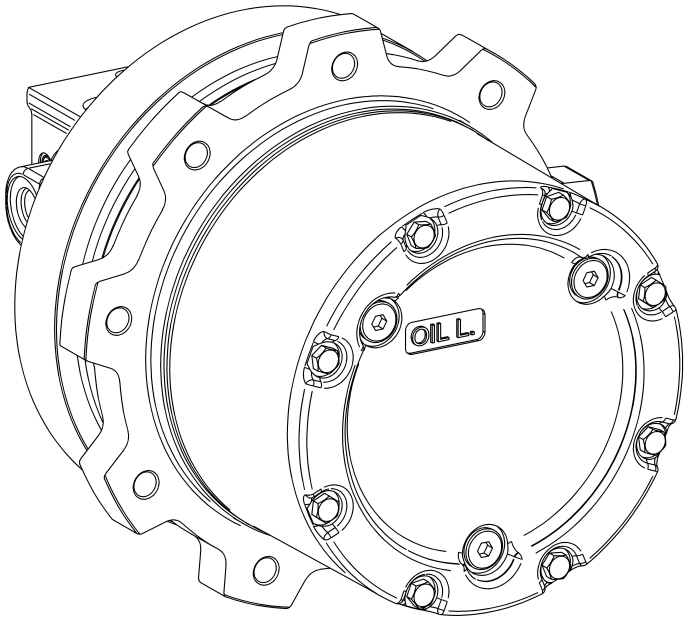
TH Series

Hydraulic Motor with Reduction Gears

Operation Manual



Please be sure to read and understand this manual before using the product.
The administrator and operator of the product should have access to this manual.
Store this manual at a specified safe place so that it can be referred to when necessary.

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Table of Contents

CONTENTS OF MANUAL....3
IMPORTANT NOTICE....4
1. Intended Use of Product....4
2. Precautions for Safe Use of TH....4
3. Notice on the Operation Manual....5
4. Disposal of TH....5
5. Other Important Notice....5
Chapter 1 SAFETY....6
1.1. Strict observance and Prohibition....6
1.2. Types of Warnings and their Meanings....7
1.3. Notation and Meaning of Important Information....7
Chapter 2 OVERVIEW OF TH....8
2.1. Name of Each Part....8
2.2. Storage of TH....9
Chapter 3 PREPARATION FOR INSTALLATION....10
3.1. Installation Environments....10
3.2. Preparation of Necessary Materials....10
3.3. Transportation and Unpacking....11
Chapter 4 INSTALLATION IN THE MACHINE....14
4.1. Precautions on Hoisting....14
4.2. Hoisting and Installing TH....15
4.3. Hydraulic Piping Connection....17
4.4. Trial Run after Installation....17
4.5. Setting Method of Free Mechanism....18
Chapter 5 HYDRAULIC OIL AND LUBRICANT....20
5.1. Precautions when Handling Hydraulic Oil and Lubricant....20
5.2. Type of Hydraulic Oil....21
5.3. Replacing Hydraulic Oil....22
5.4. Type of Lubricant and Filling Volume....23
5.5. Replacing Lubricant....24
Chapter 6 MAINTENANCE & INSPECTION....27
6.1. Precautions on Maintenance and Inspection....27
6.2. Periodical Inspection....27
6.3. Removal from the Machine....29
Chapter 7 TROUBLESHOOTING....30
CUSTOMER SUPPORT....32

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CONTENTS OF MANUAL

This manual consists of the following chapters and references.

Chapter name		Description
IMPORTANT NOTICE		The following are explained: ・ Intended use of the product ・ Safety precautions ・ Notice on the Operation Manual ・ Disposal of TH ・ Other important notices
Ch.1	SAFETY	The information on safety is described as strict observance and prohibition. Safety information such as TH installation is described in Chapter 3 and later.
Ch.2	OVERVIEW OF TH	The name of each part of TH as well as how to store it described.
Ch.3	PREPARATION	Installation environments of TH, preparation of necessary materials, unpacking, and hoisting are described, along with safety precautions.
Ch.4	INSTALLATION	Installation procedure of TH, and precautions to avoid human injuries during installation as well as damage of TH.
Ch.5	HYDRAULIC OIL AND LUBRICANT	The following information on hydraulic oil and lubricant is described: ・ Precautions for handling ・ Recommended brand ・ Filling volume ・ Replacing interval and procedure
Ch.6	MAINTENANCE & INSPECTION	Precautions for maintenance and inspection works, and procedure of periodical inspection and TH removal are described.
Ch.7	TROUBLESHOOTING	How to deal with problems is described.
CUSTOMER SUPPORT		Support contact at our corporation is described.

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IMPORTANT NOTICE

1. Intended Use of Product

TH-Series; Hydraulic Motor with Reduction Gears (hereafter referred to as TH) is a hydraulic driven rotary actuator. The product contains a reduction gears, a hydraulic motor, a mechanical brake (parking brake), and a flushing valve integrated into one compact unit. It has been developed for use as an actuator applicable to construction and agricultural machinery requiring high-speed rotation as well as closed circuits such as HST.

The following conditions are to be satisfied for the use of TH.

- TH should be used within the specification and the limitation specified by our corporation. (Specifications and the limitation should be in compliance with those in confirmation notice (that is equivalent to delivery specification sheet) for TH or the specifications and operating agreement on the machinery for which TH is used.)
  - If it is used beyond the limitation range, it may cause abnormal wear due to poor lubrication or may cause damage due to seizure.
  - If TH is operated continuously at a high temperature, or at high load or at high rotation speed, the life or performance decline and damage may occur.
  - TH is not intended for the use in a series circuit, and problems related to the use in a series circuit are not our responsibility.
  - TH does not include a counter balance valve. If necessary, prepare it separately.
- The product should be properly assembled in the customer's equipment.

  (Refer to p.14 in Chapter 4.)
- The proper lubrication condition should be maintained. (Refer to p.20 in Chapter 5.)
- The product should be installed in the environmental condition specified by our corporation.

  (Refer to p.10 on 3.1. in Chapter 3.)
- Make sure THs of the same type are used when applying them facing each other or synchronizing.
  - To prevent damages of TH and the machinery, do not use TH of other type or other manufacturer's product.
- The following precautions should be observed:
  - When the end user is concerned with military or when the intended use is the manufacture of arms, the product may be regarded as an object of export regulation according to the Foreign Exchange and Foreign Trade Act in Japan. When exporting the product in this case, prepare review and necessary procedures.
  - Prepare an oil tray to prevent the lubricant from leakage due to malfunction or deterioration.

2. Precautions for Safe Use of TH

- Be sure to read this manual before use of TH.
- NOTICE that this manual cannot cover all of the precautions related to safety. In transportation, installation and maintenance of TH, ensure to observe general safety precautions.
- To prevent accidents, use the product only for the intended purpose. Avoid installation and maintenance work not specified or recommended in this manual.
- Do not disassemble, repair, or modify the product, as it may cause malfunction or failure of the product. If disassembly or repair is necessary, contact our customer support. (Refer to p. 32)
- Not only workers but also administrators should try to avoid any accidents.
- The installation and maintenance of the product should be performed only by personnel with at least basic knowledge of the hydraulic motor and reduction gears and who have fully read and understood this manual.

- Use of TH out of the intended use or without understanding the contents of this manual may cause the following hazard:
  - Hazard to life and health of the user
  - Breakage of TH or the machinery incorporating TH
- Wear hand protection such as leather gloves, prior to the handling because there is a risk of injury due to edges of the product that are not intended for manufacturing.
- When an operation qualification is required to operate equipment with TH installed, a qualified person must handle the installation to the equipment and operation of the equipment required for maintenance and inspection.

3. Notice on the Operation Manual

- This manual is intended for workers who are fluent in English. If this product is going to be operated or serviced by workers who are not fluent in English, the responsibility falls on the customer to provide thorough training on operation and safety.
- Ensure to operate the product according to the procedure and precautions specified and recommended in this manual. Any operation neglecting the described specification or recommendation may cause accidents and/or damage.
- This manual is copyrighted and all rights are reserved by our corporation. Any part of the drawings and technical references including in this manual shall not be copied, photocopied, or reproduced to any electronic medium or machine-readable form without prior consent of our corporation.
- The photographs and drawings described in this manual may not represent actual products strictly.
- If this manual is lost or damaged, immediately contact our customer support. Operating or servicing the product without this manual may result in accident.
- If you are going to transfer the product or machinery (attached or assembled in any way) to another party, be sure to submit this manual and related document to the new user.
- Reflect at least the description on lubricant (Chapter 5) and maintenance & inspection (Chapter 6) in this document to the operation manual for the customer machine into which TH is incorporated.

4. Disposal of TH

Disposal of TH and packaging materials may be regulated by laws and regulations in each country / region.
In addition, recyclable materials are required to be reused.
When disposing, ask an industrial waste disposal contractor and follow these regulations.
If there is anything uncertain, please contact our customer support for processing.

5. Other Important Notice

- It is prohibited to analyze and use the product by any measure of reverse engineering or other related technology.

Chapter 1 SAFETY

The safety precautions are to be guidelines to avoid human accidents during the transportation, installation, and maintenance of TH, as well as to avoid damage to TH.

1.1. Strict observance and Prohibition

Overall precautions are classified into strict observance and prohibition.

For precautions at installation and maintenance, be sure to refer to the description of the corresponding chapter.

● Strict observance

- The transportation, installation, and maintenance should be performed only by personnel who understand the manual.
- The tools required for the work should be cleaned up to a specified place after work. Mixing a foreign object such as tools, screws and/or nuts may cause damage to the product.
- For handling of the hydraulic oil and the lubricant, refer to the indications and recommendations in this manual.

● Prohibition

- The work coordinator and/or administrator should not let personnel who have no ample knowledge of the product. It may result in an injury to the operator or damage to the product.
- Do not put fingers or any foreign object at the opening end of the product. It may result in serious or moderate injury.
- Do not modify or disassemble the product. It may result in breakage of the product.
- Do not apply excessive impact or vibration to the product. It may cause breakage of the product.
- The product may be very hot during operation. After the operation, do not touch the product until it has cooled down. Otherwise it may result in a heat-related injury.
- Do not perform rapid cooling for high-temperature TH. When cooling, perform air cooling by atmospheric air.
- Do not put any inflammable object around the product. It may result in fire.
- If any abnormality or breakage should occur in the product, do not operate it until a proper countermeasure is prepared.

1.2. Types of Warnings and their Meanings

The following four types of warnings are used according to the expected hazards during operation and maintenance of the product. Neglecting such safety rules and warnings may cause accidents, resulting in serious injury and/or damage to this product.

Signal word	Meaning
⚠ DANGER	Indicates an imminently hazardous situation which, if not avoided or prepared protection measures, will result in death or serious injury.
⚠ WARNING	Indicates a potential hazardous situation which, if not avoided or prepared protection measures, could result in death or serious injury.
⚠ CAUTION	Indicates a potential hazardous situation which, if not avoided or prepared protection measures, may result in minor or moderate injury.
NOTICE	Indicates a potential hazardous situation which, if not avoided or not prepared protection measures, may result in property damage.

1.3. Notation and Meaning of Important Information

Notation	Meaning
NOTE	Important maters or useful information for the TH operation, maintenance and inspection.

Chapter 2 OVERVIEW OF TH

2.1. Name of Each Part

Here is an explanation of the name of each part.

TH may come with a free mechanism. Refer to Section 4.5. Setting method of free mechanism (p.18,19) for usage.

NOTE

The following drawings may not strictly represent the actual appearance of the product ordered.

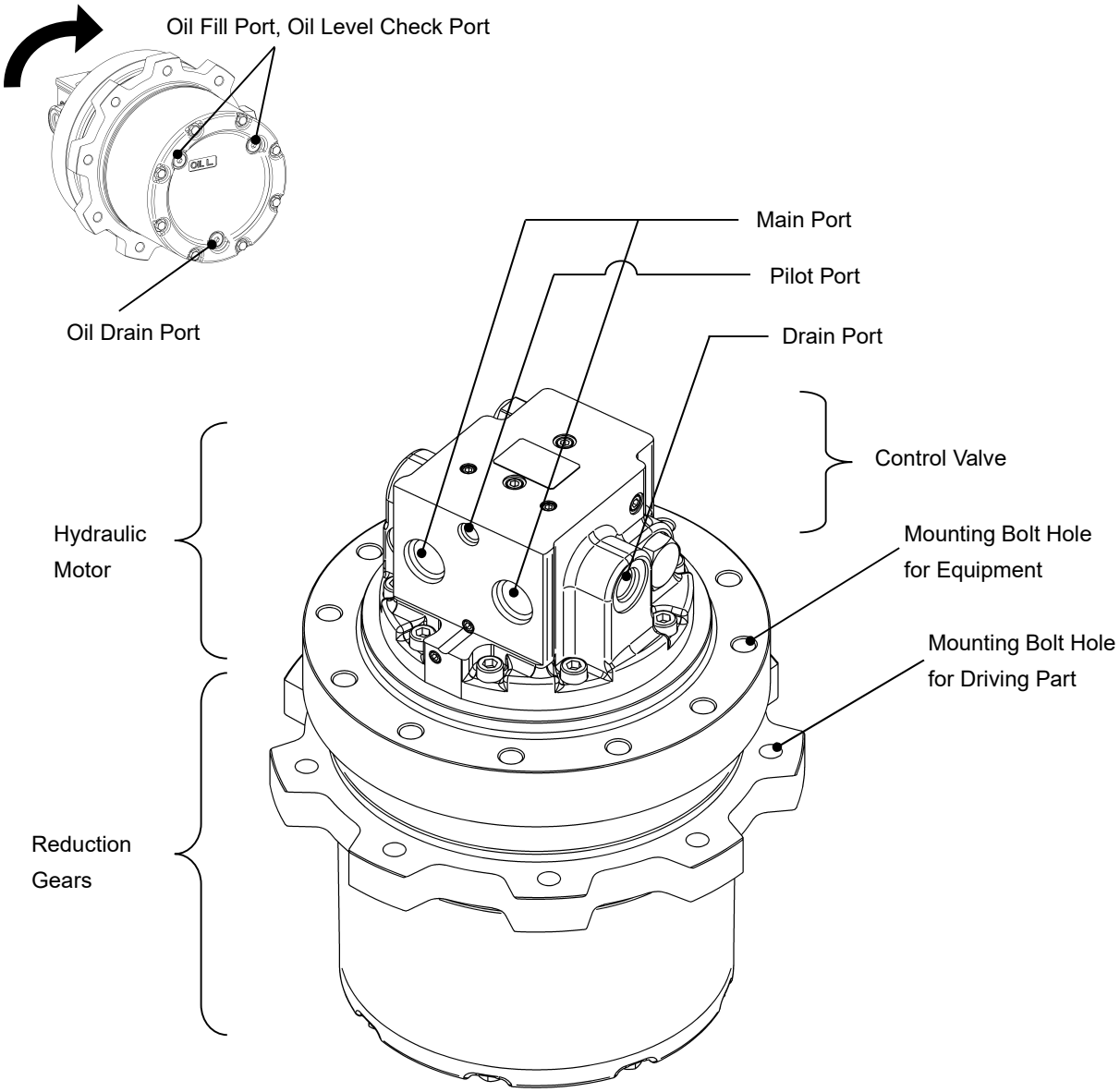


Fig. 2-1

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2.2. Storage of TH

NOTICE

When storing the product, follow the same packing condition as before unpacking.
If the packaging conditions change, foreign matter may enter inside or rust may occur.

To avoid rust, corrosion, and deterioration of seals, avoid storage in places such as:

- Places where the surrounding temperature is under -10°C or over 40°C
  (Temperature recommended as the storage environment)
- Places of high humidity
- Places with direct sunlight
- Places where dew may condensate or freeze
- Outdoors with wind and rain directly
- Places near chemical substances such as an organic solvent, acid, and alkali
- Places exposed to corrosive gas and/or dust
- Places with unstable flooring
- Places where the floor strength is insufficient
- Places under vibration

NOTE

When the product is used or re-operated after a long-term, check the following:

- **That there is no rust or corrosion;**
  Although TH has antirust oil applied to the outside before shipping, check the antirust state at least once a year. Take an antirust measure as necessary. The antirust state before shipping will be maintained for approx. twelve month.
- **That seal parts has not been deteriorated over time.**
- **That lubricant has not leaked.**

Chapter 3 PREPARATION FOR INSTALLATION

3.1. Installation Environments

⚠ WARNING

The installation environments should be in compliance with those specified in confirmation notice (that is equivalent to delivery specification sheet) for this product or the specifications and operating agreement on the machinery for which this product is used. Also, please do not use under the following environmental conditions. Using TH out of the specified environmental conditions may result in serious physical injury or fatal property damage.

- **Places exposed to seawater or underwater**
- **Places exposed to toxic gases that may cause metal corrosion**

3.2. Preparation of Necessary Materials

The installation of TH requires the following parts and materials.

Please prepare them after confirming the confirmation notice which includes installation drawing.

● Mounting bolt

The specifications and quantity of bolts required to mount TH are described in the confirmation notice.
If there is anything uncertain, please contact our customer support.

● Hydraulic oil

A small amount of hydraulic oil remains in TH at the time of shipment. It remains in the process of shipping inspection and does not affect the performance of the product.

For detailed information on the hydraulic oil, refer to Chapter 5 (p.20) and the Safety Data Sheet. For the Safety Data Sheet, contact our customer support or the supplier of the hydraulic oil.

● Lubricant

TH is filled with the lubricant specified by our corporation at the factory.

For detailed information on the lubricant, refer to Chapter 5 (p.20) and the Safety Data Sheet. For the Safety Data Sheet, contact our customer support or the supplier of the lubricant.

3.3. Transportation and Unpacking

3.3.1 Transportation

WARNING

- **The mass of TH is heavy. Be sure to use transportation equipment such as a forklift to transport TH units.**
- **In transporting TH, handle it with ample care to avoid drops or falls. Otherwise it may result in injuries of the operator or damage to TH.**
- **For the personnel who carry out transportation, at least observe the following condition and wear the protective gear.**
  - **A forklift must be operated by a qualified person.**
  - **Be sure to wear a helmet, leather gloves and protective footwear.**
- **Be sure to check that TH is in the correct vertical orientation before unpacking the package. If it is turned upside down, the packaging material may be damaged, and TH may jump out and cause injury to workers.**

- **TH weight**

Refer to the confirmation notice.

3.3.2 Unpacking

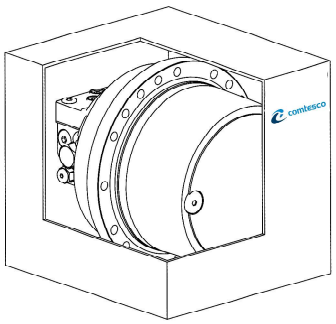
NOTICE

Since TH has antirust oil applied to the outside before shipping, it may be slippery.
Wipe off the antirust oil before operation.

NOTE

- **The drawings in this manual do not necessarily represent the individual packaging or the product. They change by the individual product or the confirmation notice. Also, for convenience, the drawings are cut out of the packaging material so that the contents can be imaged.**
- **Reduction gears of TH is filled with lubricant specified by our corporation at the factory.**
- **When hoisting TH, refer to the Hoisting TH section (Sections 4.1 and 4.2 on p.14 and p.15).**

[Packing example 1]



[Packing example 2]

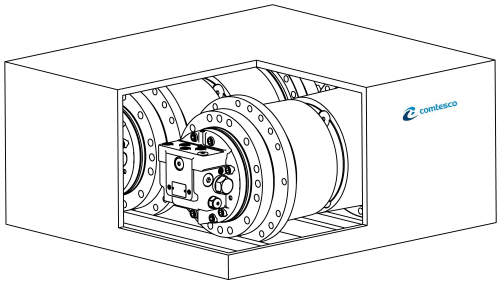


Fig. 3-1

- **Confirmation of contents**

Confirm the following before using the product:

Please contact our customer support if there is any delivery error or damage.

- The confirmation notice number matches the MS number on the nameplate, and the type code shown on the confirmation notice matches the type code shown on the nameplate. (Refer to nameplate contents p.13)
- There was no breakage during transportation. (Refer to the confirmation notice.)
- Check the confirmation notice and TH, there was no missing of the bolts by visual confirmation.

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NOTE

At the time of delivery, covers or plugs are attached to ports of the product to prevent contamination from entering inside. (They are not shown in the confirmation notice.) Do not remove it during storage, and remove it when connecting pipes.

- **Confirmation of lubricant**

Refer to Replacement procedure (p. 24) in Sections 5.5 Replacing Lubricant. And check that the lubricant is filled by using the oil level check port.

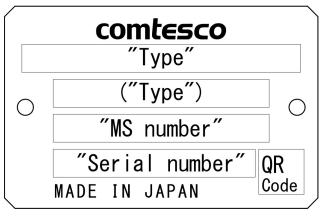
- **Labeling**

The nameplate is attached on the body of TH.

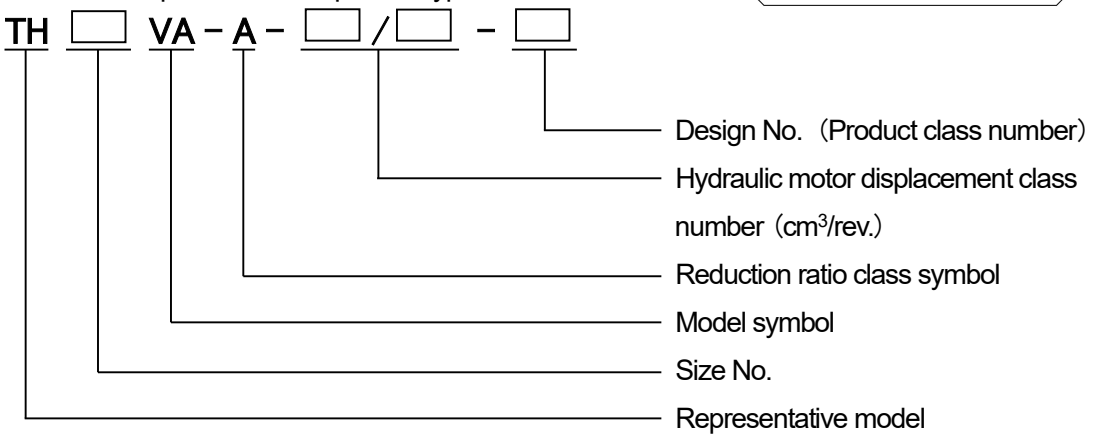
It indicates the product type, and others.

The type information includes the following product information.

＜Nameplate example＞



＜Indication example of standard product type＞



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Chapter 4 INSTALLATION IN THE MACHINE

4.1. Precautions on Hoisting

⚠ CAUTION

- The crane operation during hoisting must be conducted by a qualified person.
- Be sure to wear a helmet, leather gloves and protective footwear during hoisting work.
- The mass of TH is heavy. Use a hoisting tool robust enough to endure the mass of TH.
  If the strength of the hoisting tool is insufficient, the tool may be damaged and/or drop TH.
- Never get under TH while it is being hoisted.

⚠ WARNING

Hoist TH body horizontally in a balanced manner. If it loses its balance and falls, operators may be injured or the customer's machine and TH may be damaged.

4.2. Hoisting and Installing TH

Step 1 Attach the hoisting tool to TH.

Step 2 Hoist TH body.

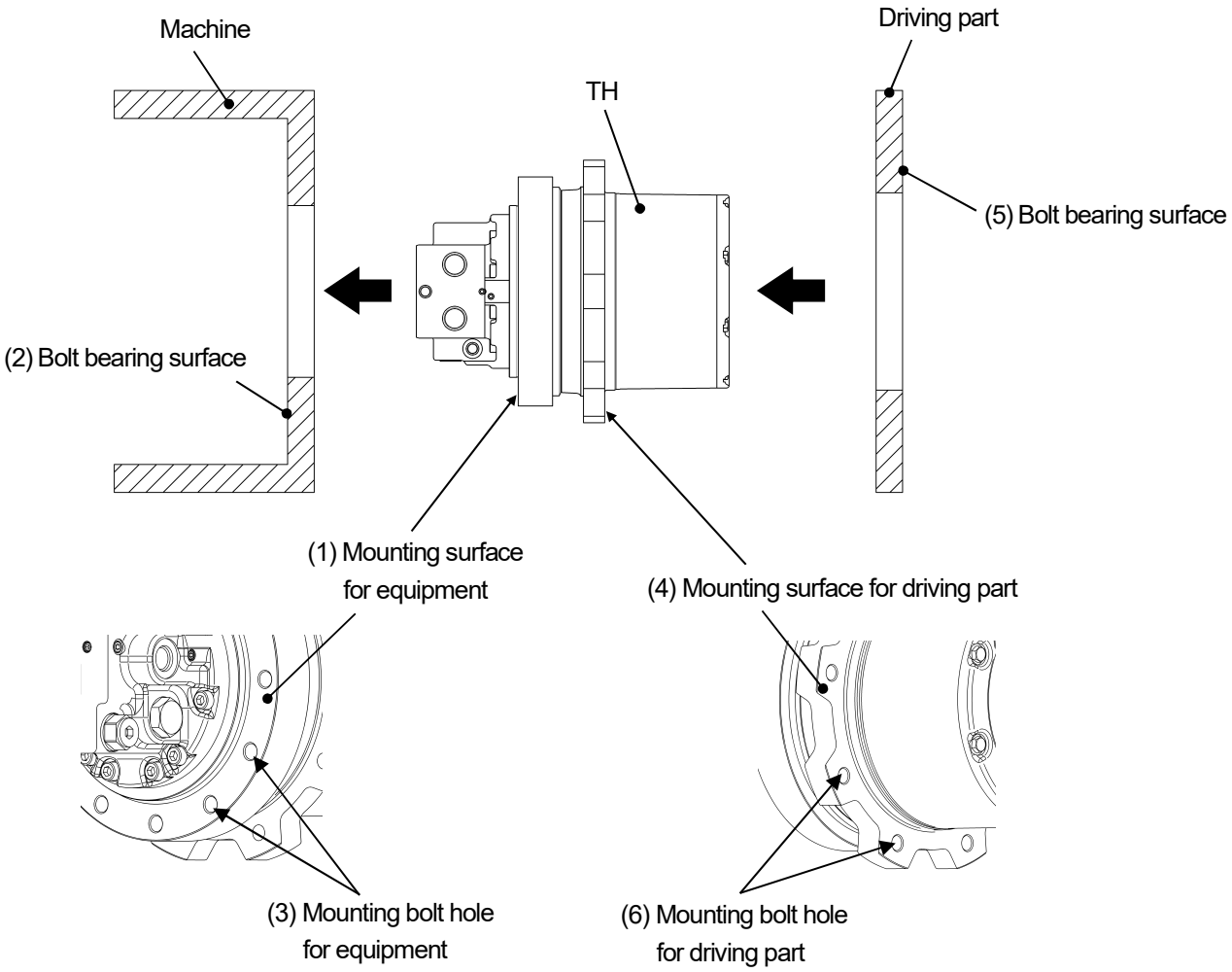


Fig. 4-1

Step 3 Check that there are no burrs or dirt on (1) Mounting surface for equipment of TH and TH mounting surface of the machine, and wipe off the antirust oil on (1) Mounting surface for equipment of TH and (2) Bolt bearing surface of the machinery.

NOTE

TH has antirust oil applied to the non-painted surfaces before shipping. To keep the transmitting torque by bolts high, wipe off the antirust oil on the mounting surface sufficiently.

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Step 4 Align (3) Mounting bolt hole for equipment of TH with the mounting holes of the machinery, and assemble TH into the machinery.

NOTICE

During the installation, do not hit TH with a hammer and the like.

Step 5 Insert the flat washers and the mounting bolts into (3) Mounting bolt hole for equipment of TH.

NOTICE

Use the specified number of TH mounting bolts and tighten with the specified tightening torque. Otherwise, not only TH may not provide its performance but also the customer machine and TH may be damaged.

Step 6 Tighten the mounting bolts for equipment uniformly with the specified tightening torque. Refer to the confirmation notice for the quantity and bolt size.

Table 4-1 Bolt tightening torque

Bolt size	M16 (P2.0)	M20 (P2.5)
Tightening torque [N-m] (Recommendation)	252±39.2	493±78.5

Step 7 Check that there are no burrs or dirt on (4) Mounting surface for driving part of TH and TH mounting surface of the driving part, and wipe off the antirust oil on (4) Mounting surface for driving part of TH and (5) Bolt bearing surface of the driving part.

NOTE

TH has antirust oil applied to the non-painted surfaces before shipping. To keep the transmitting torque by bolts high, wipe off the antirust oil on the mounting surface sufficiently.

Step 8 Align (6) Mounting bolt hole for driving part of TH with the mounting holes of the driving part, and assemble the driving part into TH.

NOTICE

Please do not hit TH with a hammer or the like at the time of mounting.

Step 9 Insert the flat washers and the mounting bolt for driving part into (6) Mounting bolt hole for driving part of TH.

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NOTICE

Use the specified number of TH mounting bolts and tighten with the specified tightening torque. Otherwise, not only TH may not provide its performance but also the customer machine and TH may be damaged.

Step 10 Tighten the driving part mounting bolts uniformly with the specified tightening torque. (Refer to Table 4-1 on p.16) Refer to the confirmation notice for the quantity and size of bolts.

4.3. Hydraulic Piping Connection

After installing TH, connect hydraulic piping.

Step 1 Remove the covers or plugs attached to the port.

Step 2 Fill the motor casing with hydraulic oil. Refer to the confirmation notice for the amount of hydraulic oil.

NOTICE

Fill the motor casing with hydraulic oil before use. If TH is operated without supplying hydraulic oil, the product may be damaged.

Step 3 Connect each hydraulic pipe.

NOTICE

- **Confirm TH piping port, rotation direction, and piping size in the confirmation notice.**
- **Select the piping size so that the drain port back pressure is below 0.20MPa (peak pressure; below 0.69MPa).**

4.4. Trial Run after Installation

After installing TH on the customer's equipment and piping it, check that the rotating direction is the intended direction. Also, follow the note below and operate safely after running-in TH.

NOTE

In the running-in operation, use the engine of the equipment in low idling and keep idling for 5 minutes or more to remove the inside air with TH at 1st speed.

⚠ CAUTION

- **Never approach the rotating part during machine operation. Person(s) may be caught by the rotating part, causing fatal accidents.**
- **TH may become hot during operation. After stopping the operation, do not touch TH until it has cooled down.**
- **Immediately stop operation when any abnormality occurs. Continuous operation may cause injuries to the operator.**
- **Observe TH specifications and the limitation of specifications specified by us. (Specifications and the limitation should be in compliance with the confirmation notice for TH or the specifications and operating agreement for the machine for which TH is used.)**

NOTICE

Do not perform rapid cooling for high-temperature TH. When cooling, perform air cooling by atmospheric air.

4.5. Setting method of free mechanism

TH may come with a free mechanism that allows the reduction gears part to rotate freely. Refer to the confirmation notice regarding the presence or absence of the free mechanism.

Follow the procedure below to set ON/OFF of the free mechanism.

(Follow that procedure if the confirmation notice includes the setting method of free mechanism.)

⚠ WARNING

When operating the free mechanism, be sure to fasten it on a flat surface or take appropriate measures. If you do this operation on a slope, there is a possibility of running out of control and causing an accident.

⚠ CAUTION

The case may become hot immediately after operation. It may cause burns if touched. If the free cover is removed at high temperature, the pin may pop out due to pressure in the reduction gears.

NOTICE

- **Do not perform rapid cooling for high-temperature TH. When cooling, perform air cooling by atmospheric air.**
- **If the lubricant leaks out, replenish it. Refer to Section 5.5 Replacing Lubricant (P. 24) for how to replenish.**

① To turn on the free mechanism (free rotation mode)

Step 1 Clean the surface of the free cover by removing dirt on it.

Step 2 Loosen the bolt carefully so that the pin does not fall off, and remove the bolt and free cover.

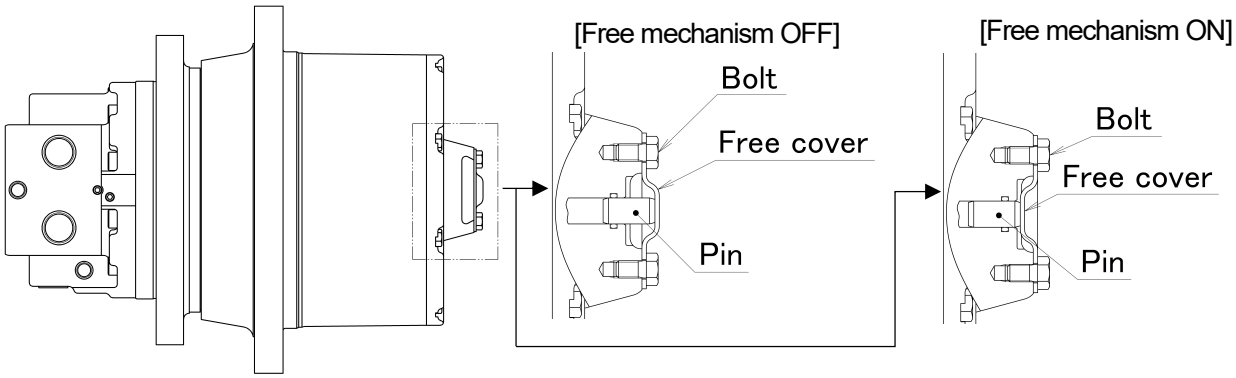
Step 3 Push the pin in at the convex part of the free cover and tighten the bolt until the free cover comes into close contact. [Tightening torque: 29.4±4.9 N-m]

② To turn off the free mechanism (power transmission mode)

Step 1 Clean the surface of the free cover by removing dirt on it.

Step 2 Loosen the bolt carefully so that the pin does not fall off, and remove the bolt and free cover.

Step 3 Make sure that the pin has protruded, install the free cover, and tighten the bolt.
[Tightening torque: 29.4±4.9 N-m]



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Chapter 5 HYDRAULIC OIL AND LUBRICANT

This chapter describes hydraulic oil and lubricant. The description on hydraulic oil and lubricant (this chapter) in this document should be reflected at least to the operation manual for the customer's machine into which TH is incorporated.

⚠ CAUTION

- **When replacing the hydraulic oil and lubricant, turn off the power to the customer machine.**
- **TH may become hot during operation. After stopping the operation, do not touch TH until it has cooled down. If the oil fill port and oil drain port are unplugged in the high-temperature state, the high-temperature lubricant may blow out accidentally due to the pressure change in the reduction gears, which can cause burn injury.**

NOTICE

- **TH is filled with the lubricant at the factory. Filling up the lubricant excessively may result in heat generation and leakage of the lubricant.**
- **TH is drained hydraulic oil at the time of shipment. Be sure to fill the motor casing with hydraulic oil before operation.**
- **If the amount of the lubricant has decreased due to some reason, identify and remove the cause, and then add the lubricant.**
- **When draining the lubricant, do not drain it on the ground. Be sure to drain it into a container. Disposal of the waste oil should be in accordance with the applicable laws and regulations.**
- **Do not perform rapid cooling for high-temperature TH. When cooling, perform air cooling by atmospheric air.**

5.1. Precautions when Handling Hydraulic Oil and Lubricant

● Precautions when handling hydraulic oil and lubricant are as follows:

- Before handling hydraulic oil and lubricant, be sure to read the precautions described on the case/bottle of each lubricant for correct use. Wrong usage may cause fatal accident.
- Be sure to wear protective goggles in order to prevent hydraulic oil and lubricant from entering into eyes.
- Be sure to wear rubber gloves to prevent hydraulic oil and lubricant from contacting your skin.
- Do not eat or put hydraulic oil and lubricant into your mouth.
- For detailed information, refer to Safety Data Sheet of hydraulic oil and lubricant.
  Ask to the Safety Data Sheet from our Customer Support or the purchaser of hydraulic oil and lubricant.

- **Emergency measure:**
  - If hydraulic oil or lubricant comes into contact with eyes, flush for 15 minutes with clean water and seek medical treatment.
  - If hydraulic oil or lubricant comes into contact with skin, wash affected area with water and soap.
  - If hydraulic oil or lubricant is swallowed, do not induce vomiting and seek medical treatment immediately.

- **Disposal of waste oil and container:**
  - Proper disposal is required by laws and regulations. Follow the laws and regulations.
  - Consult the purchaser of hydraulic oil and lubricant for assistance or advice if any uncertainty arises.

- **Storage**
  - To avoid any foreign object or water from being mixed in, seal container of hydraulic oil and the lubricant after use.
  - Avoid direct sun light, keep away from fire or heat sources, and store in a cool and dark place.

5.2. Type of Hydraulic Oil

NOTICE

Use the hydraulic oil recommended by us. Use of any other hydraulic oil may degrade the performance and durability of TH.

- **Hydraulic oil specified by Comtesco**
  - Use a wear-resistant hydraulic oil with a viscosity equivalent to ISO VG32 to VG46.
  - The cleanliness of hydraulic oil should be maintained within level NAS9.
  - The recommended brands are as follows.

Grade	Viscosity (40 [℃])	32 [mm^2/s]	46 [mm^2/s]
	JIS	VG32	VG46
Manufacturer name	Idemitsu Kosan	Daphne Super Hydro A32	Daphne Super Hydro A46
	Exxon Mobil	Mobil DTE24	Mobil DTE25
	ENEOS	SUPER HYRANDO 32	SUPER HYRANDO 46
	Cosmo Oil	Cosmo Hydro AW32	Cosmo Hydro AW46

- **Filling volume of hydraulic oil**

Prepare hydraulic oil according to the amount of hydraulic oil described in the confirmation notice.

- **Temperature and viscosity range of hydraulic oil**

Make sure that the operating temperature range and viscosity range of the hydraulic oil do not exceed the following ranges.

- Operating temperature range : -20～+90 [℃]
- Practical viscosity range : 15～500 [mm^2/s]

NOTICE

When using with a viscosity of 500 [mm^2 / s] or more, the motor may not be able to suck oil and may cause malfunction. In addition, if the viscosity is less than 15 [mm^2 / s], the performance will decrease significantly, and if it is used for a long time, the motor sliding part may get damaged, resulting in a permanent deterioration in performance.

5.3. Replacing Hydraulic Oil

- **Replacement interval**

- Replace with new oil every 1000 engine hours or 1 year.
- If the deterioration of the hydraulic oil is severe even within the above replacement interval, replace it according to the following standard.

Test items		Replacement criteria
Viscosity change (40[℃])	[mm^2/s]	Within ±10[%]
Total oxidation	[mgKOH/g]	Consult with the hydraulic oil manufacturer because it depends on the oil type and manufacturer.
Water content	[%]	Within 0.1
Impurities	[mg/100mL]	Within 10
Insoluble content	[%]	Within 0.05
Color	—	Drastic change

- **Replacement procedure**

Replace and replenish according to hydraulic oil replacement and replenishment procedure of the machine.

NOTICE

Use the same hydraulic oil brand for replacement and replenishment, and do not mix different brands.

5.4. Type of Lubricant and Filling volume

NOTICE

Use the lubricant recommended by us. Use of any other lubricant may degrade the performance and durability of TH.

- **Lubricant specified by Comtesco**

Use a lubricant with extreme-pressure additive equipment to SAE # 90 (API class GL-4 or higher).The following brands are recommended.

Manufacturer name	Product name
ENEOS	Gear Oil GL-4 90
Idemitsu Kosan	Apolloil Gear HE90
Exxon Mobil	Mobilube HD80W-90
Shell	Shell Spirax EP90
Cosmo Oil	Cosmo Gear GL-4 90

- **Filling volume lubricant**

Prepare lubricant according to the amount of lubricant in the confirmation notice.

- **Temperature range of lubricant**

Operating temperature range : -20 ~+80 [℃]

5.5. Replacing Lubricant

● Replacement interval

- Replace with new oil at 500 engine hours first, after that every 1000 engine hours. Replace the lubricant if it has been in stock for a long time (1 year or more).
- If the lubricant deteriorates severely even within the above replacement interval, replace it according to the following standard.

			Replacement	Apply
Viscosity change (40[℃])		[mm^2/s]	Within 10% compared with new oil	Progress of oxidative degradation Mixing of different oils
Water content		[%]	Within 0.2	External contamination
Pentane insoluble matter		[%]	Within 1.0	Oxide, carbon, additives, wear powder, dust, and so on. from outside
Total oxidation		[mgKOH/g]	0.5 increase compared with new oil	Progress of oxidative degradation
Metal analysis	Al	[ppm]	Within 150	
	Cr	[ppm]	Within 20	
	Cu	[ppm]	Within 20	
	Fe	[ppm]	Within 600	
	Si	[ppm]	Within 350	

● Replacement procedure

⚠ CAUTION

- **Confirm that the power of the customer machine is turned off before beginning the replacement work.**
- **Immediately after operation, TH and lubricant may be hot and may cause burns if touched. Work after the temperature has dropped sufficiently.**
- **Lubricant may eject when removing the reduction gears plug to supply and drain oil. Please work with great care, such as slowly removing the plug to relieve internal pressure.**
- **Be sure to wear protective goggles and rubber gloves.**
- **Do not replace/replenish the lubricant in a subfreezing environment. Failure to observe this may result in cold injury. Also, if the lubricant is replaced/replenished in a subfreezing environment, the temperature difference from the operating temperature increases and the pressure increase in the reduction gears may cause oil leakage.**

NOTICE

Do not perform rapid cooling for high-temperature TH. When cooling, perform air cooling by atmospheric air.

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NOTICE

Use the same lubricant brand for replacement and replenishment, and do not mix different brands.
When changing the oil type, flush the inside of reduction gears.

Replace or replenish the lubricant according to the following procedure. Also, work with TH in the posture with the oil fill port up and the oil drain port down as shown below.

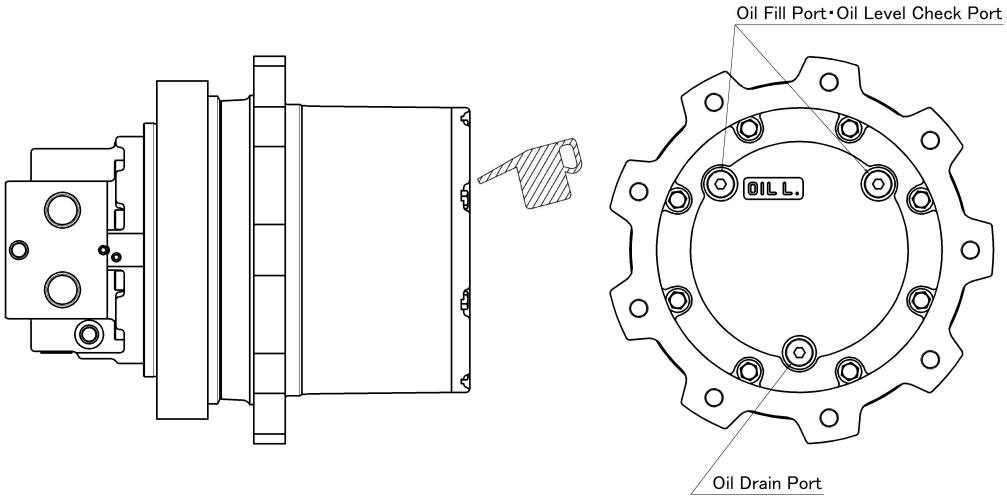


Fig. 5-1

Step 1 When replacing, remove the plug of the oil fill port, oil drain port, and oil level check port, and drain the lubricant. When replenishing the lubricant, do not remove the plug of the oil drain port.

NOTICE

Receive the drained lubricant with a container.

Step 2 After the completion of drainage, plug the oil drain port, and tighten the plug with the specified tightening torque (p.26 Table 5-3).
（Refer to the confirmation notice for plug size）.

Step 3 Fill up the lubricant from the oil fill port.

Referring to the amount of filled lubricant described in the confirmation notice,

(The Oil Level Check Port is a reference for oil level.)

NOTE

If the lubricant is filled up excessively, the inner pressure increases, which can cause a leakage of the lubricant or damage to the oil seal.
When the lubricant is small in amount, insufficient lubrication may cause damage to TH.

Step 4 When filling is complete, insert the plug into the oil fill port and oil level check port, and tighten with the specified tightening torque. (Refer to the confirmation notice for the plug size.)

NOTICE

When tightening the plug with O-ring to each port, make sure that the O-ring is not damaged.

Step 5 If the lubricant has adhered to the periphery, wipe it off sufficiently.

Table 5-3 Plug size and tightening torque

Size	G3/8	G1/2
Tightening torque [N-m]	58.8±9.8	98.1±19.6

Chapter 6 MAINTENANCE & INSPECTION

This chapter describes the maintenance and inspection. Reflect at least the description on maintenance & inspection (this chapter) in this document to the operation manual for the customer machine into which TH is incorporated.

6.1. Precautions on maintenance and inspection

⚠ CAUTION

- **Turn off the power to the customer machine before starting maintenance and inspection. If maintenance or inspection is performed during machine operation, person(s) may get burned due to high temperature or be caught by the rotating part, causing fatal accidents.**
- **Do not perform maintenance and inspection in a subfreezing environment. Failure to observe this may result in cold injury. Also, if maintenance or inspection is performed in a subfreezing environment, the temperature difference from the operating temperature increases and, as the result, the increased pressure in the reduction gears may cause oil leakage.**
- **TH may become hot during operation. After stopping the operation, do not touch TH until it has cooled down.**
- **Wear appropriate clothing and appropriate protective equipment (protective goggles, protective gloves, and protective footwear).**
- **Abnormal noise should be checked during operation. Never touch the machine during the check.**

NOTICE

Do not perform rapid cooling for high-temperature TH. When cooling, perform air cooling by atmospheric air.

6.2. Periodical Inspection

● Periodical inspection list

Inspect the following items at least once in a year.
Lubricant must be replaced based on the operating time. Refer to Section 5.5 Replacing Lubricant (p.24) and replace as appropriate. For hydraulic oil, replace it appropriately referring to Section 5.3 Replacing Hydraulic Oil (p.22).

No.	Inspection item	Description	Reference
1	Leakage of lubricant	Check whether there is not a leakage of lubricant from the mating surface around TH and floating seal section.	6.2.1.
2	Bolt looseness	Check whether each mounting bolt is not loose.	6.2.2.
3	Abnormal noise	Check whether there is not any abnormal noise or sudden change in sound.	6.2.3.
4	Surface temperature of TH	Check whether surface temperature of TH is abnormally high.	6.2.4.

- **Necessary tools**

The typical tools required for maintenance and inspection are listed below.

- Hexagon wrench
- Wrench
- Torque wrench
- Surface thermometer

6.2.1. Checking for lubricant leakage

Visually check the periphery of the reduction gears, joint surface with the machine, and the entire machine to make sure that there is no leakage of the lubricant.
If a leakage of the lubricant has been found, identify and remove the cause, and then fill the specified amount of lubricant.

NOTICE

The adhering dirt and sand may cause seizure, heat generation, or protrusion, and the lubricant may leak due to the loss of the sealing performance of the floating seal.

6.2.2. Inspecting the mounting bolts

Check looseness of the mounting bolts for equipment and the mounting bolts for driving part. If any are loose, retighten with the specified tightening torque. (Refer to p.16 Table 4-1 for the tightening torque.)

6.2.3. Checking for abnormal noise

⚠ CAUTION

Abnormal noise should be checked during operation. Never touch the machine during the check.

Step 1 Be careful not to touch TH and check abnormal noise or sudden changes in sound.

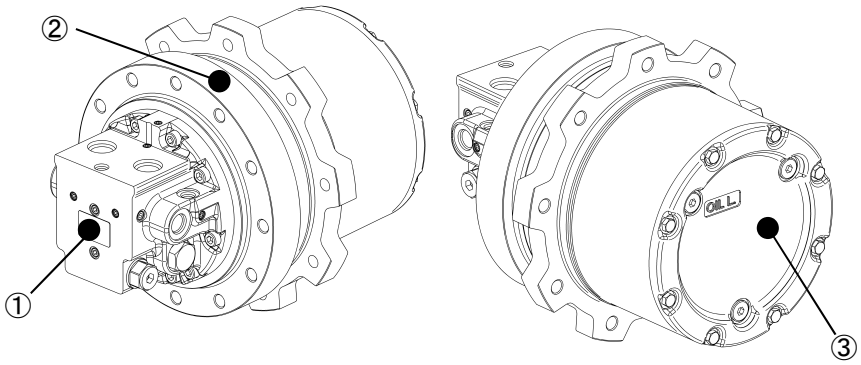
Step 2 If any abnormal noise has been detected, report it to the administrator and stop the machine operation.

6.2.4. Inspecting the surface temperature

Measure the surface temperatures of the motor and reduction gears to check whether they are not over the standard temperature. Perform the measurement after continuous operation.

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Step 1 Using a surface thermometer, measure the surface temperature at the measurement point shown in the following figure below and the surrounding area to check the maximum value.



①、② : Hydraulic motor temperature measurement point
※② anywhere on the circumference
③ : Reduction gears temperature measurement point

Fig. 6-1

NOTE

For the method of using the surface thermometer, refer to the operation manual attached to the product you use.

Step 2 If the surface temperature is more than 80°C, report it to the administrator and stop the machine operation.

Standard surface temperature of hydraulic motor and reduction gears in continuous operation : Maximum 80℃

6.3. Removal from the Machine

If it is necessary to remove TH from the machine for maintenance, inspection, or replacement, pay the following precautions and remove it in the reverse procedure described in Section 4.2 Hoisting and Installing TH (refer p.15).

⚠ CAUTION

- **To remove TH, hoisting by crane operation is needed. Before starting the removal, refer to "4.1 Precautions on Hoisting" (p.14) to confirm the precautions on hoisting and work procedure. Hoist TH in accordance with the description.**
- **Make sure no torque remains on TH before starting work.**

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Chapter 7 TROUBLESHOOTING

If there is any problematic phenomenon, check the cause and take measures according to the following table.
If the measure marked with a circle is needed, stop the machine operation and contact our customer support.

For the item marked with a circle, contact our customer support. ↓

Phenomenon 1	Phenomenon 2	Possible cause	Countermeasure	
Does not rotate	No pressure is applied	Low set pressure of the relief valve	Set the pressure correctly.	
		Malfunction of the pump	Repair.	
		Malfunction of the flushing valve	Replace or repair the flushing valve.	○
	Pressure is applied	Malfunction of the hydraulic motor	Repair.	○
		Damage of the gears (reduction gears)	Replace TH.	○
		Overloaded	Remove the load.	
Oil leakage	From the mating surfaces	Scratches on mating surfaces	Polish the surface using a grindstone, polishing paper, and so on.	○
		Looseness of bolts	Retighten the bolts.	
	From the reduction gears	Looseness of plugs	Retighten the plugs.	
		Cracks with stones	Replace TH.	○
	From between the reduction gears and the hydraulic motor	Wear of sliding surfaces	Replace TH.	○
		O-ring creep	Replace TH.	○
	From the hydraulic motor	Looseness of bolts	Retighten the bolts.	
		O-ring damage	Replace the O-rings.	○
		Scratches on the sealing surface	Polish the surface using a grindstone, polishing paper, and so on.	○
Rotated by load during use	Increased internal or external drain	Increased leakage (drain) from the sliding surface	Replace TH.	○
	Parking brake is not working	Damage to springs	Replace the springs.	○
		Friction plate wear	Replace the friction plate and the mating plate.	○

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Phenomenon 1	Phenomenon 2	Possible cause	Countermeasure	
The surface temperature of the reduction gears is high		Lack of lubricants	Replenish to proper amount.	
		Pitting occurs in bearings and gears	Replace TH.	○
		Hydraulic oil enters the gear case	Replace the oil seal and lubricants.	○
Meander (when used as a travel motor)		Carried load mismatch in both side	Match carried load in both side.	
		The left and right hydraulic motor drains are different	Replace TH.	○
		Malfunction of the flushing valve	Replace or repair the flushing valve.	○
Speed is insufficient	Low pump discharge	Pump does not work properly.	Replace or repair the pump.	
		Excessive pump leakage	Replace or repair the pump.	
		Large amount of leakage from the hydraulic motor	Replace TH.	○
Abnormal noise is produced.	From TH	Damage to the hydraulic motor or reduction gears	Replace TH.	○
	From the pipe	Vibration of pipes	Clamp the pipes.	
2-speed does not switch	Do not switch from low speed to high speed	malfunction of the high pressure selection check valve	Replace the control valve	○
		malfunction of the switching valve	Replace or repair the valve.	○
		Low pilot pressure	Set to the specified pressure	
		malfunction of the 2-speed switching piston	Replace TH.	○
	Do not switch from high speed to low speed	malfunction of the switching valve	Replace or repair the valve.	○
		malfunction of the 2-speed switching piston	Replace TH.	○
Free mechanism does not switch		malfunction of the free mechanism	Replace TH.	○

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CUSTOMER SUPPORT

For inquiries related to products and servicing, please contact customer support (see the following addresses):

For inquiries, be ready to provide the product information described on the nameplate attached on the product.

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