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## Internal Gear Pump

Model: TRP

TRP-e

### **Warning**

Do not carry out operation, inspection or maintenance of the pump until you read this manual and understand the content.

Keep this manual carefully at hand so that it can be consulted at anytime when operating, inspecting or maintaining the pump.

For contractors who carry out equipment work:

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Please be sure to deliver this manual to the customer who will operate, inspect or maintain the pump.

## Limited warranties

1. In the event of a failure or breakage under proper use of the product during the warranty period, equipment supplied by TERAL INC. shall be repaired or replaced free of charge within the scope of the relevant part, provided that such failure or breakage is attributable to inadequacy of the design or workmanship of the equipment.  
The warranty period of this product shall be one year after the date of delivery.
2. The warranty mentioned in the above clause shall be only the mechanical warranty of the defective part, and shall not cover any expenses or other damage arising from the failure or breakage. Moreover, the warranty is available for Japan domestic use only.
3. In the event of the following failures and breakage, the costs of the repairs shall be borne by the user.
  - (1) Failures and breakage attributable to equipment that was not delivered by TERAL INC.
  - (2) Failures and breakage after the expiration of the warranty period
  - (3) Failures and breakage caused by disasters or force majeure, such as fire, acts of God, or earthquakes
  - (4) Failures and breakage resulting from repairs or modifications made without the consent of TERAL INC.
  - (5) Failures and breakage when parts other than those designated by TERAL INC. are used
  - (6) Failures and breakage caused by use or storage outside the specification range
4. TERAL INC. shall not be liable for the damage caused by incorrect or reckless use of the pump. Cost and expenses incurred for sending engineer(s) in such a case shall be borne by the user.
5. If the cause of the failure is unclear, necessary actions shall be determined through mutual consultation.

## Purpose of this manual

The purpose of this manual is to provide the user with detailed information necessary to properly operate, maintain and inspect the pump. Incorrect operation of this product may lead to an unexpected accident.

Please use the product correctly according to this instruction manual.

This manual contains the following information and is intended for persons experienced in the operation of pumps, or for those who have been trained by such experienced operators. Only qualified personnel such as licensed electrical engineers are allowed to carry out the electrical wiring work.

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# 1. Safety precautions




Before using the unit, thoroughly read this “Safety precautions” to properly use the product. Information described below is vital to safe and proper use of the unit and prevention of hazard and/or damage.

## 1.1 Types and meanings of safety signs and graphic symbols











This instruction manual divides precautions into the following four categories according to the level of hazards (or the severity of the accident). In addition, prohibited or mandatory actions as well as cautions are indicated with a graphic symbol.

Be sure to understand the meanings of the following terms and comply with the content (instructions) of the instruction manual.

### ■ Explanation of warnings

















Safety sign	Meaning
 <b>Danger</b>	Indicates an imminently hazardous situation. Failure to observe this will result in death or serious injury.
 <b>Warning</b>	Indicates a potentially hazardous situation. Failure to observe this will result in death or serious injury.
 <b>Caution</b>	Indicates a potentially hazardous situation. Failure to observe this will result in minor or moderate injury or property damage.
<b>Note</b>	Indicates information that is in particular to be noted or emphasized.



























### ■ Explanation of the graphic symbols















				
Don'ts	Do not touch	Do not disassemble	Do not touch with wet hand	Do not expose to water
These graphic symbols indicate prohibited actions (that must NOT be done).				
	This graphic symbol indicates mandatory actions (that must be done).			
Do's				
				
Caution	Electric shock hazard	Rotation hazard	Hot surface	
These graphic symbols indicate existing hazards to beware of.				




























## 1.2 Safety precautions

 <b>Danger</b>	
 	Once the main power is turned on, do not touch any live parts. A high voltage applied to live parts may cause a serious electric shock, thus leading to death.

 <b>Warning</b>	
 Properly move the unit according to lifting instructions. Otherwise, the unit may fall, thus leading to an injury or damage.	 Do not carry out any work with/on the pump that is being lifted. Otherwise, the unit may fall, thus leading to an injury or damage.
 Only those who are authorized by the site manager are allowed to operate the pump. Operation by unskilled personnel may lead to an unforeseen accident.	 Installation, maintenance, and inspection must only be carried out by personnel who have been trained to handle the pump. Operation by unskilled personnel may lead to an unforeseen accident.
  Only qualified personnel, such as licensed electrical engineers, are allowed to carry out electric work. Otherwise, it may lead to an electric shock, fire, failure, or other problems.	  Use high-quality wiring equipment and devices, and carry out wiring work safely and securely according to the technical standards for electrical facilities, as well as the indoor wiring regulations. Otherwise, it may lead to an electric shock, fire, or other problems.
  Securely install the ground wire and ensure to carry out grounding work. Otherwise, it may lead to an electric leak or electric shock.	  Be sure to install the leakage circuit breaker at the main power supply. Otherwise, it may lead to an electric shock or fire.
  Correctly and securely connect the wires according to the wiring diagram within the terminal box and the instruction manual. Incorrect wiring may cause a fire, electric shock, failure, or other problems.	 Do not connect the ground wire to a gas pipe or water pipe. Such a connection is illegal and leads to an electric shock, explosion, or fire.

 <b>Warning</b>	
  <p>Check the wiring sections and wires for any looseness. A loose connection may cause a fire or electric shock.</p>	 <p>Do not run the unit if abnormal condition is observed in any operation, movement, parts, etc. Otherwise, it may lead to an injury, failure, or various accidents.</p>
 <p>Before starting the unit or carrying out maintenance/inspection work, ensure that all the relevant workers are informed of the operation and that there are no workers in the dangerous zone. Otherwise, it may lead to an unforeseen accident.</p>	  <p>Before starting the maintenance or inspection work, be sure to stop the pump and turn off the main power of the panel board. Otherwise, it may lead to an electric shock, injury, damage, or leakage.</p>
  <p>Before rotating the main shaft by hand to check its smooth rotation, be sure to turn off the main power. Otherwise, it may lead to an injury.</p>	 <p>In the event of a power failure, be sure to turn off the power switch. Otherwise, the pump may suddenly start up on restoration of the power, thus leading to an injury.</p>
  <p>Be sure to put a shaft coupling protective cover during operation. Otherwise, it may lead to an injury or damage.</p>	  <p>Be sure to keep the terminal box cover attached during the operation of the pump. Otherwise, it may lead to an electric shock.</p>
  <p>After turning on the power, do not touch any parts of the pump other than those required for operation. Otherwise, it may lead to an electric shock or injury.</p>	  <p>Do not perform zero-discharge operation for more than one minute continuously. Otherwise, the temperature and pressure may increase inside the pump, thus damaging the pump or causing steam to blow off.</p>
  <p>Do not put your fingers or foreign objects into any openings or rotating part of the motor during operation. Otherwise, it may lead to an injury or damage.</p>	  <p>For overhaul, parts replacement, and repairs that involve disassembly, contact TERAL INC. If unskilled personnel carry out work that requires special knowledge, it may lead to an accident or failure.</p>
 <p>Do not use the product in any explosive atmosphere. Otherwise, it may lead to any injury or fire.</p>	 <p>Regularly inspect your equipment and perform maintenance on each component.</p>
 <p>If motors or control panels are used for more than a certain period of time, it may cause ignition or other accidents due to aging deterioration.</p>	 <p>Electric motor or control panel insulation degradation may result in electric leakage, electric shock, or fire. Keep the ambient temperature at 0 to 40°C with sufficient ventilation to prevent damage to the equipment and deterioration of its life. Avoid dust, corrosive or explosive gases, salinity, humidity, condensation. For indoor installations avoid direct sunlight or wind and rain.</p>

 <b>Caution</b>	
  <p>Do not use the unit outside the range of the product specifications. Otherwise, it may lead to an electric shock, fire, leakage, failure, or other problems.</p>	 <p>Check that the delivered items are exactly what you ordered. The use of a wrong product may cause an injury or failure.</p>
 <p>Do not modify the pump. Any accident or damage due to the modification by customer is beyond our warranty.</p>	 <p>Do not run the pump at a frequency exceeding 60 Hz (50Hz for 50Hz models). Otherwise, it may lead to motor burnout or a fire.</p>
 <p>Do not use a single pump unit as the only means of directly operating key facilities or sustaining life. In the event of a failure, the water supply may stop. Ensure to make a backup unit available for operation.</p>	 <p>Do not give the product any physical shock during transportation, transfer, and installation. Otherwise, it may cause damage to the product.</p>
 <p>Ensure that the floor at the unit's installation place is oil-proofed and fitted with drainage. Otherwise, it may lead to serious damage in the event of leakage.</p>	 <p>Do not use the unit at an incorrect power voltage. An incorrect voltage may damage the motor.</p>
 <p>When two or more pumps are installed together, every pump should have its own separate suction piping. Otherwise, it may lead to an abnormal operation.</p>	 <p>Strictly observe the precautions for installation on pump installation environment. Otherwise, It may lead to quick damage of the pump.</p>
 <p>Do not step on the pump, motor, wiring and piping. Otherwise, it may lead to an injury, damage, or other problems.</p>	 <p>Before unpacking the delivered container, check that the container is placed in the correct orientation (not upside down). Carefully unpack the container, while paying special attention to nails. Otherwise, it may lead to an injury or damage.</p>

 <b>Caution</b>	
 Operate the controls carefully. Otherwise, it may lead to an injury or damage.	 Do not install two or more different cables or control wires in one pipe or duct. Otherwise, it may lead to malfunction of the product or other equipment.
 Before operation, thoroughly clean (flush) the inside of the piping to remove foreign matter. Otherwise, the piping system may be contaminated with foreign matter, thus leading to an accident or a pump failure.	 Do not expose the motor to water. Otherwise, it may lead to an electric shock, electric leak, failure, or other problems.
 Do not put a cloth or other covering on the motor. Otherwise, it may lead to overheating or ignition.	 Do not place any obstacles around the product that may hinder ventilation. Otherwise, it may lead to a fire.
 Do not touch the motor body while the pump is running or immediately after the pump has stopped. Otherwise, you may get burns from the hot surface.	 Never run the pump dry (no-discharge operation) or with insufficient amount of priming liquid. Otherwise, it may cause damage to the sliding part of the pump.
 Do not run the pump with tools or other objects placed on the pump. Otherwise, it may lead to an injury or damage.	 In the event of an alarm or abnormal condition that cannot be resolved, immediately stop the operation, turn off the power, and then contact TERAL INC. Otherwise, it may lead to an accident.
 Be sure to install a strainer at the suction side of the pump. Otherwise, foreign objects may enter into the piping and thus cause damage to the sliding parts of the pump.	 Be sure to conduct inspection according to the Maintenance checklist. Otherwise, you cannot prevent potential failures, thus leading to a higher risk of accidents.
 Do not touch the motor if the liquid used exceeds 40 °C. Otherwise, it may lead to a fire	 Once you turn off the power, wait until the pump stops completely. Do not restart the pump until it does. Otherwise, the main shaft may be subjected to an excessive load, which makes the service life of the pump shorter.
 Do not place any combustibles around the product. Otherwise, it may lead to an injury or damage.	 Minimize the frequency of startups and shutdowns of the pump (Max. 5 times per hour). Otherwise, it may lead to quick damage of the pump.
 Ensure to install an overcurrent protective device. The user is required by the technical standards for electrical facilities to install one. Otherwise, it may damage the product, thus leading to a fire or failure. It is also recommended to install protective devices such as a ground fault interrupter.	 When you lift the product by hand, pay attention to its weight. Do not allow a single person to lift a product heavier than 15 kg. Otherwise, it may put strain on the body, thus leading to an injury.
 Before lifting the product, refer to the catalog, dimensional drawing, and other documents to check the weight of the product. Do not lift the product if its weight exceeds the rated load of the hoisting devices. Otherwise, the product may topple over or fall, thus leading to an injury.	 Whenever disassembly and inspection of the pump, replace the packing and O-ring. Otherwise, it may lead to liquid leakage.
 Before disassembly, be sure to close the suction/discharge valve and drain the high-pressure water in the pump/piping. Otherwise, the product may topple over or fall, thus leading to an injury.	 When the pump is not used for a long time, turn off the main power and the pump shall be sufficiently drained for storage. Otherwise, it may lead to liquid leakage.
 Align the shafts correctly. Otherwise, It may lead to damage, vibration or noise.	 Dispose of the product as industrial waste.
 Take the companion flange out of the pump and screw the pipes. Otherwise, It may lead to damage or leakage.	 If the temperature difference between the operating liquid and the pump casing is 40 ° C or more, do not suddenly pour the liquid into the pump. Otherwise, It may lead to damage or leakage.

### 1.3 Location of warning labels and caution labels

Check the locations of warning labels and caution labels on the product. If these labels become dirty and illegible or if they are peeled off, replace them with a new one.



## 2. Configuration and overview of the pump

This chapter describes the standard specifications of the pump. If you have purchased a customized product, some information in this chapter may not be applicable to your unit. Refer to the delivery specifications for the details separately.

### 2.1 Model type description

**TRP - M A 10 J - - 2TK -**  
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧

- ① Model
- ② Motor included
- ③ A type
- ④ Discharge rate(10,18,27,39,45)
- ⑤ Coupling
- ⑥ Relief valve (None, DB, DBT)
- ⑦ Motor specification (75W,100W,2TK,2EK)
- ⑧ Rotation direction  
None (L) : Standard(counterclockwise  
R: Reverse rotation
- ⑨ looking from motor side)

**TRP - M HC B 30 - -15 FE- -e**  
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

- ① Model
- ② Motor included
- ③ HC type
- ④ with a base (B)
- ⑤ Discharge rate (30, 40, 50, 65)
- ⑥ Relief valve (None, DB, DBT)
- ⑦ Motor specification  
(75: 0.75kW,15: 1.5kW, 22: 2.2kW, 37: 3.7kW,  
55: 5.5kW)
- ⑧ Rotation direction  
None (R) : Standard (clockwise looking from  
motor side)  
L: Reverse rotation
- ⑨ Appended to the products with a built-in top  
runner efficiency (IE3 equivalent)

**TRP - M H G B 3 - -4FK - -e**  
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

- ① Model
- ② Motor included
- ③ H type
- ④ Type (G, A)
- ⑤ with a base (B)
- ⑥ Discharge rate (G type: 3-12, A type: 14-20)
- ⑦ Relief valve (None, DB, DBT)
- ⑧ Motor specification  
(75: 0.75kW,15: 1.5kW, 22: 2.2kW, 37: 3.7kW,  
55: 5.5kW)
- ⑨ Rotation direction  
None (L) : Standard(counterclockwise looking  
from motor side)  
R: Reverse rotation
- ⑩ Appended to the products with a built-in top  
runner efficiency (IE3 equivalent)

**TRP - M S 03 L - DB -**  
 ① ② ③ ④ ⑤ ⑥

- ① Model
- ② Motor included
- ③ Discharge rate (03, 05)
- ④ Mounting method (L : with legs)
- ⑤ Relief valve (None, DB, DBT)
- ⑥ Rotation direction  
None (L) : Standard(counterclockwise looking  
from motor side)  
R: Reverse rotation

**TRP - BH 4**  
 ① ② ③

- ① Model
- ② BH type, BY type
- ③ Discharge rate  
(BH type : 4,6,8,10,12)  
(BY type : 12,20,27)

**TRP - E 18 L -**  
 ① ② ③ ④ ⑤

- ① Model
- ② E type
- ③ Discharge rate (18,27,39)
- ④ Mounting method (L : with legs)
- ⑤ Rotation direction  
None (L) : Standard(counterclockwise looking  
from motor side)  
R: Reverse rotation



## 2.2 Part names and functions

① Motor (for the product with a motor)

② Spacer (for the product with a motor)

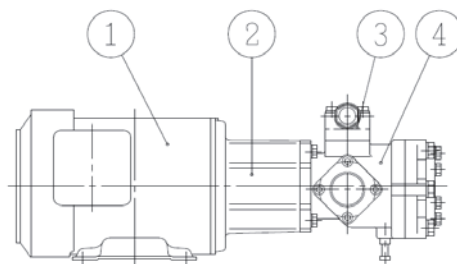
A coupling is housed in it. The spacer connects the pump and motor shafts, transmitting the power. It absorbs offset between the centers of the two shafts.

③ Relief valve (for the product with a relief valve)

When the pressure at discharge side becomes a prescribed temperature or more, it works to protect the pump and motor etc.

④ Casing

The casing connects the piping. A gear rotates inside to pressurize the liquid used.



\* The figure shows a typical model.

## 2.3 Standard specifications

If you have purchased our standard product, refer to the “Standard specifications” table. For details, refer to the specifications including the dimensional drawing and the internal structure drawing. Also if you have purchased a customized product with special specifications, refer to the specifications including the dimensional drawing and the internal structure drawing.



Do not use this product under any conditions other than those provided in the specifications. Failure to observe this may cause an electric shock, a fire, leaks, or failures.

### • Standard specifications

Applicable liquid	Quality	Petroleum-base lubricating oil, Hydraulic oil
	Temperature	0 ~ 50 °C
	Kinematic viscosity <sup>*1</sup>	Recommended viscosity range: 20 ~ 100 mm <sup>2</sup> /s Usable viscosity range: 15 ~ 500 mm <sup>2</sup> /s
Installation location		Indoors Height above sea level: 1,000m or less; ambient temperature: 0 to 40 °C ; humidity: less than RH85% (no condensing); place not exposed to direct sunlight; place without any corrosive gas, explosive gas, or vapor in the atmosphere
Allowable suction pressure <sup>*2</sup> (at oil temperature of 20 °C)		−0.03MPa
Structure	Gear	Internal gear
	Shaft seal	Oil seal
	Bearing	Deep groove ball bearing
Material	Casing	FC250
	Gear	Iron base sintered alloy
	Main shaft	S45C
Motor	Type, Poles, Power supply <sup>*3</sup>	Refer to the delivery specifications including the dimensional drawing
Pump connection structure		Screwed type

\* 1 When running the high viscosity oil with a high speed, the volumetric efficiency of a pump reduced and operation sound become larger. Run the pump with a low speed. In case of normal oil (turbine oil ISO VG 32), either of low or high speed is available.

\* 2 Increased suction resistance induces cavitation and prevents normal oil discharge. Trochoid pumps generally have large suction force, but the suction pressure should be kept within the range above. Cavitation occurs when bubbles are formed in the pump due to drop in absolute pressure of the liquid. Cavitation is frequently accompanied by noise and vibration as well as damage.

\* 3 Limit the fluctuations of the power voltage within ±10% of the rated voltage, and also limit the fluctuations of the frequency between −5% and +3% of the rated value. Avoid continuous operation if the voltage is not within ±5% of the rated value or if the frequency is not within ±2% of the rated value.



### 3. Installation

#### 3.1 Before using the pump

Upon receiving the pump, check the following points first.

The container may greatly incline depending on its center of gravity.



Before unpacking, ensure that the delivered container is placed in the correct orientation (not upside down). Pay special attention to nails especially when opening a wooden crate. Otherwise, you may get injured.

#### Note

After the unpacking, ask the waste-disposal company to dispose of packaging materials that are no longer necessary.

- (1) Check the nameplate to verify that the delivered product is exactly what you ordered.
- (2) No part of the product is damaged during transportation.
- (3) All fastening parts including bolts and nuts are securely tightened.
- (4) All the accessories that you ordered have been delivered.

#### 3.2 Precautions for installation



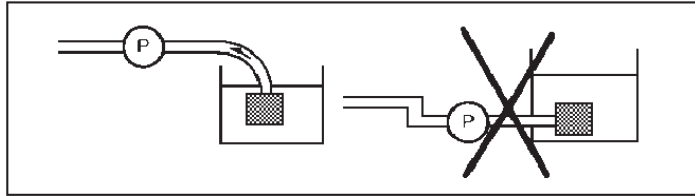
Electric motor or control panel insulation degradation may result in electric leakage, electric shock, or fire.

Keep the ambient temperature at 0 to 40°C with sufficient ventilation to prevent damage to the equipment and deterioration of its life. Avoid dust, corrosive or explosive gases, salinity, humidity, condensation. For indoor installations avoid direct sunlight or wind and rain.



Observe the precautions for installation in the main text below. Failure to observe this may cause failure or damage. It may also result in shortening the service life of the unit.

- (1) Install the product at a location where the following conditions are all satisfied:
  - A place sheltered from wind and rain  
The product is for indoor use. If it is used at outdoors, the place must be sheltered from wind and rain, or specification change is required for outdoor use (special specification).
  - A well-ventilated place at an ambient temperature of 0°C to 40°C with minimum exposure to dust and moisture
  - A place that is free from the exposure to a jet of steam and salt damage
  - A place where the pump cannot easily be accessed or operated by unauthorized persons
  - A place as close to the water supply source as possible so that the suction pipe can be short  
Install the pump so that the total suction head will comply with the requirement specified in “2.3 Pump specifications - Standard specifications.” However, the total suction head may be required to be shorter than the requirement depending on the oil temperature.
  - A place that is free from a secondary hazard in the event of oil leakage.
  - Ensure that the pump is not located below the oil level. Failure to follow this may result in leakage from the oil seals while the pump is stopped.



Do not install the product in a place exposed to high temperature and moisture. Failure to observe this may cause heating, ignition or electric leakage.



Install the product so that the suction pressure (suction height + suction pipe resistance) is as small as possible within the standard specifications.



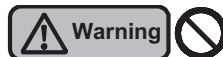
Do not install the pump at an upward curve of piping (where air is trapped). Failure to observe this may cause the pump to run dry, and seize up the sliding part in the pump.

- (2) Install the pump on a horizontal and rigid surface with no backlash.
- (3) Firmly fix the pump on a level concrete foundation. (For the models with a base, refer to “3.3 Installation procedure.”)

#### Note

Securely fix the pump in place with anchor bolts. Otherwise, it may lead to abnormal vibration or other problems.

- (4) When lifting or transporting the pump, handle with care not to give any shock or load. The pump may be inclined due to the deviated gravity center.



Do not hoist the whole unit using the main shaft of the pump, the lifting harness on the motor, or any other parts not intended for the purpose.



Before lifting the product, refer to the catalog, dimensional drawing, and other documents to check the weight of the product. Do not lift the product if its weight exceeds the rated load of the hoisting devices.



Never use a pump or install parts to it while the pump is lifted. Otherwise, the unit may fall, thus leading to an injury.



When lifting the product, pay attention to its center of gravity. Otherwise, the product may topple over or fall, thus leading to an injury.



When lifting the pump by hand pay attention to its center of gravity and weight. Do not allow a single person to lift a product heavier than 15kg. Failure to observe this may put a burden on the body, thus leading to an injury.

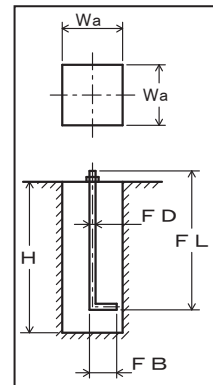
- (5) Ensure to provide an oil drain ditch around the pump.
- (6) If the system could be exposed to the freezing temperature in winter, ensure to take measures to prevent freezing in the pump room or to prevent the pump, valves, piping, and other devices from freezing.
- (7) Use sound-insulating materials for door and walls of the pump room. Especially if there is a risk that the noise may cause problem, take necessary measures against the noise.
- (8) If the pumping oil is cold, condensation may occur inside the motor while the pump is stopped. Take measures to prevent condensation, for example, by installing the pump in a sufficiently dry room or by heating and insulating the motor even when the pump is stopped.
- (9) Carry out repair painting at a time interval suitable for the environment of use. Depending on the humidity, condensation, and other conditions, rust may form on areas such as threaded parts, worked areas, anticorrosive-coated sections.
- (10) Do not put a cover or filter over the motor. Failure to observe this may raise the temperature inside the motor, thus leading to product damage, fire, or other problems.

### 3.3 Installation procedure (for the models with a base)

- (1) The area and thickness of the foundation concrete must be large enough to withstand the pump weight and the operating load.
- (2) Make foundation holes in advance, according to the drawing or the size of the actual bolts.

**Table - Dimensions of Foundation Bolts and Foundation Holes**

FD	FL	FB	Wa	H
M10	200	45	100	250
M12	250	55	120	300



- (3) Ensure that the top surface of the foundation concrete is level, and that the concrete is sufficiently cured before the installation of the pump.
- (4) Place the pump on the foundation concrete. At that time, drive a square steel plate and metal wedges between the common base and the foundation concrete to provide a clearance (about 10 mm to 30 mm) for mortar to be poured into.

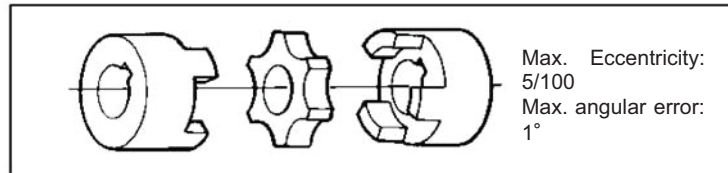
#### Note

The metal wedges are used to adjust the horizontal level of the pump, and also to sustain the pump weight and the operating load. Use as thick a wedge as possible to reduce the total number of pieces. Uniformly place them close to the foundation bolts so that the loads are evenly supported.

- (5) Fix foundation bolts to the common base with nuts so that they are suspended in mid-air at the center of each foundation hole.
- (6) Place a level on the flange surface to check the vertical accuracy. If it is not vertical, adjust it with metal wedges.
- (7) Pour mortar into the foundation holes, the clearance under the common base, and the area around the common base. When the mortar has set completely after a few days, tighten the foundation bolts. (At that time, ensure to tighten the nuts evenly and gradually.)
- (8) Be sure to align the shafts correctly.

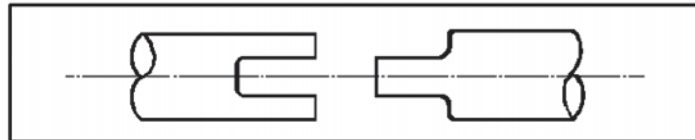
Although the shaft is aligned at the factory before shipment, it could get misaligned during transportation or installation (at fastening the anchor bolts). Check the alignment and re-align it after the installation is complete.

### Flexible couplings



Joint type should be avoided due to low wear resistance. The pump shaft (including flattened end) is hardened, and if the other half of the joint is of low hardness, it may wear and result in dry-running of the pump.

### Joint type



Be sure to turn off the power switch before starting alignment. The pump may be unexpectedly activated and cause an injury.



Remove the shaft coupling cover when carrying out alignment. Before operating the pump, however, be sure to fit the cover back on. If the pump is operated without the cover, you may get caught in the machinery and injured.



Improper alignment may lead to machine damage, vibrations, or noise. Ensure to achieve accurate alignment.

## 3.4 Precautions for piping work



Before piping work, remove the protective seals attached to the suction port and the discharge port of the pump. Running the pump with those seals attached may damage the pump and the piping.



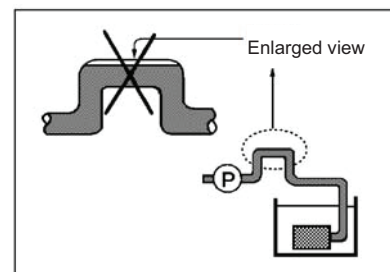
Be sure to install an oil strainer at the suction port of the pump. Otherwise, the piping may be contaminated with foreign objects, thus damaging the pump and the piping.

- (1) Remove the protection seal or the cap attached to the suction side and the discharge side of the pump casing.
- (2) Based on the size of the pump connections, select a suction pipe and a discharge pipe so that the maximum flow rates are 1.5m/sec or less and 3m/sec or less respectively.
- (3) Be sure to provide pipe supports so that the weight of pipes is not applied directly to the pump main body.



Be sure to provide pipe supports for the pipes. Otherwise, the main shaft may be displaced from the center, thus leading to the equipment damage, vibration, or noise.

- (4) The suction pipes should be as short as possible with minimum bends. Do not attach a sluice valve to the suction pipes. Do not install the piping with a shape of upward bend (i.e. providing the piping with a rising gradient and then a descending gradient).
- (5) Bends must be as far from the suction port of the pump as possible with maximum bend radius.
- (6) To prevent air from being trapped inside the suction pipe, provide a rising gradient (at least 1/100 degrees) leading up to the pump.
- (7) Carefully attach joints and other parts to the suction pipe to block air suction.
- (8) The suction piping should be corresponding to or larger in diameter than the pump port (a size larger as a guide). In case, for lifting operation, you use a suction pipe with larger diameter than that of the pump suction port, attach an eccentric reducer to prevent air from being trapped. Also if you use a suction pipe with smaller diameter than that of the pump, it may cause cavitation.
- (9) Install an oil strainer at the suction side of the pump to block the entrance of foreign matter and other objects (such as cutting chips, sand, rust, and scale) to the pump.
  - Recommended mesh size for the strainer is 100~150 mesh. Avoid particles such as polishing sludge.
  - Use a strainer having a capacity of at least twice the pump discharge capacity.
  - Ensure that the tip of the strainer is set a little away from the bottom of the oil tank.
- (10) Since the resistance of the piping changes with the viscosity of the oil, pay attention to ensure the sufficient suction performance.
- (11) Ensure that the oil tank is as large as possible.
  - A capacity of at least three times the pump discharge is recommended. If the oil tank is too small, the oil temperature may rise to deteriorate oil, sucked cutting chips may damage the pump, and bubbles may generate to reduce the discharge rate. Also pour quietly so as not to get caught up the air when you pour the oil to the tank.
  - Ensure that the design allows the tank to be cleaned easily.
  - Fit the oil level gauge to the tank.
  - Fit dividers in the tank to separate bubbles and foreign matter.
  - Arrange the oil return apart from the intake as far as possible.
- (12) Attach a sluice valve and a check valve to the discharge pipes. If water hammer may occur, attach a buffer type check valve.
- (13) If there is an upward curve in the discharge pipe, ensure that air can be vented from the section.
- (14) If two or more pumps are used for lifting operation, every pump should have its own separate suction piping.



If two or more pumps are used for lifting operation, every pump should have its own separate suction piping. Otherwise, air may be sucked from the inactive pump during single-pump operation, thus preventing water from being pumped.

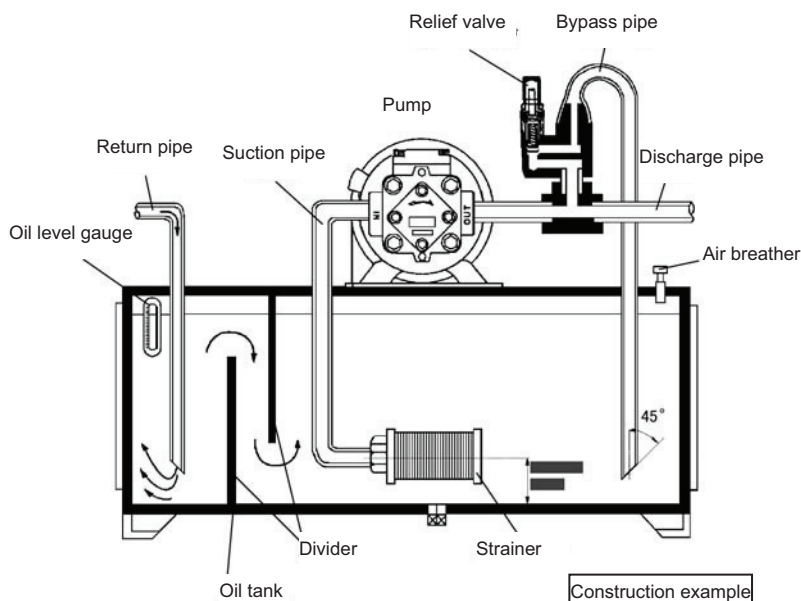
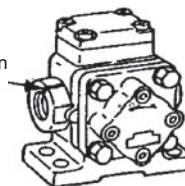
- (15) If you take heat insulation measures for the pump, be sure to avoid the motor section. Otherwise, the motor may heat up and ignite. Furthermore, since the mechanical seal needs to be replaced periodically, install detachable insulation for it.



Never install heat insulation to the motor section. Otherwise, the motor may heat up and ignite.

- (16) Do not forcibly screw a pipe into the suction and discharge ports. Connections may crack if over-tightened.
- (17) After completing installation, ensure the oil tank is cleaned and free of foreign objects which may be sucked into the pump.
- (18) For the models with a base, check the alignment after completing installation and re-align it, referring to “3.3 Installation procedure (8).”

Crack in connection



### 3.5 Precautions for wiring work



Use high-quality wiring equipment and devices, and carry out wiring work safely and securely according to the technical standards for electrical facilities, as well as the indoor wiring regulations. Only qualified personnel such as licensed electrical engineers are allowed to carry out electrical wiring work. Unqualified persons are prohibited by law to carry out wiring work, and it is very dangerous.



Securely connect the terminals of the power cable. Loose terminals may cause the motor to run in open-phase condition, thus leading to motor burnout.



Be sure to install a ground fault interrupter dedicated to the unit for the power supply source. Failure to observe this may cause electric shock or fire.

- (1) Be sure to install a ground fault interrupter and an overload protection device on the primary power side of the pump.

\* When switching from an IE1 motor-equipped product, it is necessary to verify the applicability of its ground fault interrupter and overload protection device. The starting current of Top Runner efficiency (equivalent to IE3) motor-equipped products tends to become higher than that of standard efficiency (IE1) motor-equipped products. If you have any questions, contact TERAL INC.

**Note**

When switching from an IE1 motor-equipped product, it is necessary to verify the applicability of its protection device on the primary side of the pump. Failure to observe this may cause the protective device to trip on startup.

- (2) Be sure to attach a ground wire to prevent an electric shock.  
Connect the ground wire to the ground terminal inside the terminal box of the motor.



Be sure to attach a ground wire to the motor and perform grounding work.



Connecting a ground wire to gas pipe or water pipe is illegal and extremely dangerous.

- (3) Pass the power cable through a metal tube or a metal conduit for shielding, and connect a ground wire to the outer surface of the tube.



Do not install two or more different cables or control wires in one pipe or duct.

- (4) Limit the fluctuations of the supply voltage within  $\pm 10\%$  of the rated voltage, and also limit the fluctuations of the frequency between  $-5\%$  and  $+3\%$  of the rated value. Although you can run the pump in these ranges, avoid continuous operation if the voltage is not within  $\pm 5\%$  of the rated value or if the frequency is not within  $\pm 2\%$  of the rated value.

Even if the power fluctuations fall within the allowable ranges, the pump characteristics, motor characteristics, and the temperature rise of the motor may differ from those at the rated voltage and frequency.

- (5) Precautions for using the inverter drive

- Ensure that the electric current during operation does not exceed 90% of the rated value.
- Ensure that the minimum frequency is set to 20Hz.  
(Contact us if you need to run the drive at 20Hz or lower.)
- Do not use the inverter to drive a motor equipped with a self-protecting device.
- When driving a 400V-class motor, contact TERAL INC. In some cases it might be necessary to take measures for inverter surge.
- An inverter-driven motor generates a magnetic sound which may be annoying compared with the drives using commercial power supply.
- Although this magnetic sound does not adversely affect the quality of the motor, some inverters allow the user to adjust the tone by changing the carrier frequency. However, changing the frequency may reduce the allowable output of the inverter. Pay particular attention when selecting the inverter.
- If the pump and motor produce resonance during normal operation, do not run them in the range of the rotation speed.



Do not run the pump at a frequency exceeding 60 Hz. Failure to observe this may overload the motor, causing it to burnout.



## 4. Operation

### 4.1 Check items before test operation

#### 4.1.1 Check items related to the electrical system



Before changing the wiring, be sure to turn off the main power supply. Otherwise, you may receive an electric shock.



Do not use the product at any voltage other than the rated value. A fire or electric shock may occur.

- (1) Check that the equipment is correctly wired.
- (2) Check that the terminals are securely connected.
- (3) Check that the equipment is securely grounded.
- (4) Check that the setup value of the overload protection device is consistent with the rated current value of the motor.

#### 4.1.2 Check items related to the pump



Do not put a cover or a filter over the motor. The temperature may rise inside the motor, thus leading to failures.



Do not allow a large amount of foreign matter to enter the pump. Failure to observe this may cause damage to the sliding parts (bearings etc.) inside the pump, oil leakage or unusual noise.



Ensure that a strainer is installed on the suction side of the pump (Recommended strainer mesh: 100~150 mesh). Foreign matters may enter the pump and cause damage to the sliding parts (bearings etc.) in the pump, oil leakage or unusual noise.

- (1) If the difference in temperature between the oil and the pump casing exceeds approximately 40°C, preheat the pump casing to the close temperature of the oil.



Do not pour oil into the pump suddenly if the difference in temperature between the oil and the pump casing exceeds 40°C. Pouring the oil under such conditions may result in thermal distortion, consequent problems with the centering of the shaft, and associated seizing.

- (2) Fully open the suction and discharge sluice valves.
- (3) Rotate the pump shaft by hand to check smooth rotation. If the rotation is stiff or not uniform, there may be some rust or foreign matter inside the pump. Inspect the pump in such a case.



Never run the pump dry (operation without priming). Failure to observe this may cause the sliding parts inside the pump to seize up.

- (4) For the models with a base, check the alignment of the shaft. Re-align it, if necessary, referring to "3-3. Installation procedure (8)."

## 4.2 Running the pump (test operation)



Do not operate the pump if any abnormal condition is observed or if there is anything wrong with the parts, components, and others during the check before test operation. Failure to observe this may cause an injury, failure, accident, or other problems.



For the models with a base, be sure to put a shaft coupling protective cover during operation. Failure to observe this may cause an injury.



Be sure to attach the cover of the terminal box of the motor. Failure to observe this may cause an electric shock.



If the oil used exceeds 40°C, do not touch the pump. The surface of the pump may be so hot that it may cause burns.



Do not allow a large amount of air or foreign matter to enter the pump. Failure to observe this may cause damage to the sliding parts (bearings, etc.) inside the pump, disability of pumping, oil leakage or unusual noise.

- (1) Check the rotation direction of the pump by turning ON and OFF the power switch once or twice. If the pump shaft rotates in reverse,

for three-phase models: swap two of the three wires of the power cable; and

for single-phase models: after reviewing the correct wiring pattern, rewire.

The pump has a drain for the seal section on the pump suction side. If a mistake is made in setting the rotation direction, the suction and discharge positions will be switched. As a result discharge pressure may build up against the oil seal, causing the seal to break and oil to be sprayed out of the pump. Reversible pumps, such as TRP-BH and TRP-BY, can be used in both forward and reverse rotation directions.



Never check the rotation direction by running the pump dry. Running the pump dry even for a short time may cause damage to the sliding parts (bearings etc.) inside the pump, oil leakage or unusual noise.



Do not run the motor in reverse because it may cause a failure.

- (2) Turn on the power to start the pump.



If oil is not discharged with approximately 30 seconds after starting pump operation, stop the pump immediately and check the suction pipe etc.



Note that when starting the pump in cold conditions, the increased viscosity of the oil may result in increased load on the motor, and a consequent increase in pump operating noise and vibration.

- (3) When operating the pump for the first time after installation, flushing (circulation cleaning) must be carried out in the piping and system. After flushing (circulation cleaning), clean the strainer.
- (4) Adjust the sluice valve on the discharge side so that the specified pressure is achieved.



Do not perform long hours of no-discharge operation continuously. Failure to observe this may increase the oil temperature and pressure in the pump, resulting in an unexpected failure.

- (5) As a guide, limit the frequency of the startups and shutdowns to about five times an hour.



Minimize the frequency of startups and shutdowns of the pump because frequent startups and shutdowns may damage the pump sooner than usual. Do not start the pump more than five times an hour or so.

- (6) In the event of a power failure during operation, be sure to turn off the power.



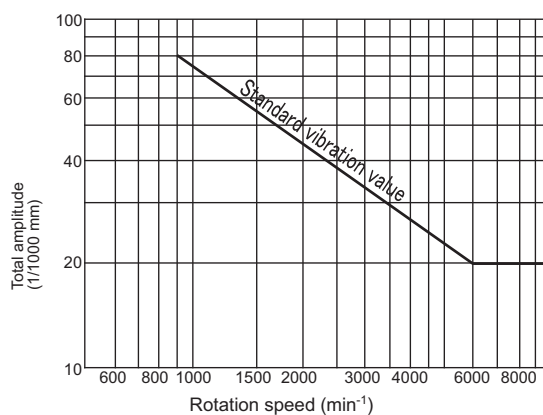
In the event of a power failure, be sure to turn off the main power. The pump may suddenly start up on restoration of the power, thus leading to an injury.

- (7) Before restarting the pump, confirm that the pump has completely stopped.



Before restarting the pump, be sure to check that the pump has completely stopped. Turning on the power while the pump is still rotating causes an excessive torque on the pump and may cause a failure.

- (8) Check for any abnormal pressure, electric current, vibration, noise, and other conditions. Refer to the following chart for the “vibration vs. rotation speed.” (If you install the pump on a vibration isolator, the standard vibration values are different from those in the following chart. Contact us in such a case.)



Standard vibration value at the bearing section

[For reference only]

Relation between the total amplitude (a) and the vibration velocity (V)

$$a = \frac{V \times 6 \times 10^4}{\pi \times n}$$

a: Total amplitude (μm)  
V: Vibration velocity (mm/s)  
n: Equipment rotation speed (min⁻¹)

(9) Stop the pump.



Do not put your fingers or other objects into the opening of the motor. Otherwise, it may lead to an electrical shock or injury.



Keep the cocks of the pressure gauges, compound pressure gages, and other parts closed all the time except when they are used for measurement. Otherwise, they become more susceptible to failure.



Do not run the pump using the power beyond the allowable current value. Otherwise, the motor may burn out.

## 5. Maintenance and inspection



Before checking the pump, be sure to turn off the main power. The pump may suddenly start up in automatic mode or on other occasions and lead to a great danger.



Before starting the unit or carrying out maintenance/inspection work, ensure that all the relevant workers are informed of the operation and that there are no workers in the dangerous zone.



For overhaul, replacement of parts, or repairs, ask TERAL INC. Incorrect work may cause a failure or accident.

### 5.1 Precautions for maintenance and inspection



Regularly inspect your equipment and perform maintenance on each component.

#### (1) Observe the following instructions, in particular, during daily inspection.

- ① A large deviation in the pump's discharge pressure, electric current, vibration, noise, or other conditions from the normal status is a sign of an imminent failure. Therefore, immediately take measures, referring to the Maintenance checklist in Section "5.2 Maintenance checklist."  
For this purpose, it is recommended to keep an operation log.
- ② If the bearing temperature gets abnormally high, immediately stop the pump and check the bearing. It is normal if the difference of the temperature of the bearing case surface near the bearing and ambient temperature is 40°C or less.
- ③ Replace the bearings if they generate unusual noise or vibration.
- ④ Check the piping for any oil leakage or damage.
- ⑤ Check that all mounting bolts and the power terminal block are securely connected.
- ⑥ Except when inspection is required, keep the cocks of the pressure gauges and compound gauge closed all the time with the pressure being released.
- ⑦ In the event of a power failure, be sure to turn off the power. The pump suddenly starts up on restoration of the power, and it is dangerous.



In the event of a power failure, be sure to turn off the power switch. The pump may suddenly start up on restoration of the power, which leads to a danger.

- ⑧ Check the oil strainer fitted on the pump suction side, for any clogging. Clean it if it is clogged.



Periodically clean the strainer located on the pump suction side. A clogged strainer may cause pressure fluctuations, a lower discharge rate, abnormal noise, and other problems, thus leading to a pump failure.

#### (2) If you do not use the pump for a long time, observe the following points.

- ① To prevent possible freezing inside the pump in winter, be sure to take antifreeze measures such as heat insulation or the installation of a heater to the pump or completely drain the pump.

- ② At intervals of about one week, rotate the pump shaft by hand or with motor. Also, turn the pump shaft by hand to check its smooth rotation before running the pump.



Before turning the pump shaft by hand to check its smooth rotation, be sure to turn off the main power. Otherwise, the pump may start unexpectedly, thus leading to an accident.

- ③ If you have a backup pump, run it from time to time to make it available for operation at any time.

## 5.2 Maintenance checklist

Item	Inspection point	Inspection item	Inspection method	Criterion (Reference page)	Inspection interval				Consumables
					Daily	Monthly	Half-yearly	Yearly	Timing of replacement (as a guide)*
Ambient conditions	Temperature	Check against the specified range.	Measure	Between 0 and 40°C (2-2)	✓				-
	Humidity		Measure	Less than 85% RH (2-2) (no condensing)	✓				-
	Dust and other contaminants		Visual check	No dust or other contaminants	✓				-
Power	Power terminal block	Voltage	Measure	Specified voltage (2-2)			✓		-
		Voltage fluctuation	Measure	Within the allowable fluctuation range (2-2)			✓		-
		Loose screws	Retighten	Securely tightened				✓	-
Pump and Motor	Operation condition	Performance	Visual check	As per the specifications	✓				When abnormality is recognized, disassemble and inspect the pump.
		Current value	Measure	As per the specifications	✓				
		Noise, vibration	Listen, Touch	No abnormal vibration	✓				
	Inner rotor Outer rotor	Clogging	Disassemble and inspect	No clogging				✓	When worn out and performance is deteriorated
		Wear	Disassemble and inspect	No backlash				✓	
	Main shaft and its surrounding area	Smooth rotation	Rotate by hand	Rotation is smooth and uniform				✓	-
	Bearing	Heat-generation, noise, vibration	Touch, Listen, Visual check	No abnormal condition(5-1)				✓	Every three years (or after 15000 hours operation)
	Oil seal	Leakage	Visual check	No leakage		✓			Every 1~2 years (or after 8000 hours operation)
	Appearance	Unusual noise, vibration	Visual check, Listen	No abnormal condition	✓				-
	Winding resistance	Resistance value between each winding (U-V, V-W, W-U)	Measure	Resistance value is uniform between the windings				✓	-
	Insulation resistance	Between the ground and each lead wire	Measure	1 MΩ or more (by DC500V Megger tester)				✓	-

\* The timing of replacing consumables (as a guide) does not mean their guaranteed service life. The service life of parts varies depending on the ambient conditions and the conditions for use.



If motors or control panels are used for more than a certain period of time, it may cause ignition or other accidents due to aging deterioration.

### Note

The timing of replacement for the consumables is the reference values when normally used and checked regularly. It may become short according to the use condition.

### Note

Dispose of the waste components generated by the repair or the replacement according to the local regulations, by asking the specialized waste disposal contractor.

## 6. Troubleshooting

If you find any abnormal conditions of the pump, carefully investigate the problem. For overhaul, replacement of the parts or repairs, contact TERAL INC.

Problem	Cause (Reference page)	Action (Reference page)
The pump does not start.	Wiring is disconnected or broken.	Check the wires and connections to repair or replace.
	Poor connection or contact of power wires (3-6)	Check by a tester and replace the defects with a good one if any.
	The power fuse is blown.	Replace it with an appropriate fuse.
	Tripping of the thermal relay	Check the thermal relay.
	The power voltage is too low. (2-2)	Check the power voltage and contact the power company.
	The motor has failed.	Contact us because disassembly and inspection are required.
	Foreign matter is caught in the gear.	
	The shaft seal is bound.	
	The bearing is rusty.	
The pump starts, but cannot achieve the specified discharge rate and the specified head.	The oil level in the oil tank is low.	Supply the oil used to increase the level.
	The pumping oil contains many bubbles.	Prevent the formation and suction of bubbles.
	The air intrudes from the suction piping.	Check the joint of each suction piping.
	The rotation direction is reverse. (4-2)	Correct the wiring so that the motor rotates in normal direction. (4-2)
	The piping loss is high.	Check the diameter, route and length of the pipes.
	The piping is clogged with foreign matter.	Check and clean the piping and filter.
	The gear and the gear shaft are worn.	Contact us because disassembly and inspection are required.
	Foreign matter is accumulated in the gear and in the casing.	
	The rotation speed is low.	Check with the tachometer.
	The sluice valve is closed.	Open the sluice valve.
	There is a leak in the discharge pipe.	Check and repair the pipe.
	The suction pressure (negative pressure) is too large.(2-2)	Consult us.
	The viscosity of the oil is not proper.	Check the planned specifications.
Overload and overcurrent of the motor	The rotation speed is too high.	Check with the tachometer.
	The stator winding is broken, shorted, or grounded.	Contact us because disassembly and inspection are required.
	The stator and rotor are in contact due to wear of the bearing.	
	The motor is running in open-phase condition.	Check the wiring.
	The setting of overload protection device is too low.	Correctly set the motor overload protection device.
Overload and overcurrent of the motor	The power supply voltage is out of the allowable fluctuation range.(2-2)	Check the voltage and contact the power company.
	The discharge rate is high.	Throttle the sluice valve to adjust the rate as per the specifications.
	A rotating part is in contact with another part.	Contact us because disassembly and inspection are required.
	Foreign objects enter into the pump.	
	The viscosity of the oil is too high.	Properly adjust the viscosity to the planned specifications.



Problem	Cause (Reference page)	Action (Reference page)
Overheat of bearing	The bearing is worn or damaged. (5-1)	Contact us because disassembly and inspection are required.
	The grease is deteriorated.	Contact us because disassembly and inspection are required.
	Incorrect installation of the pump and the piping, misalignment of the shaft (3-1)	Check and correctly install or realign them.
Unusual noise and unusual vibration of the pump	The bearing is worn or damaged.	Contact us because disassembly and inspection are required.
	The gear is clogged with foreign matter, thus leading to imbalanced load.	
	The main shaft is winding.	
	The motor is running in open-phase condition.	Check the wiring.
	Cavitation has occurred. (3-5)	Contact us.
	Incorrect installation of the pump and the piping, misalignment of the shaft (3-1)	Check and correctly install or realign them.
	Inverter is used.(3-7)	Change the operating frequency or carrier frequency.
Irregular operation of the pump and sluice valve	Leakage of air into the system.	Check the seals on piping connections.
	Problem occurs in the sliding part or Foreign objects enter into the pump.	Packing is over-tightened. For the other case, contact TERAL because disassembly and inspection are required.
	The sluice valve is damaged.	Inspect and repair the pipes.



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