATED			

Curves are based on shop test while handling clean water at 20°C and at sea level. Performance guarantees apply at rating point only. Efficiencies shown are overall wire to water. Numbers beneath model designations indicate full load kilowatt ratings for the referenced motor load lines. When pumping fluids with specific gravities other than 1.0, select pump model (see load line) to handle load equivalent in feet of water. e.g, 40 feet of fluid of Sp. Gr.=1.5 is load equivalent of 60 feet (1.5x40) of water. Please note that this is merely a short cut method to estimate the model required. For proper model selection, especially when handling a fluid with a Sp. Gr. greater than 1.7, consult your Chempump representative or the factory.



	DRAWN	DATE	CURVE	REV.
	JFK	04-26-72	A-70037	5

Appx. J. Curve - GVHS (T)

PUMP CASING **D-38281**	SIZE **2 x 1 x 9 1/2**	MODEL **GVHS(T)**
IMPELLER **C-38508**	IMP. DIA.	RPM **3450**
SERIAL #	REVISION DATED 9/92: COMPUTER GENERATED	

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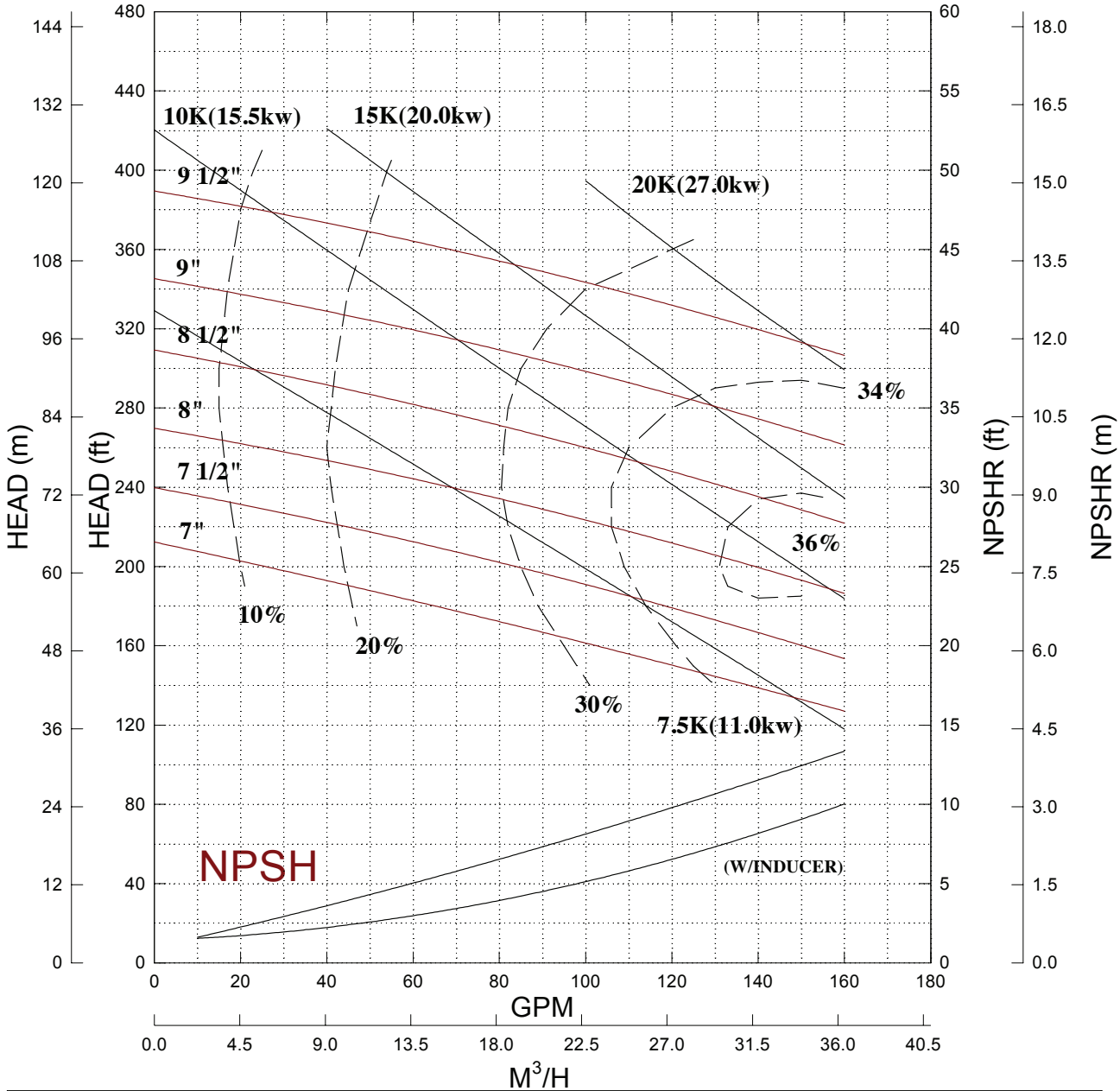
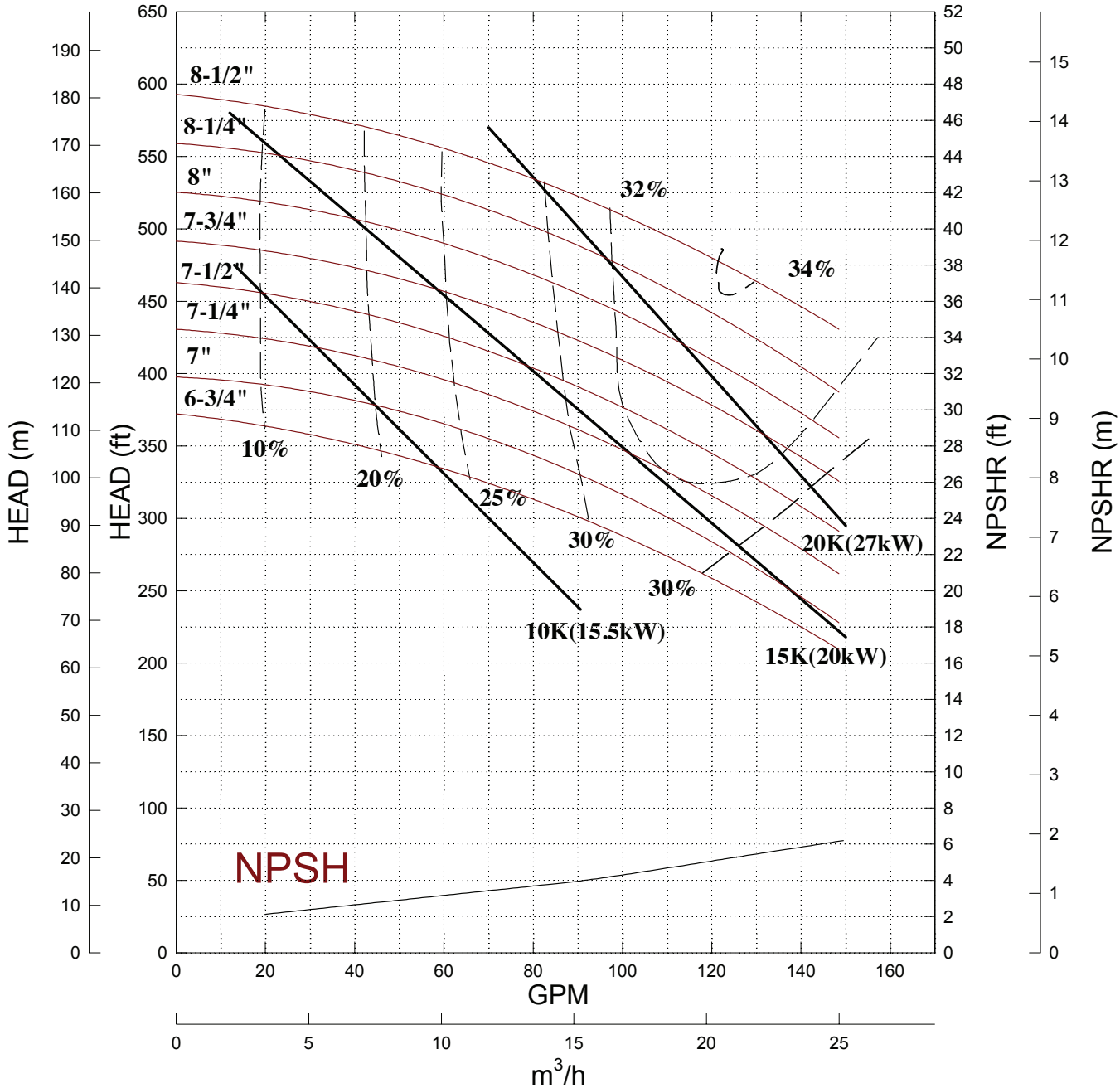


	DRAWN	DATE	CURVE	REV.
	JFK	09-16-75	A-70057	3

Appx. K. Curve - N2S 10, 15, and 20K

PUMP CASING	**D-38113**	SIZE **3 x 1-1/2**	MODEL **N2S-10, 15 & 20K**
IMPELLER 1st Stage	**C-38222**	IMP. DIA.	RPM **3450**
IMPELLER 2nd Stage	**C-38110**	Revision Dated 08/03: Computer Generated	

Curves are based on shop test while handling clean water at 20°C and at sea level. Performance guarantees apply at rating point only. Efficiencies shown are overall wire to water. Numbers beneath model designations indicate full load kilowatt ratings for the referenced motor load lines. When pumping fluids with specific gravities other than 1.0, select pump model (see load line) to handle load equivalent in feet of water. e.g, 40 feet of fluid of Sp. Gr.=1.5 is load equivalent of 60 feet (1.5x40) of water. Please note that this is merely a short cut method to estimate the model required. For proper model selection, especially when handling a fluid with a Sp. Gr. greater than 1.7, consult your Chempump representative or the factory.



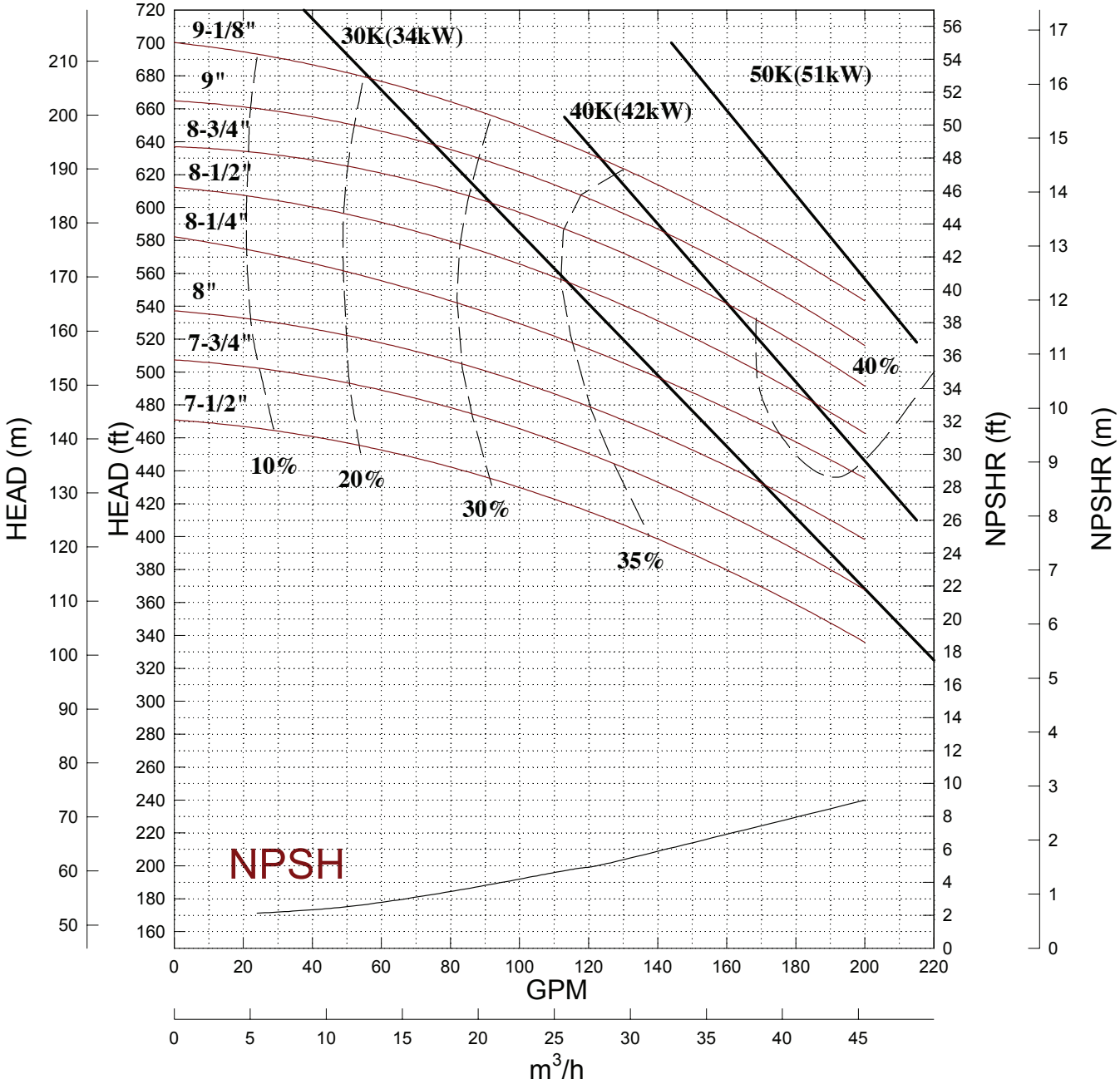
	DRAWN	DATE	CURVE	REV.
	WF	04-23-86	A-70067	2

Rev 2 - Computer Generated Curve

Appx. L. Curve - N2S 30, 40, and 50K

PUMP CASING	**D-38113**	SIZE	**3 x 1-1/2**	MODEL	**N2S-30, 40 & 50K**
IMPELLER 1st Stage	**C-38222**	IMP. DIA.		RPM	**3450**
IMPELLER 2nd Stage	**C-38110**	Revision Dated 08/03: Computer Generated			

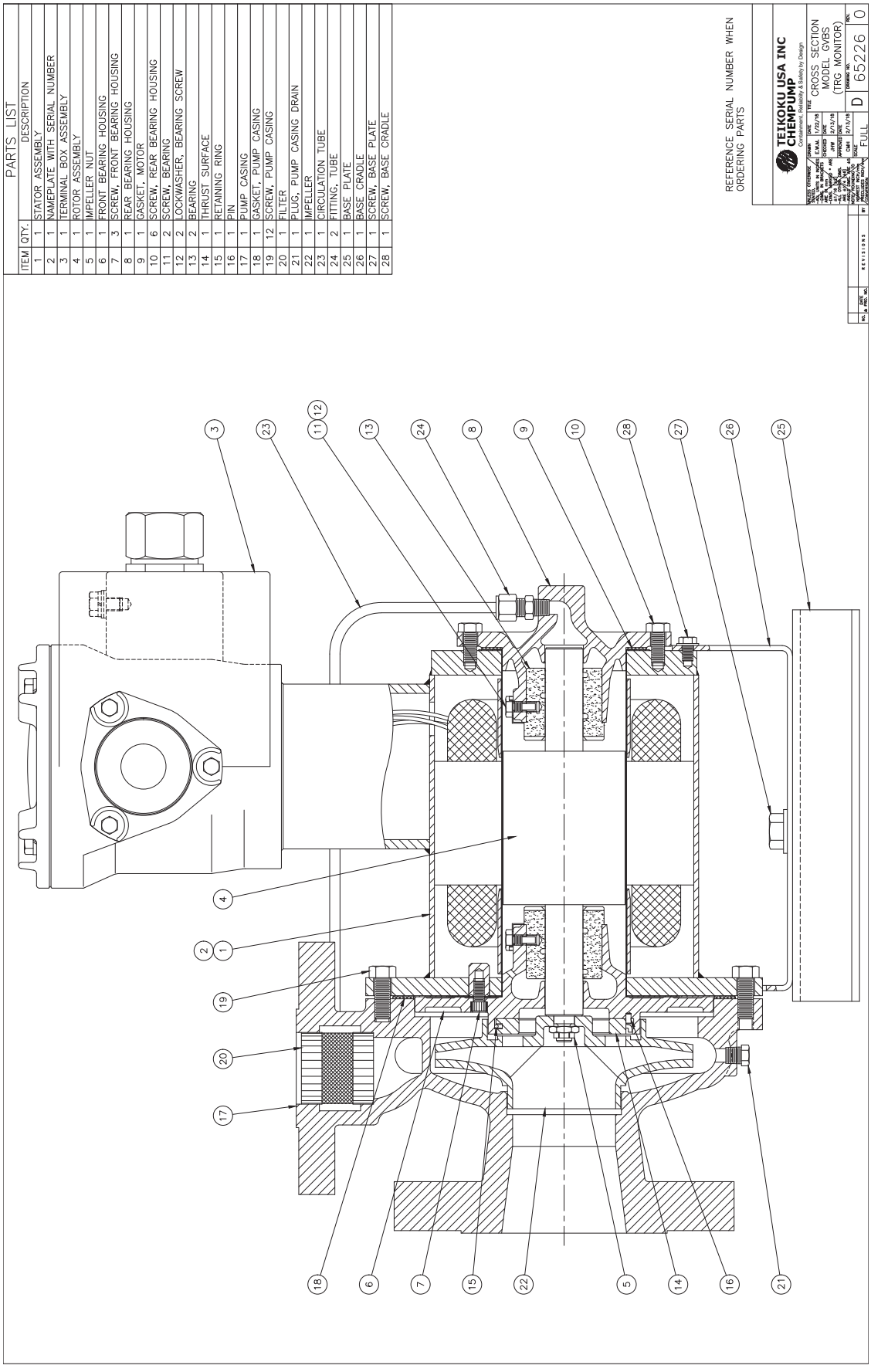
Curves are based on shop test while handling clean water at 20ºC and at sea level. Performance guarantees apply at rating point only. Efficiencies shown are overall wire to water. Numbers beneath model designations indicate full load kilowatt ratings for the referenced motor load lines. When pumping fluids with specific gravities other than 1.0, select pump model (see load line) to handle load equivalent in feet of water. e.g, 40 feet of fluid of Sp. Gr.=1.5 is load equivalent of 60 feet (1.5x40) of water. Please note that this is merely a short cut method to estimate the model required. For proper model selection, especially when handling a fluid with a Sp. Gr. greater than 1.7, consult your Chempump representative or the factory.



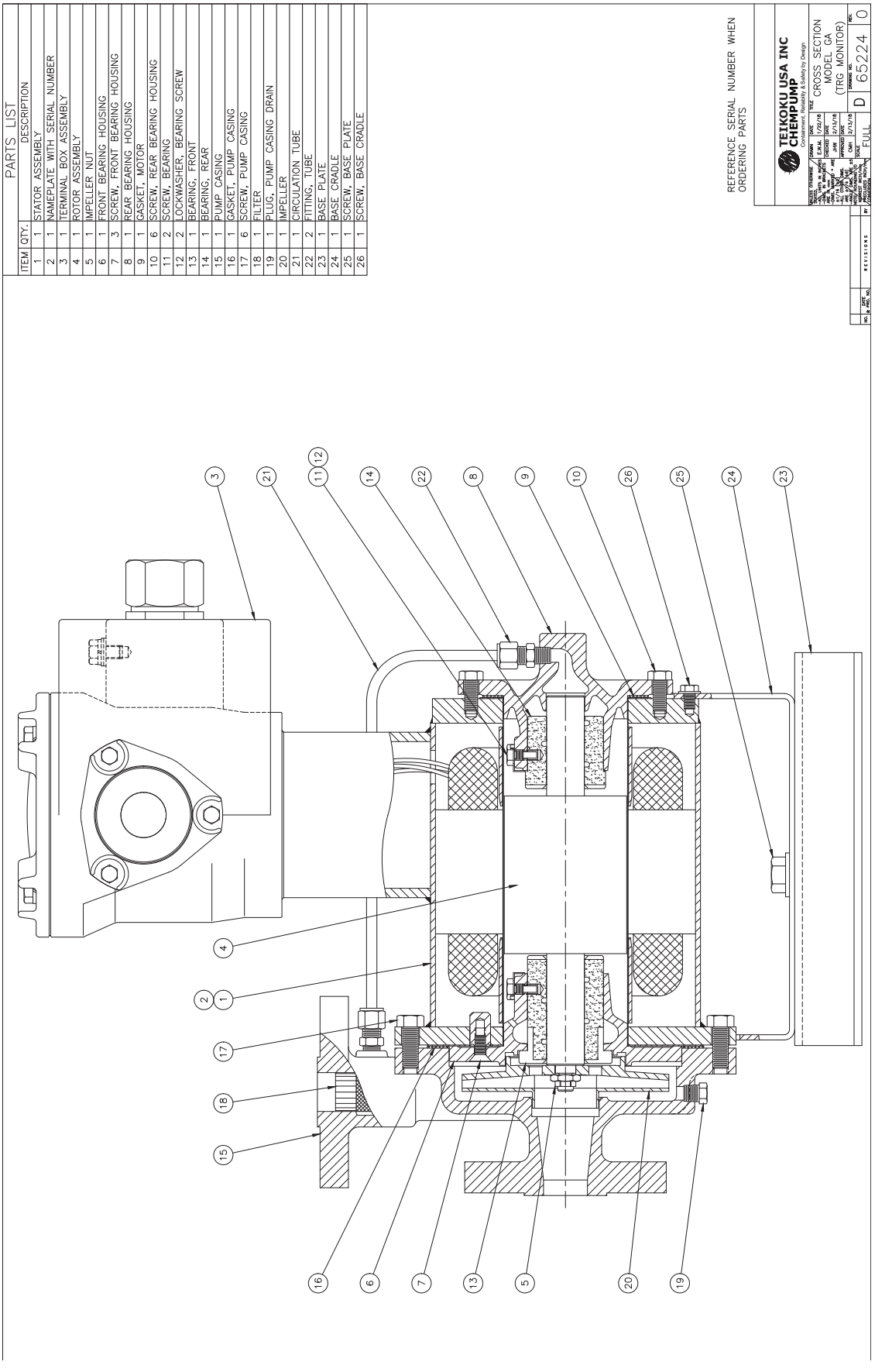
	DRAWN	DATE	CURVE	REV.
	WF	04-23-86	A-70068	2

Rev 2 - Computer Generated Curve

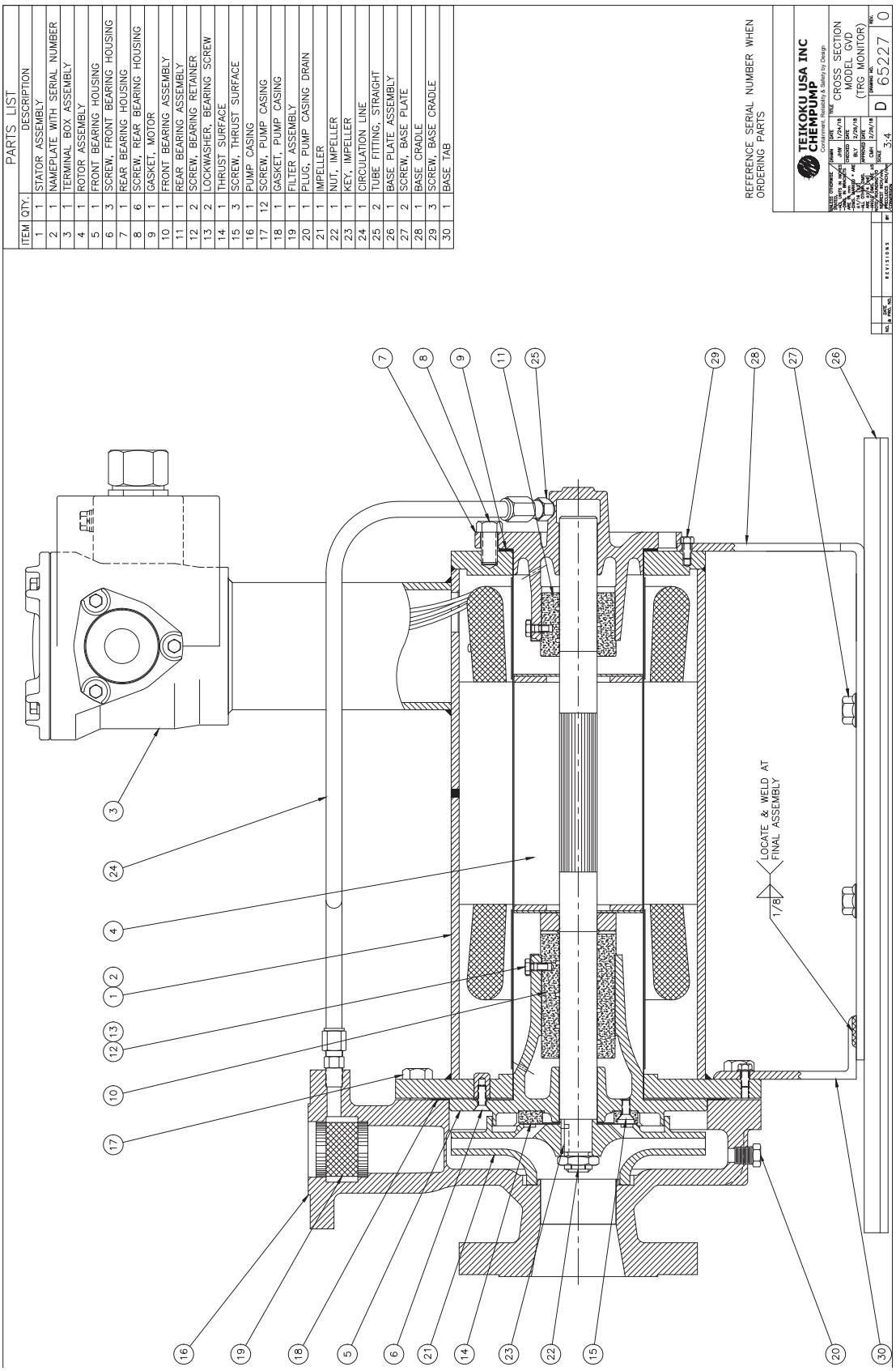
Appx. M. Sectional View GVBS



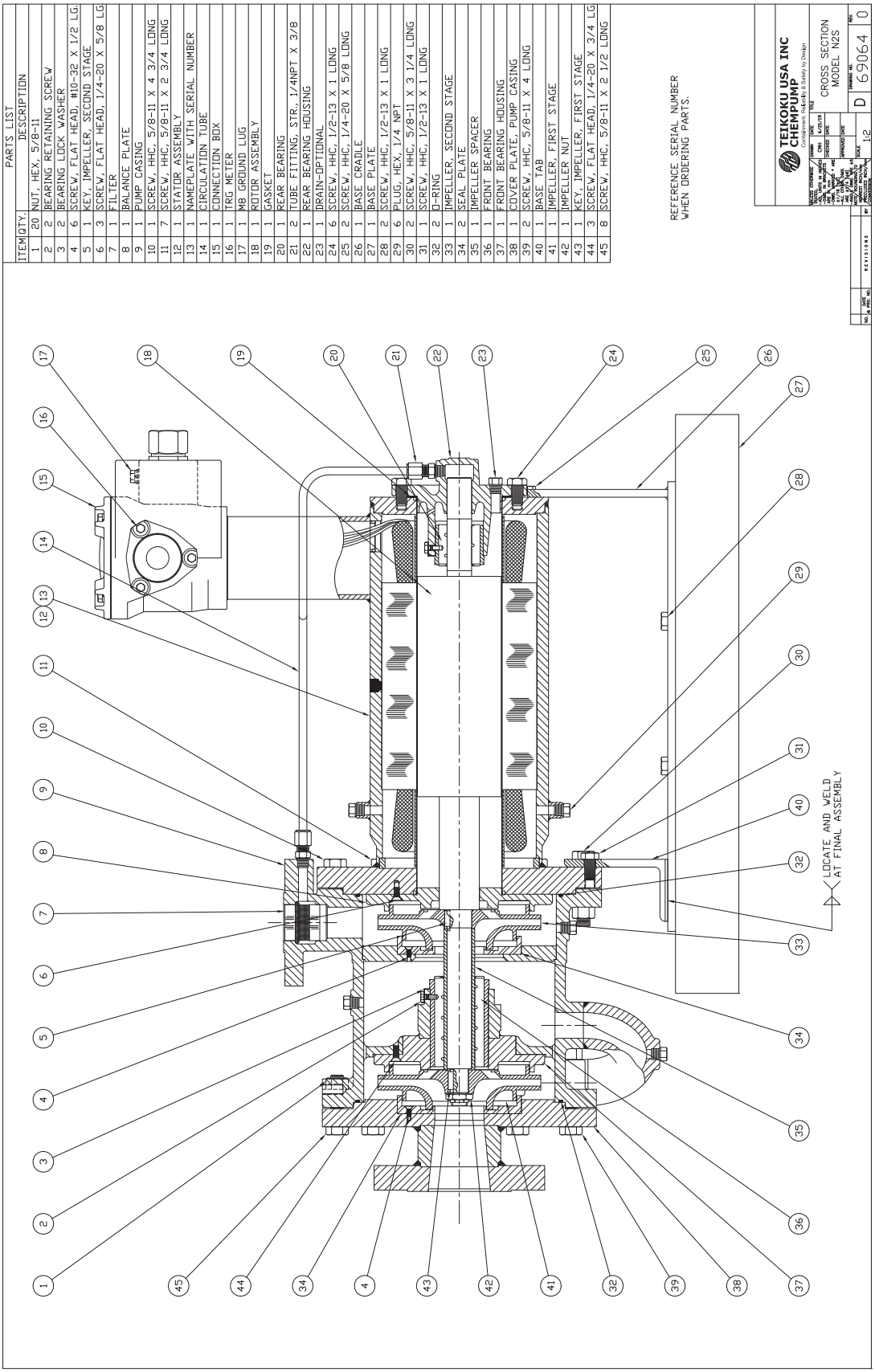
Appx. N. Sectional View GA, GB, GC



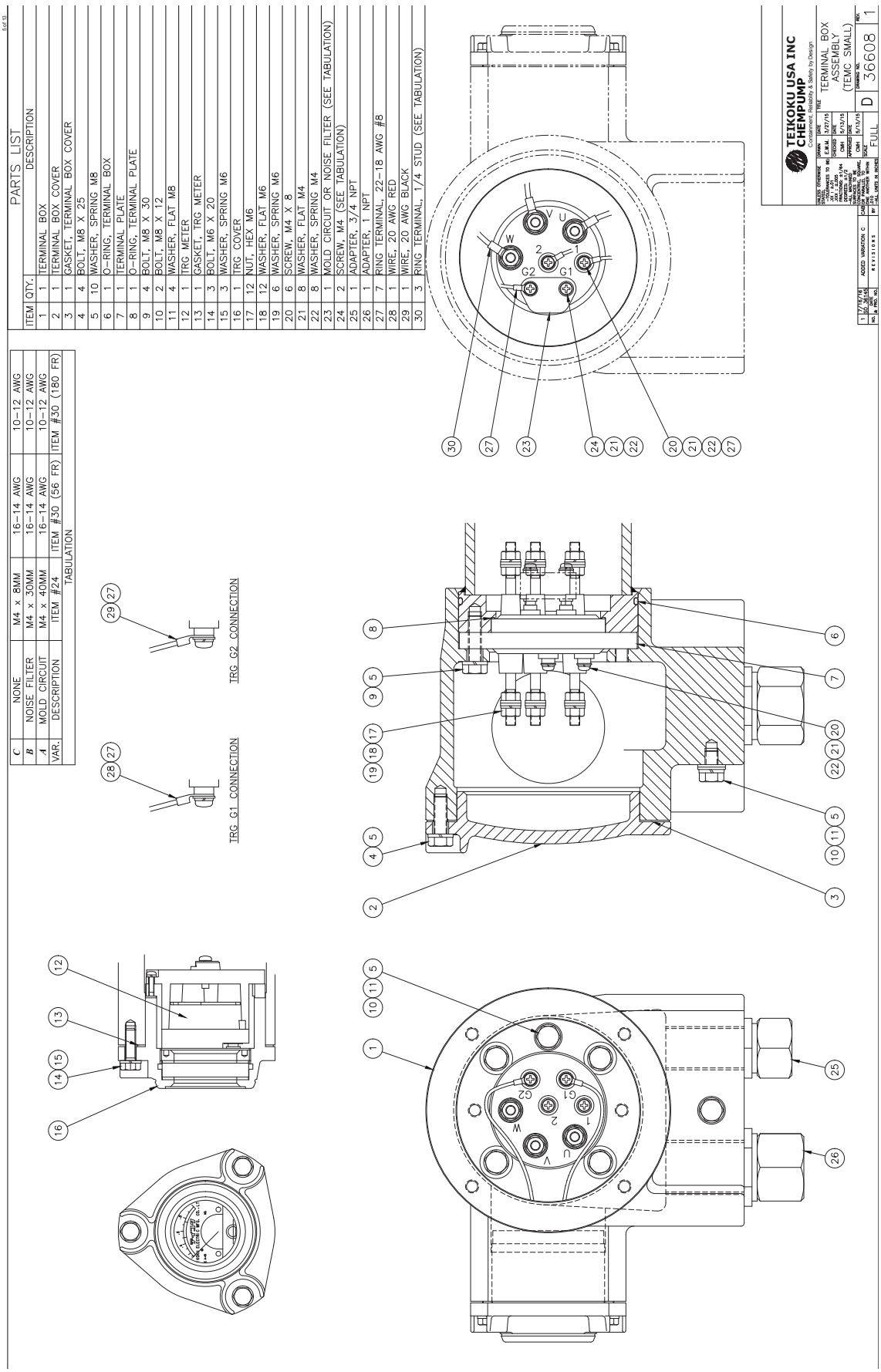
Appx. O. Sectional View GVD, GVE, GVHS



Appx. P. Sectional View N2S



Appx. Q. Terminal Assembly Box



Appx. R. Decontamination Certification and Flushing Procedure

TEIKOKU USA INC
CHEMPUMP

DECONTAMINATION CERTIFICATION
AND FLUSHING PROCEDURE

CUSTOMER _____ DATE: _____

ADDRESS: _____ PHONE: _____

_____ FAX: _____

CONTACT: _____ RMA #: _____

EMAIL: _____

Please complete the items below. Providing this information will allow us to work as quickly and safely as possible.

PUMP MODEL: _____ SERIAL NUMBER: _____

PART NUMBER: _____ DATE INSTALLED: _____

DATE PURCHASED: _____ INDOOR / OUTDOOR: _____

REASON FOR RETURN: ☐ WARRANTY REQUEST ☐ FACTORY SERVICE

FAILURE INFORMATION:

☐ Failure To Deliver Required Capacity
☐ Loses Prime After Starting
☐ Axial Wear Due To Thrust
☐ Vibration
☐ Bearing Failure
☐ Insufficient Pressure
☐ Motor Burnout
☐ Bearing Monitor reading:
☐ Other:

BRIEF DESCRIPTION OF PUMP FAILURE: _____

_____

_____

DECONTAMINATION INFORMATION

All pumps/parts must be completely decontaminated and all information in this section must be completed prior to shipment to our factory or service center. Shipments received without this documentation will not be accepted and will be returned to the point of shipment.

CHECK ONE OF THE FOLLOWING:

☐ The pump has been flushed by following steps A through A3 of the Teikoku USA Flushing Procedure on page 2 of this form. No liner rupture is suspected.

☐ Both the complete pump and the stator assembly have been flushed by following steps A through B3 of the Teikoku USA Flushing Procedure on page 2 of this form. The motor must be rewound.

FLUID PUMPED: _____ WHAT FLUID DID YOU FLUSH WITH: _____

Attach completed material safety data sheets (MSDS) for these fluids. If either fluid is proprietary, please attach a description of any characteristics that will assist Teikoku USA in safe handling. Without detailed and complete information on the pumped fluid, we will not be able to process your order.

PROTECTION EQUIPMENT RECOMMENDED FOR SAFE HANDLING OF THE PROCESS FLUID: _____

_____

DECONTAMINATION CERTIFIED BY: _____ DATE: _____

TITLE: _____ PHONE: _____

RETURN COMPLETED FORM AND PUMP/PART TO:

☐ TEIKOKU USA
FACTORY SERVICE CENTER
959 MEARNS ROAD
WARMINSTER, PA 18974
PHONE: (215) 343-6000
FAX: (267) 486-1037

☐ TEIKOKU USA
MIDWEST SERVICE CENTER
27881 STATE ROUTE 7
MARIETTA, OH 45750
PHONE: (740) 538-5332
FAX (740) 538-5015

☐ TEIKOKU USA
SALES AND SERVICE CENTER
5880 BINGLE ROAD
HOUSTON, TX 77092
PHONE: (713) 983-9901
FAX: (713) 983-9919

TEIKOKU USA INC
CHEMPUMP

DECONTAMINATION CERTIFICATION
AND FLUSHING PROCEDURE

FLUSHING PROCEDURES FOR TEIKOKU USA PRODUCTS

THE FOLLOWING FLUSHING PROCEDURES ARE REQUIRED TO ALLOW FOR MAXIMUM REMOVAL OF PROCESS FLUIDS.

A. COMPLETE PUMP

A1) WITH THE SUCTION FLANGE DOWN, INTRODUCE AN APPROPRIATE NEUTRALIZING FLUID THROUGH THE DISCHARGE FLANGE. FLUSH THE PUMP IN THIS MANNER FOR A SUFFICIENT TIME TO ALLOW FOR THE REMOVAL OF ALL PROCESS FLUID. VENT THE PUMP AND/OR REMOVE THE REAR BEAING HOUSING, AS REQUIRED.

A2) AGAIN, WITH THE SUCTION FLANGE DOWN, REMOVE THE CIRCULATION LINE (AND FITTING IF NECESSARY) AND INTRODUCE AN APPROPRIATE NEUTRALIZING FLUID TO THE REAR OF THE PUMP. FLUSH THE PUMP IN THIS MANNER FOR A SUFFICIENT TIME TO ALLOW FOR THE REMOVAL OF ALL PROCESS FLUID. ALSO FLUSH THE CIRCULATION LINE AND/OR HEAT EXCHANGER TUBING, AS REQUIRED.

A3) AFTER FLUSHING AS SPECIFIED ABOVE, REMOVE AS MUCH OF THE NEUTRALIZING FLUID AS POSSIBLE USING COMPRESSED AIR OR INERT GAS.

A4) NOTE: FOR SOME PUMPS WITH O-RINGS UNDER THE SHAFT SLEEVES, COMPLETE DISASSEBLY MAY BE REQUIRED TO REMOVE TRAPPED FLUID.

B. G and J-SERIES STATOR ASSEMBLY (if equipped with a relief valve): IF A STATOR LINER RUPTURE IS SUSPECTED, FOLLOW THIS SECTION TO FLUSH THE STATOR CAVITY. CAUTION: IF THIS STEP IS FOLLOWED, THE MOTOR MUST BE REWOUND.

B1) REMOVE THE RELIEF VALVE. INSERT A SCREWDRIVER INTO THE RELIEF VALVE ADAPTER AND PRY THE LISK FILTER TO ONE SIDE. REMOVE THE CONNECTION BOX FROM THE LEAD NIPPLE AND CHIP AWAY THE POTTING COMPOUND FROM THE LEAD NIPPLE.

B2) POSITION THE STATOR ASSEMBLY WITH THE LEAD NIPPLE DOWN AND INTRODUCE AN APPROPRIATE NEUTRALIZING FLUID TO THE RELIEF VALVE ADAPTER. THE FLUID WILL EXIT THROUGH THE LEAD NIPPLE. FLUSH THE STATOR CAVITY IN THIS MANNER FOR A SUFFICIENT TIME TO ALLOW FOR THE REMOVAL OF ALL PROCESS FLUID AND STATOR OIL.

B3) REMOVE AS MUCH OF THE NEUTRALIZING FLUID AS POSSIBLE BY PURGING THE STATOR CAVITY WITH COMPRESSED AIR OR INERT GAS FOR 3 - 5 MINUTES.

C. NC and LE-SERIES STATOR ASSEMBLY (no relief valve): IF A STATOR LINER RUPTURE IS SUSPECTED, FOLLOW THIS SECTION TO FLUSH THE STATOR CAVITY. CAUTION: IF THIS STEP IS FOLLOWED, THE MOTOR MUST BE REWOUND.

C1) DRILL A HOLE THROUGH BASE CRADLE MOUNTING HOLE LOCATED IN REAR END BELL, DRILL THIS HOLE JUST DEEP ENOUGH TO BREAK THROUGH END BELL. DRILL A SECOND HOLE THROUGH STATOR LINER ON OPPOSITE END OF STATOR.

C2) POSITION THE STATOR ASSEMBLY WITH REAR END BELL UP AND INTRODUCE AN APPROPRIATE NEUTRALIZING FLUID THROUGH DRILLED HOLE IN REAR END BELL. THE FLUID WILL EXIT THROUGH THE DRILLED HOLE ON OPPOSITE SIDE. FLUSH THE STATOR CAVITY FOR A SUFFICIENT TIME TO ALLOW FOR THE REMOVAL OF ALL PROCESS FLUID.

C3) REMOVE AS MUCH OF THE NEUTRALIZING FLUID AS POSSIBLE BY PURGING THE STATOR CAVITY WITH COMPRESSED AIR OR INERT GAS FOR 3 - 5 MINUTES.

TEIKOKU USA INC
CHEMPUMP

DECONTAMINATION CERTIFICATION
AND FLUSHING PROCEDURE

D. FOR ALL TEIKOKU PUMP AND LE DYNAPUMP MODELS WITH RUPTURED LINERS: IF A STATOR LINER RUPTURE IS SUSPECTED, FOLLOW THIS SECTION TO FLUSH THE STATOR CAVITY.
CAUTION: IF THIS STEP IS FOLLOWED, THE MOTOR MUST BE REWOUND.

D1) THERE MIGHT BE A CASE IN WHICH PRESSURE IS RELEASED WHEN TERMINAL BOX COVER OR TERMINAL PLATE IS REMOVED. TAKE THE NECESSARY PRECAUTIONS. WITH THE TERMINAL BOX UP, REMOVE THE COVER AND THE TERMINAL PLATE.

D2) WHEN PROCESS FLUID IS IN STATOR WINDING, SUPPLY FLUSHING FLUID TO THE OPENING FOR SUFFICIENT TIME TO FULLY NEUTRALIZE THE PROCESS FLUID. AFTER WASHING IS COMPLETED, DRAIN ALL THE FLUID.

D3) REMOVE AS MUCH OF THE NEUTRALIZING FLUID AS POSSIBLE BY PURGING THE STATOR WITH COMPRESSED AIR OR INERT GAS FOR 3 – 5 MINUTES.

E. FOR JS SERIES STATOR ASSEMBLY, DECONTAMINATION NOT POSSIBLE – SCRAP.

F. FOR ALL OTHER PUMP MODELS NOT LISTED, CONTACT THE FACTORY SERVICE CENTER FOR THE PROPER DECONTAMINATION PROCEDURE.

NOTE ON DECONTAMINATION:

TEIKOKU USA RESERVES THE OPTION TO RETURN PUMPS, AT THE CUSTOMER'S EXPENSE, IF THEY HAVE NOT BEEN PROPERLY DECONTAMINATED.

TEIKOKU USA INC
CHEMPUMP

959 Mearns Road
Warminster, PA 18974
www.TeikokuPumps.com
(215) 343-6000
(267) 486-1037

5880 Bingle Road
Houston, TX 77092
www.TeikokuPumps.com
(713) 983-9901
(713) 983-9919

27881 State Route 7
Marietta, OH 45750
www.TeikokuPumps.com
(740) 538-5332
(740) 538-5015

Repair Receipt Policy

Teikoku USA policy requires that an RMA be generated prior to the shipment of pumps or components to any Teikoku USA facility. With the shipment Teikoku USA also requires a copy of the RMA, a completed Teikoku USA Decontamination Form, an SDS for the process fluid to which the pumps or parts were subjected and an SDS on the decontamination flush fluid that was used to decontaminate the equipment.

THESE DOCUMENTS MUST ACCOMPANY THE SHIPMENT. IF THESE DOCUMENTS ARE NOT PROVIDED, TEIKOKU USA PERSONNEL WILL REFUSE THE SHIPMENT AND INFORM BOTH THE CARRIER AND CUSTOMER OF THE REFUSAL.

These requirements are essential to Teikoku USA's safety practices and reviews that serve to protect all of Teikoku USA's associates, visitors and customers. Teikoku USA thanks you in advance for your adherence to our policy regarding returns for evaluation and/or service. Please feel free to contact the service center personnel at the Teikoku USA facility to which the pump was sent for repair.

As part of its ongoing process improvement policy, Teikoku USA continually reviews business processes to ensure that a safe work environment is provided for all employees, associates, visitors, customers and the community. As such this policy is subject to change without prior notice. To check for any changes to this policy, please use the contact numbers for each facility as listed in the above letterhead.

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