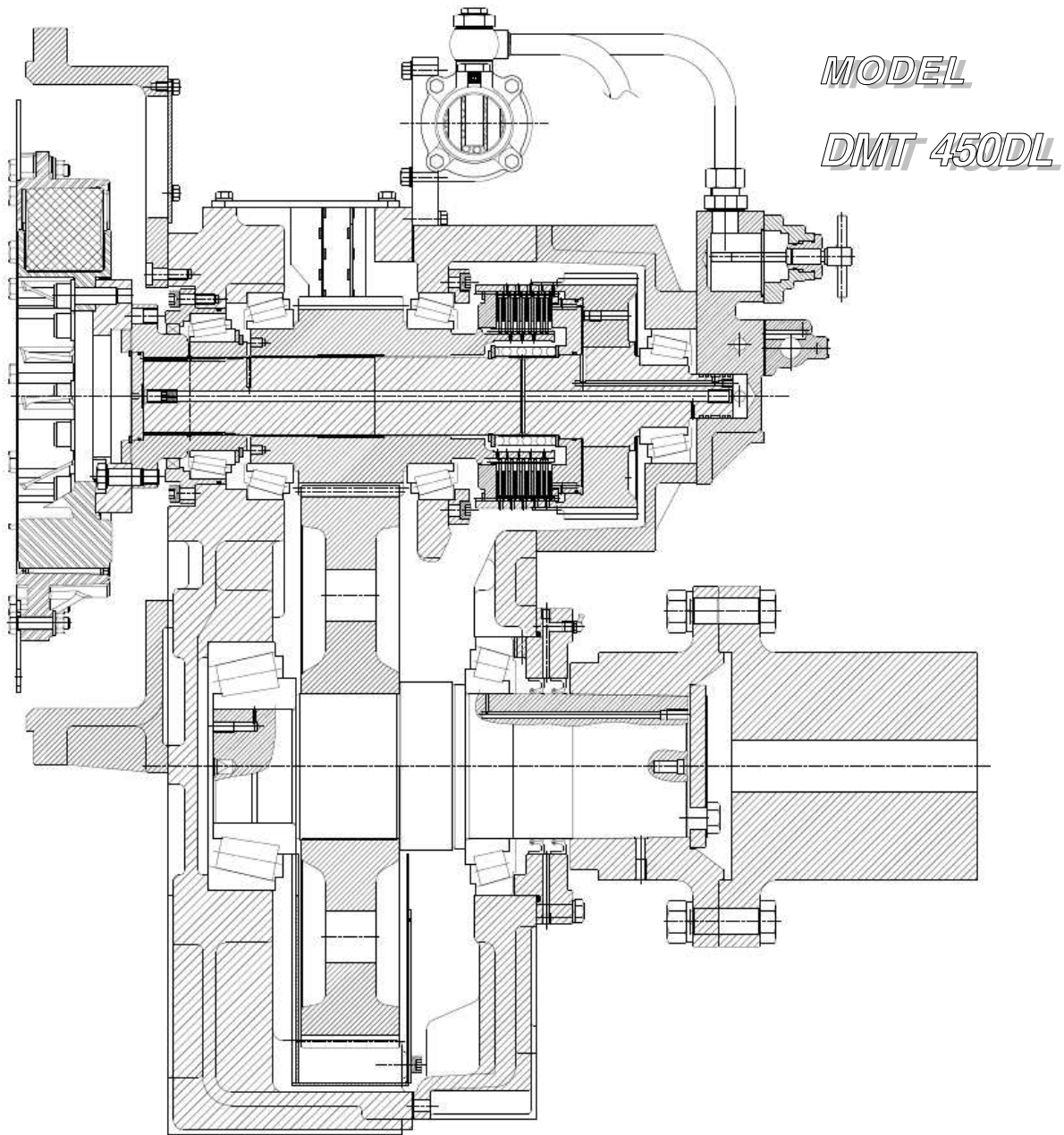


The users should read this manual thoroughly before operation and observe the operating method and precautions for more effective operation.

MARINE TRANSMISSION INSTRUCTION MANUAL




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Introduction





This manual contains descriptions of construction, operation principle, correct operation, handling method, caution for installation, simple maintenance and overhaul, etc. regarding D-I Marine transmission (DMT450DL).

APPLICATION	HYDRAULIC MARINE TRANSMISSION
MODEL	DMT450DL
To use this product safely and correctly the users must read this manual thoroughly and understand it enough before operation. Keep this manual at a designated place for next time.	

Please read the contents marked with  in this manual and use this product correctly.

Users must follow the instruction now that the contents marked with  are very important information on safety.

In this manual, DANGER degrees for wrong handling are divided into 4 degrees as following table.

 DANGER	If the contents with this mark are ignored and it is mishandled, urgent situations such as death, serious injury could occur.
 CAUTION	If the contents with this mark are ignored and it is mishandled, it is possible to suffer a loss of life and property or serious injury.
 IMPORTANT	If the contents with this mark are ignored and it is mishandled, a loss of property could occur.
	The contents with this mark should be read carefully.

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CHAPTER 1 – OVERVIEW

1-1. FUNCTION

The D-I marine transmission described in this manual is the power-transmitting unit which transmits the power generated from Engine to Propeller.

The main functions are the ahead, neutral, astern and reduction of speed at fixed rate. The marine transmission has the structure which can safely endure the power generated by propeller's propulsion.

The power for the ahead and astern is transmitted by clutches with hydraulic multiple plates. The necessary hydraulic system is integral inside.

1-2. SPECIFICATIONS

Model	Reduction ratio	Max. Input speed	Max. Input torque	Operating pressure	Lubricating pressure	Dry Weight	Flow of cooling water
		(rpm)	(kgf-m)	(kg/cm ²)	(kg/cm ²)	(kg)	(l/min)
DMT450DL	3.02	2400	453	20~27	0.5~4	957	90~120
	3.28						
	3.56						
	4.07		409.1				
	4.48						
4.95	374						

※ The weight does not include the fly wheel housing Ass'y, coupling Ass'y, propeller coupling and mounting brackets.

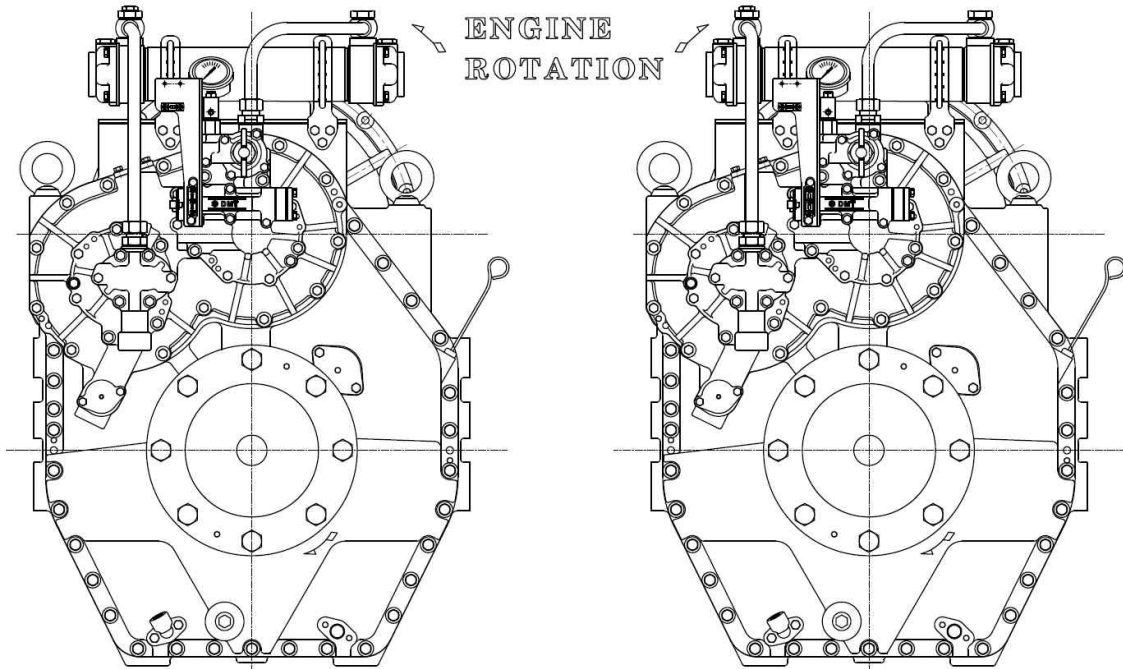
 **CAUTION**

D-I marine transmission must be applied to marine engine with regulated capacity, otherwise the slip, overheat or breakage could happen to power transmission system.

The capacity must be observed and If there are any inquiries, please contact D-I Industrial Co., Ltd.

D-I marine transmission must not be used for the marine engine which is rotated clock wise seen from the rear of the engine.

If D-I marine transmission needs to be used for the engine with clock wise rotation, please contact D-I Industrial Co., Ltd. for consultation.



[C.C.W ENGINE]

[C.W ENGINE]

CHAPTER 2 – CONSTRUCTION

2-1. OVERVIEW

D-I marine transmission is the reduction unit which generates ship's propulsion and consists of major components in drive line system such as input shaft sub Ass'y, astern shaft sub Ass'y and output shaft Ass'y, etc. five sub Ass'ys.

Now that the hydraulic clutches controlled by oil pressure are applied for ahead and astern operation, there are pump Ass'y to generate oil pressure, oil cooler, selector valve Ass'y, valve holder Ass'y and pump holder Ass'y in hydraulic system.

The marine transmission is directly mounted to engine flywheel housing by bolts. The power is transmitted from the outer part which is assembled onto engine flywheel to input shaft through the inner part with rubber blocks.

In other words, the power is transmitted by the flexible coupling.

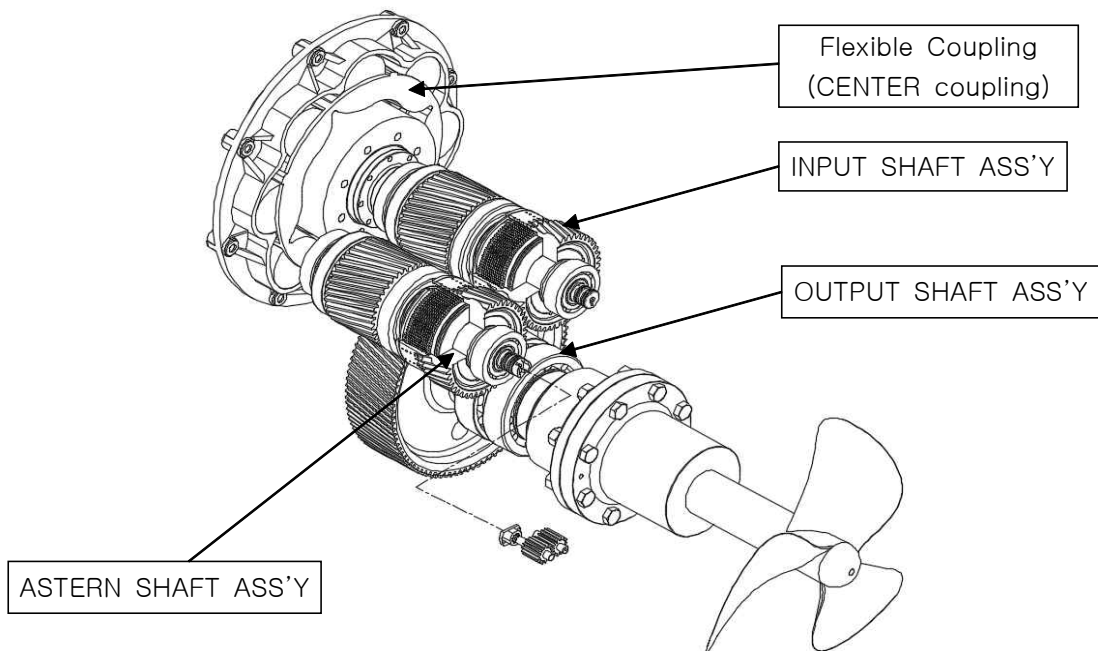
IMPORTANT

Responsibility for Torsional vibration

Torsional vibration analysis is carried out by the engine maker or independent consultants. D-I Industrial Co., Ltd. can provide relevant data for the analysis of marine transmission supplied by D-I Industrial Co.,Ltd.

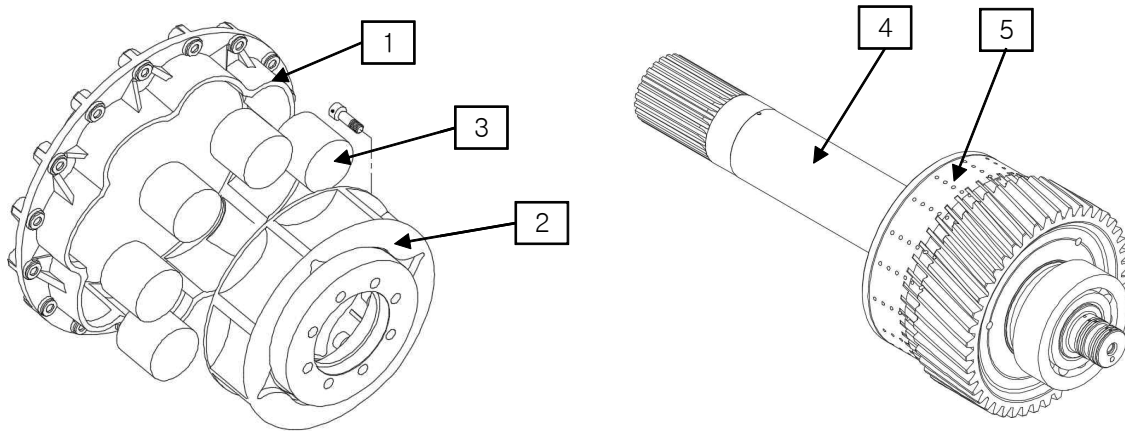
The equipment installer is responsible for ensuring the torsional compatibility of the propulsion system.

D-I Industrial Co.,Ltd. has no liability for noises/damages of marine transmission and damages of flexible coupling and other drive units caused by that kind of vibration. For safe operation, users should refer to instruction manual prior to operation.



[Fig-1] Construction of Marine transmission

2-2. INPUT SHAFT SUB ASS'Y



1) Outer Part

The outer part has the grooves in regular shape for the rubber blocks to be assembled to transmit the power. It is assembled to engine flywheel by screws.

2) Inner Part

The Inner part is assembled to input coupling by reamer bolts and has the structure for the rubber blocks to be assembled.

3) Rubber block

They are rubber products and relieve the rotational vibration by engine which means they let the power transmitted smoothly.

4) Input shaft

The input shaft is assembled to input coupling with spline and shrink-fitted to input clutch housing.

5) INPUT SHAFT ASS'Y

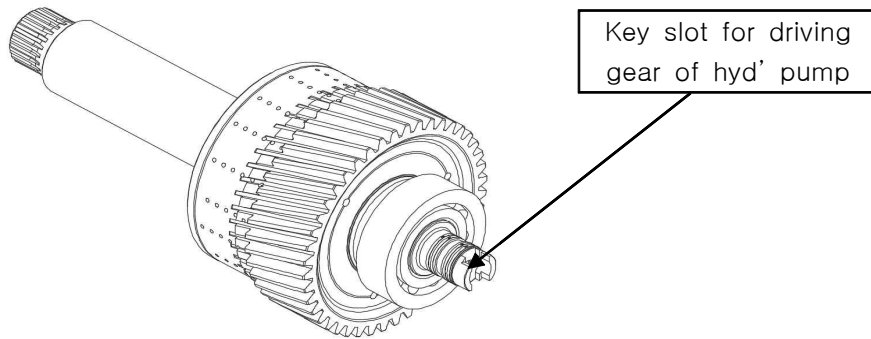
The input shaft sub Ass'y consists of input clutch housing, clutch piston, steel plates, sintered plates, back plate and return spring.

The steel plates have inner teeth which engage with the input pinion and sintered plates have outer teeth which engage with the input clutch housing.

The steel plates and sintered plates are alternately assembled one by one and when the selector valve lever is shifted in ahead position, the oil pushes the clutch piston to actuate the input clutch. At this moment, the steel plates and sintered plates are engaged and the power is transmitted from the input clutch housing to input pinion.

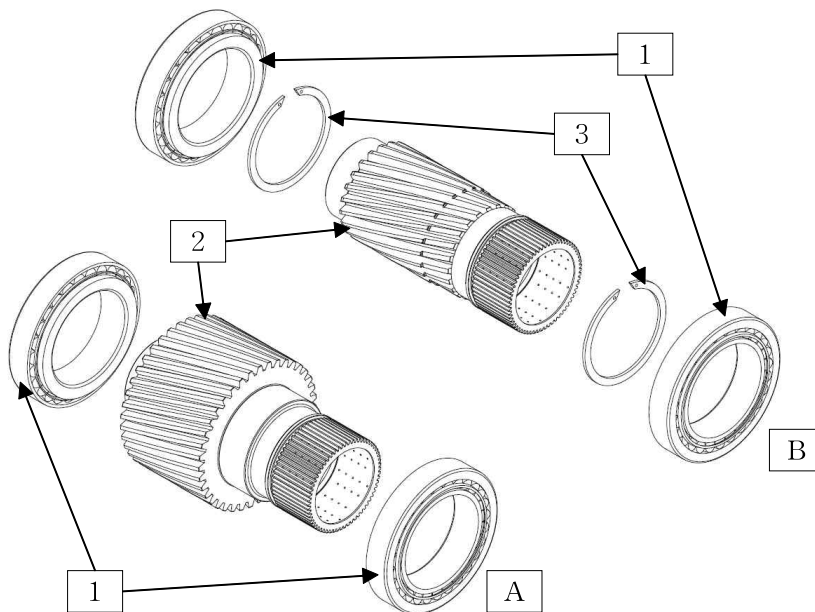
When the lever is shifted in neutral position, the clutch piston returns to its original position by the return spring. At this moment, the oil is drained from the clutch piston section and the clutch is automatically disengaged.

2-3. ASTERN SHAFT ASS'Y



The astern shaft Ass'y consists of the same parts as the input shaft Ass'y except for the astern shaft sub Ass'y and pump driving block at the rear of shaft.

2-4. PINION



1) Taper roller bearing

Taper roller bearings which are shrink-fitted to pinions are assembled to sides of case and case cover. They support the load generated by pinions' rotation.

2) Pinion

The input and astern pinion are identical and are engaged with the output shaft gear. When the ahead or astern operation is on, the power is transmitted from the input shaft sub Ass'y to output shaft gear.

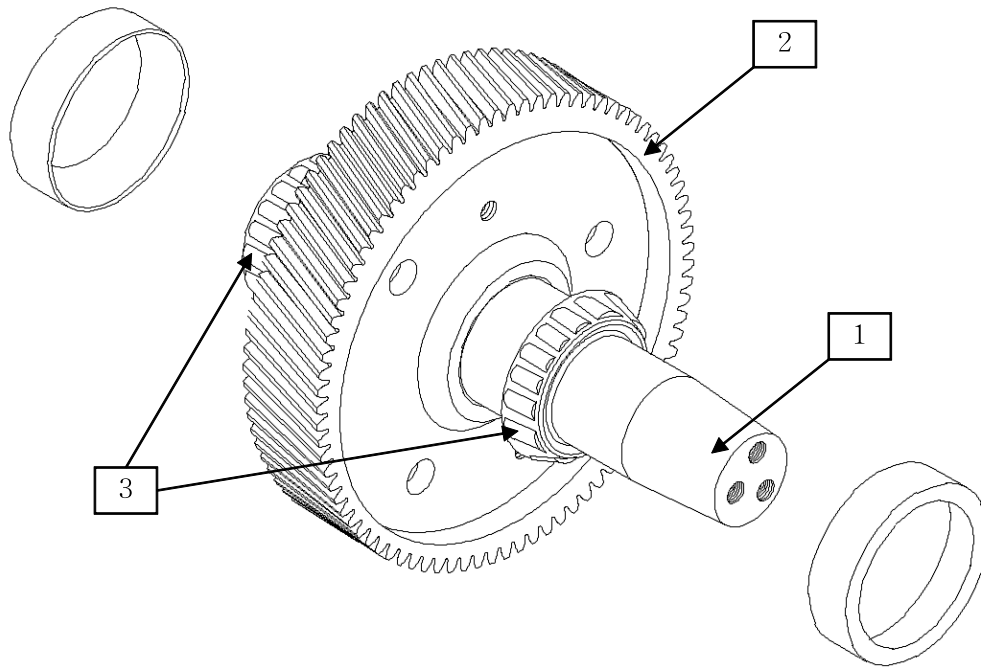
Unlike other models, the shim adjustment for DL model is carried out after assembled to case Ass'y.

3) SNAP RING

The snap rings support the bearings' load.

- Ratio for A Type(snap rings unapplied) : 3.02, 3.28, 3.56, 4.07, 4.48
- Ratio for B Type(snap rings applied) : 4.95

2-5. OUTPUT SHAFT ASS'Y



1) Output shaft

Output Shaft has the support by two taper roller bearings and shrink-fitted with output gear. on the input side's taper, the output coupling is assembled.

2) Output gear

The output gear is shrink-fitted to output shaft and engaged with the input and astern pinion at all times.

3) Taper roller bearing

The taper roller bearings fixed on both sides of the output shaft support the thrust force generated from the propeller during the ahead or astern actuation.

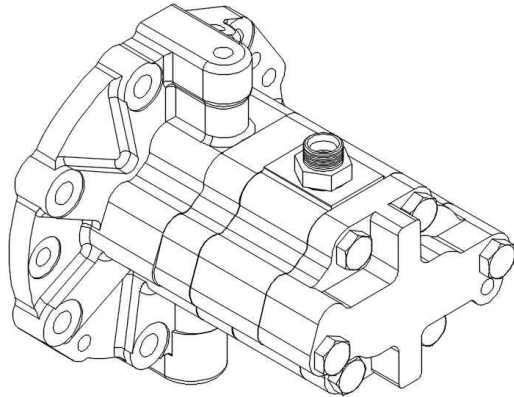
4) Output coupling

The output coupling is assembled to output shaft in taper and is firmly fixed by a plate and screws.

2-6. CASE, CASE COVER, BEARING CARRIER

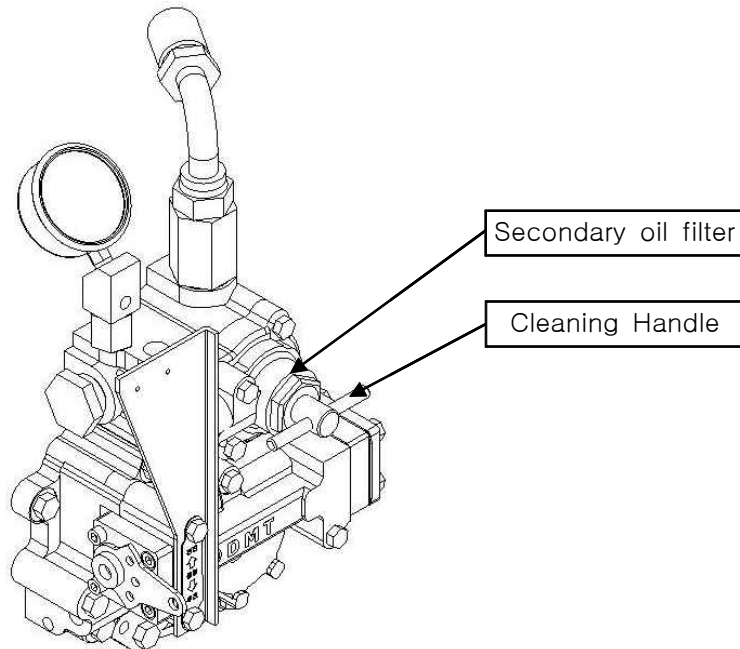
The case, case cover and bearing carrier is made of cast iron.

2-7. PUMP HOLDER GROUP



The pump holder is made of cast iron. The hydraulic pump is the circumscribed gear type, and bolted on the pump holder. The pump driving gear is driving block and spline fitted at the end of the astern shaft, and rotated at the same speed as that of engine, but in the opposite to engine direction.

2-8. SECONDARY OIL FILTER



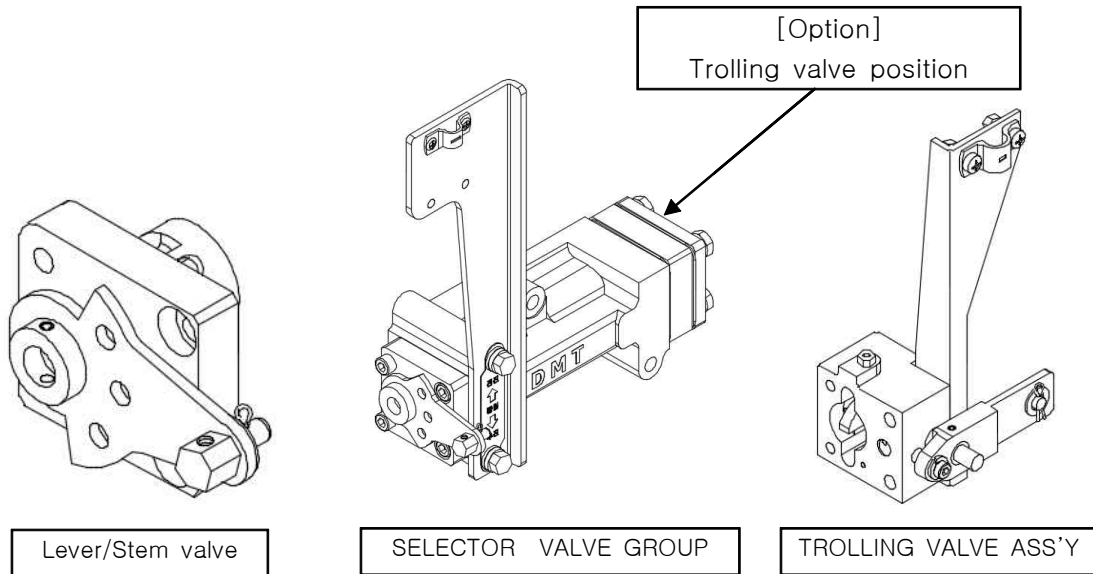
This is attached to the inlet of the valve holder to re-filtrate the oil which is filtered through a strainer on the inlet side of the pump before leading it to the bearing carrier.

As it has simple construction, it is very easy to clean by rotating the cleaning handle.

Periodic Inspection : ANNEX I

2-9. SELECTOR VALVE GROUP

The main components are the pressure-regulating valve and piston to control the operating pressure and orifice plate to adjust the impact and time when operating.



1) Selector valve body

The selector valve body is made of cast iron, and bolted on the valve holder.

2) Valve stem

The valve stem is rotated in the valve body, and has three ports leading oil to the passages for ahead, neutral, and astern position. The pressured oil for actuation of the clutch is led to each clutch through these passages.

3) Lever / Stem valve

The lever is fixed on the valve stem with a spring pin, and clutch operation for ahead, neutral, or astern position can be performed by operation of this lever. And it is provided with a proper control head to make remote control.

※4) TROLLING VALVE ass'y (Option)

Trolling valve is a device that controls imperceptibly the rotation of output shaft at the low rpm of engine. It is constructed to control remotely by the cable.

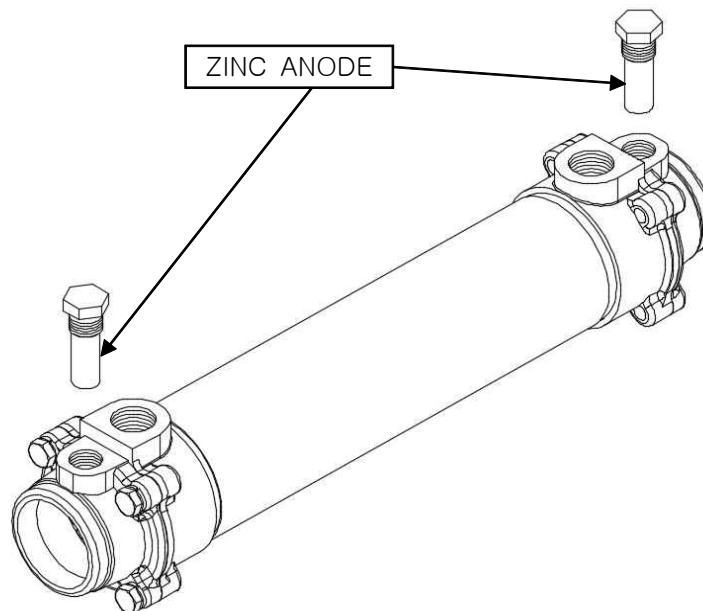
2-10. HYDRAULIC PUMP ASS'Y

The hydraulic pump is circumscribed gear type and bolted on the pump holder. The pump driving gear is driving block and spline fitted at the end of the astern shaft, and rotated at the same speed as that of engine, but in the opposite to engine direction.

2-11. SCREEN FILTER ASS'Y

The screen filter assembly is connected with a suction pipe of the pump inlet side of filtrating oil and fixed on the bottom side of the case cover with screws. It is easy to clean by removing the screen filter cover.

2-12. OIL COOLER



Oil Cooler is the device that cools the operating oil inside of marine gearbox and uses the seawater as cooling water. It is bolted on the cooler fixing block fitted in the case and cools the oil supplied from hydraulic pump and sends to the secondary oil filter. It uses Aluminum brass pipe which is strong against corrosion, and applies the Zinc anode.

Periodic Inspection : ANNEX I

CHAPTER 3 – PRINCIPLES OF OPERATION

3-1. OVERVIEW

D-I Marine transmission is operating with the hydraulic pressure and must be operated within the limits of rated load capacity, and has the same capacity and reduction ratio for the ahead and astern actuation. Therefore it can be appropriately used in the application of twin engine system.

The clutches are hydraulic multi-plates types and performed by the hydraulic pressure. The lubrication for the each part is divided into 2 ways, one is lubricated by force and another by scattering.

* Lubrication by force: the input shaft spline, input coupling oil seal, bearings, gears, internal steel plates and external sintered plates, clutch housing gears and etc.

* Lubrication by scattering: bearings, pinion gears, output gear.

3-2. DIRECTION OF ROTATION

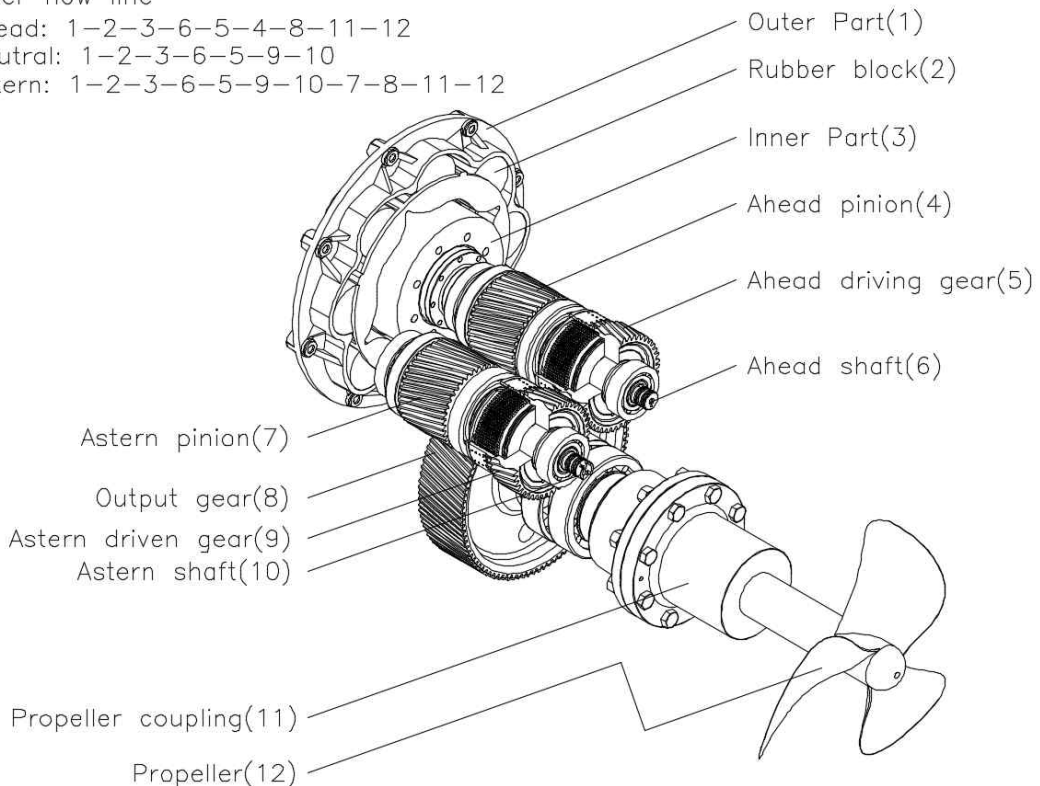
The input shaft is rotated in the same direction as that of engine, and the output shaft in the opposite direction during ahead actuation but in the same direction during astern actuation.

Power flow line

Ahead: 1-2-3-6-5-4-8-11-12

Neutral: 1-2-3-6-5-9-10

Astern: 1-2-3-6-5-9-10-7-8-11-12



[Fig-2] Drive line system of marine Transmission

3-3. POWER TRANSMISSION (Refer to Fig.2)

1) Neutral position

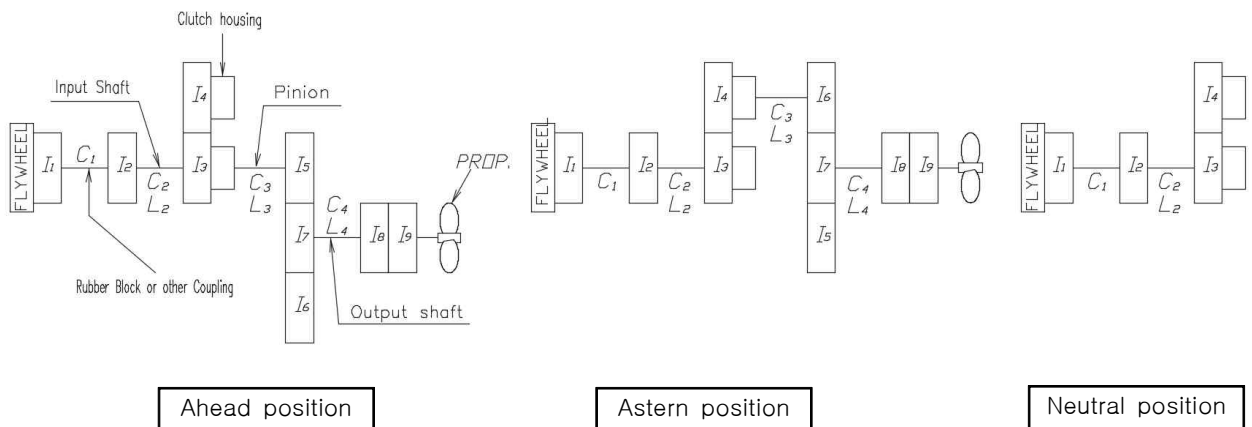
- ① The power is transmitted from the outer part bolted to engine flywheel to inner part with rubber blocks in order.
- ② The inner part transmits the power to input coupling and then the power is transmitted to input shaft through the input coupling's spline. At this moment, the input clutch housing which is shrink-fitted to input shaft also rotates because the inner teeth of input clutch housing are engaged with outer teeth of sintered plates.
- ③ At the same time, the outer teeth of input clutch housing are engaged with outer teeth of astern clutch housing and inner teeth of astern clutch housing are engaged with outer teeth of sintered plates, so the astern clutch housing and sintered plates rotate in the opposite direction of engine.
- ④ Any rotating parts of marine transmission do not transmit the power in the neutral condition.

2) Ahead position

- ① The high-pressure oil from the selector valve pushes the clutch piston in the input clutch and then steel plates are engaged with sintered plates.
- ② Friction plates rotate in the same direction of input clutch housing.
- ③ The pinion engaged with steel plates rotates.
- ④ The power is transmitted to output gear and propulsion force (opposite direction of engine) occurs.

3) Astern position

- ① The high-pressure oil from the selector valve pushes the clutch piston in the astern clutch and then steel plates are engaged with sintered plates.
- ② Friction plates rotate in the same direction of astern clutch housing.
- ③ The pinion engaged with steel plates rotates.
- ④ The power is transmitted to output gear and propulsion force (same direction of engine) occurs.



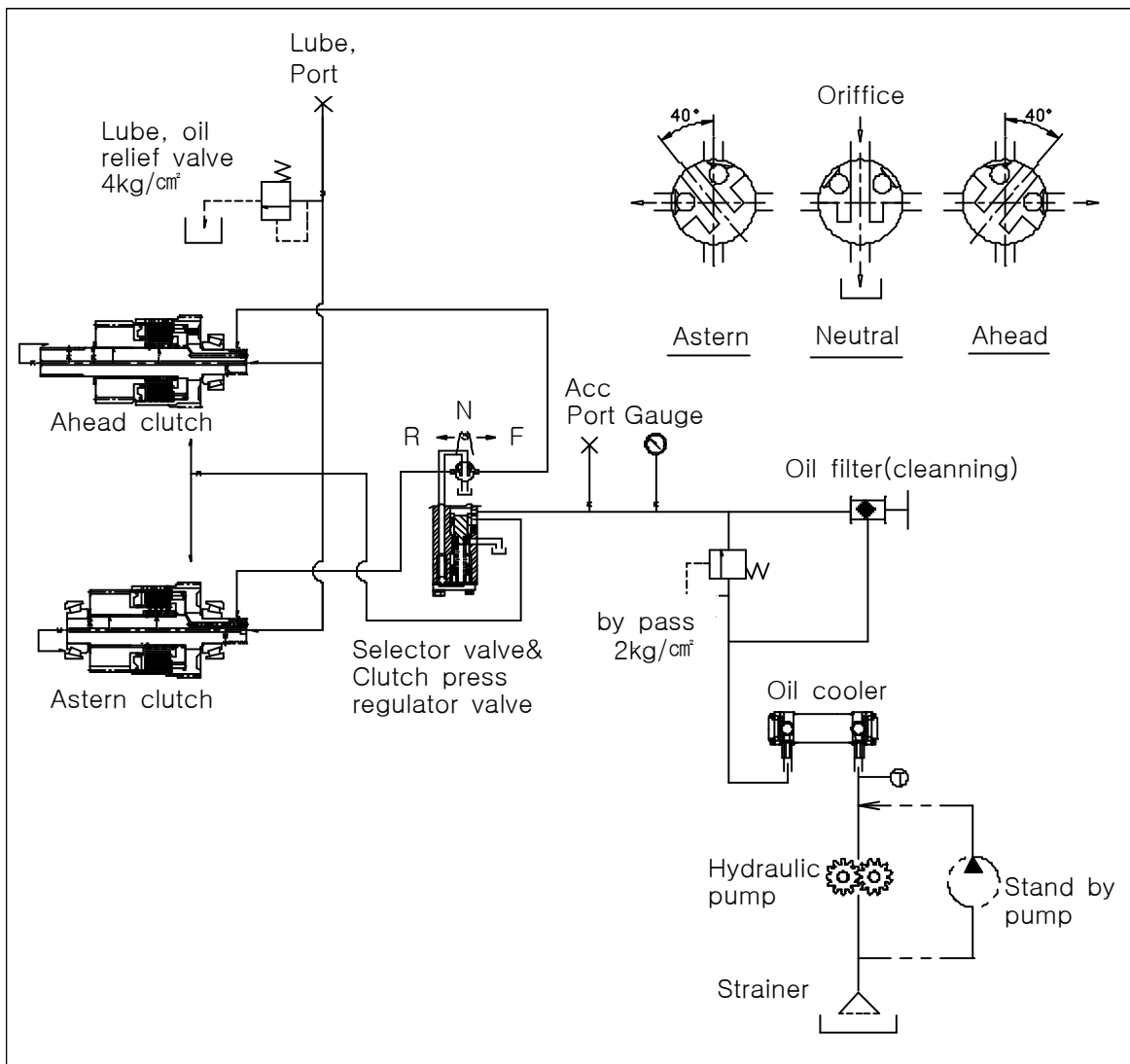
[Fig-3] Sequence of power transmission

CHAPTER 4 – HYDRAULIC SYSTEM

4-1. OVERVIEW

The hydraulic system is shown in Fig.4. The oil contained in the marine transmission flows into the pump through the oil strainer, and high pressure oil that is discharged from the gear pump is led to the selector valve body through the oil cooler, the secondary oil filter and the valve holder. And then, the oil is regulated to the determined pressure by means of the oil pressure regulating valve before being led to the selector valve stem for clutch actuation.

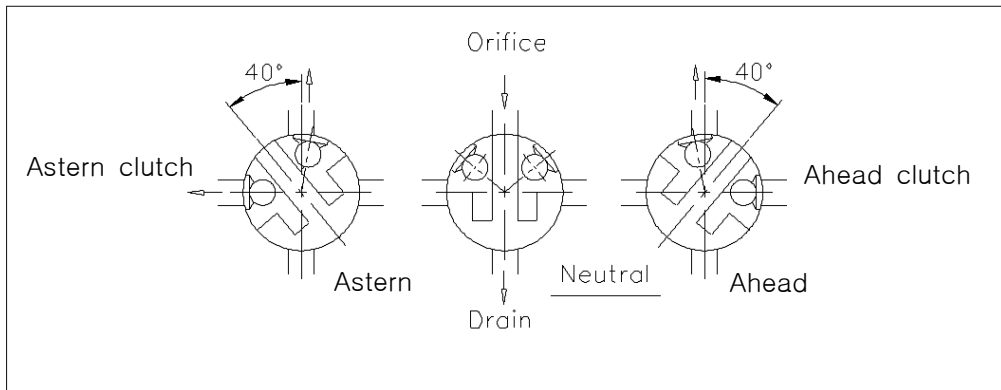
By changing the oil direction of the selector valve stem, the oil is led to either the ahead or astern actuating clutch.



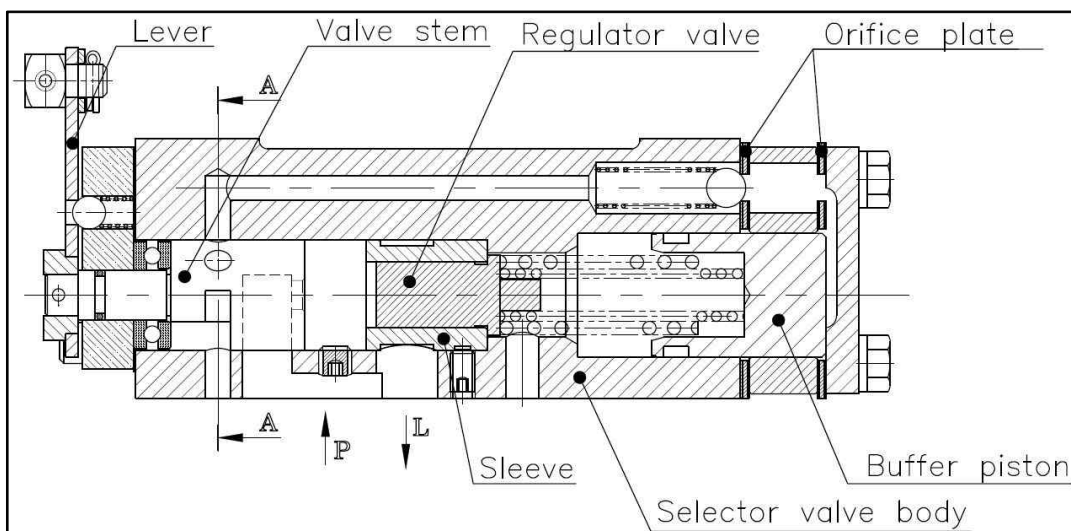
[Fig-4] Hydraulic System

4-2. SELECTOR VALVE ASS'Y

- 1) Flow of the pressured oil by operation of the selector valve is shown in [Fig.5]. The pressured oil discharged from the gear pump is led to the direction of the arrow "P" in [Fig.6], and then into the hole of the valve stem.
- 2) When the selector valve is operated for ahead or astern position, part of the oil is led to the rear surface of the clutch piston to actuate the clutch, and another part of it is led to the oil pressure regulating piston through the orifice of a check valve to raise the oil pressure to the determined pressure gradually. And the rest of the oil by continuous discharge from the hydraulic pump, pushes the oil pressure regulating valve and flows through the passage "L" into the lubricating oil passage to forced-lubricate respective parts with pressure regulated by means of the lubricating oil pressure regulating valve.
- 3) When the selector valve is shifted toward the neutral position, the return spring of the clutch returns the clutch piston to disconnect the clutch, and the piston is also returned to lower the pressure down.



[Fig-5] Oil Passage of Valve Stem - [SEC. A-A of Fig-6]



[Fig-6] Selector Valve ass'y

CHAPTER 5 – INSTALLATION

Installation of marine transmission have an important effect on the function and performance of the marine transmission.

GAUGE / TOOL	SPEC.	REMARK
DIAL GAUGE	0.01	
MAGNET BASE	-	
THICKNESS GAUGE	0.01 ~ 1	
WRENCHES	M16 ~ M32	



DANGER

The Key, which is used for starting a marine engine, should be pulled off before installing Marine transmission to the Marine engine.

5-1. CHECK POINT BEFORE INSTALLATION

D-I marine transmission is supplied to customers without oil. Thus, before operation, make sure that the marine transmission is fed with oil SAE #30 and check the oil amount with oil gauge. (Oil Quantity : check with the name plate)

– MARINE GEAR Recommended Oil –

Name	Manufacturer
Daphne Marine Oil SX30	S-Oil
Delo 1000 Marine 30	GS Caltex
diamond Marine T103(TBN13 SAE#30)	MICHANG OIL IND,CO.,LTD.
Exxmar 12TP30	Esso Oil Co., Ltd
Mobilgard 312(SAE#30)	Mobil KOREA
Shell Gadinia Oil 30	Showa Shell Oil Co., Ltd
Jomo marines D13	Japan Energy Corporation

5-2. INSTALLATION

The alignment of the engine and the marine transmission is the most important factor for normal performance and extension of life.

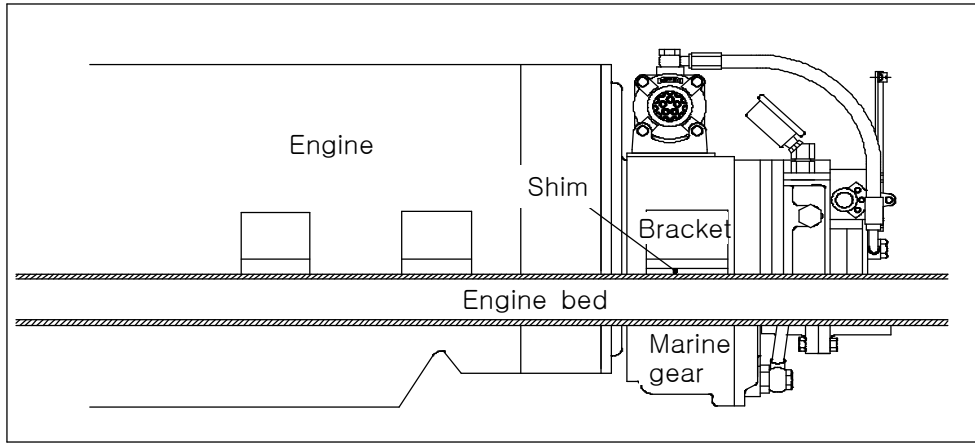
1) Bedrail

Use the engine bedrail made of well-dried rigid wood or steel.

If the engine bedrail is not rigid, the alignment will be deviated due to the vibration of the engine or other influence.

2) Supporting

The support brackets for the marine transmission have to fix on the engine bedrail firmly like the engine mounting. Especially, the bolts of housing and brackets should be tightened firmly.(Arrows)

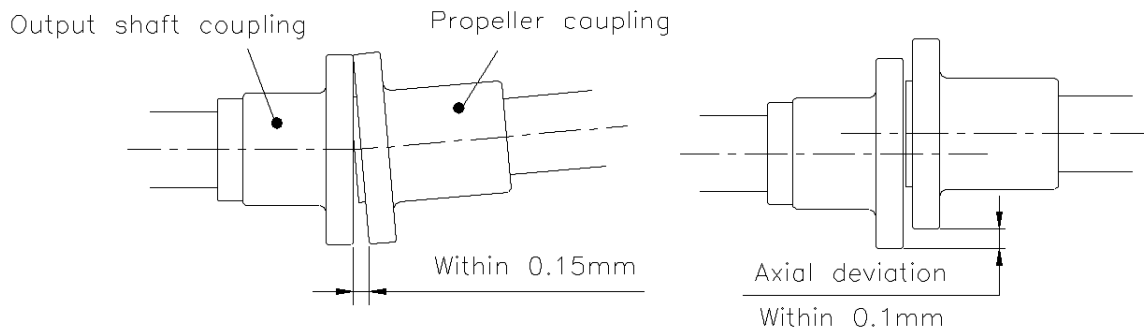


! CAUTION

Bolts for Housing and Brackets of marine transmission should be tightened firmly. If not, a noise, vibration or breakage of housing can be occurred.

3) Alignment

The alignment of marine transmission's output shaft coupling and the propeller shaft coupling should be aligned well and the allowable deviation is as indicated in the following figures :



! CAUTION

The alignment must be made only when the ship is afloat, not in a dock. In addition, in case of a wooden ship, periodic check should be made every one or two months since the engine bedrail may be bent up to about six months after initial installation, and also a FRP or steel ship must be checked periodically.

CHAPTER 6 – OPERATION

6-1. PREPARATIONS FOR OPERATION

- 1) Check the whole parts of marine transmission and if the bolts, nuts, etc. are loosened.
- 2) Check the oil level with oil level gauge and neutral pressure.
 - 2-1) Check if the neutral pressure(1~5 kgf/cm²) is formed within 30 seconds at idle RPM after the engine starts up.(If not, just stop the engine and then check relevant parts)
 - 2-2) After running the engine at idle RPM for 2~3 minutes, stop the engine and check the oil level in 2~3 minutes.
- 3) Place the selector valve lever on the neutral position before starting the engine.



CAUTION

Check the oil amount in marine transmission before operation.
If the oil is not enough, fill it up with oil.

6-2. Operation and stop

- 1) Run the engine at engine idle RPM for about 10 minutes for warming-up.
- 2) During 10 minutes warming-up, check on oil leakage, abnormal noise, over-heat, cooling water condition, etc.
- 3) Check the neutral oil pressure as increasing the engine RPM gradually.
(The clutch oil pressure is 1~5 kgf/cm² at engine idle RPM in neutral position)
- 4) Check if the operating oil pressure is normal when operating the marine transmission in ahead and astern position.(Refer to 1-2 "Specifications")
When decreasing the engine RPM, the operating oil pressure could be decreased a little bit, however, it is normal.
- 5) The shifting of selector valve lever to ahead or astern position must be taken at 50% of rated engine RPM or under.
- 6) The oil temperature during continuous operation is 50-90°C, but it could be increased a little bit by frequent ahead and astern operations.
- 7) Observe abnormal noises, over-heat, etc. all the time during operation. If abnormal conditions are found, stop the engine and find out the cause of them and then take measures to solve them.
- 8) Be sure to place the selector valve lever on the neutral position before stopping the engine.
- 9) To use emergency screws in an emergency
In case that the ahead clutch is slipped or not operated, it can be engaged mechanically by emergency measures. The ahead clutch has three screws called emergency screws assembled and it can be engaged by tightening the screws. If the failure is repairable on the spot, repair it correctly as referring

to "Trouble shooting". If it is not repairable on the spot, enter the nearest port by using the emergency screws and then repair it.

⚠ CAUTION	Shifting of selector valve lever to ahead and astern position must be taken at 50% of rated engine RPM or under.
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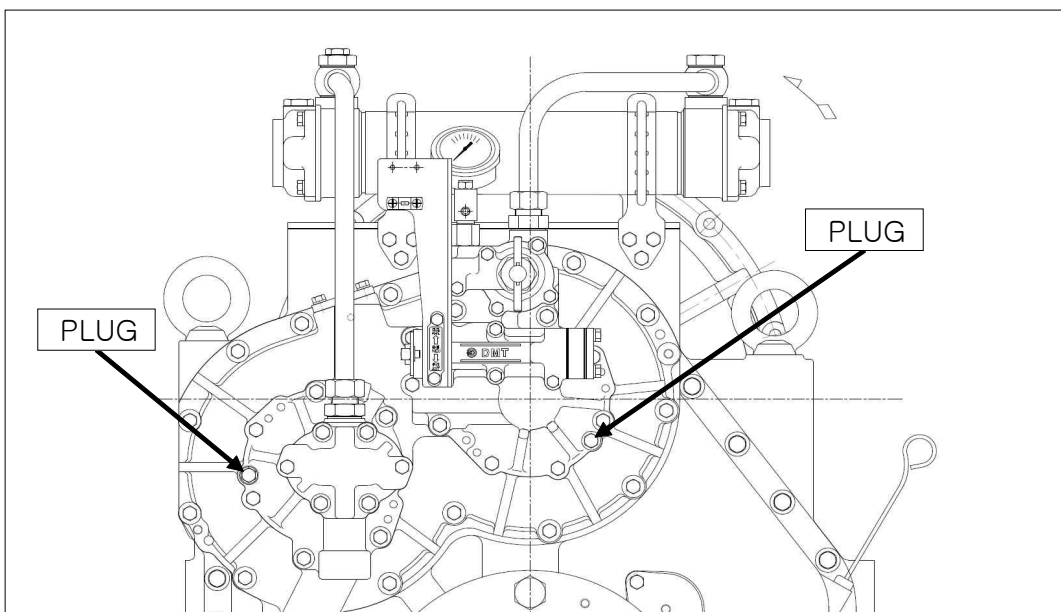
*** How to use the emergency screws**

- 1) First, stop the engine.
- 2) Remove the plug shown in [Fig.7].
- 3) After finding the emergency screws through the hole(covered with the plug) as turning the engine flywheel, tighten the three screws by 5mm hexagonal wrench.(torque130kg.cm)
- 4) Re-assemble the removed plug.

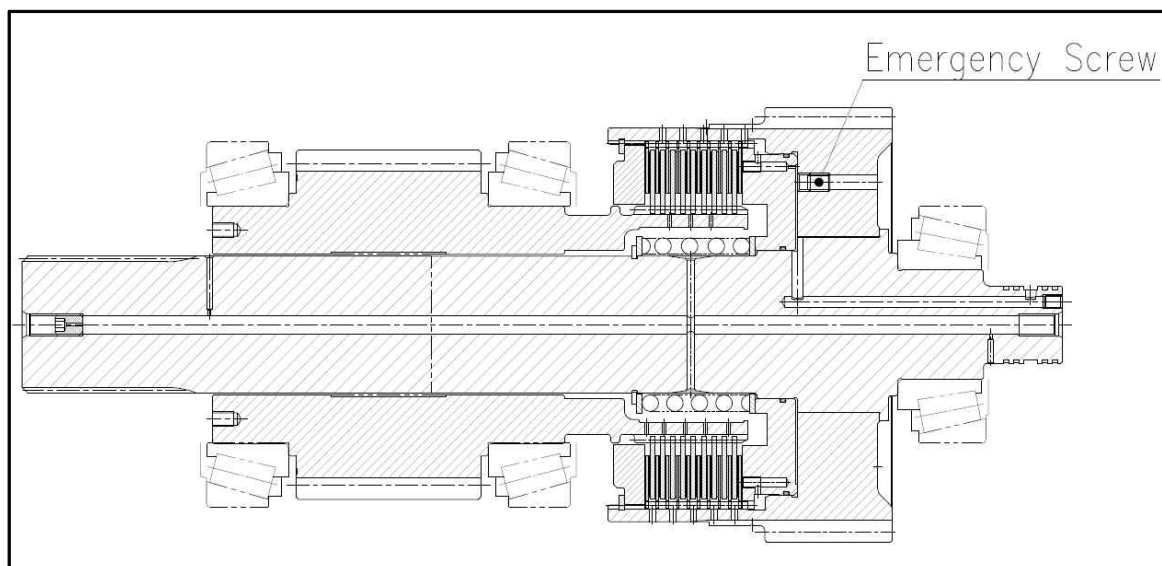
To make the ahead clutch return to original condition, loosen the emergency screw again.

⚠ CAUTION	To use the emergency screws means that the ahead clutch is engaged all the time. Therefore, be careful when the engine starts up because the vessel moves forward once the engine is on. During a sail, the selector valve must be placed on the ahead position and the engine should be operated at 70% of rated engine RPM or under. When using the emergency screws, fill the marine transmission with oil till the oil level comes up to center of astern shaft.
------------------	---

⚠ DANGER	The vessel should slow down before entering the port and be taken in tow because the astern function does not work while using the emergency screws.
-----------------	--



[Fig-7] Position of Emergency Screw



[Fig-8] Position of Emergency Screw


CHAPTER 7- MAINTENANCE & OVERHAUL

7-1. OVERVIEW

All the rotating parts of the marine gear are lubricated with oil in the case. The followings are the check points for maintenance of the proper performance.

7-2. OIL

- 1) Use only SAE-API service class SAE#30 engine oil.
- 2) Check the oil level everyday. (Refer to 5-1, Section 5)
- 3) Replace the oil after first 100 hours, and then every 1,000 hours.
 - * If a foreign substance such as water, seawater, etc comes into the marine transmission, overhaul it and clean its part before assembly, and then feed it with new oil.

 CAUTION	Use only SAE-API service class SAE #30 engine oil. Multi-grade oils(SAE#10W, 15W40,etc) should not be used in D-I marine transmission because they have influence on the coefficient of friction to make the clutch slipped.
--	---

- MARINE GEAR Recommended Oil -

Name	Manufacturer
Daphne Marine Oil SX30	S-Oil
Delo 1000 Marine 30	GS Caltex
diamond Marine T103(TBN13 SAE#30)	MICHANG OIL IND,CO.,LTD.
Exxmar 12TP30	Esso Oil Co., Ltd
Mobilgard 312(SAE#30)	Mobil KOREA
Shell Gadinia Oil 30	Showa Shell Oil Co., Ltd
Jomo marines D13	Japan Energy Corporation

7-3. OIL FILTER

Also, disassemble the oil strainer and the secondary oil filter to clean them at the time of oil changing.

7-4. VISUAL INSPECTION

Inspect external parts of the marine transmission frequently, and repair it if any defect is found. Particularly, inspect the rubber blocks through an inspecting window of the flywheel housing frequently, and if they are damaged or worn out, replace them with new ones.

7-5. OVERHAUL

The overhaul period of the marine gear is the same as that of the engine. If any worn out or damaged part is found, replace it according to the followings :

- 1) Replace all of the gaskets, O-rings, and other rubber products in every overhaul.
- 2) Replace the rubber blocks and bearings every 10,000 hours, after 5years or earlier if excessive wear or damage is found.
- 3) [Table 1] shows the allowable wear limits of the important parts.

[Table 1]

Parts	Point to be measured	Allowable wear limits (mm)	Remedy when limit is excessive
input coupling and input shaft	Spline backlash	0.3	Replacement
pinion and output gear	Gear backlash	0.5	"
clutch housing gear	"	0.4	"
sintered plates and clutch housing	Gear backlash	0.5	"
steel plates and pinion	"	0.5	"

[Table-1] abrasion limit for main components

7-6. MAINTENANCE & OVERHAUL

Periodic overhaul : ANNEX I

CHAPTER 8 TROUBLESHOOTING

If something is wrong with the marine transmission, refer to [Table 2].


Symptom	Cause	Remedy
1. Low main oil pressure	1) Oil strainer clogged 2) Secondary oil filter clogged 3) Oil pressure regulating piston stuck in the control valve 4) Seal damaged or worn 5) Hydraulic pump damaged or worn 6) Remote control faulty 7) Orifice clogged 8) Clutch oil pressure regulator valve's spring damaged or worn	1) Remove clog and clean 2) " 3) " 4) Replacement 5) " 6) Adjustment 7) clean it 8) Inspect length of spring and replace it if necessary
2. No oil pressure	1) Oil level low 2) Hydraulic pump defective 3) Air leak on suction side of pump	1) In case of oil leakage, replace of the components such as gaskets, oil seals, etc. which cause oil leakage and fill the oil 2) Replace hydraulic pump 3) Correct cause of air leak
3. High main oil pressure	1) regulating valve stuck	1) Remove clog and clean
4. Low Lubricating oil pressure	1) Lubricating oil pressure regulating valve operated poorly	1) Remove clog and clean
5. Over-heat	1) Clutches slipping 2) Excessive oil level 3) Bearing damaged 4) Defective rotating part	1) Disassemble marine transmission and check of clutch plates 2) Regulation of oil level 3) Overhaul marine transmission 4) Refer to Item 6
6. Rotating parts defective	1) Clutch plates stuck 2) Clutch piston's returning spring is damaged or broken	1) Disassemble of clutch ass'y and replace clutch plates 2) Disassemble and replace of spring
7. Improper Shifting of ahead / astern	1) Clutch plates stuck 2) defective Remote controller 3) Clutch piston's return spring is damaged or broken	1) Disassemble of clutch ass'y and replace clutch plates 2) Adjust and replace remote controller 3) Refer to Item 6-4).
8. Abnormal noise	1) Gear teeth or spline damaged worn 2) Bearing damaged 3) Rubber blocks damaged or worn 4) Bolts or nuts loosened or removed	1) Disassemble and repair or replace 2) Disassemble and replace 3) " 4) Secure tightening

[Table 2. Cause and Troubleshooting]

CHAPTER 9 – DISASSEMBLY AND ASSEMBLY

It is explained to disassemble and assemble the marine transmission by part separately.

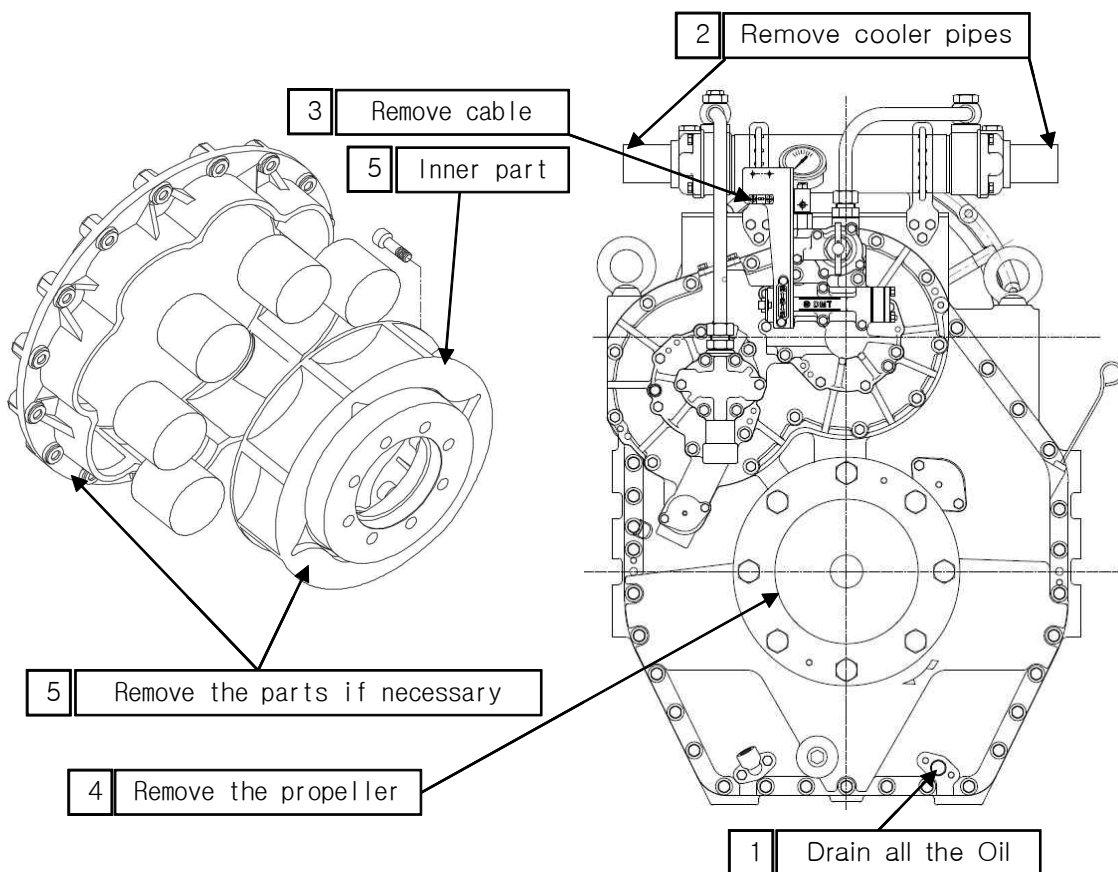
The disassembly and assembly should be carried out as being careful in the mentioned cautions.

 CAUTION	<p>Assembly and disassembly should be performed in where there is no dust and foreign substance, etc.</p> <p>Don't assemble or disassemble the marine transmission in where it is raining or highly humid.</p> <p>The following figures, which is used to help you understand, are for DMT450DL. Therefore, for other models, please refer to the parts list and perform the assembly or disassembly accordingly.</p>
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TOOLS	SPEC.	REMARK
Wood	□90*90*700	
Rags		
Combination Wrench sets	5, 6, 8, 10, 12mm	
Torque Wrench	200~500kg.cm	
Zig for Shim Adjustment		
Bearing Puller		
Bearing Heater	120℃	
Snap Ring Pliers		
Impact socket sets	10, 12, 14, 17, 19, 21, 22, 36	


9-1. Disassembly

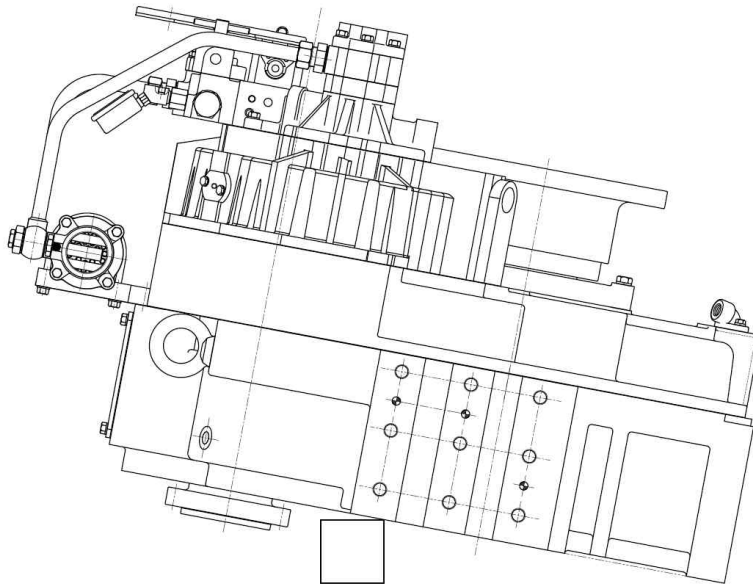
- 1) To disassemble the marine transmission. (When it is dismantled from a engine)
 - ① Drain the oil from the marine transmission after disassembling the drain plug.
 - ② Disassemble the cooling water pipe of engine from the oil cooler of marine transmission.
 - ③ Disassemble the selector valve lever's cable of marine transmission which is connected with a wheel house.
 - ④ Disconnect the output shaft coupling from the propeller coupling for sufficient space to remove the marine transmission easily.
 - ⑤ Disassemble the marine transmission's flywheel housing which is assembled to engine. During the disassembly, make a clearance between the engine flywheel and marine transmission's flywheel housing as much as rubber blocks do not drop. Please make sure that the rubber blocks do not fall out of inner part by using a restraining strap.



- 2) To disassemble the case group
 - ① Lay the marine transmission with the input side facing down on a wooden bar as Fig. 9 and there should be no contact between the input coupling and ground.
 - ② Disassemble the pump Ass'y and selector valve group.
 - ③ Disassemble the pump and valve holder Ass'y assembled to the bearing carrier.
 - ④ Disassemble the bearing carrier assembled to the case cover.
 - ⑤ Disassemble the input and astern shaft Ass'y and unless the replacement is necessary, please keep the friction plates engaged by emergency screws. In this way, they can be re-assembled directly when the marine transmission is re-assembled because the teeth of friction plates are aligned.

- ⑥ Disassemble the output shaft coupling. (Refer to P.33)
- ⑦ After disassembling the seal carrier, disassemble the case cover assembled to case.
- ⑧ Disassemble the input coupling.

 CAUTION	<ul style="list-style-type: none">Ⓐ Do not disassemble the input coupling Ass'y, unless its replacement is necessary.Ⓑ When disassembling the case, please be careful with damage or loss. Because the clearance for taper roller bearings could be changed, please carry out the shim adjustment for the input/astern shaft Ass'y, output shaft Ass'y and pinions during re-assembly.Ⓒ If taper roller bearings, pinions and input/astern shaft sub Ass'y are replaced, the clearance for them could be changed. Therefore please carry out the shim adjustment referring to article 9-3.
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[Fig-9] Disassemble the marine transmission

3) To disassemble the Input shaft Ass'y

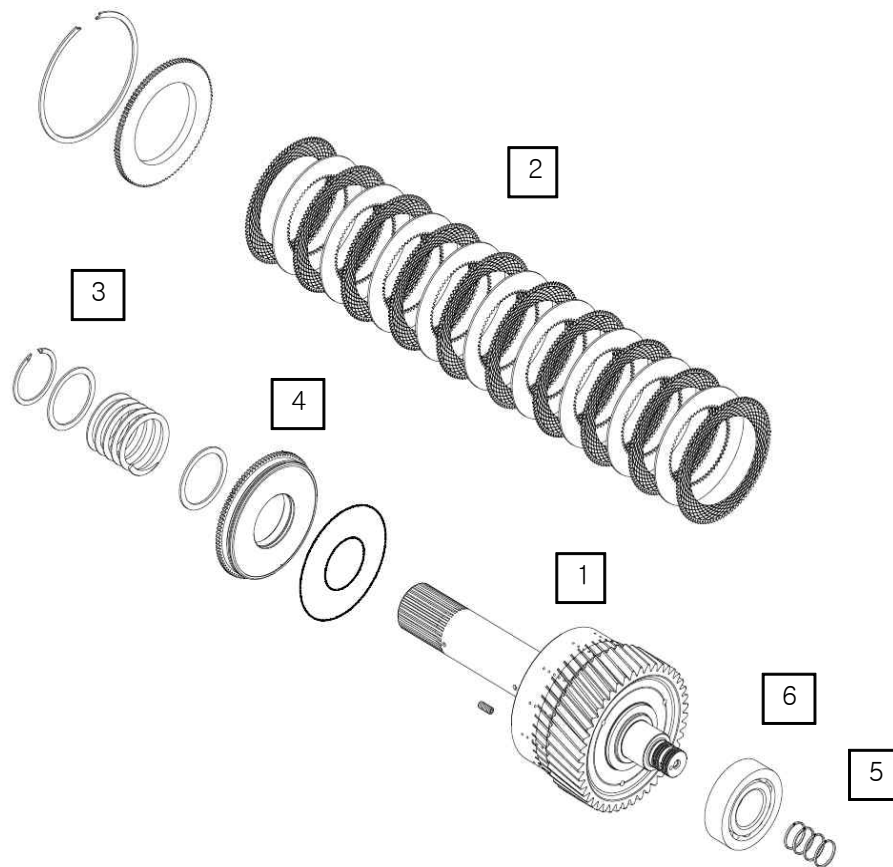
- ① Put the input shaft Ass'y disassembled from the marine transmission uprightly with its spline facing upwards to disassemble it easily.
- ② Disassemble the snap ring from the clutch housing and then back plate, steel and sintered plates.
- ③ Disassemble the snap ring from the input shaft and then washer, return spring, and washer.
- ④ Disassemble the clutch piston from the input shaft by inserting the air into the operating flow path or using the clutch piston's tap.

⚠ CAUTION	Do not use a steel table because the input/astern shaft Ass'y could be damaged. Please use a wooden table.
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- ⑤ Disassemble the seal rings from the end of input shaft.

⚠ CAUTION	Be careful not to damage the seal rings.
------------------	---

- ⑥ Do not disassemble the taper roller bearings unless their replacement is necessary.



Check Point

☞ [Refer to Table-1 abrasion limit for main components]

4) To disassemble the astern shaft Ass'y

- ① The disassembly process of astern shaft Ass'y is the same as that of input shaft Ass'y.

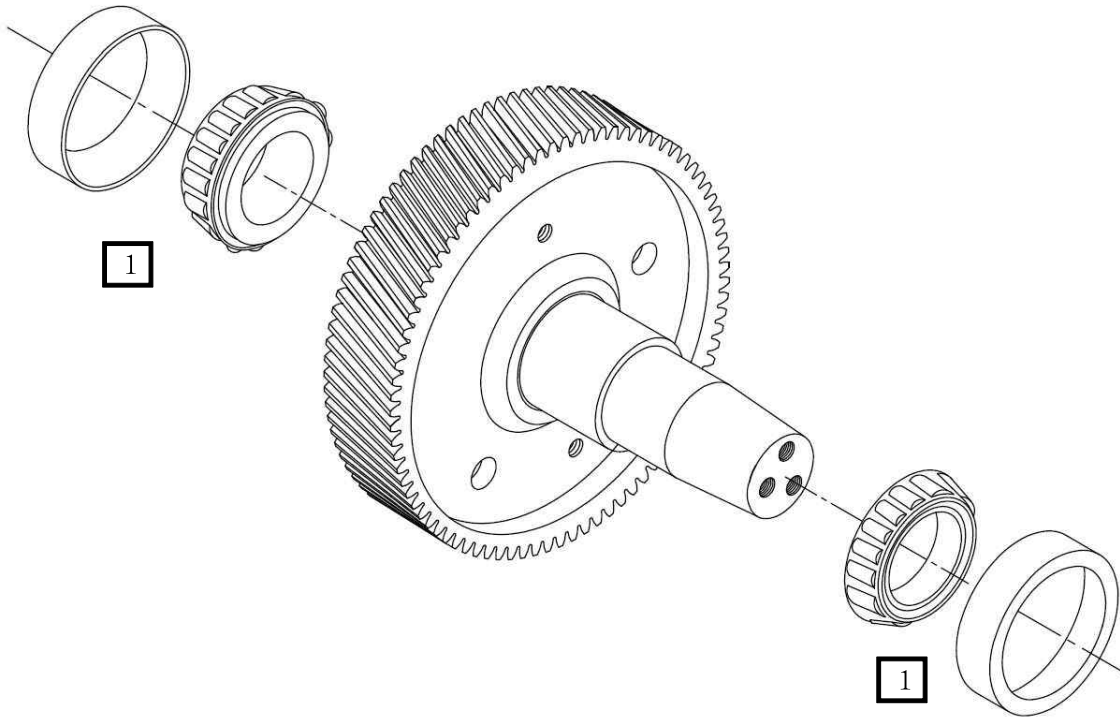


Check Point

- ☞ [Refer to Table-1 abrasion limit for main components]


5) To disassemble the output shaft Ass'y

- ① When disassembling the bearings, please use the extraction hole for bearings of output shaft.
- * Unless the replacement is necessary, please do not disassemble the bearings at both ends of output shaft.



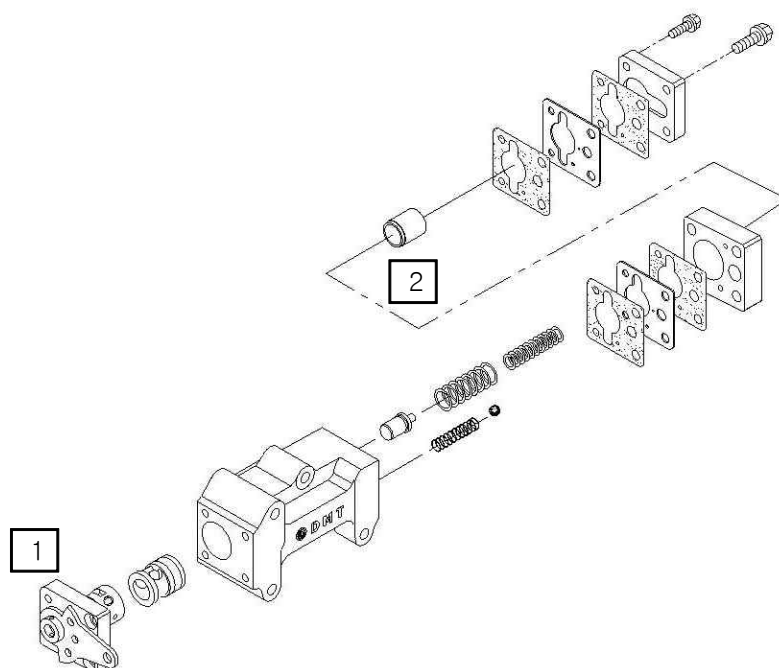
Check Point

👁 [Refer to Table-1 abrasion limit for main components]

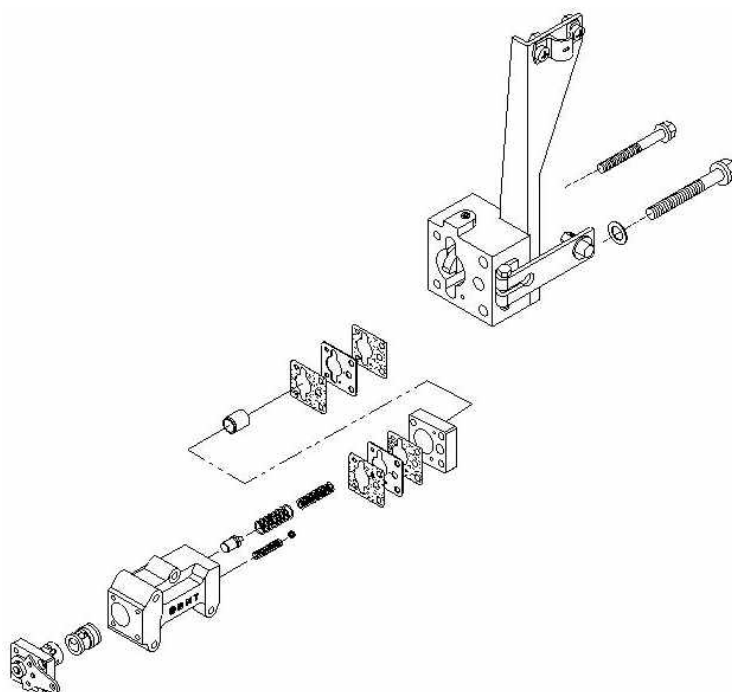
 CAUTION	<p>As the input/astern and output shaft Ass'y are shrink-fitted, it is impossible to disassemble them. Never try to disassemble them.</p>
--	---

6) To disassemble the selector valve group

- ① Remove the hexagonal socket screws and then disassemble the lever group.
- ② After removing the screws, disassemble the piston cover, plate, orifice plate, plate gasket, piston, outer spring, trolling spring, ball, check valve spring, regulator pressure valve in order.



Trolling Valve(Optional)



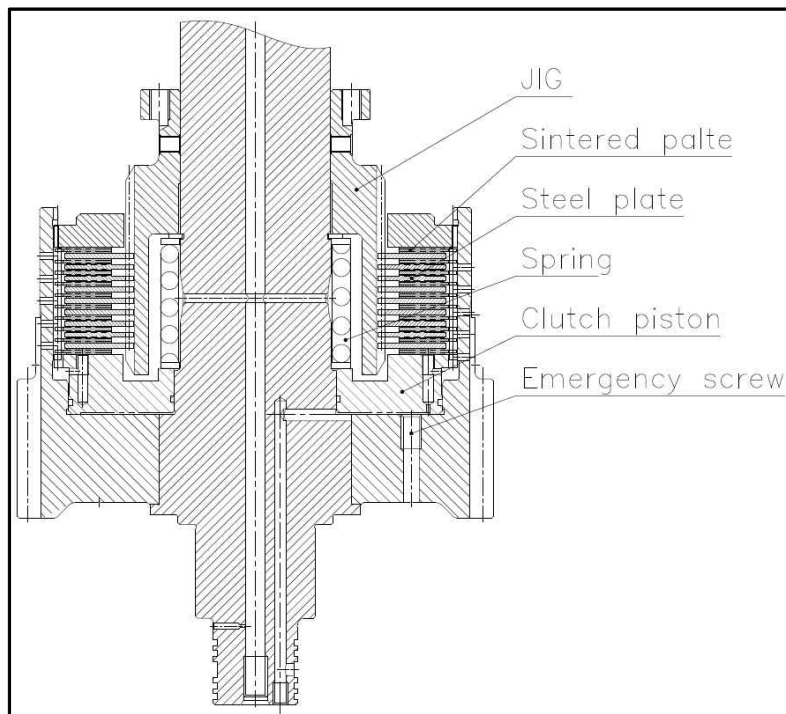
Check Point

- ☞ [Refer to Table-1 abrasion limit for main components]

9-2. To assemble the marine transmission

Assembly shall be performed in the reverse order of disassembly. Please clean all the parts to remove dust or metal chips, etc. foreign substances before assembling them. Afterwards start the assembly as observing the following.

- 1) Replace the parts which cause oil leakage.
- 2) Replace bearings excessively discolored or worn out.
- 3) Replace parts worn over the abrasion limit.
- 4) Replace all the gaskets, copper gaskets, and o-rings.
- 5) Apply enough grease to o-rings, rubber parts before assembly.
- 6) Check if the bent condition of flat and spring washers is normal before assembly.
- 7) The followings are cautions for assembling the input and astern shaft Ass'y.
 - ① Before assembling the input and astern shaft Ass'y, check if there are any sharp edges on the parts where the clutch piston, input shaft or o-rings are assembled. If any, remove the sharp edges and then grease them before assembly.
 - ② The clutch piston is located and steel and sintered plates should be assembled as Fig.10. The teeth of steel plates should be aligned correctly by a jig and on completion of assembly check if the snap ring to prevent the back plate from breaking away is firmly assembled in the clutch's groove.
 - ③ While the jig is being assembled, stick the clutch piston to friction plates by using emergency screws because it prevents the teeth alignment of input/astern shaft Ass'y from misalignment.



[Fig-10] Structure of clutch

- ④ Assemble the input/astern shaft Ass'y to pinions which are assembled to bearings of case cover.
- ⑤ The input shaft Ass'y is assembled in two steps. The input shaft Ass'y is assembled

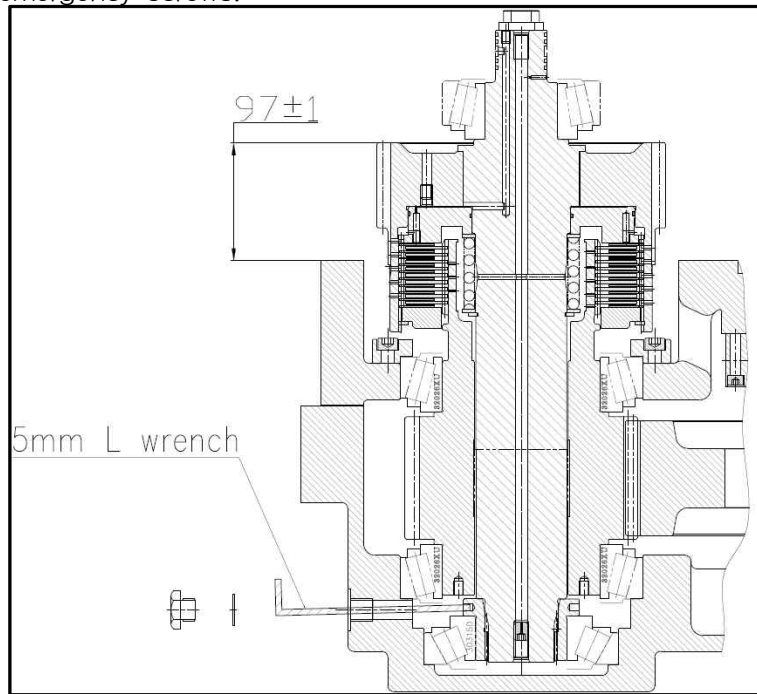
to spline of input coupling Ass'y as 1st step and the inner teeth of steel plates in the input shaft Ass'y are assembled to outer teeth of pinion as 2nd step.

Check if the assembly is done well by checking the height as Fig.11. Afterwards, engage the friction plates by turning the emergency screws C.C.W.

- ⑥ The astern shaft Ass'y is also assembled in two steps. The inner teeth of steel plates in the astern shaft Ass'y is assembled to outer teeth of pinion as 1st step and the astern shaft Ass'y is assembled to spline of bearing sleeve as 2nd step.

For the spline assembly there is a hole at the side, so turn the bearing sleeve by an L wrench for the assembly after removing the plug of case as Fig.11.

Check the assembly height as the input shaft Ass'y after the assembly is done and loose the emergency screws.



[Fig.11] Astern shaft Ass'y

⚠ CAUTION	<p>If the emergency screws are not pushed outwards by turning C.C.W after assembling the input/astern shaft Ass'y, the engine could not start up or it could cause the marine transmission failure. Therefore the emergency screws of input/astern shaft Ass'y must be pushed outwards by turning C.C.W.</p>
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8) Standard torque for screws and nuts

- ① The standard torque for the screws and nuts are as the following [Table 3].

(Unit : kgf · m)

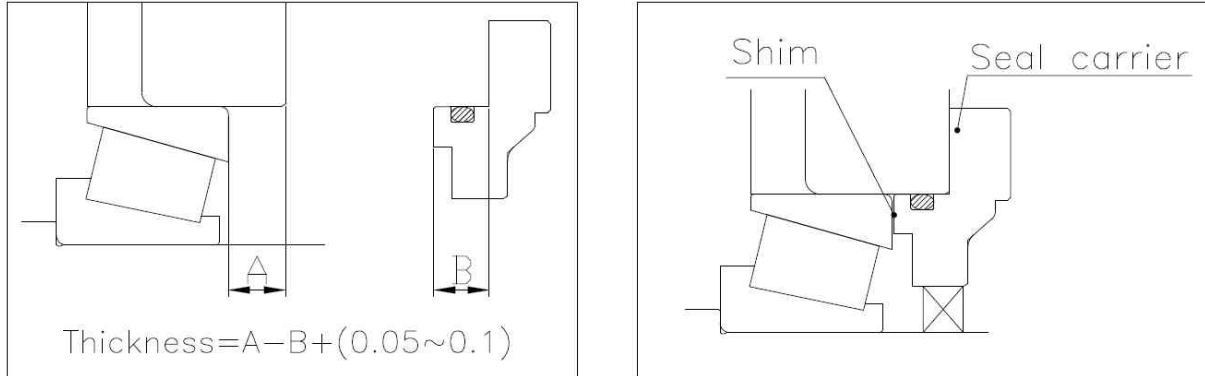
Category	M5	M6	M8	M10	M12
Screws & nuts		0.5 - 0.8	1.8 - 2.0	4.3 - 4.5	7.4 - 8.0
Hexagonal socket screw	0.6 - 0.7	1.1 - 1.2	2.6 - 3.0	4.5 - 5.0	

[Table-3] Standard torque for screws and nuts

9-3. Adjustment of shims

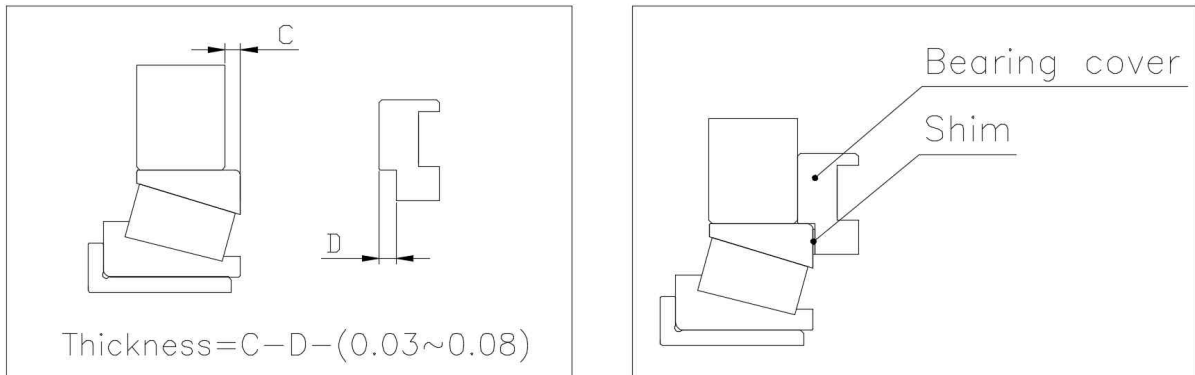
Adjust the clearance of taper roller bearings holding the input shaft, astern shaft, output shaft and pinions by shims as [Fig-12~15].

- 1) Output shaft side: Carry out press fit(0.05 ~ 0.1mm) as pushing the taper roller bearing of output side towards input side.



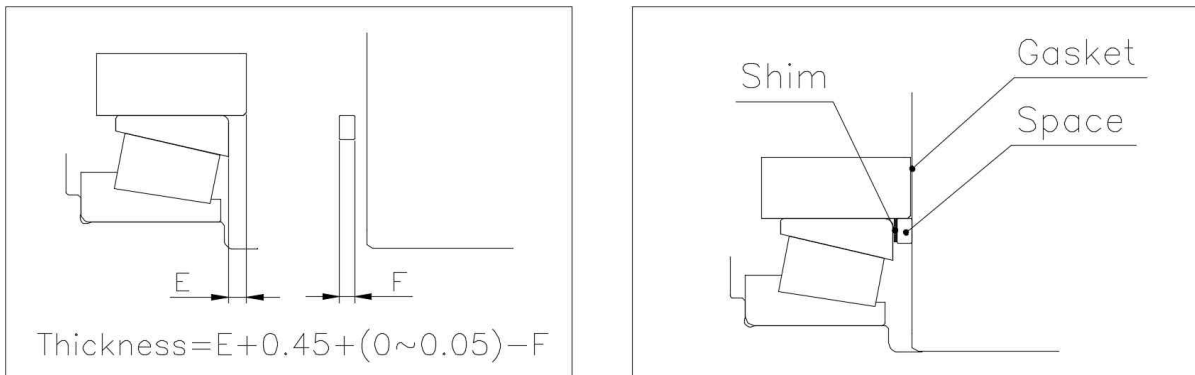
[Fig-12] Shim adjustment for output shaft

- 2) Pinion side: Adjust the clearance to $-0.03 \sim -0.08$ mm as pushing the taper roller bearing of output side towards input side.



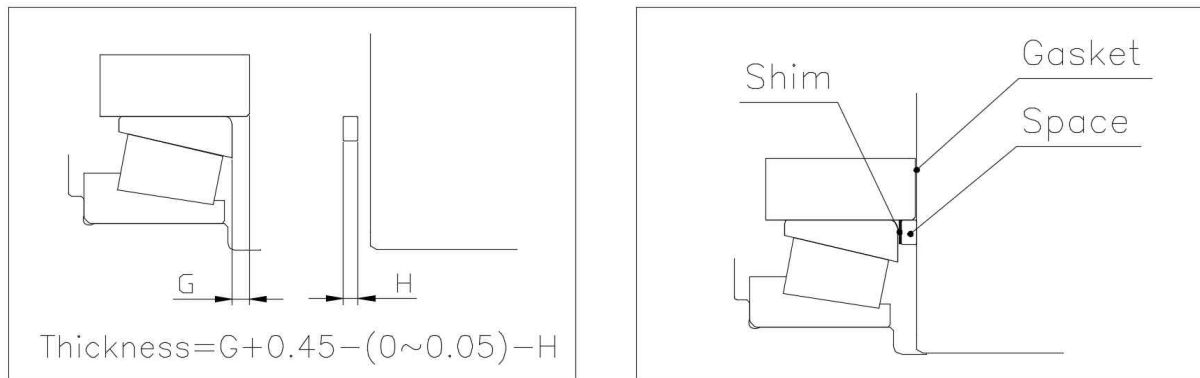
[Fig-13] Shim adjustment for pinions

- 3) Input shaft side: Carry out press fit(0 ~ 0.05mm) as pushing the taper roller bearing of output side towards input side.



[Fig-14] Shim adjustment for input shaft

- 4) Astern shaft side: Adjust the clearance to $-0.05 \sim 0$ mm as pushing the taper roller bearing of output side towards input side.



[Fig-15] Shim adjustment for astern shaft



CAUTION

1. The shim adjustment should be performed very accurately.
2. Too small clearance may cause taper roller bearings faster wear and the high oil temperature(overheat). Too large clearance may cause the valve/pump holder, gears abnormal wear and oil leakage from oil seals, etc.

COUPLING -How to Disassemble Output Coupling

NO	FIGURE	INSTRUCTION
1		<p>1) Assemble the support plate as Fig.1. - It is to prevent the output coupling from popping out in a moment by oil pressure during disassembly.</p>
2		<p>1) Pour oil into the tapped hole on the output coupling and then screw the bolt in the tapped hole. Repeat it two or three times. - It is to fill the output shaft's groove with oil enough.</p>
3		<p>1) Wrap the screw with teflon seal tape enough considering the screw-tightening direction. - It is to avoid the oil back flow by internal pressure during disassembly.</p> <p>※Screw Length(L) : 30mm or over.</p>
4		<p>1) Insert grease into the tapped hole on the output coupling. - It is to avoid the oil back flow through gaps of threads.</p> <p>2) Tighten the screw with teflon seal tape quickly. - It is to increase the internal pressure in a moment.</p> <p>3) The disassembly is completed.</p>

[CAUTION]

The output coupling could not be disassembled at one go due to some conditions. If so, repeat the above procedures two or three times.

ANNEX I

TABLE OF PERIODIC OVERHAUL

○ Check, ◎ Exchange

	NAME	Check / Exchange (year)				Parts to Using	Remark
		1	3	5	10		
M A R I N E G E A R B O D Y	*Gasket, paper				◎	Cover, Case, Holder etc.	
	*Gasket, copper				◎	Drain/Magnet Plug etc.	
	*O Ring				◎	Screen/Secondary Filter Air Breather ass'y etc.	
	*Seal, oil				◎	Input Coupling, Output Shaft	
	Ring, oil Seal		○		◎	Input/Astern Shaft	Wear, Breakage
	Spring		○		◎	Selector Valve Regulator Pressure etc.	
	Plate (sintered/steel)		○	○	◎	Clutch housing	Wear, Taken off ,Deformed
	*Ring, external				◎	Input/Astern Shaft	
	Bearing, taper roller			○	◎	Input/Astern/Output Shaft	Wear, Damage, Taken off
	※Magnet Plug					Cover	
	※Oil(SAE#30)						See Chapter7.2
	※Screen Filter		◎	◎	◎		Breakage, Deformed
※Secondary Filter		◎	◎	◎		Breakage, Deformed	
P U M P	*Gasket, pump/plate					BODY, pump	
	Bearing, bush			○		Plate, pump Cover, pump	Wear, Damage, Taken off
	Pump ass'y			◎	◎		
C O O L E R	*O Ring					Cover, cooler	
	*Gasket, copper					Bolt, union	
	Zinc Anode						Every 6 month to exchange

MARK : The parts, which are marked, should be replaced with new ones once marine transmission is disassembled and assembled.

※MARK : The parts, which are marked※, are recommended to be cleaned during oil replacement (Replace oil after first 100hours and then every 1000hours)

ANNEX III
WARRANTY LETTER

The marine transmission, which D-I Industrial Co.,Ltd. manufactures, is guaranteed to have a good operation in case that D-I Marine Transmission is operated according to the instructions mentioned in the D-I marine Transmission manuals. D-I Industrial Co.,Ltd. warrants D-I Marine Transmission as follows.

1. SCOPE OF WARRANTY

Warranty is limited to repair or supply with new one against D-I Marine transmission or its parts which is occurred by defective materials or workmanship within warranty period.

2. WARRANTY PERIOD.

D-I Industrial Co.,Ltd. warrants against defective materials or workmanship for a period of twenty-four(24) months from the date of original shipment by D-I Industrial Co., Ltd. to original customer or twelve(12) months from the first sea trial, whichever occurs first.

3. WARRANTY NON EFFECTIVE

D-I Industrial Co.,Ltd. does not warrant

- 1)The parts that are not produced by D-I Industrial Co.,Ltd. or genuine parts which are lost.
- 2)The cost or the breakdown that is occurred for repairing before contacting with D-I Industrial Co.,Ltd.
- 3)The breakdown which is occurred due to any modification to D-I Marine Transmission or its parts without the prior to consent of D-I Industrial Co.,Ltd.
- 4)The breakdown that is occurred due to that the customers do not keep the right handling, operation, periodical maintenance and storage way mentioned in the instruction manuals.
- 5)Consumable parts such as gaskets, packings, tubes and other similar ones.
- 6)The breakdown that is occurred due to the customer's negligence, faulty maintenance. Misuse or non observance of recommended or operation instructions.
- 7)The breakdown caused by using products at over rated power.
- 8)The breakdown caused by other application (other than propulsion of ship) without approval of D-I Industrial Co.,Ltd.
- 9)The breakdown caused by negligence of corrosion protection.
- 10)The breakdown caused by torsional vibrations.

4. OBLIGATION OF USERS.

- 1)D-I Marine Transmission should be inspected and repaired according to the instructions mentioned in the manuals.
- 2)Use of unsuitable parts, inspection or repair can cause a fatal damage. In case that D-I Transmission should be repaired in a workshop, contact CS team of head office or use a workshop that is appointed by D-I Industrial Co.,Ltd.

5. WARRANTY REPAIR

- 1)This warranty letter is accompanied D-I Marine Transmission and is effective with signature of D-I Industrial Co.,Ltd.
- 2)Users should submit this warranty letter to warranty repairman when warranty repair or periodic inspection is performed.

6. D-I Industrial Co.,Ltd. does have no obligation to apply new specifications to the D-I Marine Transmission that was supplied before changing specifications.

7. WARRANTY SUCCESSION

In case that owner is changed because D-I Marine Transmission is resold or contributed to the other customer within warranty period, D-I Industrial Co.,Ltd. warrants the rest of warranty period. In order to do that, this warranty letter should be accompanied with D-I Marine Transmission.

D-I INDUSTRIAL CO.,LTD.

The contents of this manual can be modified without prior notice for the improvement of quality.



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