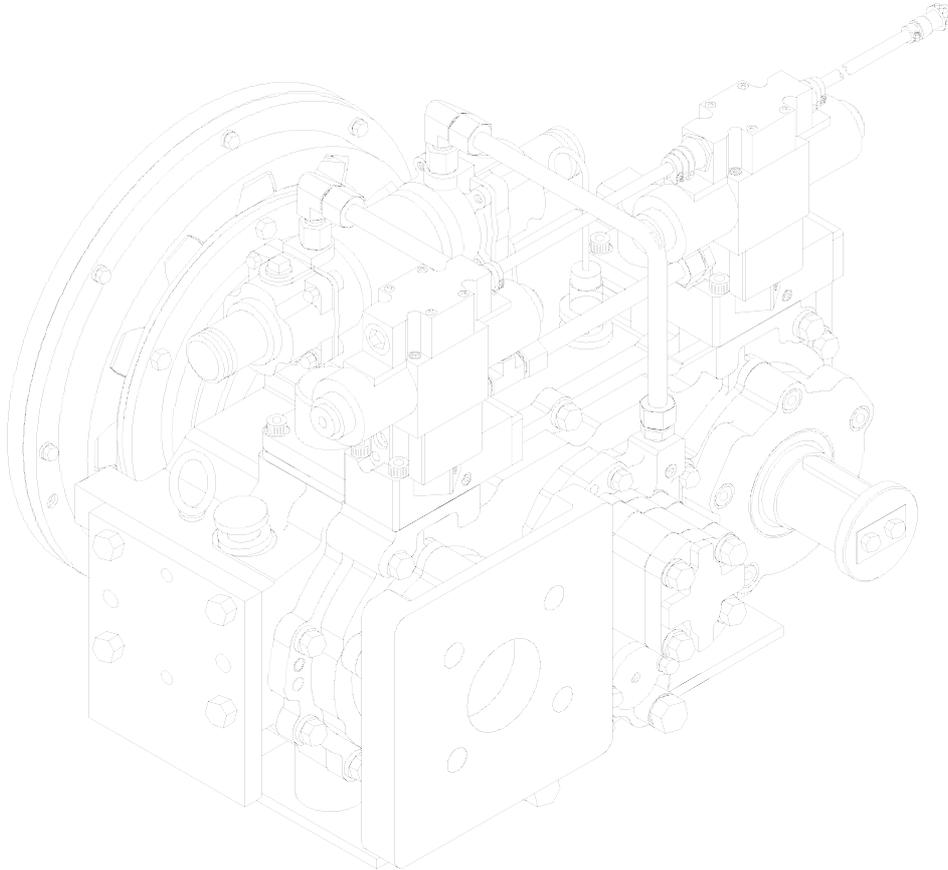


The user should read this manual thoroughly before operation and observe the method and precautions for more effective operation.

POWER TAKE OFF

INSTRUCTION MANUAL

MODEL : DPO 087



© D-I INDUSTRIAL CO., LTD.

APPRECIATION

Appreciate you prefer to use our PTO. D-I PTO was made under the scientific research and design, hi-technology and thorough quality control to get the customer`s reliability. In case of inconvenient things and further requirements while you use the PTO, you are kindly required to contact to our agent or head office.

TIP TO RECEIVE THE WARRANTY SERVICE

1. You shall sign on the receipt of PTO delivery when you receive the new PTO.
2. After installation of PTO, contact the A/S department of head office to get the periodical check.
3. In case of the abnormal condition under the warranty period, contact our agent or A/S department in head office and present the warranty letter of this manual. If the third party D-I doesn`t admit maintains the PTO, you cannot get any warranty benefit.

INTRODUCTION

This manual contains description of construction, operating principles, correct operation and handling methods, precautions for installation, information on repair and check, etc. for D-I P.T.O

APPLICATION	POWER TAKE OFF (P.T.O)
MODEL	DPO-087
The users should read this manual thoroughly before operation and observe the operating methods and precautions. Keep this manual at a safe place for future reference.	

Before operation, users should read the contents  marked in this manual. Since the contents  marked are very important for safety, users should follow the instructions.

In this manual, danger degrees, which can be occurred by faulty use, are shown in the following table.

 DANGER	Failure to observe these items could result in severe injure or death.
 CAUTION	Failure to observe these items could result in severe injure or death. Mechanical damage can also occur.
 IMPORTANT	Failure to observe these items could result in mechanical damage.

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SECTION 1	INTRODUCTION
SECTION 2	CONSTRUCTION
SECTION 3	PRINCIPLES OF OPERATION
SECTION 4	.....	HYDRAULIC SYSTEM
SECTION 5	.....	INSTALLATION
SECTION 6	.....	OPERATION
SECTION 7	.....	PREVENTIVE MAINTENANCE
SECTION 8	.....	TROUBLE SHOOTING
ANNEX I	.....	PERIODIC INSPECTION TABLE
ANNEX II	.....	PARTS ORDER SHEET
ANNEX III	.....	WARRANTY LETTER

SECTION 1 – INTRODUCTION

1-1. MAJOR FUNCTIONS

The D-I Power Take Off (Hereunder PTO) described in this manual is a product to take power off an engine for the purpose of operating Hydraulic pumps, Winches or Generators etc.

The major functions are Stop, Stand-by, Operation in a certain rate of increased speed or at the same rate of engine speed. The PTO is constructed to fit a Hydraulic pump and a Pulley.

This PTO provides one pulley always running and two output shafts possible to run only when necessary. It has 2 kinds of ratios by model as below specifications for various applications.

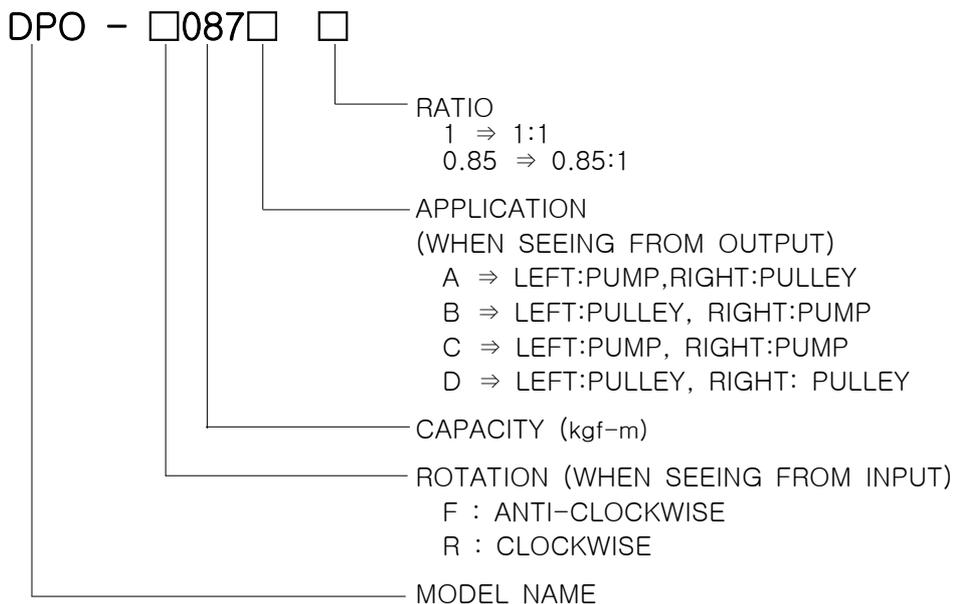
The power for operation of PTO is transmitted by hydraulic multiple clutches and the necessary hydraulic system is built-in the PTO.

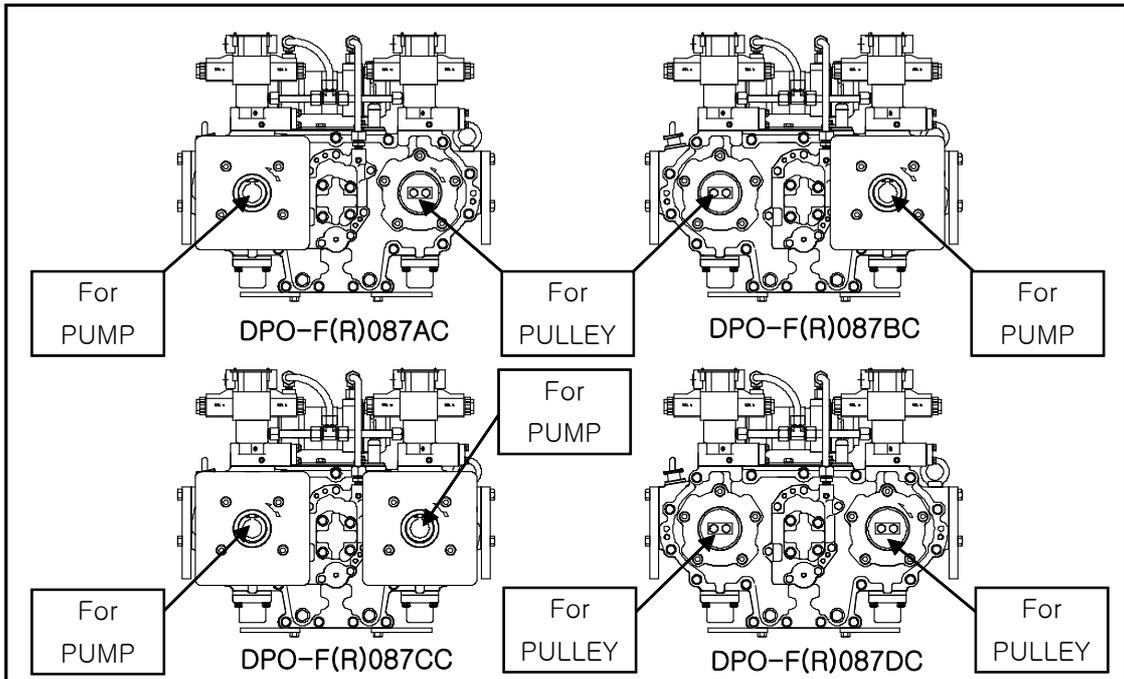
1-2. SPECIFICATION

[Table.1-1]

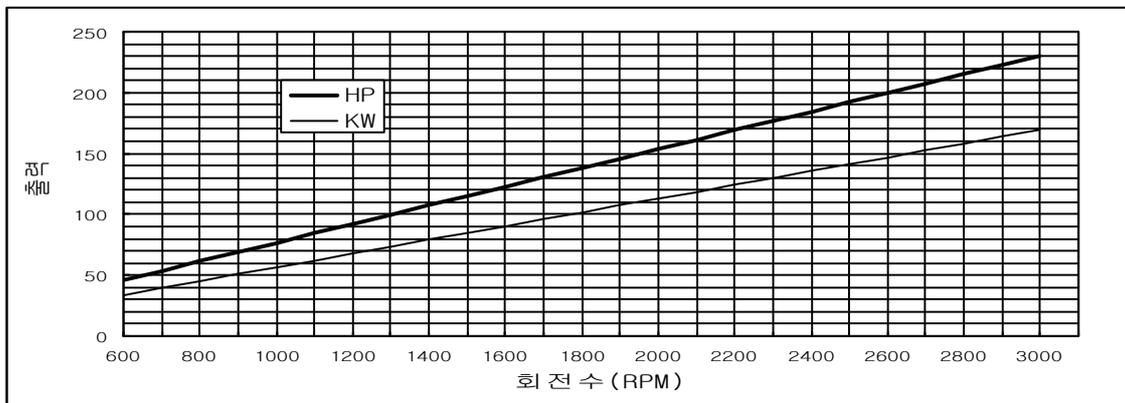
MODEL	RATIO	Facility		speed (rpm)		Input torque (kgf-m)	Operation Pressure (kgf/cm ²)	Lub. Pressure (kgf/cm ²)	Dry Weight (kg)	Flow of cooling water (ℓ/min)
		LEFT	RIGHT	MIN	MAX					
DPO-F087AC	1:1 /	PUMP	PULLEY	600	3000	55	MIN 16	0.5~4	150	20~40
DPO-F087BC		PULLEY	PUMP							
DPO-F087CC	1:0.85	PUMP	PUMP							
DPO-F087DC		PULLEY	PULLEY							

1-3. MODEL NAME EXPLANATION





[FIG 1-1] PTO SPECIFICATIONS



[FIG 1-2] PTO - 087 PERFORMANCE CURVE

⚠ CAUTION

D-I PTO must be operated within the limit of capacity of Winch, Roller, Alternator or other equipment which PTO drives. If not, Slippage, Overheating or Breakage can occur.

D-I PTO is largely divided into two kinds of PTO. One is Front PTO. Another is Rear PTO. Front PTO should be operated at the front of engine. Rear PTO should be operated at the rear of engine.

SECTION 2 – CONSTRUCTION

2-1 GENERAL

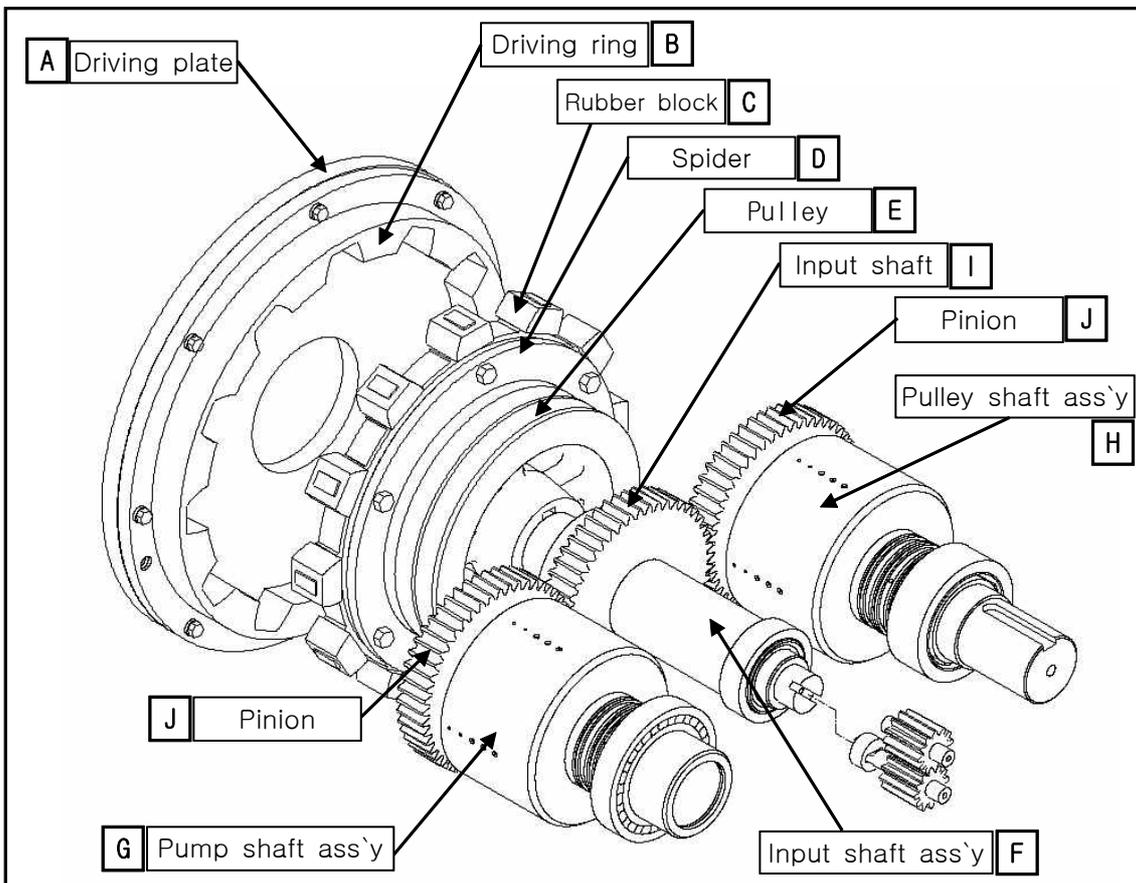
D-I PTO is a device that can take power off an engine and provides the convenience of work and consists of three major assemblies. They are Input shaft assembly, Pump shaft assembly and Pulley shaft assembly.

The operation of PTO is performed by the hydraulic clutch including oil pressure-producing pump assembly, oil cooler assembly, remote control valve assembly and manifold assembly with the hydraulic system.

In order to prevent a dragging rotation in stop position or in stand-by position, a brake system is incorporated in the PTO. Dummy plate is mounted between the engine pulley and the driving ring from which the power is transmitted to the Input shaft through the spider assembled with rubber blocks and the pulley. Or, the engine and PTO transmits the power through the flexible coupling.

The pulley assembled at the input shaft always runs when the engine starts and the pump shaft assembly and the pulley shaft assembly operate by the clutch.

(Depending on model)



[FIG. 2-1] PTO Internal structure

2-2 Input Shaft Group

1. Driving dummy plate – [FIG. 2-1 A]

The driving plate supplied is to be fitted to the pulley of engine. In order to fit the driving plate to the engine pulley, the driving plate should be suitably machined for the pulley. The driving plate is to be bolted directly to the pulley of engine.

2. Driving Ring – [FIG. 2-1 B]

The driving ring is furnished with the involute grooves on which the rubber blocks are fixed to transmit power, and is bolted directly to the driving plate.

3. Rubber Block – [FIG. 2-1 C]

The rubber blocks are in the shape of involute gear teeth, and reduce rotative vibration of the engine and transmits the power smoothly.

4. Spider – [FIG. 2-1 D]

The spider is fixed on the pulley of PTO with fitted bolts, and constructed in a manner that the rubber block can be fixed on it.

5. Pulley – [FIG. 2-1 E]

The pulley on the PTO is V type double pulley, and fitted to Input shaft.

6. Input Shaft – [FIG. 2-1 F]

The input shaft is supported by two taper roller bearings on the both side, with input gear shrink-fitted to it.

7. Input gear – [FIG. 2-1 I]

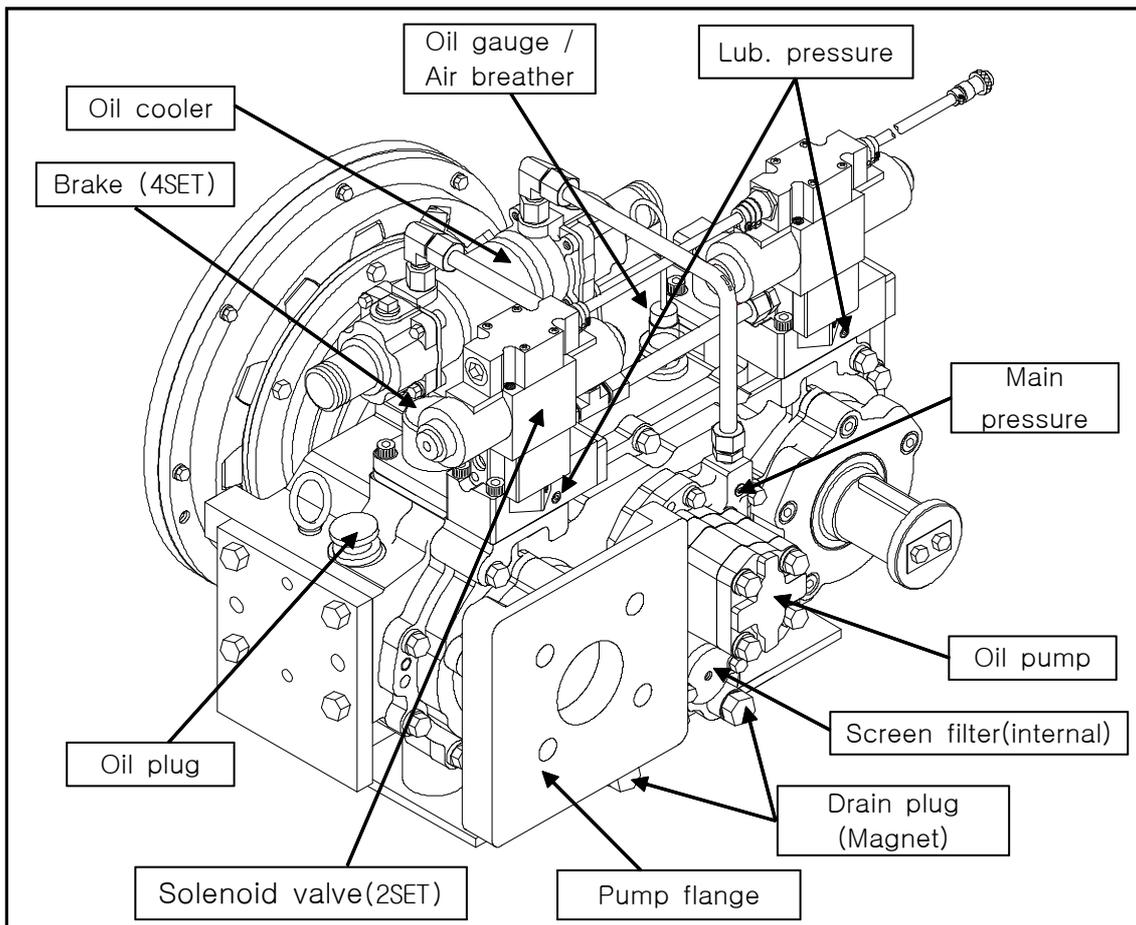
The input gear is always engaged with pinion gears.

2-3 Pump Shaft Ass'y

1. Pump shaft ass'y – [FIG. 2-1 I]

Pump shaft ass'y is Pump Shaft which is shrink fitted to Clutch housing, and consists of Pinion gear, Hydraulic piston, External Plate, Internal Plate and Back Plate. There are Ball bearings and Roller bearings on the both sides of shaft for support. The steel plate (Internal Plate) are furnished with internal gear teeth which are engaged with external gear teeth of the pinion, and the external sintered plates are furnished with external gear teeth which are engaged with internal gear teeth of the clutch housing.

The internal steel plates and external sintered plates are assembled alternately with each other, and when putting the switch on the operation position(SOL a) of Control box, the operating oil pushes the piston to operate the clutch. Then, the internal steel plates and external sintered plates are stuck fast to each other to transmit the power from the pump clutch housing to the pinion. If the switch is shifted to the Stand-by position(SOL neutral) or Stop position(SOL b), the piston returns to its original position by the force of a return spring, and thereby oil is discharged from the piston and the clutch is automatically separated.



[FIG. 2-2] PTO external structure

2. Pinion - [FIG. 2-1 J]

The Pinion gear is engaged with the input gear to transmit the power from the input gear to the output shaft through the clutch housing.

2-4 Pulley Shaft Ass`y

The components in the Pulley Shaft Ass`y are almost same as those of Pump Shaft Ass`y except for the output shaft and clutch housing.

2-5 Case Group

The Case Group is made of cast iron and consists of case and case cover.

2-6 Manifold Ass`y

Manifold is made of cast iron, with the pump and screen filter assembled in it.

2-7 Remote Control Valve Group

1. Remote control block ass'y

The remote control block is made of cast iron and consists of the operating valve, check valve, and the pressure spring. It is assembled in the case cover and transfer cooling oil from oil cooler to the case cover responding the electric sign of operation, stand-by, and stop of the solenoid valve.

2. Solenoid valve

The Solenoid valve controls the electric sign of Stand-by, Operation and Stop on the PTO.

2-8 Hydraulic Pump Ass'y

The hydraulic pump is the circumscribed gear type, and bolted on the manifold. The pump driving gear is connected by a keyed way on the end of the input shaft to be driven and rotated at the same speed and direction as that of the engine.

PERIODIC INSPECTION : REFER TO ANNEX I



IMPORTANT

In case of a special engine (clock wise when seeing from rear of the engine), please contact with D-I for consultation.

2-9 Brake Ass'y

The Brake is bolted with the upper and below side of the case and the brake shoe is close to the upper and below side of the housing, which functions to prevent clutch from rotating in Stand-by position or Stop position.

When the switch is shifted on the Stop or Stand-by the spring pushes the shoe and on the operation position, the hydraulic pressure pushes it.

PERIODIC INSPECTION : REFER TO ANNEX I

2-10 Screen Filter Ass'y

The Screen Filter Assembly is connected with a suction pipe to the inlet side pump and is fixed on the bottom side of the manifold by the Screen Filter Cover.

PERIODIC INSPECTION : REFER TO ANNEX I

2-11 Oil Cooler

The Oil Cooler is fixed above the case cover with bolts, and cools the oil supplied from the hydraulic pump and then sends the oil to the remote control block. The Oil Cooler contains brass (mixed aluminum and brass) pipe which is corrosion resistant. In addition, Zinc anodes are put into the both sides of the Oil Cooler.

PERIODIC INSPECTION : REFER TO ANNEX I

SECTION 3 – PRINCIPLES OF OPERATION

3-1 GENERAL

D-I PTO (DPO-087) has two output drives. The two drives, which are taken off the PTO, have same capacities. The two facilities, which are situated inside the PTO to take off two drives respectively, have same ratios and operation methods.

PTO is operated by hydraulic pressure and must be operated within the limits of load capacity described on our catalogues or technical data.

Since the clutch consists of hydraulic multiple clutches, the operation of PTO is accomplished by hydraulic pressure.

Each component of PTO is force-lubricated or splash-lubricated.

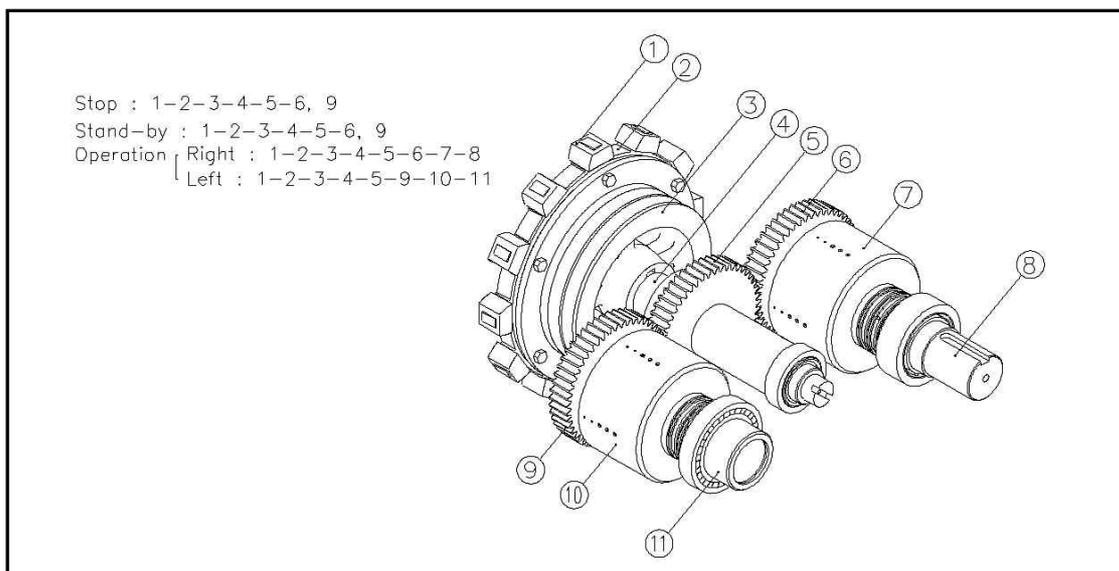
Force-lubricated : Oil seal, Bearing, Gear, Bush of Pinion gear, Plates, etc

Splash-lubricated : Bearing, Pinion gear

3-2 DIRECTION OF ROTATION

The input shaft is rotated in the same direction as an engine and the output shaft is rotated in the opposite direction as an engine.

3-3 POWER TRANSMISSION FLOW



[FIG. 3-1] Power Transmission flow

3-3-1. STOP POSITION

- ① Power is transmitted from a dummy plate, which is fitted to a pulley of an engine with bolts, to the spider(②) fitted with rubber blocks(①).
- ② The power is transmitted to Input shaft(④) through the pulley(③) of the PTO and then rotates input gear(⑤) which is shrink-fitted to the Input shaft.
- ③ Both Pinion gears(⑥,⑨) which are engaged with input gear are rotated, and then Internal plates which are engaged with pinion gears are rotated in the opposite direction of that of engine.

3-3-2. STAND-BY POSITION

- ① In Stand-by position, pressure for lubricating and actuating is produced respectively.

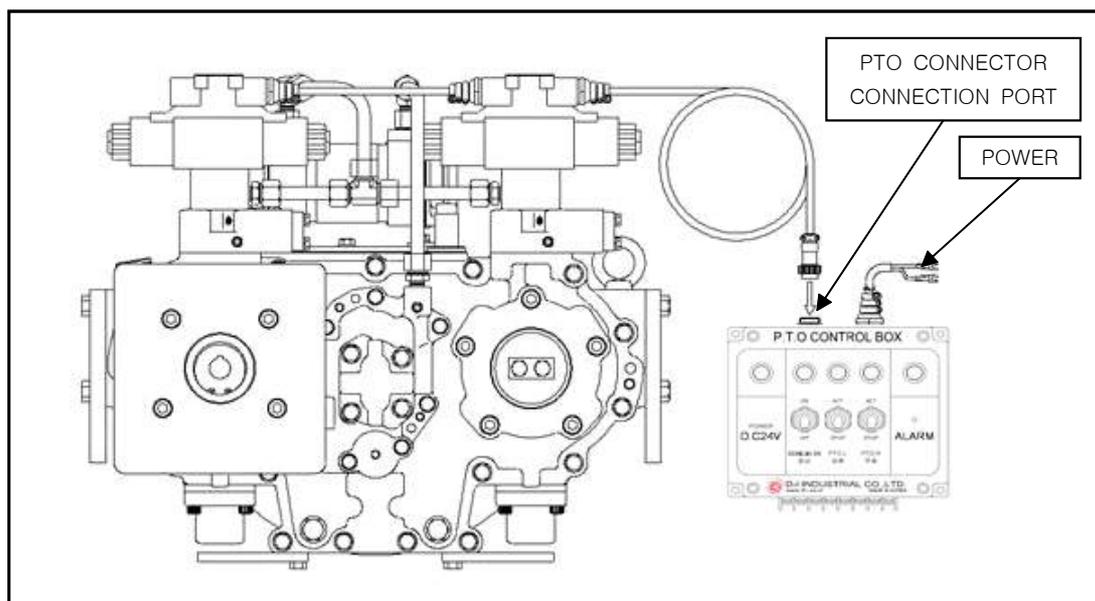
3-3-3. OPERATION POSITION

- ① High pressured oil which is regulated in each remote control valve pushes Hydraulic pistons in the clutches respectively.
- ② The internal plates and the external plates in the each clutch are stuck fast to each other and then rotate together.
- ③ The external plates are engaged with internal gear of clutch housing(⑦, ⑩) and the power is transmitted to output shafts(⑧,⑪) which are shrink-fitted to the clutch housings.

3-4 OPERATING METHOD BY SOLENOID VALVE

The electrical signal by operation of control box activates solenoid valve on PTO main body, and it operates or stops the equipment.

(A-TYPE control box) (refer to FIG. 3-2)

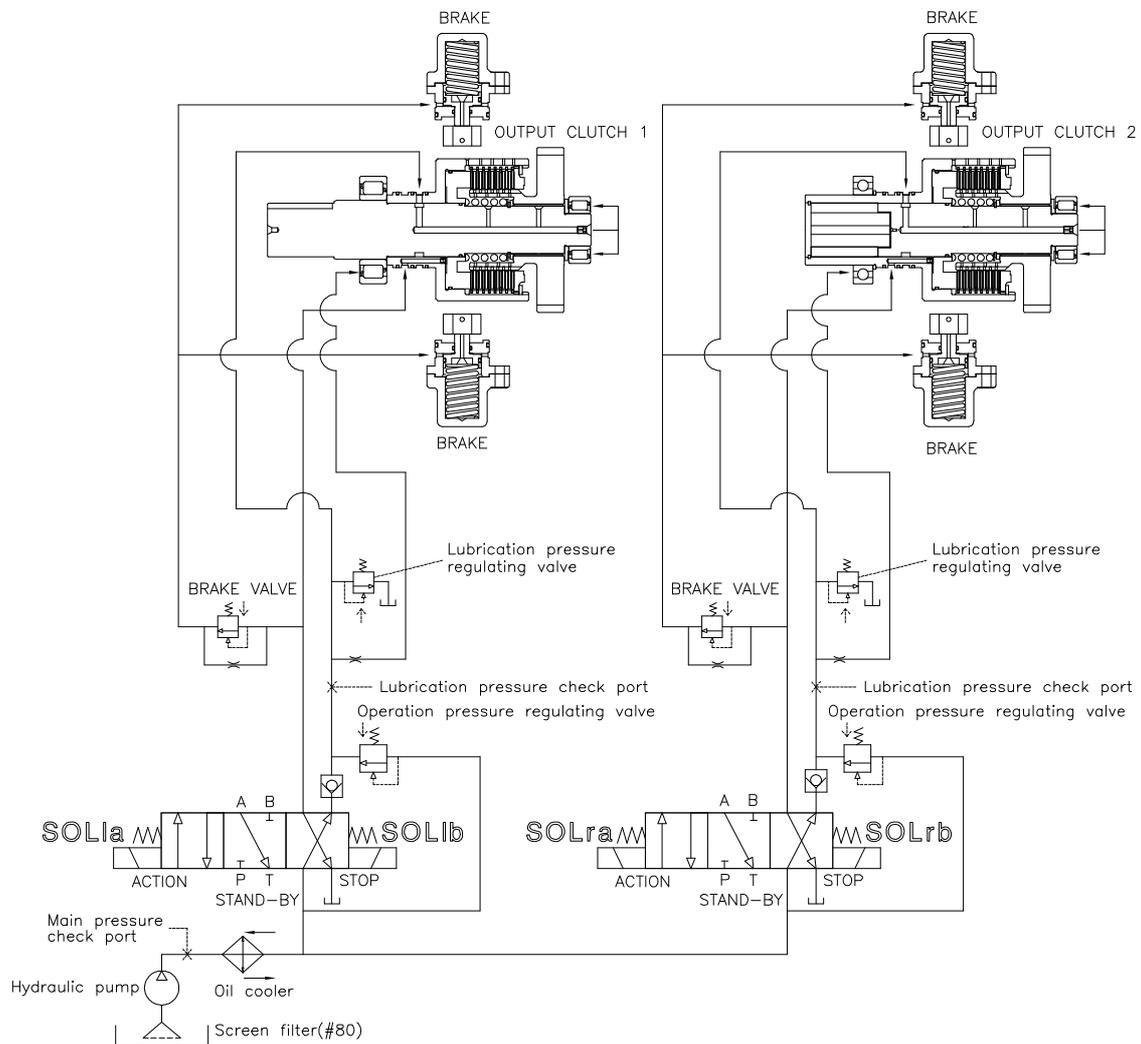


[FIG 3-2] PTO WITH ELECTRIC VALVE / CONTROL BOX

SECTION 4 – HYDRAULIC SYSTEM

4-1 GENERAL

The hydraulic system is shown in [Fig. 4-1]. The oil contained in the PTO flows into the pump through the oil screen filter. High pressure oil discharged from the pump is led to remote control block ass'y through the oil cooler. The oil, which is regulated to the determined` pressure by means of the actuating oil pressure valve and the lubricating oil pressure valve, is supplied to solenoid valve for actuating and lubricating. According to the solenoid`s electric sign, the oil is flowing through the oil path of the Stop, Stand-by and Operation position.



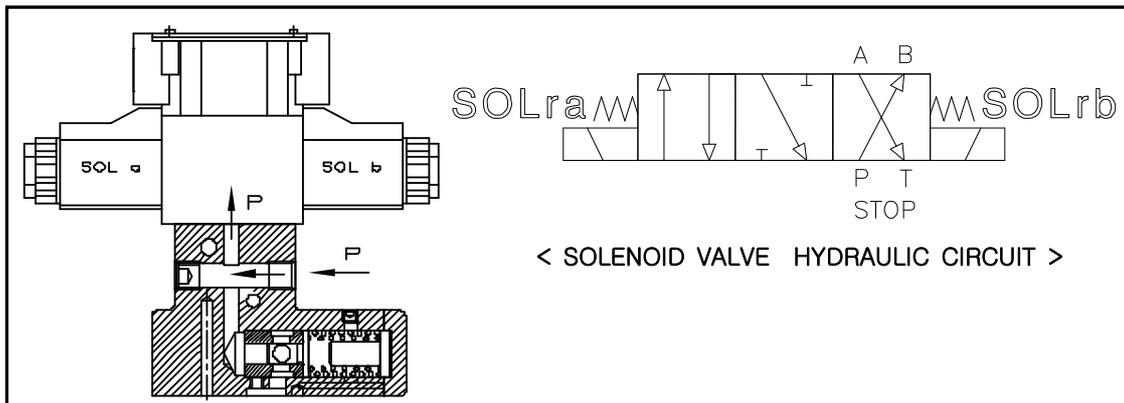
[FIG. 4-1]HYDRAULIC CIRCUIT DIAGRAM

4-2 Remote Control Block Ass'y

1. The oil discharged from the pump goes in the direction of the "P" of remote control block ass'y after being cooled through the oil cooler.
2. Oil flow direction by solenoid valve location.

1) STOP POSITION (SOL b) [FIG. 4-2]

The oil filled with the "P" is connected from port P to Port B of Solenoid valve through the remote control block, and this path is supplying the lubricating oil connecting with each lubricating line of the case cover. The spring situated on the case cover controls the pressure of the lubricating oil.

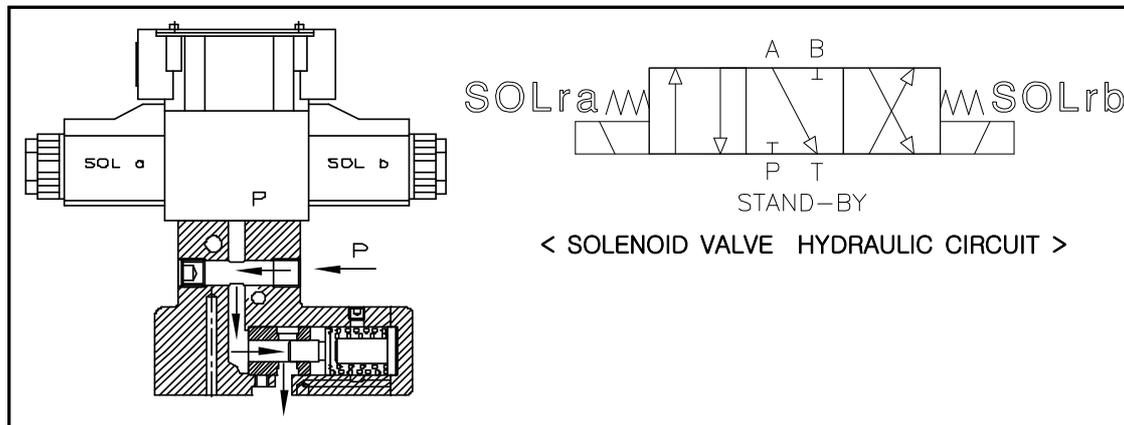


[FIG. 4-2] OIL FLOW OF STOP

2) STAND-BY POSITION (SOL neutral) [FIG. 4-3]

As when the oil filled with the "P" is moving to the port P of the solenoid valve through the remote control block, the valve is closed, the oil opens the operating valve and connects with each lubricating line of the case cover and the lubricating oil is supplied with each necessary parts.

The pressure of lubricating oil is controlled by the lubricating pressure spring. At the same time, high pressure is produced between the actuating valve and gear pump.



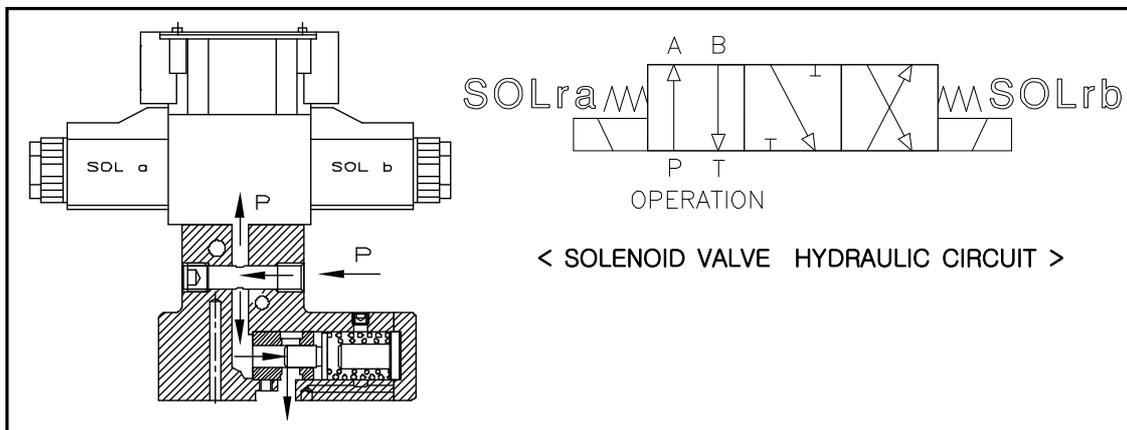
[FIG. 4-3] OIL FLOW OF STAND-BY

3) OPERATION POSITION [Fig. 4-4]

The oil filled with the "P" connects from port P to port A of Solenoid valve through the remote control block and this path through the case cover supplies the oil to the piston inside the clutch and makes the clutch operated. At this time, the operating brake by brake spring is relieved by actuating pressure.

The remaining oil after actuating clutch pushes the operating valve and generates the operating pressure by pressure spring. In case the actuating pressure is over, the operating valve is opened and connected with lubricating line of the case cover and the oil is supplied to the each lubricating part.

The pressure of this lubricating oil is regulating by the pressure valve spring in the case cover.



[FIG. 4-4] OIL FLOW OF OPERATION

SECTION 5 – INSTALLATION

Installation of PTO has an important effect on the function and efficiency of the PTO. Therefore, please study this manual before installing the PTO.

GAUGE / TOOL	SPEC	REMARK
DIAL GAUGE		
MAGNET BASE		
THICKNESS GAUGE		
WRENCHES		

⚠ DANGER

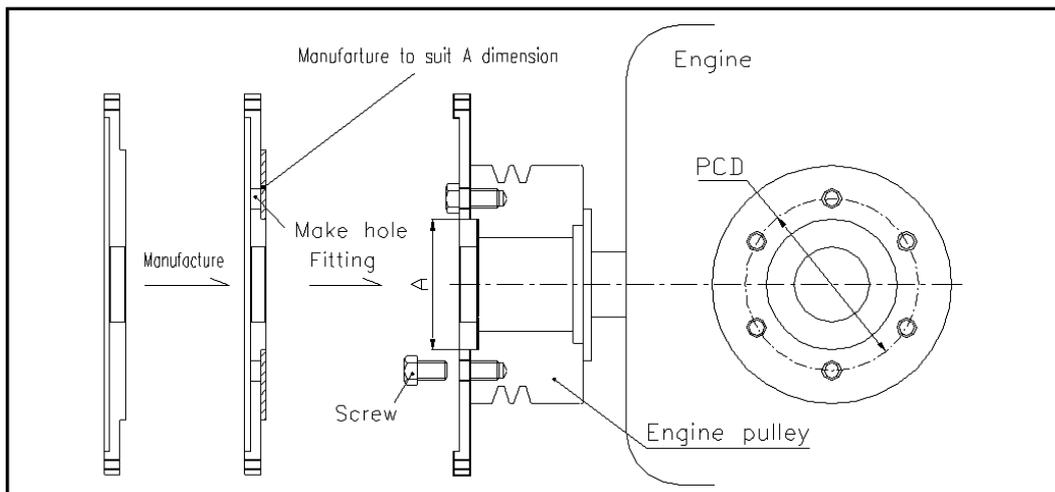
MAKE SURE NOT TO RUN ENGINE WHILE INSTALLING PTO

5-1 WHEN THE PTO IS COUPLED TO THE FRONT OF MARINE ENGINE.

1. INSTALLATION

1) Machining dummy plate and fitting

- ① Machine the dummy plate in accordance with the engine pulley diameter and thread specifications.
- ② Bolt the dummy plate to the pulley.



[FIG. 5-1] Fitting Dummy plate

2) Inspection of the diameter of the dummy plate guide (Concentricity) [FIG 5-2]

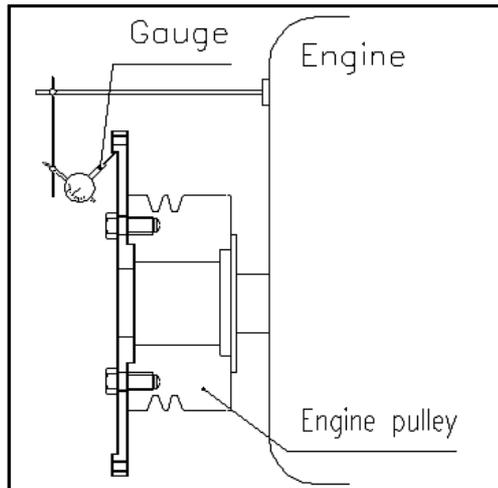
Install a dial test indicator gauge as shown FIG 5-2, and read off the deviation of indicator gauge's scale, rotating the pulley in the same direction.

At this point, the value of deviation should not exceed 0.2 mm.

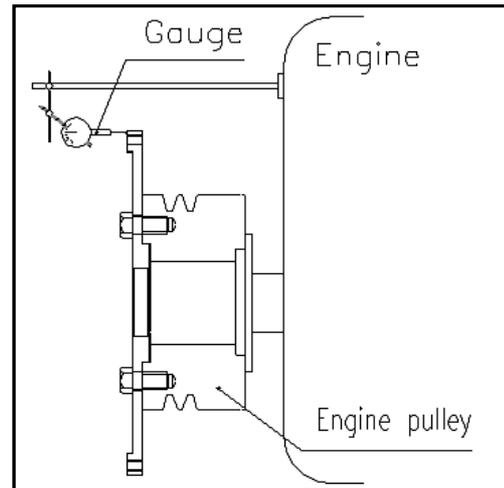
3) Check the dummy plate face (Flatness) [FIG 5-3]

Install a dial test indicator gauge as shown FIG 5-3, and read off the deviation of indicator gauge's scale, rotating the pulley in the same direction.

At this point, the value of deviation should not exceed 0.2 mm.



[FIG. 5-2] Concentricity Inspection



[FIG. 5-3] Flatness Inspection

4) Coupling PTO to Engine : The alignment of the engine and PTO is the most important factor for normal performance and extended 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 deviate due to the vibration of the engine or other influence.

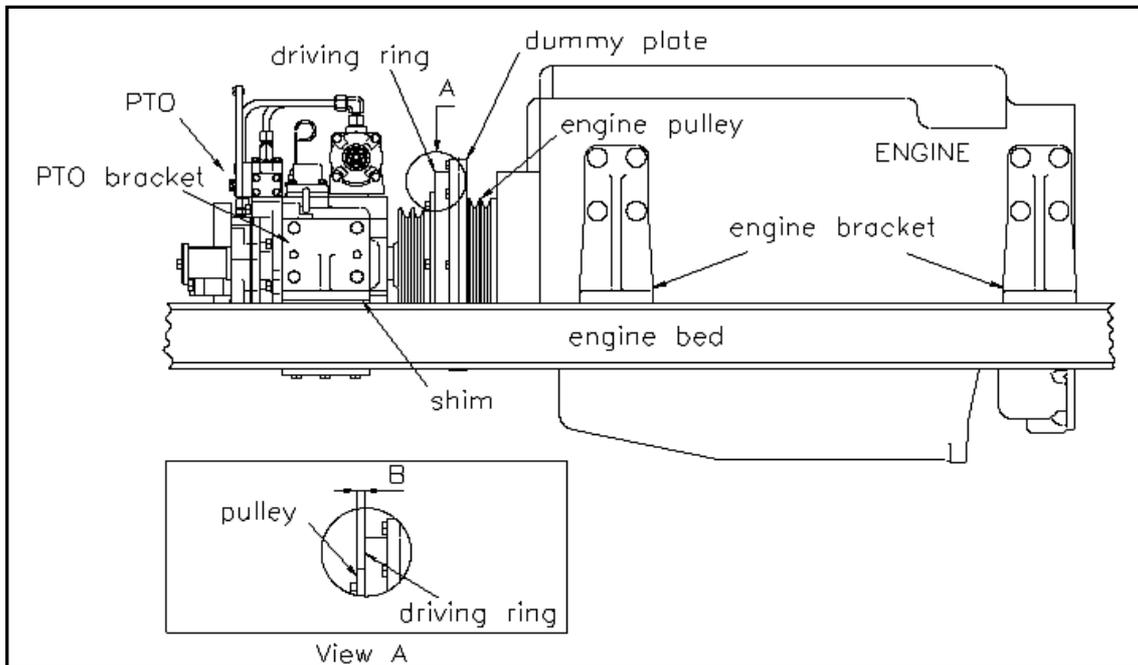
(2) Fitting PTO and Fixing.

①Fit driving ring to the dummy plate with bolts.

②Fit the PTO rubber blocks assembled into the driving ring.

③After fitting, try to accord the driving ring and rubber blocks faces

together. (Refer to the detailed drawing of the back in this manual)



[FIG. 5-4] PTO installation

**CAUTION**

If the dummy plate and the brackets are not bolted firmly, they could be broken due to the vibration of engine while cruising.

5-2 HOW TO FIT HYDRAULIC PUMP AND PULLEY

1) Hydraulic Pump [FIG. 5-5]

- ① Check the dimension A-1 ~ G-1 of Hydraulic Pump.
- ② Machine the sleeve suitably according to the dimension of A-1, B-1, C-1 of the shaft of Hydraulic Pump.
- ③ Machine the pump plate suitably according to the dimension D-1, E-1, G-1 of Hydraulic pump.
- ④ Fit the sleeve into the pump plate and the assemble a snap ring.
- ⑤ Fit the hydraulic pump to the pump plate with bolts.

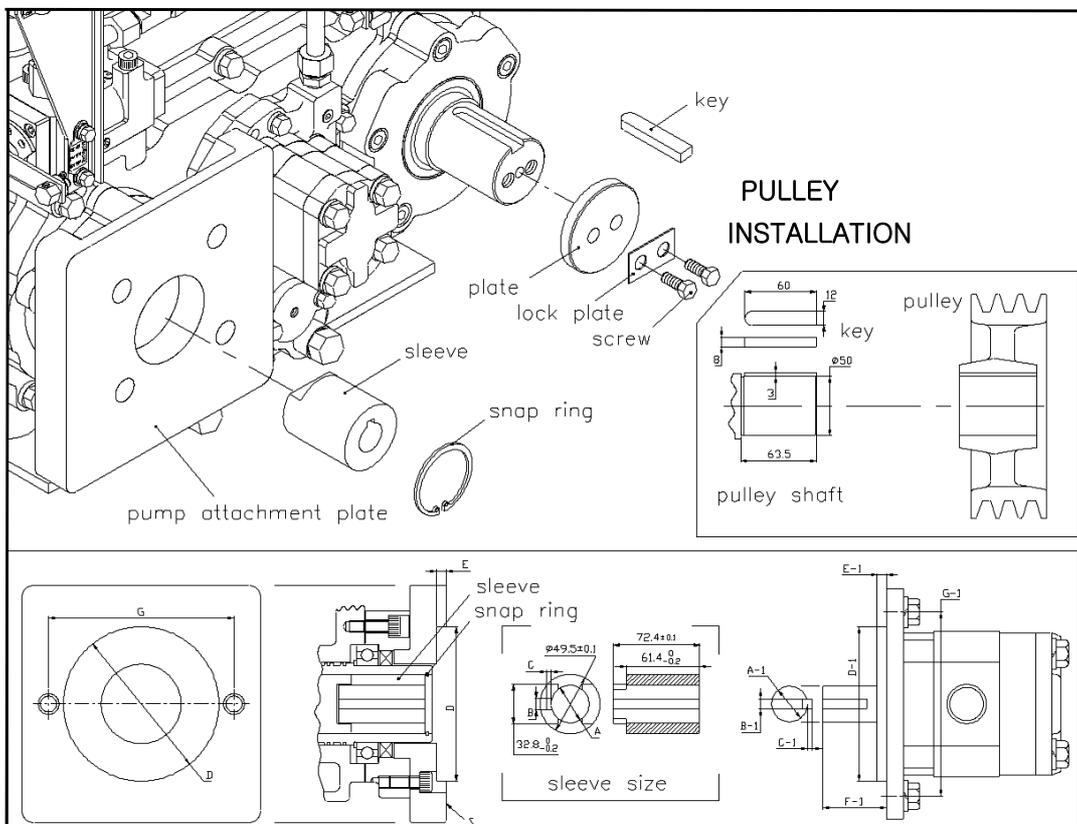
**CAUTION**

Machine "S" surface as much as possible so that the shaft of hydraulic pump can be engaged with the sleeve sufficiently.

2) Pulley [FIG. 5-6]

- ① Machine the pulley suitably according to the shaft of PTO
- ② Assemble following parts in order.
 - Key, Pulley, Washer (for Retainer), Plate (for lock), Screw.

 CAUTION	The pulley of PTO should be pushed by the Washer (for Retainer) and should be press fitted into the shaft of PTO.
--	---



[FIG. 5-5] PUMP INSTALLATION

5-3 When PTO is coupled to Auxiliary engine

1. Check points before installation.

Clean Engine flywheel and flywheel housing.

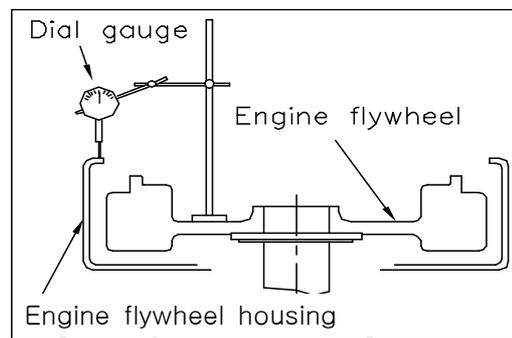
SAE HOUSING NO.	00	0	1/2	1	2	3	4	5	6
Flatness deviation	0.012	0.010	0.010	0.008	0.008	0.008	0.006	0.006	0.006
Concentricity deviation	0.012	0.010	0.010	0.008	0.008	0.008	0.006	0.006	0.006

[Table 5-1]

- 1) Check the surface of the flywheel housing (flatness).

Install a dial test indicator gauge as shown in below figure, and read off the deviation of the indicator gauge's scale, by rotating the flywheel in the same direction.

(Allowable deviation is referred to [table. 5-1])

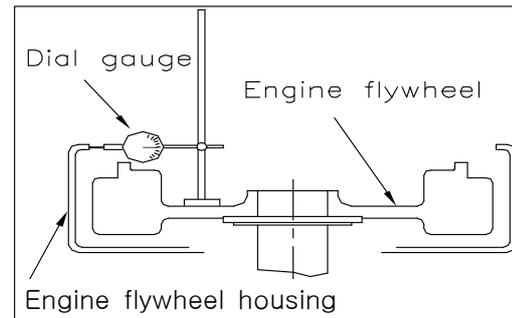


[FIG. 5-6] FLYWHEEL HOUSING FLATNESS CHECKING

- 2) Check the engine flywheel housing guide (concentricity).

Install a dial test indicator gauge as shown in below figure, and read off the deviation of the indicator gauge's scale, by rotating the flywheel in the same direction.

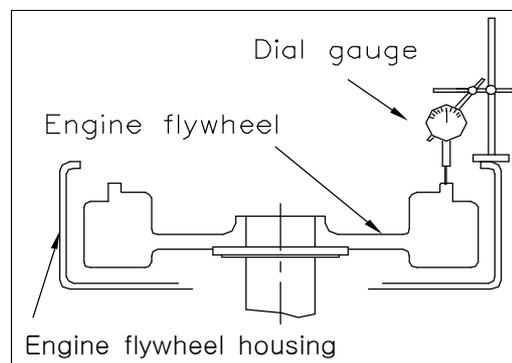
(Allowable deviation is referred to [table. 5-1])



[FIG. 5-7] FLYWHEEL HOUSING CONCENTRICITY CHECKING

- 3) Check the surface of engine flywheel as shown in below figure, and read off the deviation of the indicator gauge's scale, by rotating the flywheel in the same direction.

(Allowable deviation is referred to [table. 5-1])

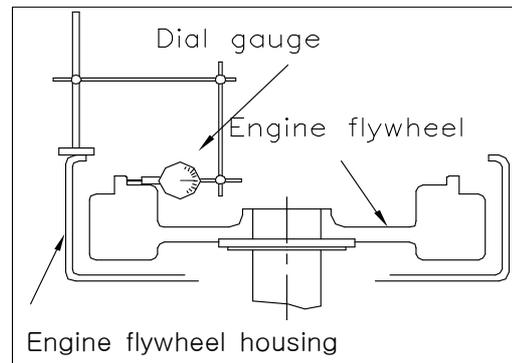


[FIG. 5-8] FLYWHEEL FLATNESS CHECKING

- 4) Check the diameter of the flywheel driving ring seating guide (concentricity)

Install a dial test indicator gauge as shown in below figure, and read off the deviation of the indicator gauge's scale, by rotating the flywheel in the same direction.

(Allowable deviation is referred to [table. 5-1])



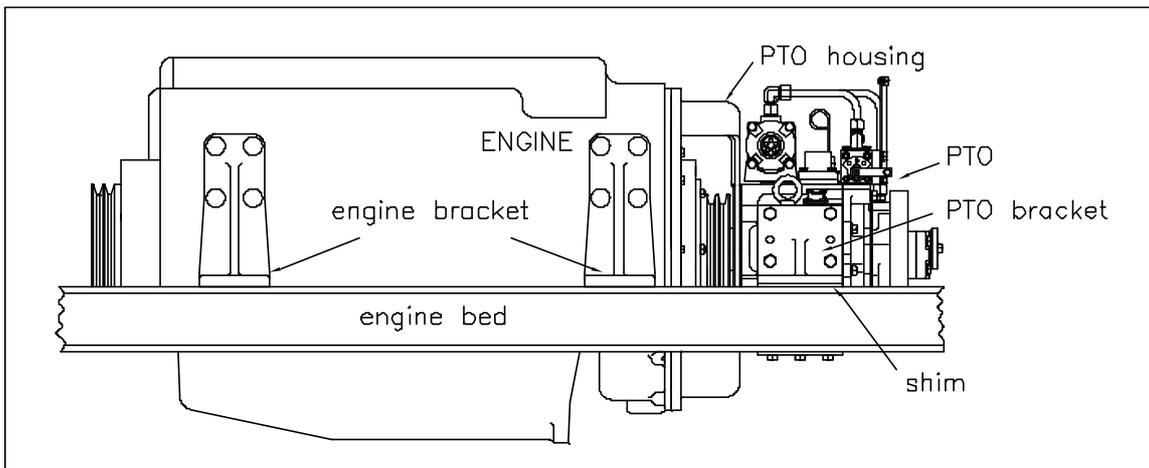
[FIG. 5-9] FLYWHEEL CONCENTRICITY CHECKING

2. Installation (REFER TO [FIG. 5-10])

The alignment of the engine and the PTO is the most important factor for normal performance and extended life.

1) FIXING

The support brackets for the PTO have to be fixed to the engine bed firmly like the engine mounting.



[FIG. 5-10] PTO INSTALLATION TO AUXILIARY ENGINE



CAUTION

Bolts for housing and brackets of PTO should be tightened firmly. If not, a noisy, vibration or breakage of housing can occur while cruising.

5-4 Installation of Control Box (A-TYPE)

1. Cautions of Installation

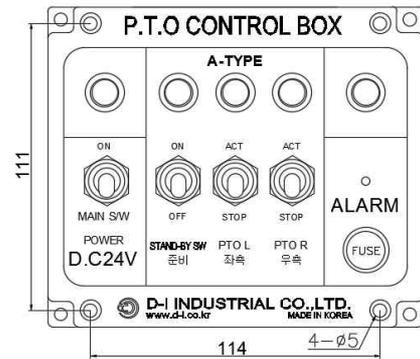
- * Do not install PTO in wet or watery spots.
- * Only DC 24V of power supply is allowed to be used.
- * Fix a control box and cables firmly so that they do not move.
- * Be cautious when you fix the control box so that any short circuit does not occur.
- * Connecting and wiring should be conducted in the same method as shown in the wiring diagram. (refer to FIG. 5-13)

2. How to install

- 1) Select a place where PTO control is needed, and where you would fix the control box.
- 2) Connect cables to solenoid on PTO main body and terminal block correctly. When you connect the cables, make sure to check numbers and colors of them not to be confused. (refer to FIG. 5-13, Table. 5-2)

③ Black	④ Blue	⑤ Green	⑦ Brown
Sol L,R b(+)	Sol La(+)	Sol Ra(+)	Sol L,R (-)

[TABLE. 5-2] The wire colors and numbers of solenoid



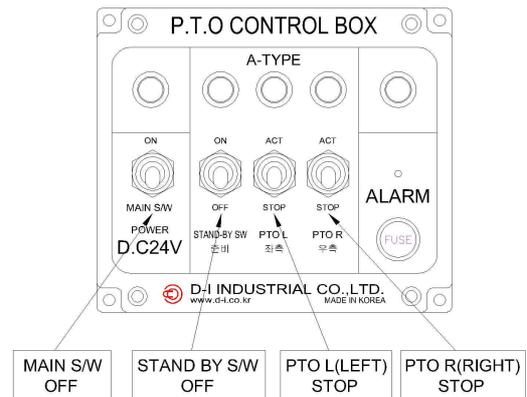
[FIG. 5-11] Installation of control box

- 3) Wire the electric cables connected to PTO main body to the spot where control box is placed and to the terminal block. Then mark the terminal block which is connected to the control box and the electric cables in order not to be confused when connecting them.

- 4) Control box should be fixed firmly. When you fix it, open the cover not to trigger any short circuit.

- 5) Before you connect the cables, all the switches should be placed at the positions as shown in the figure.

(refer to FIG. 5-13, Table. 5-3)



[FIG. 5-12] Switch position when installed

MAIN S/W	STAND-BY S/W	PTO L (LEFT)	PTO R (RIGHT)
OFF	OFF	STOP	STOP

[TABLE. 5-3] Switch position before wiring cables

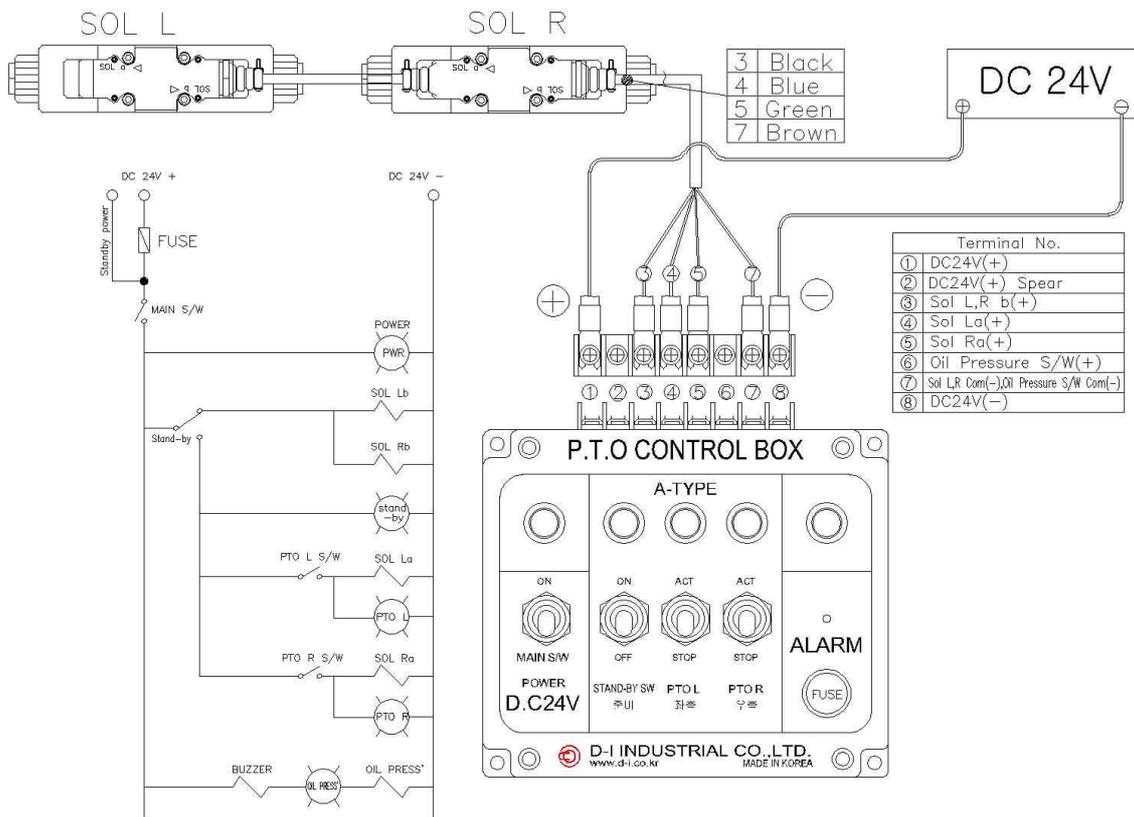
- 6) Connect the terminal block and wires which are connected to PTO main body to terminal block behind the control box using electric cables. (refer to FIG. 5-13, TABLE. 5-4)
- 7) Connect electric wires to power supply (DC 24V) so that current flows through them. +(red) should be connected to terminal no.1 and -(white) to terminal no.6.

No.	Name of terminal block
①	DC 24V(+)
②	Standby DC 24V(+)
③	Sol Lb(+), Sol Rb(+)
④	Sol La(+)
⑤	Sol Ra(+)
⑥	Oil Pressure S/W(+)
⑦	Sol L,R COM(-),Oil Pressure S/W Com(-)
⑧	DC 24V(-)

[TABLE. 5-4] Terminal block of control box

Terminal no.2 connects to none of the wires when installed since it will be used as standby power supply terminal when fuse breaks.

- 8) The wiring connection should be conducted in the same method as shown in the figure. Otherwise, malfunctions might occur or even the machine would not be operated.



[FIG. 5-13] The wiring connection of control box and electrical circuit diagram

5-4 How to check the polarity of control box power supply (In case the polarity is unknown)

1. Cautions

- * Only terminal no.2 and 8 will be used to check the polarity, and all the connection of electric cables should be separated from the terminals.
- * When you connect wires, all the switches should be placed at 'OFF, STOP' and power should be blocked.

2. How to check the polarity

- 1) Connect two strands of power supply wire to terminal no.2 and 8. (Block the power supply while connecting them)
- 2) Activate(ON) the main switch of control box.
- 3) If power lamp is turned on, one strand connected to terminal no.1 is +(positive) and the other connected to terminal no.8 is -(negative).
- 4) Connect the +(positive) wire to terminal no.1, and -(negative) wire to terminal no.8
- 5) If the power lamp is not turned on when you activate the main switch, connect the wires the other way around and activate(ON) the main switch again to check the power lamp.
- 6) If the power lamp is turned on, check the polarity and connect cables according to step 3 and 4.



DANGER

Do not install the control box in spots where sea water or rainwater comes in. Only DC 24V of power supply is allowed to be used.

SECTION 6 – OPERATION

6-1 Preparations for operation

1. Check all the parts of PTO, and check if bolts, nuts, etc in major parts are tightened.
2. Check the oil level with oil level gauge.
(Run the engine at idle speed for 2~3 minutes, and check immediately after stopping it)
3. Place the switch on the Stop-position of the control box before operating the engine.

 CAUTION	Check the oil of PTO before operation. If the oil is insufficient, fill to correct level.
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6-2 OPERATION

1. Run the engine at idling speed for about 10 minutes for warming-up.
2. At this point, check oil leakage, abnormal noise, overheating, coolant condition, etc.

6-3 Operation and Stop

1. The normal temperature of oil in the PTO during continuous actuation is between 50~90°C, but may be raised a little due to frequent Operating, Stand-by and Stop operation.
2. Check at all the time if there is abnormal noise or over-heat during operation.
If an abnormal condition is found, stop the engine, find out the cause and correct it.
3. Place the switch on the Stop position before stopping the engine.

 CAUTION	Before operation of PTO, ensure engine RPM is suitable to run the other equipments fitted to the PTO.
--	---

6-4 How to operate control box (A-TYPE)

1. Checks points before operation
 - * The power lamp should be turned on when power is connected to control box and main switch is activated(ON). Check the power connection part and battery if the lamp is not turned on.

- * PTO main body and cables of control box should be connected.
- * Operation switch of control box should be placed at 'OFF' when engine starts.
- * Check the connection and wiring referring to the wiring diagram.

2. Operation method

- 1) Place all the operation switches of control box at 'OFF, STOP' when engine starts.
- 2) When the main switch is activated(ON), the red lamp above fuse will be turned on.
- 3) When the switch is activated, the power will energize the solenoid on PTO main body, 'Sol Lb' and 'Sol Rb' on both solenoids will operate, and the lamps of 'Sol Lb' and 'Sol Rb' on them will be turned on.
- 4) If the power energize the control box and standby switch is activated, the green lamp above the switch will be turned on, and Sol Lb and Sol Rb on both solenoids will switch to neutral and the lamps on them be turned off.
- 5) If you activate PTO-L or PTO R switch when the power and standby switch is on, the green lamp above the switch you have activated will be turned on, 'Sol La' or 'Sol Ra' on solenoid will operate, and the lamp on the solenoid will be turned on. If hydraulic device operates in the opposite as you have controlled, check the wiring system again referring to the wiring diagram.

PTO L(Left) ACTIVATED				PTO R(Right) ACTIVATED				PTO L,R(Both sides) ACTIVATED			
①	②	③	X	①	②	X	③	①	②	③	③
Main Switch	Standby Switch	PTO L Switch	PTO R Switch	Main Switch	Standby Switch	PTO L Switch	PTO R Switch	Main Switch	Standby Switch	PTO L Switch	PTO R Switch
ON	ON	ACT	STOP	ON	ON	STOP	ACT	ON	ON	ACT	ACT

TABLE 6-1 PTO operating method

3. Cautions

- * If control box does not operate in spite of the same wiring system as the circuit diagram, open the fuse cap and check the fuse inside of control box.
- * If the fuse inside of control box breaks, connect the cable in terminal block no.1 to terminal block no.2, which is standby DC24V(+).
- * Replace the broken fuse after using standby power supply, and reconnect the standby DC24V(+) cable in terminal block no.2 to terminal block no.1.
- * The fuse will be broken if current over 3A flows through the control box. In this case, find and solve the cause of overcurrent and replace the fuse.
- * PTO should be turned off when it is not used. Otherwise, it could be dangerous due to sudden operation of the equipment when engine starts, and the solenoid valve could be broken due to overheat.


DANGER

Slipping would occur if you activate the PTO L and R switches without placing the standby switch at 'ON'.

SECTION 7 – PREVENTIVE MAINTENANCE

7-1 GENERAL

All the rotating parts in the PTO is lubricated by oil in the PTO.

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.

 CAUTION	<p>Use only SAE-API service class SAE#30 engine oil. Multi-grade oils (SAE#10W, 15W40, etc) should not be used in D-I PTO because they have influence on the coefficient of friction and cause the clutch to slip.</p>
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2. Check the oil level every day.
3. Replace the oil after first 100hours operation and then every 1000hours.

 CAUTION	<p>If a foreign substance such as clean water, seawater, etc has come into the PTO, overhaul and clean all parts before assembly. Refill with new oil.</p>
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7-3 Oil Filter

At the time of oil replacing, clean screen filter and magnetic plug.

7-4 Visual Inspection

Inspect the external parts of PTO frequently and repair if any defect is found. Particularly, inspect the rubber blocks and replace them with new ones if they are damaged or worn out.

7-5 Overhaul

1. Look for our distributor in your country for overhaul of the PTO.
2. Replace all gaskets, o-rings, and other rubber products whenever disassembling
3. Replace rubber blocks and bearings after 10,000hours operation or earlier if excessive wear or damage is found.

SECTION 8 – TROUBLE SHOOTING

If something is wrong with the PTO, refer to [Table. 8-1]

[Table. 8-1]

Symptom	Cause	Remedy
Low main oil pressure	Oil strainer clogged	Remove the residue and clean
	Oil pressure regulating valve stuck in the control valve	Remove the residue and clean
	Seal damaged or worn	Replacement
	Hydraulic pump damaged or worn	Replacement
	Clutch oil pressure regulator valve's spring damaged or worn	Inspect length of spring and replace it if necessary
No oil pressure	Oil level low	In case of oil leakage, replace of the components such as gaskets, oil seals, etc. which cause oil leakage and fill the oil
High main oil pressure	regulator pressure valve operated poorly	Remove the residue and clean
Low Lubricating oil pressure	Lubricating oil pressure regulating valve operated poorly	Remove the residue and clean
Over-heat	Clutches slipping	Disassemble PTO and check the clutch plates
	Excessive oil level	Regulation of oil level
	Bearing damaged	Overhaul PTO and check the bearing.
Rotating parts defective	Clutch plates stuck	Disassemble of clutch ass'y and replace clutch plates
	Pinion bush stuck	Disassemble and replace
	Clutch piston's returning spring is damaged or broken	Disassemble and replace of spring
Improper Shifting	Clutch plates stuck	Disassemble of clutch ass'y and replace clutch plates
	Failure of remote control system	Remote control system adjusting and replacement
	Defective Remote controller	Adjust and replace the remote controller
	Clutch piston's return spring is damaged or broken	Disassemble and replace the spring
Abnormal noise	Gear teeth or spline damaged worn	Disassemble and repair or replace
	Bearing damaged	Disassemble and replace
	Rubber blocks damaged or worn	Disassemble and replace
	Bolts or nuts loosened or removed	Secure tightening

ANNEX I (PERIODIC INSPECTION TABLE)

○ Check, ◎ Exchange

	NAME	Check / Exchange (year)				Parts to Using	Remark
		1	3	5	10		
P T O B O D Y	*Gasket, paper				◎	Cover, Case, Manifold etc.	
	*Gasket, copper				◎	Drain & Magnet Plug etc.	
	*O-Ring				◎	Screen Filter, Brake etc.	
	*Seal, oil				◎	Input Shaft Pump & Pulley Shaft	
	Ring, oil Seal		○		◎	Pump & Pulley Shaft	Wear, Breakage
	Spring		○		◎	Remote control block, Brake etc.	
	Brake Shoe		○	○	◎	Brake	wear, Breakage
	Plate (sintered/steel)		○	○	◎	Clutch housing	wear, Taken off ,Reform
	*Snap Ring				◎	Pump & Pulley Shaft	
	Trust Metal			○	◎	Pump & Pulley Shaft	Wear, Damage, Taken off
	Bush Bearing			○	◎	Pump & Pulley Shaft	"
	Bearing, taper roller			○	◎	Input Shaft	"
	Bearing, roller			○	◎	Pump & Pulley Shaft	
	Bearing, ball			○	◎	Pump Shaft	
	※Magnet Plug						
※Oil(SAE#30)						Refer to Section 7-2	
※Screen Filter		◎	◎	◎		Breakage, Reform	
P U M P	*Gaskets					BODY, pump	
	Bush Bearing			○		Pump Gear	Wear, Damage, Taken off
	Pump Ass'y			◎	◎		
C O O L E R	*Gasket, paper					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 when replacing oil (Replace oil after first 100hours and then every 1000hours)

ANNEX III

WARRANTY LETTER

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

1. SCOPE OF WARRANTY

Warranty is limited to repair or supply with new one against D-I PTO 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 dose 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 occurs for repairing before contacting with D-I Industrial Co.,Ltd.
- 3) The breakdown which is occurred due to any modification to D-I PTO or its parts without the prior consent of D-I Industrial Co.,Ltd.
- 4) The breakdown that is occurred due to the customer's negligence, faulty maintenance. Misuse or non observance of recommended or operation instructions.
- 5) Consumable parts such as Gaskets, packings, tubes, and etc.,

4. OBLIGATION OF USERS.

- 1) D-I PTO 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 PTO should be repaired in a workshop, use a workshop that is appointed by D-I Industrial Co.,Ltd.

5. WARRANTY REPAIR

- 1) This warranty letter is accompanied D-I PTO 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.

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

7. WARRANTY SUCCESSION

In case that owner is changed because D-I PTO 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 PTO.

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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