



TEIKOKU REVERSE CIRCULATION PUMP

**TYPE-R (API-685 Plan 13-SE)
For Refrigeration Applications Only**



INSTRUCTION MANUAL

for Installation, Operation, and Maintenance

Introduction

Thank you for purchasing the Teikoku Type-R (Plan 13-SE) refrigeration canned motor pump. Please carefully read this instruction manual and all Safety Warnings prior to use.

A [Quick Start Guide](#) is included in the Appendix of this manual.

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 Teikoku Type-R (Plan 13-SE) pump conforms to the following standards:

1. Japanese Industrial Standard (JIS)
2. Japan Electrical Manufacturers' Standard (JEM)
3. American Society of Mechanical Engineers (ASME) B-16.5
4. Canadian Standards Association (CSA): UL 778 CSA 22.2 No 108
5. International Institute of Ammonia Refrigeration (IIAR): ANSI/IIAR 2-2014

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.

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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 and gaskets. You must take adequate precautions to protect personnel and the environment if the liquid could be considered hazardous.

Overview

Teikoku Type-R (Plan 13-SE) sealless canned motor pumps are designed for the industrial refrigeration market and offer an advanced low probability, true secondary containment, environmentally friendly alternative to sealed pumps and single containment sealless pumps.

Care should be exercised upon installation, start up, removal and maintenance of the pumps. Recommended safety equipment should be used at all times.

This manual, containing basic instructions for installation, operation and maintenance of the Teikoku Type-R (Plan 13-SE), is designed to assist you in obtaining this service. It is important that the persons responsible for the installation, operation, and maintenance of the pump read and understand this manual thoroughly.

The Teikoku Type-R (Plan 13-SE) pump is supplied with the Teikoku Rotary Guardian (TRG™), the radial monitoring system of the rotating assembly of a Teikoku canned motor pump. The TRG monitors bearing wear and gives a direct readout as to bearing condition. The TRG is mounted on the electrical junction box as standard.



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1. General Information

1.1 General Design and Operation

The Teikoku Type-R (Plan 13-SE) is a combined centrifugal pump and squirrel cage induction electric motor built together into a single hermetically-sealed unit. The pump impeller is of the closed type, and is mounted on one end of the rotor shaft which extends from the motor section into the pump casing. The rotor is submerged in the liquid being pumped and is, therefore, “canned” to isolate the motor rotor from contact with the liquid. The stator winding is also canned to isolate it from the liquid being pumped. Liquid film journal bearings are submerged in system liquid and are therefore lubricated by the process liquid.

The Teikoku Type-R (Plan 13-SE) has only one moving component, a combined rotor-impeller assembly that is driven by the induced magnetic field of an induction motor. A portion of the pumped liquid is allowed to circulate through the rotor cavity to cool the motor and lubricate the bearings. The stator windings are protected from contact with the circulating liquid by a corrosion resistant, non-magnetic, alloy liner, which completely seals or cans the stator winding.

Flow paths of the Teikoku Type-R (Plan 13-SE) reverse circulation pumps are shown in [Figure 1-1](#). The circulating liquid is channeled into the motor section by holes drilled in the front bearing housing. A portion of the circulating liquid lubricates the front liquid

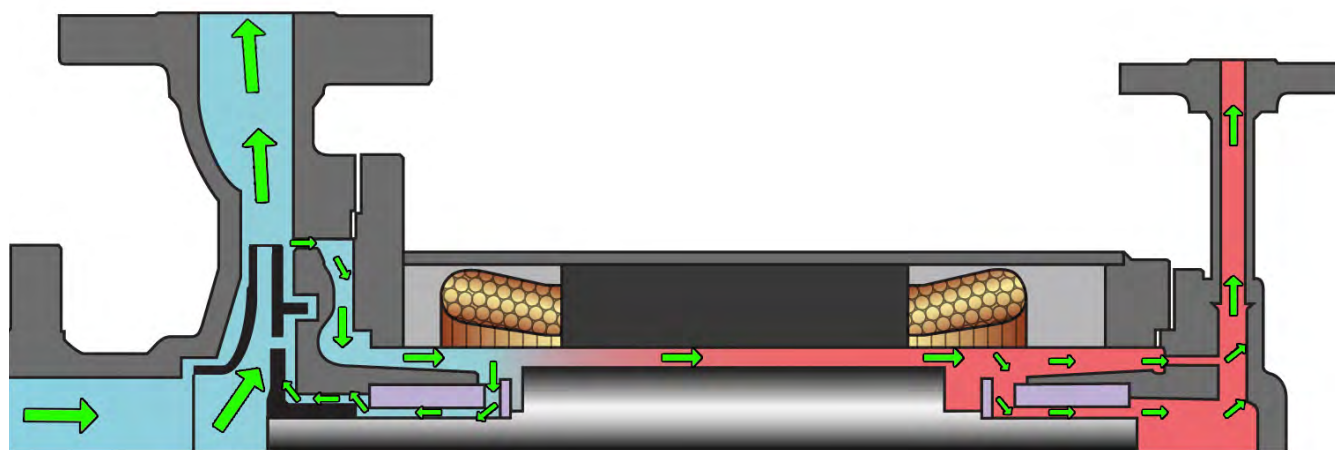
film journal bearing and returns to the rear of the impeller. The remainder of the circulating liquid passes over the rotor, cools the motor, lubricates the rear liquid film journal bearing and then exits the rear bearing housing returning to the vapor space of the suction tank via the reverse circulation line. The Teikoku Type-R (Plan 13-SE) reverse circulation design avoids the heated circulating liquid returning directly to the pump suction.

The Teikoku Type-R (Plan 13-SE) offers advanced low probability true secondary containment as a standard design feature. In the event of a failure of the primary containment can, the stator assembly in conjunction with the leak proof terminal plate assembly provides the secondary containment. This design prevents any release of the process liquid out to the atmosphere.

A standard feature of the Teikoku Type-R (Plan 13-SE) is the patented Teikoku Rotary Guardian (TRG™). The TRG is an electrical meter that continuously monitors the condition of the bearings. For more information on the TRG see [Section 2.3.3](#).

The Teikoku Type-R (Plan 13-SE) sealless pump is a precision built unit that with proper operation and maintenance will provide years of trouble-free, leakproof service. The entire unit is mounted on a fabricated steel base cradle. Operation is unaffected by the mounting or operating position, eliminating the need for any costly alignment procedures.

Figure 1-1. Reverse Circulation Type-R (Plan 13-SE)



1.2 Stator Assembly

The stator assembly consists of a set of three-phase windings. Stator laminations are of low-silicon grade 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. The stator liner is, in effect, a cylindrical can placed in the stator bore and welded to the rear end bell and front end bell to hermetically seal off the windings from contact with the liquid being pumped.

Terminal leads from the windings are brought into an electrical terminal box. Motor lead wires are isolated from the users' conduit line by a leakproof terminal plate assembly mounted inside the terminal box. The design of the stator assembly in conjunction with the leakproof terminal plate assembly provides an advanced low probability true positive secondary containment.

1.3 Rotor Assembly

The rotor assembly is a squirrel cage induction rotor constructed and machined for use in the Teikoku Type-R (Plan 13-SE). It consists of a machined corrosion-resistant shaft, laminated core with cast aluminum bars and end rings, corrosion-resistant end covers, and a corrosion-resistant can.

The 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.

The impeller is keyed to the shaft and held in place with a bolt and lockwasher. The shaft is fitted with replaceable shaft sleeves and thrust collars. These parts are pinned or keyed to prevent rotation. Axial movement is restricted by the thrust collars contacting the face of the front and rear bearings.

1.4 Liquid Film Journal Bearings

The liquid film journal bearings for the Teikoku Type-R (Plan 13-SE) are carbon graphite as standard and are machined with special helix grooves through the bore to assure adequate liquid circulation at the journal area. Each liquid film journal bearing is manufactured to close tolerances for a high degree of concentricity and is held in a bearing housing by a retaining screw. Liquid film journal bearings are easily replaced by removing the retaining screw and sliding the bearing from its housing.

1.5 Thrust Collars and Shaft Sleeves

All Teikoku Type-R (Plan 13-SE) models are equipped with thrust collars, providing a replaceable surface against which axial loads can be carried during process upset conditions. The shaft is also fitted with replaceable shaft sleeves. Both the thrust collars and shaft sleeves are constructed of 316SS with a Stellite wear surface for long life. These parts are pinned or keyed to prevent rotation.

1.6 Cooling Flow

Flow paths of the Teikoku Type-R (Plan 13-SE) reverse circulation pumps are shown in [Figure 1-1](#). The circulating liquid is channeled into the motor section by holes drilled in the front bearing housing. A portion of the circulating liquid lubricates the front liquid film journal bearing and returns to the rear of the impeller. The remainder of the circulating liquid passes over the rotor cools the motor, lubricates the rear liquid film journal bearing and then exits the rear bearing housing returning to the vapor space of the suction tank via the reverse circulation line. The Teikoku Type-R (Plan 13-SE) reverse circulation design avoids the heated circulating liquid returning directly to the pump suction.

1.7 Automatic Thrust Balance

Based on hydraulic principles, Teikoku Type-R (Plan 13-SE) automatic thrust balance is accomplished by the pressure of the pumped liquid itself, operating in a balance chamber at the front and rear of the impeller.

When a change in load shifts 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.

2. Installation

2.1 Receipt Inspection

1. Visually inspect the shipping container for evidence of damage during shipment.
2. Check unit to see that suction, discharge, and any other connections are covered.
3. 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.
4. Check all nameplate data against shipping papers.
5. Verify receipt of the reverse circulation line restriction orifice.

2.1.1 Storage Note

In situations where a Teikoku Type-R (Plan 13-SE) 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, suction and discharge flange, and any other openings must be sealed to prevent moisture from entering the internals of the pump. Teikoku's long term storage procedures are available upon request.

2.2 Structural

The pump design and construction eliminates the necessity of aligning the pump and motor. The pump should be supported from the mountings provided. It should be mounted in such a way as to have its weight 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 liquid supply with a positive suction head. 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 liquid at the pump inlet. NPSH requirements at the design point are stated on the pump order data sheet.

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. C. Troubleshooting](#).

2.2.2 Mounting and Alignment

Base plate assemblies are offered on all models. Simply set the pump on a foundation strong enough to support its weight. There is no need to bolt down or grout a Teikoku Type-R (Plan 13-SE).

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

2.2.3 Piping Data

Observe the standards of the Hydraulic Institute and International Institute of Ammonia Refrigeration when sizing and making up suction and discharge piping. Follow these procedures:

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 design and size the suction system to minimize pressure losses and to be sure that the pump will not be starved for liquid during operation. NPSH problems are a result of improper suction systems.

The suction pipe 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 drop.

If elbows, tees or valves must be used, locate them from 5 to 10 pipe diameters upstream from suction. When reducing to pump suction port diameter, use eccentric reducers with flat side on top to avoid air pockets.

On most Type R (Plane 13-SE) pumps there is a restriction orifice that must be installed on the reverse circulation flange of the rear bearing housing.

The design and installation of the reverse circulation line must be in accordance with reverse piping layout drawing shown in [Appx. B. Reverse Circulation \(4N-7653\)](#).

When it is necessary to connect two or more pumps to the same suction and discharge lines, 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.

A vent line back to the suction vessel is required in the discharge pipe. The connection for the vent line in the discharge pipe must be between the pump discharge flange and the first block valve and/or check valve. The vent line can also be used as the minimum flow line.

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 one or two size larger diameter pipe.

If the pump is to discharge into a closed system, an elevated tank or if there are multiple pumps connected together, place a check valve in the discharge line close to the pump.

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

2.3.1 General

Except where indicated, all Teikoku Type-R (Plan 13-SE) are started with full line voltage. Refer to [Section 3.2.3](#) for checking direction of rotation. Also see [Figure 2-2](#) for proper wiring connections.

2.3.2 Starting Equipment

Motor starters (normally not supplied with Teikoku Type-R (Plan 13-SE)) should be sized to handle the load required. The full load amps and start KVA data is listed on the nameplate.

The thermal overload protective devices in the starters should be sized for the amperage shown on the Teikoku Type-R (Plan 13-SE) nameplate. Do not size thermal overload protective devices in excess of 10% of full load amp rating. In order to provide complete protection for Teikoku Type-R (Plan 13-SE) 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 thermal overload protective devices provide adequate protection for Teikoku Type-R (Plan 13-SE) 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 if the motor is subject to locked rotor or overload conditions.

2.3.3 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. 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 indication of the TRG meter is not constant because it is influenced by the operating load. Initial indication of up to 0.4 should be allowed.

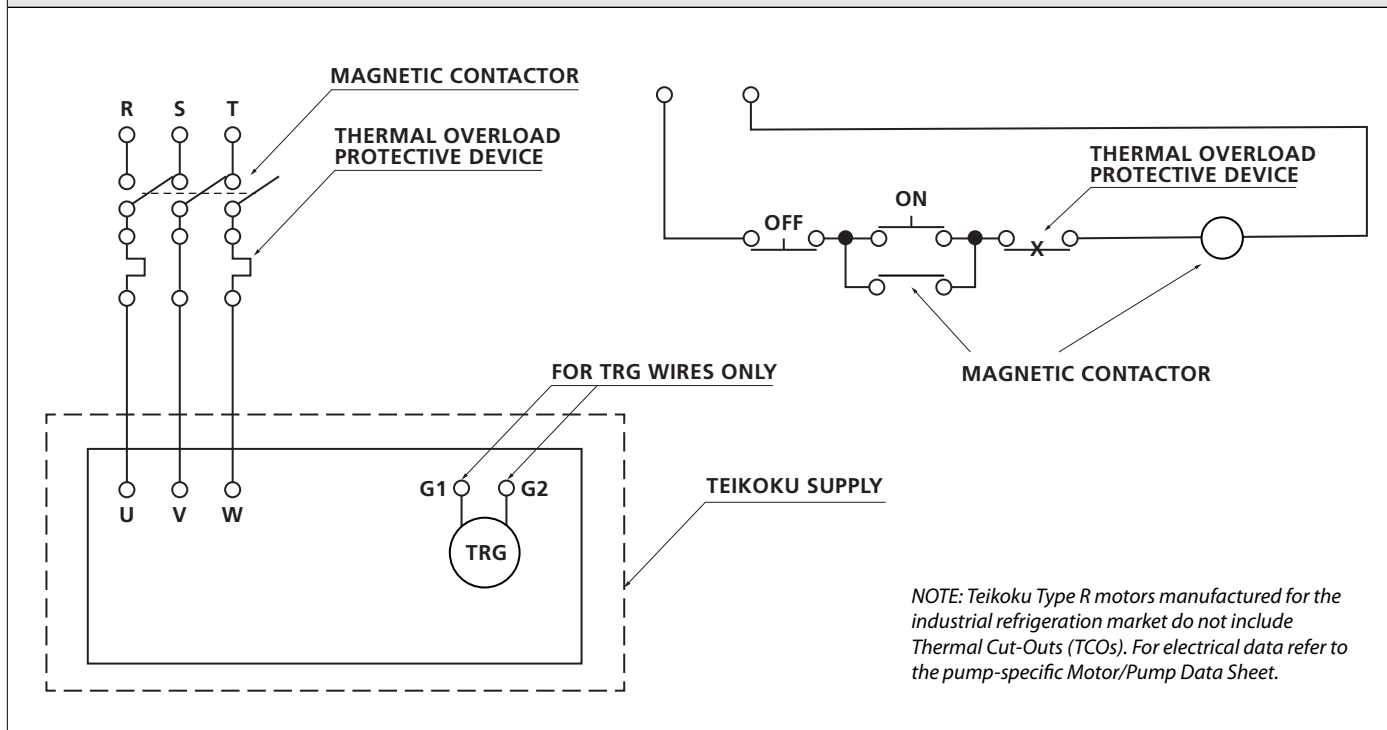
Keeping records of the TRG meter reading in conjunction with motor amp readings will provide a good indication of when the pump will require maintenance.

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 or 1-Volt	reverse rotation	change power cable connection	Green	Good	No action
Yellow to Red	phase failure	check connection of cables	Yellow or voltage increase of > 0.3 V from initial indication	Bearings worn to caution level	Plan routine maintenance
Green	normal	connection is correct	Red or voltage increased of > 0.5 V from initial indication	Immediate maintenance required	Shutdown immediately and replace worn parts
 Hazard! Do not operate if TRG meter condition is RED.					

Figure 2-1. Teikoku Type-R (Plan 13-SE) TRG



Figure 2-2. Teikoku Type-R (Plan 13-SE) 460 Volt, 3-Phase



3. Operation

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.

3.2 Preparation and Trial Operation

The following procedures are recommended for protection of canned motor pumps in industrial refrigeration 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 provided 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 on 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. Open reverse circulation line valve 100%
4. Open discharge pipe vent valve 100%
5. Open minimum flow valve (if required)
6. Wait until frost or condensation forms over the entire pump and motor



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!

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.
5. Check indication of TRG meter. If TRG meter is pegged full scale red, the pump is rotating in the reverse direction. See [Section 2.3.3](#) and [Table 2-1](#).
6. If direction of rotation is not correct, swap any two of the electrical supply leads and repeat rotation check.
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.

3.2.3.b Rotation Check using Hand-held TRC-1 Indicator

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. See [Appx. F. Decontamination Form](#)

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.
5. Check indication of TRC-1 hand-held rotation indicator. See [Figure 3-1](#).
6. If direction of rotation is not correct, swap any two of the electrical supply leads and repeat rotation check.
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.

3.2.3.c Rotation Check using Pressure & Amps

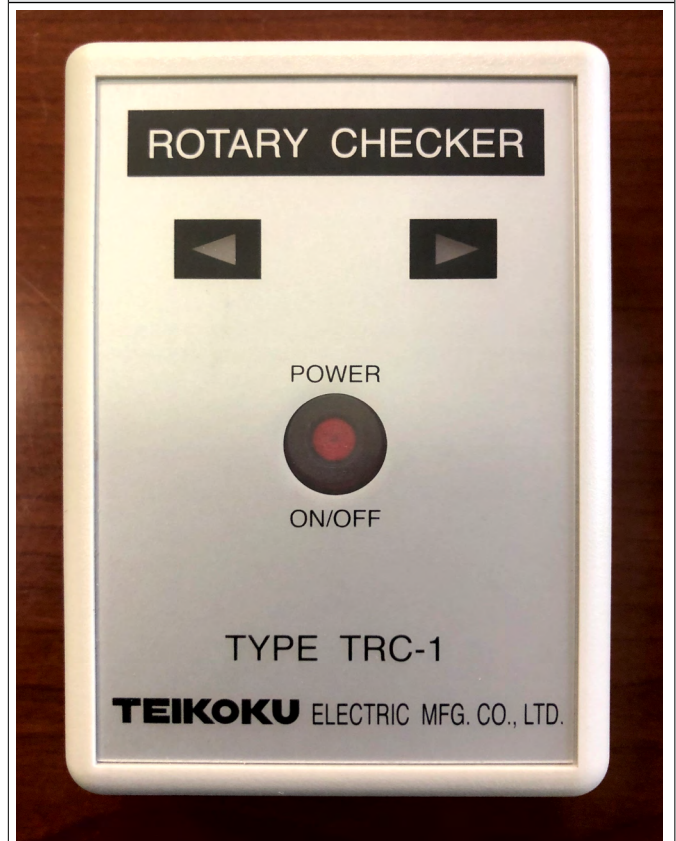
1. Open suction valve 100%.
2. Set discharge valve 10% to 20% open.
3. Check that valves in reverse circulation piping are open. Verify that the correct restriction orifice is installed in the reverse circulation line.
4. Switch on the pump for 3 to 5 seconds.
5. Note the motor amps and the discharge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

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.

Figure 3-1. Teikoku TRC Rotation Indicator



3.3 Starting Procedure



Caution!

Do not start or operate pump unless fully primed and liquid full.



Caution!

Do not continuously cavitate the pump.



Attention!

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



Attention!

Wait a minimum of five minutes between starts.

After priming, venting, 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. Set the valve in the reverse circulation line valve to 100% open.
4. Set the valve in the discharge vent line to 100% open.
5. Set the valve in the by-pass line at required percent. To accurately set the valve position in the by-pass line for the correct minimum flow amount, the valve in the discharge line must be fully closed.
6. Start the pump. Pump should operate with very low noise and vibrations. Excessive or abnormal noise or vibrations should be corrected immediately.
7. When the pump is running at full speed, slowly open the valve in the discharge line to the desired setting.
8. Once pump is operational, check the reading of the TRG meter. Record initial reading for comparison to future readings. Check indication of TRG meter. See [Table 2-1](#).
9. If the suction and discharge lines are completely filled with system liquid and adequate suction head is available, the pump can be started without closing the discharge valve. During any start up sequence, caution must be exercised not to exceed full load ampere rating indicated on the nameplate.
10. 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!

If the pump appears to be air bound 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 [Section 2.3.3](#) may be used to determine bearing changing intervals.



Hazard!

Do not operate if TRG meter condition 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 name tag.

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 a marked reduction in capacity. The discharge pressure gauge will show large fluctuations if this occurs.

If any abnormal noise or vibration is observed, stop the pump and check for possible causes, see [Appx. C. Troubleshooting](#)

3.5 Shutdown Procedure

Shutdown as follows:

1. Close the valve in the discharge line.



Attention!

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

2. Stop the pump (de-energize the motor).
3. Close reverse circulation, by-pass and suction valves if pump is to be removed from service.



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

Size	Description
Metric socket wrenches	For pump casing, rear bearing housing bolts, rear shaft sleeve retaining bolt, and impeller retaining bolt.
Metric hex wrenches	For bearing retaining screws. For front bearing housing retaining bolts.
.200" or greater travel dial indicator	To measure endplay.
Dial calipers	To measure bearing wear.
Feeler gauges	To measure "g" gap.
Torque wrench	To measure bolt tightness.
Channel-lock pliers	To bend up tabs on lock washers.

4.2 Disassembly



Caution!

Observe and adhere to the end user specific lock out tag out procedures.

1. Fully close valves in discharge, suction, reverse circulation and utility piping.
2. Disconnect the power cables from the connection box prior to disassembly.



Hazard!

Safety hazard to personnel will exist if power cables are not disconnected.

3. Drain pump per end user specific procedures.
4. Since piping loads may exist, insert bracing under piping.
5. Remove discharge, suction and reverse circulation flange bolting.



Hazard!

Always assume that there is liquid left in the pump.

6. Remove anchor bolting in order to slide pump out of piping.
7. Remove casing bolts and slide casing off. Be careful not to allow the casing to bind to or drop onto the impeller and inducer. Be careful not to spill any remaining liquid that may have been trapped in casing. Remove casing gasket.
8. Measure and record the end play and the "g" gap before further disassembly. See [Figure 4-4](#).
9. To remove impeller, extend tabs of lock washer and remove impeller bolt, Slide impeller and, if supplied, inducer off rotor shaft. Be careful of small parts that can be lost.
10. Remove impeller key.

11. Remove socket head cap screws and remove front bearing housing from stator assembly.



Hazard!

Exercise care while removing this housing because of liquids which may be contained in the stator assembly.

12. Remove impeller adjusting washer(s). Record quantity and thickness. The adjusting washer(s) may come off the shaft with the front bearing housing.
13. Remove rear bearing housing bolts and remove rear bearing housing from stator assembly. Remove rear bearing housing gasket.



Hazard!

Exercise care while removing this housing because of liquids which may be contained in the stator assembly.

14. Remove rotor assembly. Place on a clean cloth to avoid damage. During the removal of the rotor, take care in handling to prevent damage to the rotor or stator because the rotor will drop once the armature clears the stator assembly and the rotor shaft may hit the stator liner if not properly supported.
15. Remove front shaft sleeve and front thrust collar. Remove anti-rotation pin/key.



Caution!

Do not forcibly remove shaft sleeve. If shaft sleeve does not slide off easily it may be required to machine or cut the shaft sleeve off the rotor shaft.

16. To remove rear shaft sleeve and thrust collar, bend tabs up on lock washer and unscrew bolt. This bolt has left hand threads.
17. Remove rear shaft sleeve and rear thrust collar. Remove anti-rotation pin/key.
18. To remove bearing, remove set screw, slide out bearing, and remove flat washer.
19. Remove bearing adjusting washer(s) from rear bearing housing. Note quantity and measure thickness.

4.3 Inspection

4.3.1 Bearings

Check the following points:

1. Thrust face for scratches and chips. Refer to [Figure 4-3 \(L\)](#), for excess wear on thrust surface. (Check this dimension after bearing has been removed.)
2. Wear inside of bearing bore. Refer to [Figure 4-3 \(A-B\)](#).

4.3.2 Shaft Sleeves and Thrust Collars

The rotor assembly shaft sleeves and thrust surfaces should also be visually inspected at the bearing contact area for general appearance and uniform wear.

Excessive undercutting, pitting, or scoring is cause for replacement. Check the following points:

1. Corrosion
2. Contact marks and wear.

4.3.3 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. Check rotor assembly shafts for straightness.

4.3.4 Stator Assembly Inspection

The complete stator assembly should be visually inspected for cracks, breaks, pitting, or corrosion of the stator liner which may destroy the effectiveness of the barrier. Inspect the inside of the electrical junction box for corrosion and moisture. Teikoku recommends performing a megger and resistance check on the motor winding.

4.3.5 General Inspection

1. Inspect the threads on both ends of the rotor shaft to ensure they are not damaged. Teikoku Type-R (Plan 13-SE) have right-hand threads, except the rear rotor bolt which has left-hand threads.
2. Be sure that all mating faces are free of nicks and burrs so that they will have a smooth face ensuring a good seal. Clean off any trace of old gasket material.
3. Make sure all parts are clean. Inaccessible area may be cleaned with a small brush or pointed tool.
4. The impeller, casing, and front bearing housing should be inspected for wear. If excessive grooving or scoring of the rings areas, hubs, and bores is evident, these components must be repaired or replaced.
5. On the rear bearing housing, inspect the ports for reverse circulation line to ensure that the ports are clear and free of obstructions.

4.4 Reassembly

1. Clean and dry all parts. Reassemble in the reverse manner of disassembly.
2. Install adjusting washer(s) into rear bearing housing. Quantity and thickness of adjusting washers is as required for proper rotor end play.



Attention!

The front bearing has only spiral grooves, the rear bearing has spiral and straight grooves. [Figure 4-1](#) and [Figure 4-2](#).

3. Insert bearing with flat washer into front and rear bearing housings. Position flat washer side of bearing in line with set screw hole. While holding bearing down, tighten set screw.



Caution!

Do not over-tighten set screw as damage to bearing may occur.

4. Install anti-rotation pin/key. Slide on rear thrust collar, verifying that the thrust collar is installed correctly. The coated side of the thrust collar should be positioned facing outboard with the chamfer side facing inboard. Slide on the rear shaft sleeve, ensuring that the shaft sleeve is tight against the thrust collar and is engaged in the anti-rotational key or pin. Install the flat washer, lock washer, and lock bolt, ensuring that the lock washer tab is engaged in the slot in the shaft sleeve. Torque lock bolt per [Table 4-4](#). This bolt has left hand threads. Bend up tabs on lock washer.
5. Install anti-rotation pin/key. Slide on front thrust collar, verifying that the thrust collar is installed correctly. The coated side of the thrust collar should be positioned facing outboard with the chamfer side facing inboard. Slide on the front shaft sleeve ensuring that the shaft sleeve is tight against the thrust collar and is engaged in the anti-rotational key or pin. Slide assembled rotor into stator with rear end of rotor extending out of the stator.
6. Install the rear stator gasket. Slide the rear bearing housing onto the rotor and slide the rear bearing housing and rotor into the stator. Take care to tighten bolting evenly using a star or cross pattern. Torque bolts per [Table 4-4](#).
7. Slide front bearing housing onto rotor and into stator. Take care to tighten bolting evenly. Ensure that the shaft sleeve is tight against the thrust collar and is engaged in the anti-rotational key or pin. Verify that the rotating assembly rotates freely by hand with no binding or rubs.
8. Install adjusting washers onto rotor shaft. Quantity and thickness is as required for proper "g" gap.
9. Install impeller key.
10. Slide impeller and inducer, if required, onto rotor shaft, install the flat washer, lock washer and lock bolt ensuring that the lock washer tab is engaged in the impeller key slot. Check rotor assembly end play. End play should be within the range indicated in [Table 4-3](#). If the rotor assembly does not fall within this range, remove rear bearing housing, remove rear bearing and increase or decrease the adjusting washer quantity and thickness as required.
11. Measure the "g" gap by pulling impeller forward shown in [Figure 4-4](#). The "g" gap should be within indicated ranges shown in [Table 4-3](#). If gap is not within specified range, use adjusting washers behind impeller to make adjustments.
12. Make sure impeller bolt is tight (see [Table 4-4](#) for correct torque values) and lock washer locking tabs are bent over.
13. Assembled pump should rotate freely by hand with no metal to metal contact.

Figure 4-1. Front Bearing – Only Spiral Grooves

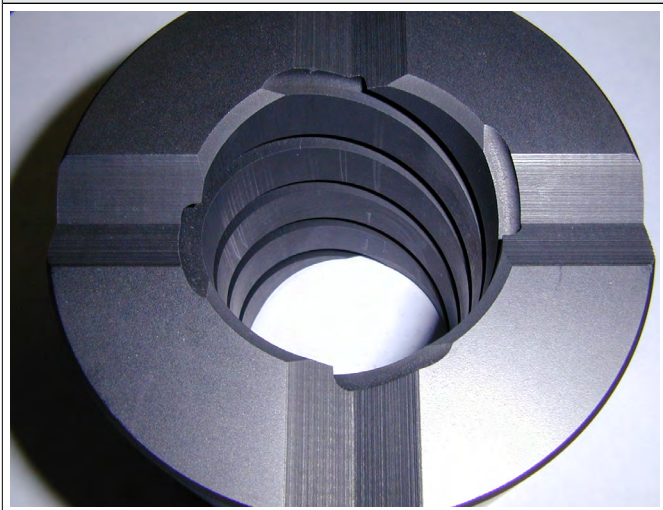
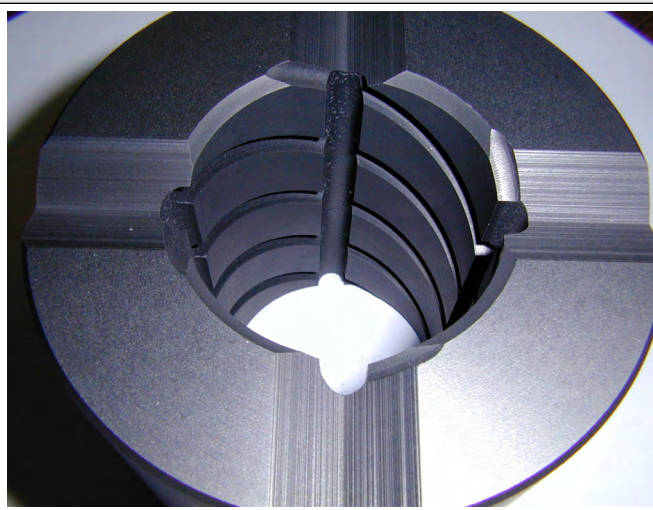


Figure 4-2. Rear Bearing – Spiral and Straight Grooves



14. Install pump casing gasket. Slide pump back into casing and tighten all bolts. Add new Teflon tape to plugs where needed. Torque bolts per [Table 4-4](#).

4.5 Service Policy

Any Teikoku USA product, damaged or inoperative for any reason, can be repaired at the Teikoku service centers at minimal cost and returned to the customer as quickly as possible. Refer to the Pump Repair Receipt Policy in the Appendix.



Caution!

Before returning units to the factory for examination or repair, clean and decontaminate the pump and/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 USA Decontamination Form. The Decontamination Form and the Pump Repair Receipt Policy are available from the factory, from the Teikoku USA field representatives, and from the Appendix of this instruction manual.

4.6 Spare Parts

Teikoku USA recommends to have on hand at least one complete repair kit for each pump model. The repair kit includes the bearings, sleeves, thrust collars, gaskets and lock washers. When ordering spare parts, provide the serial number and model number; then give the part name which is noted on the sectional drawing, [Appx. D. Sectional View \(6A-8901\)](#). When ordering an impeller, include the diameter, which can be noted from the pump order acknowledgment or from the pump nameplate.

Figure 4-3. Bearing Wear Limits

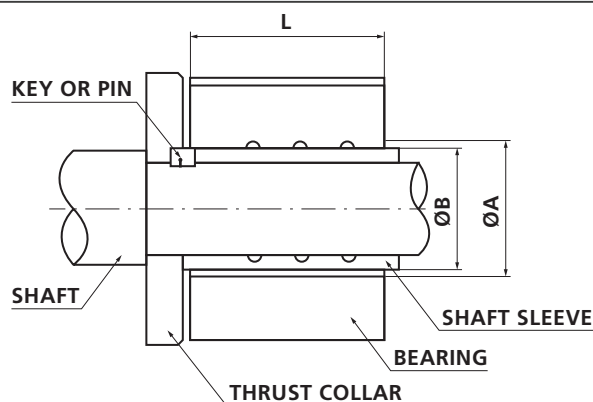


Figure 4-4. "g" Gap

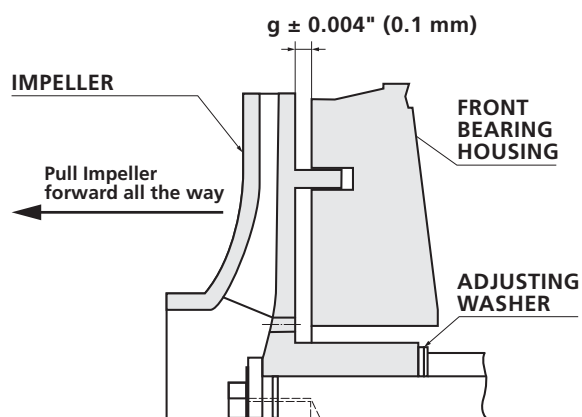


Figure 4-5. Type-R (Plan 13-SE) Model Number Identification Code Example

R42-**316**F4AM-0506**T**1-E

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MOTOR FRAME IMPELLER SIZE

Table 4-1. Bearing Wear Limit

Motor Frame Number*	øA – øB		L	
	Inch	mm	Inch	mm
119	0.012	0.3	1.746	44.2
215, 216, 217	0.016	0.4	1.937	49.2
316, 317			2.331	59.2
416, 417			2.724	69.2
426, 516, 518	0.020	0.5	3.079	78.2
526, 529			4.449	113

NOTE: For F, H, N, C, and U Insulations (Standard Carbon Bearings)

* See [Figure 4-5](#)

Table 4-2. Adjusting Value of Gap “g”

Motor Frame Number*	Impeller Size	“g” gap (rotor pulled)	
		Inch	mm
119	R	.154 to .161	3.9 to 4.1
215, 216, 217	S		
316, 317	TS (S)	.161 to .169	4.1 to 4.3
	T		
416, 417	T	.173 to .181	4.4 to 4.6
426, 516, 518	U	.193 to .201	4.9 to 5.1
526, 529	U		
	V	.232 to .240	5.9 to 6.1
	W	.248 to .256	6.3 to 6.5

* See [Figure 4-5](#)

Table 4-3. End Play

Motor Frame Number*	End-Play	
	Inch	mm
119	.039 to .063	1.0 to 1.6
215, 216, 217	.043 to .067	1.1 to 1.7
316, 317		
416, 417	.055 to .079	1.4 to 2.0
426, 516, 518	.067 to .091	1.7 to 2.3
526, 529	.071 to .094	1.8 to 2.4

* See [Figure 4-5](#)

Table 4-4. Tightening Torques

Bolt Size	Torque (ft.lb.)	Bolt Size	Torque (ft.lb.)
Rotor (304SS, 304LSS, 316SS, 316LSS)			
Note: Rear rotor bolts have left-hand threads			
M10	13	M18	73
M12	22	M20	109
M14	34	M22	145
M16	55	M24	181
Front Bearing Housing (304SS, 304LSS, 316SS, 316LSS)			
M6	3.0	M12	22
M8	6.0	M14	34
M10	13	M16	55
Set Screw (316SS, 316LSS)			
M6	1.3	M8	4.4
Pump Casing for Flat Gasket (304SS)			
M6	3.0	M12	22
M8	6.0	M14	34
M10	13	M16	55
Pump Casing for Spiral Wound Gasket (SCM435)			
M10	42	M14	116
M12	73	M16	181

Table 4-5. Torque Values for Motor Terminal Connections – Terminal Box and Connection Stud Size

Terminal Box Size*	Connection Stud Size**		Torque Values	
	U, V, W	X, Y, Z	ft.lb	Nm
Small (S)	M6	—	2.9	4
Medium (M)	M8	—	7.4	10
	M10	—	11	15
Large (L)	M12	M12	21	29

* Refer to Table 4.6

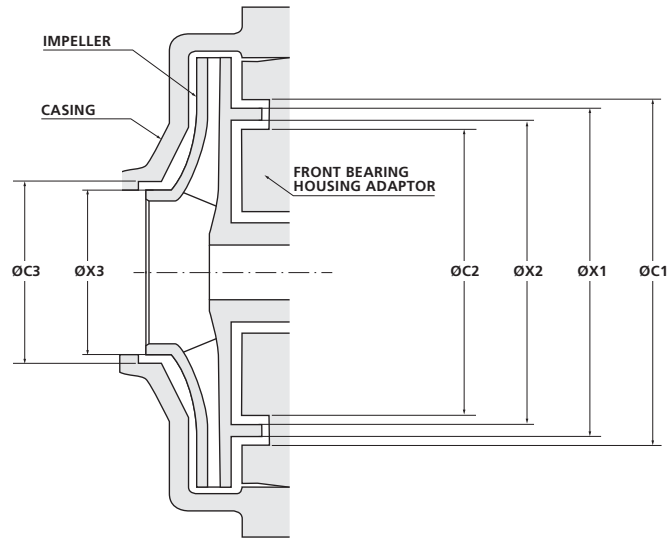
** The number after the “M” represents the nominal threads OD (mm)

Table 4-6. Motor Frame and Terminal Box Size

Motor Frame Number*	Terminal Box Size
118, 119	S
215, 216, 217	
315, 316, 317, 325, 326	
416, 425, 426	
417	M
515, 516, 517, 525, 526	
625, 626	
518, 615, 616, 617	L
715, 716, 717, 718	
725, 726, 727	

* See [Figure 4-5](#)

Table 4-7. Pump Ring Clearance (Standard Horizontal Pump)



Casing Size	C1 – X1		X2 – C2		C3 – X3—	
	Inch	mm	Inch	mm	Inch	mm
0204 R	0.030 - 0.034	0.78 - 0.88	0.030 - 0.042	0.78 - 1.08	0.028 - 0.032	0.70 - 0.80
0204 S						
0204 T						
0405 R	0.030 - 0.034	0.78 - 0.88	0.030 - 0.042	0.78 - 1.08	0.028 - 0.032	0.70 - 0.80
0405 S						
0405 T						
0405 U	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22		
0408 S	0.032 - 0.038	0.84 - 0.96	0.032 - 0.046	0.84 - 1.16	0.028 - 0.032	0.70 - 0.80
0408 T						
0506 R	0.030 - 0.034	0.78 - 0.88	0.030 - 0.042	0.78 - 1.08	0.028 - 0.032	0.70 - 0.80
0506 S	0.032 - 0.038	0.84 - 0.96	0.032 - 0.046	0.84 - 1.16		
0506 T						
0506 U	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22		
0508 S	0.032 - 0.038	0.84 - 0.96	0.032 - 0.046	0.84 - 1.16	0.028 - 0.032	0.70 - 0.80
0508 T	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22	0.030 - 0.034	0.76 - 0.86
0510 T	0.032 - 0.038	0.84 - 0.96	0.032 - 0.046	0.84 - 1.16	0.030 - 0.034	0.76 - 0.86
0608 R	0.030 - 0.034	0.78 - 0.88	0.030 - 0.042	0.78 - 1.08	0.030 - 0.034	0.76 - 0.86
0608 S	0.032 - 0.038	0.84 - 0.96	0.032 - 0.046	0.84 - 1.16		
0608 T	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22		
0608 U						
0810 S	0.032 - 0.038	0.84 - 0.96	0.032 - 0.046	0.84 - 1.16	0.030 - 0.034	0.76 - 0.86
0810 T	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22		
0810 U						
1012 T	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22	0.032 - 0.036	0.80 - 0.92
1012 U						
1012 V	0.036 - 0.044	0.94 - 1.10	0.036 - 0.052	0.94 - 1.30		
1015 T	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22	0.032 - 0.036	0.80 - 0.92
1015 U						
1015 V	0.036 - 0.044	0.94 - 1.10	0.036 - 0.052	0.94 - 1.30		
1215 U	0.034 - 0.040	0.88 - 1.02	0.034 - 0.048	0.88 - 1.22	0.032 - 0.036	0.40 - 0.46
1215 V	0.036 - 0.044	0.94 - 1.10	0.036 - 0.052	0.94 - 1.30		
1520 W	0.036 - 0.044	0.94 - 1.10	0.036 - 0.052	0.94 - 1.30	0.034 - 0.040	0.86 - 1.00

NOTE: All clearances are values in diameter.

Appendix

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A. Quick Start Guide

Teikoku Type-R (Plan 13-SE) Refrigeration Pump

Prior to Priming the Pump



Attention!

Do not operate the pump if the TRG bearing wear monitor reading is in the red. ***Doing so will void the warranty.***

1. Verify that the vessel contains enough liquid as to not cause cavitation or dry running
2. Verify the restriction orifice in the reverse circulation line is installed between the flange at the rear of the motor and the reverse circulation piping
3. Verify the reverse circulation piping is per the Teikoku recommendations as shown in Appendix B.
4. Allow compressor to pull down system temperature to normal operating temperature

Priming and Venting

1. Inspect installation
2. Open suction valve 100%
3. Open discharge valve 100%
4. Open reverse circulation valve 100%
5. Set discharge line vent valve to 100% open
6. * Open minimum flow valve 100% (If required)
7. Let pump fill with liquid until a frost layer develops on the motor body

Rotation Check with Type-M TRG Meter AM-45

1. Pump must be primed
2. Set suction valve to 100% open
3. Set discharge valve to 20% open
4. Set reverse circulation valve to 100% open
5. * Set minimum flow valve to required % open (if required)
6. Set discharge line vent valve to 100% open
7. Start pump for 3 to 5 seconds and observe TRG
8. If TRG is in the GREEN the rotation is correct
9. If TRG is pegged RED the rotation is reverse, swap two leads and repeat rotation check

Rotation Check

with TRC-1 Hand-Held Rotation Checker

Use TRC-1 on Type-L TRG Meter A-45 C

1. Pump must be primed
2. Set suction valve to 100% open
3. Set discharge valve to 20% open
4. Set reverse circulation valve to 100% open
5. Set discharge line vent valve to 100% open
6. * Set minimum flow valve to required % open (if required)
7. Place TRC-1 on motor as per instructions in [Appx. F. Decontamination Form](#).
8. Start pump for 3 to 5 seconds and observe TRC-1
9. The illuminated arrow on the TRC-1 indicates the direction of rotation
10. If the TRC-1 indicates the incorrect direction of rotation, swap two leads and repeat rotation check

Standard Start up

1. Pump must be primed and rotation checked
2. Open suction valve 100%
3. Set discharge valve to 20% open
4. Set reverse circulation valve to 100% open
5. Set discharge line vent valve to 100% open
6. * Set minimum flow valve to required % open (if required)
7. Start pump
8. Gradually open discharge valve until specified capacity is reached

Check Points

- TRG meter indicates low GREEN – check regularly
- Report when TRG meter goes into the yellow zone
- Verify motor amps are correct
- Verify differential pressure is correct
- Verify pump is operating without excessive or abnormal noise or vibrations

B. Reverse Circulation (4N-7653)

Teikoku Type-R (Plan 13-SE) Refrigeration Pump

These instructions describe the recommended method for installation of the reverse circulation piping on Teikoku Type-R (Plan 13-SE) pumps, which are specifically designed to handle highly volatile fluids. These instructions also include recommendations for the suction pipe and the bypass pipe.

1. Reverse Circulation Piping

The purpose of these recommendations is to vent any vapors that form inside the reverse circulation pipe. Trapped vapors in the reverse circulation line will cause the flow through the line to stop. In the event that the flow stops, the pump will be damaged from liquid vaporization and/or overheating. Following these recommendations will allow both the vapor and liquid to flow freely back to the suction tank.

- This line must be connected to the vapor zone in the suction tank.
- Never install a check valve on this line.
- This line must be continuously rising to the suction tank.
- This line must never be down-slope at any point, as this will create vapor traps.

- The Teikoku supplied reverse circulation line orifice must be installed in this line. Controlling the required reverse circulation flow rate using a flow meter and a control valve is an option.
- Install a block valve in this line. This block valve must be 100% open at all times.
- To prevent vapor traps, use of a full port ball type valve is recommended.
- The orifice plate must be installed in vertical line.
- This line must be individual for each pump. Never combine these lines.
- Never connect this line to the suction, discharge or minimum flow lines.
- The total head of this line (HR) must never exceed the value specified on the data sheet of the pump.

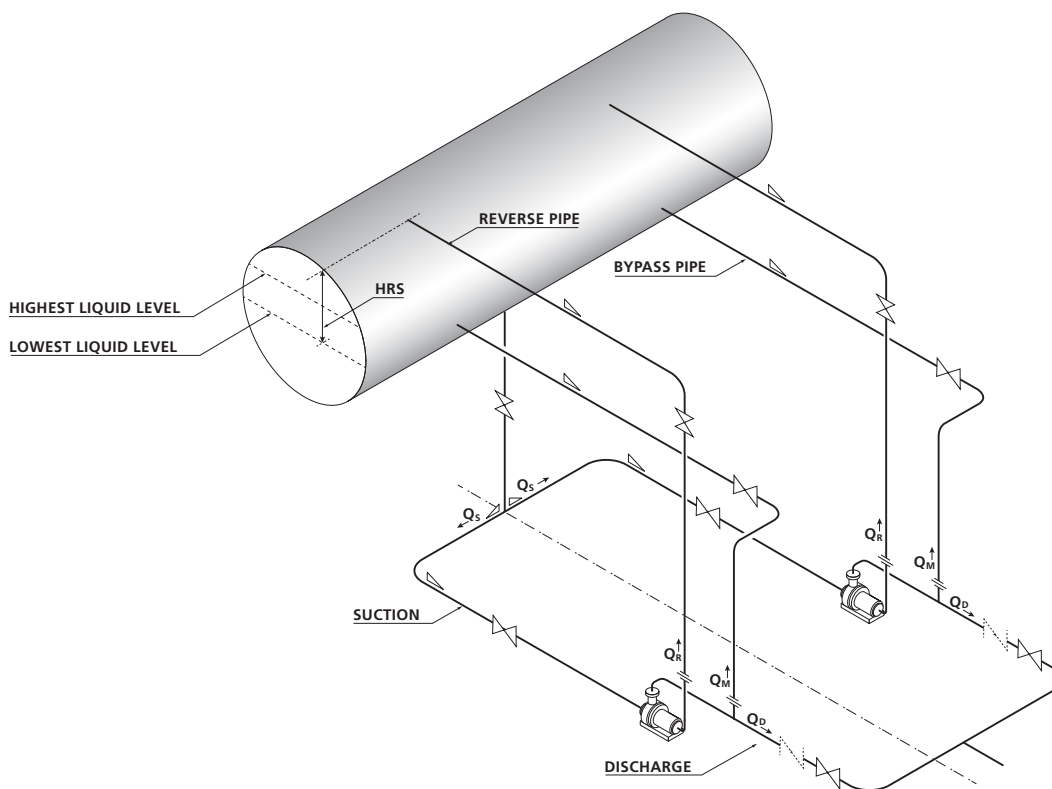
2. Suction Pipe

- Suction pipe shall be constantly falling until it reaches the pump suction.
- If any reducer is installed in the suction line, the reducer must be eccentric and must be installed with the flat side on top.

3. Bypass Pipe for Venting and Minimum Flow

- This line must be continuously rising back up to the suction tank.
- If incorporated, the orifice plate shall be installed in vertical line.
- Never combine these lines.
- A block valve shall be installed in the bypass line.

Figure B-1. Reverse Circulation Piping



C. Troubleshooting

Teikoku Type-R (Plan 13-SE) Refrigeration Pump

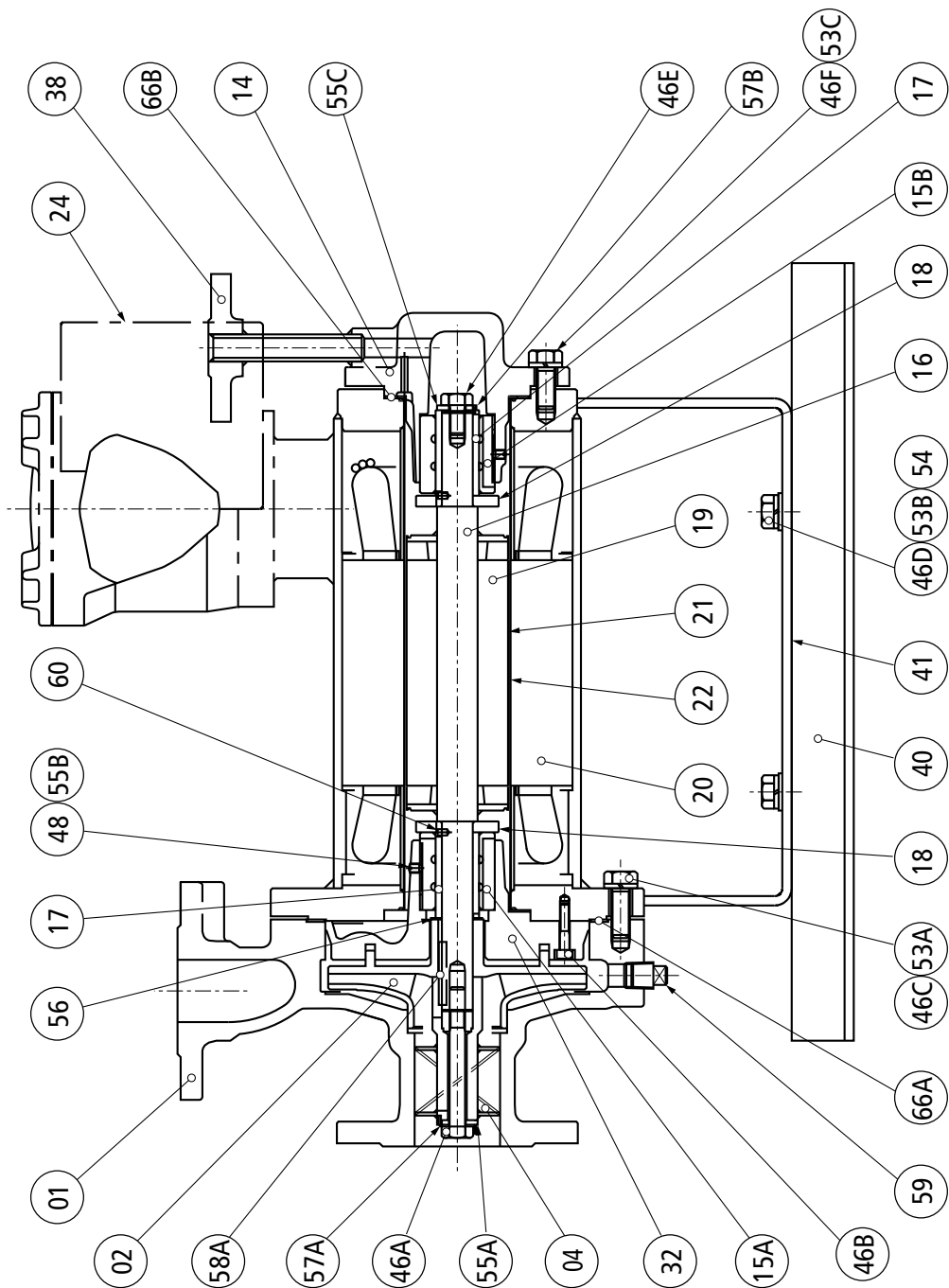
Table C-1. Troubleshooting

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
	Wrong direction of rotation.	Reverse any two motor leads.
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).
	Rotating element rubbing stator liner.	Replace bearings (see Section 4) as a result of excessive wear or check for presence of foreign material in rotor chamber
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

D. Sectional View (6A-8901)

Figure D-1. Sectional View: Teikoku Type-R (Plan 13-5E) Refrigeration Pump

01	Casing
02	Impeller
04	Inducer
14	R.B.Housing
15A	Bearing B
15B	Bearing A
16	Shaft
17	Shaft Sleeve
18	Thrust Collar
19	Rotor Assembly
20	Stator Assembly
21	Rotor Can
22	Stator Can
24	Terminal Box Ass'y
32	F.B. Housing
38	Reverse Pipe
40	Base
41	Holder
46A	Bolt
46B	Bolt
46C	Bolt
46D	Bolt
46E	Bolt
46F	Bolt
48	Set Screw
53A	Spring Washer
53B	Spring Washer
53C	Spring Washer
54	Plain Washer
55A	Washer
55B	Washer
55C	Washer
56	Adjusting Washer
57A	Lock Washer
57B	Lock Washer
58A	Key
59	Plug
60	Pin
66A	Gasket
66B	Gasket



E. TRC-1 Information Sheet



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.

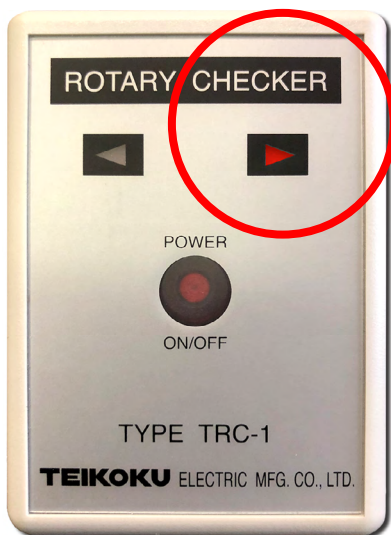
- **Place TRC-1 on an operating motor as illustrated below.**
- **The arrow that lights up indicates the direction of rotation.**
- **There is an arrow on the pump case that indicates the correct direction of rotation.**

Specifications:

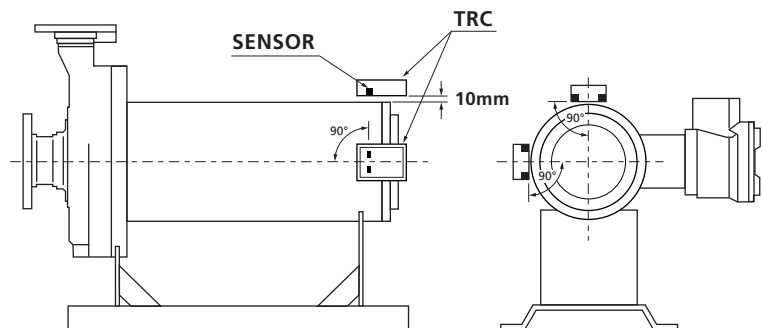
Size: 2.6"W x 3.6"L x 1.1" H (66.mm x 92mm x 28mm)

External Case : ABS plastic

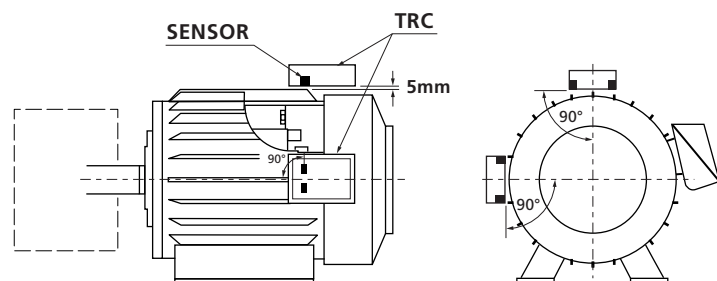
Battery operated : 9V



TEIKOKU CANNED MOTOR PUMP



THREE-PHASE INDUCTION MOTOR



F. Decontamination Form

REV. 4-17-20



DECONTAMINATION CERTIFICATION AND FLUSHING PROCEDURE

CUSTOMER: _____
ADDRESS: _____
CONTACT: _____

DATE: _____
PHONE: _____
EMAIL: _____
RMA #: _____

Please complete the items below. By providing this information, you 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 | ☐ Vibration | ☐ Motor Burnout |
| ☐ Loses Prime After Starting | ☐ Bearing Failure | ☐ Other: _____ |
| ☐ Axial Wear Due To Thrust | ☐ Insufficient Pressure | ☐ Bearing Monitor Reading |

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:

- | | |
|--|--|
| ☐ Pump is new/unused and never subjected to process fluid. | ☐ Both the complete pump and the stator assembly have been flushed by following the applicable steps in section A, plus section B, C or D of the Teikoku USA Flushing Procedure on pages 2 and 3 of this form. The motor must be rewound. |
| ☐ The pump has been flushed by following the applicable steps in section A of the Teikoku USA Flushing Procedure on page 2 of this form. No liner rupture is suspected. | |

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



FLUSHING PROCEDURES FOR TEIKOKU USA PRODUCTS

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

A. COMPLETE PUMPS AND PARTS

Pumps and parts that are returned for service are to be thoroughly decontaminated and free of process and flushing fluids.

Some pumps handle a fluid that may solidify and cannot be removed by flushing the pump. These pumps should be fully disassembled for removal of all traces of fluids to avoid solidification of the fluids in the pump.

SUGGETIONS FOR DECONTAMINATION

1. 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.
2. Introduce an appropriate neutralizing fluid to the rear of the pump for a sufficient time to allow for the removal of all process fluid. The method of fluid insertion depends on the pump design. Access may be through a circulation line, vent, drain or flush connection. In some cases, the rear bearing housing needs to be removed to thoroughly flush the pump internals.

Remove as much of the neutralizing fluid as possible using compressed air or inert gas.

For pumps with shaft sleeves, complete disassembly will be required to remove trapped fluid.

Flush all auxiliary tubing, piping and equipment such as heat exchangers.

For any questions on decontamination, contact your Teikoku service representative.

See sections "B" through "D" for stator assembly decontamination requirements where a liner breach is suspected. Pumps with the TRG bearing wear monitor will have a wear meter visible on the pump terminal box.

B. G series without TRG 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.

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.

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.

Remove as much of the neutralizing fluid as possible by purging the stator cavity with compressed air or inert gas for 3 - 5 minutes.

If the connection box is to be returned, assure that all components have been decontaminated.



C. NC-series stator assembly without TRG

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.

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 the opposite end of the stator.

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 end. Flush the stator cavity for a sufficient time to allow for the removal of all process fluid.

Remove as much of the neutralizing fluid as possible by purging the stator cavity with compressed air or inert gas for 3 - 5 minutes.

If the connection box is to be returned, assure that all components have been decontaminated.

D. For all Teikoku pumps, LE stators, G and NC stators with TRG.

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.

There might be a case in which pressure is released when terminal box cover or terminal plate is removed. Take the necessary precautions and follow Teikoku's terminal box removal procedure, that is available upon request. With the terminal box up, remove the cover and the terminal plate. Drill a hole through the stator liner on the opposite end of the stator.

Position the stator assembly with the rear end bell up and introduce an appropriate neutralizing fluid through the junction box port. The fluid will exit through the drilled hole in the opposite end. Flush the stator cavity for a sufficient time to allow for the removal of all process fluid. After washing is completed, drain all the fluid.

Remove as much of the neutralizing fluid as possible by purging the stator with compressed air or inert gas for 3 – 5 minutes. If the terminal box and terminal plate are to be returned, assure that all components have been decontaminated.

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



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