10. PTO SYSTEM

CONTENTS

PTO SYSTEM

1. GENERAL

Power can be taken off a KUBOTA engine from the following points within a certain range dicated by total engine output.

Power can be taken from the engine at several points. The amount of power that can be taken at a position may be 100% (Full engine horse power) or less than that.
This depends on strength of engine components (Example : At fuel camshaft parts are smaller), type of drive component and direction of power take - off.

To ensure proper engine performance and long life the drive system must be carefully designed.
A review by KUBOTA is recommended.

PTO Usage						
PTO Position	**Notes**	**S.M.**	**05**	**03-M**	**07**	**V3**
Crank Front	Auxiliary Power	Yes	Yes	Yes	Yes	Yes
Crank Rear	Main Power	Yes	Yes	Yes	Yes	Yes
Governor Shaft	Hydraulic Pump		Yes		No	
Rear of Fuel Camshaft	Hydraulic Pump	Yes	No	Yes	No	
Front of Fuel Camshaft	Tachometer	Yes	Yes	Yes	No	Yes
Gear case	Hydraulic Pump	No	No	Option	Yes	Yes

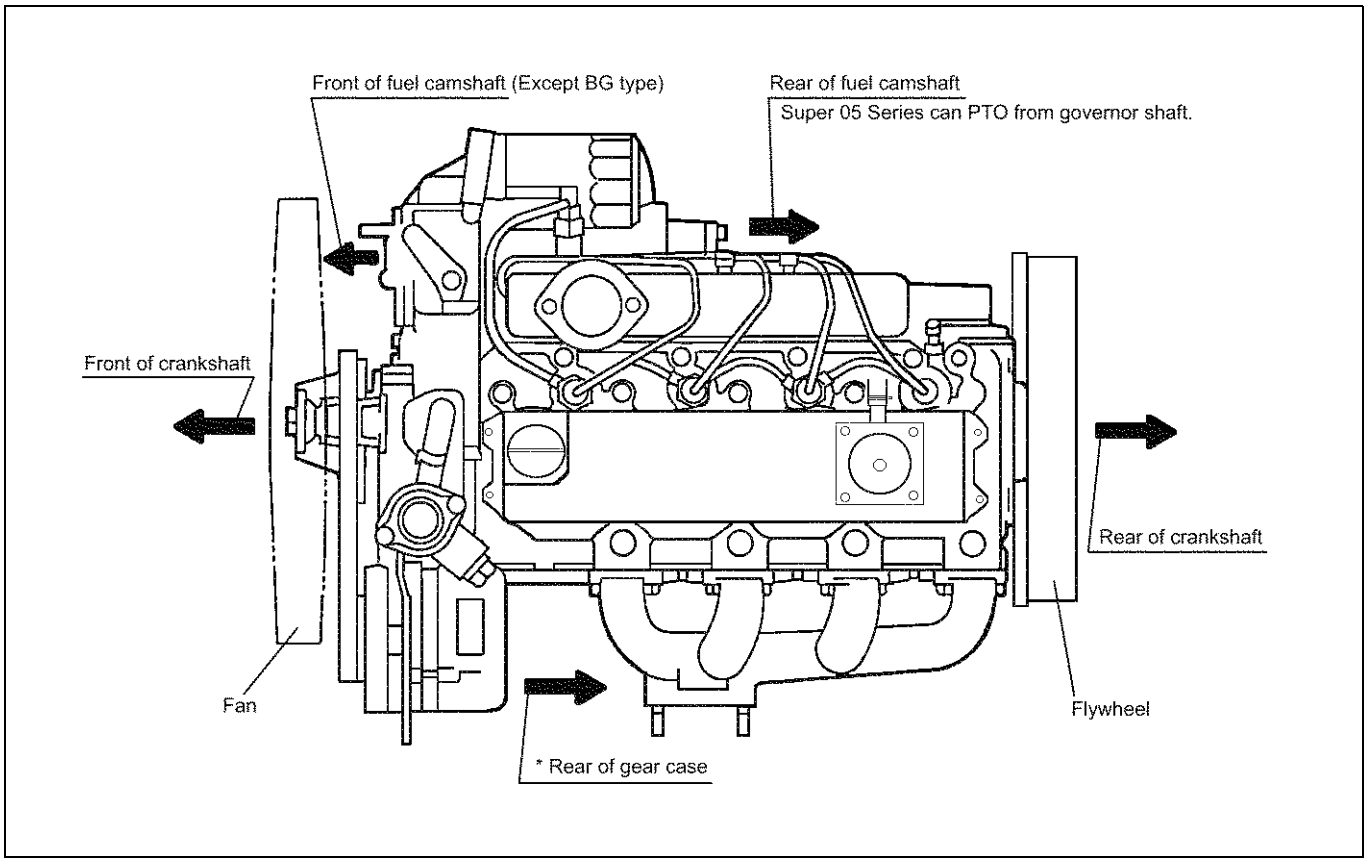


Fig. 10-1

Table of PTO

	Location		Application	Connecting method	Remarks
1	Rear of crankshaft		Main power	Flange direct-coupling	
				Belt drive by pulley	
2	Front of crankshaft		Auxiliary power drive	Rotation transmission by concentric shaft	Ex. Air Conditioning
				Belt drive by pulley	
3	Fuel camshaft	Front	Tachometer	Oldham	Contact KUBOTA for available power
		Rear	Hydraulic pump	Spline or oldham	
4	*Side PTO		Hydraulic pump	Spline	
5	*Governor shaft		Hydraulic pump	Oldham	Only 05 series

Note : 1. Rear : Flywheel side
2. *marked location : Available model is limited.
3. The transmissible power slightly varies with models and positions.

2. REAR OF CRANKSHAFT (Flywheel side)

(1) For direct connection with housing

1) Housing

Join flange faces and tighten bolts (by pilot dia or knock pin).

2) Rotating body

Join flywheel mounting face with flange face and tighten bolts (by dowel).

3) Precision of case and rotating body

Rigid connection of the PTO, marine gear or transmission to the engine flywheel housing can make the system compact. Special attention should be paid to the assembly precision for this type of conection.
Improper assembly will result in excessive power loss premature parts failure.

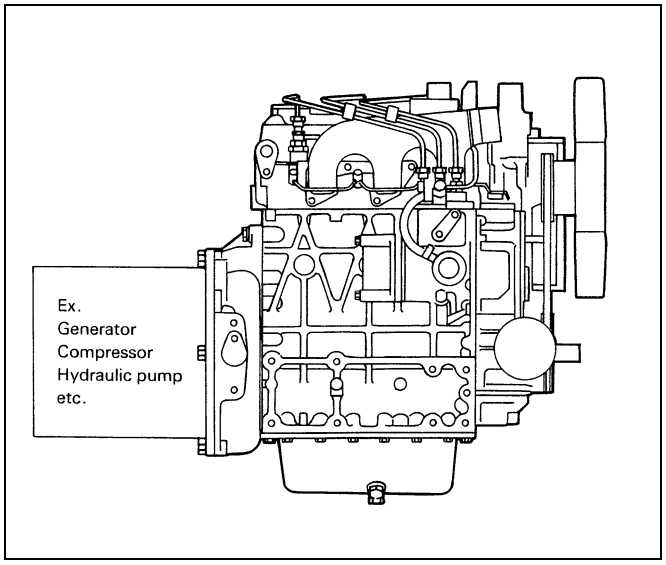


Fig. 10-2

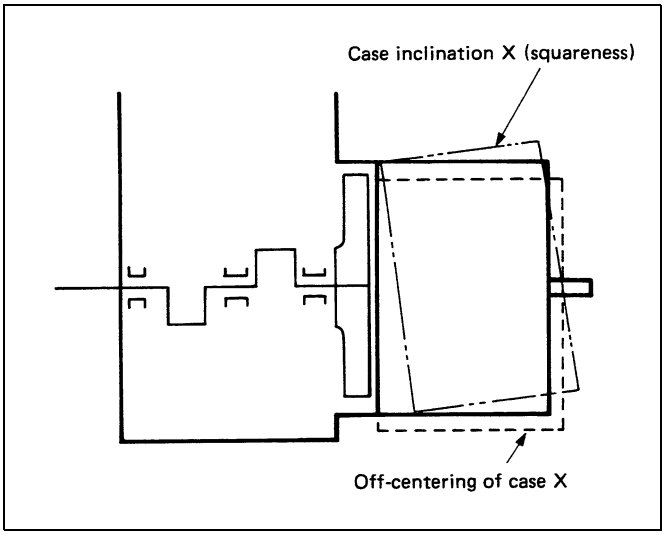


Fig. 10-3

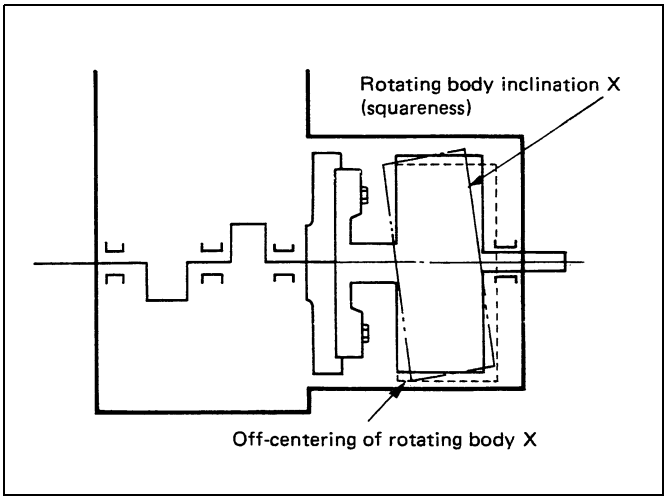


Fig. 10-4 Precision of rotating body

(2) For using belt

1) Direction

a) When taking power off in two directions, arrange so that tension is offset.

b) When taking motive power off in one direction, take it off downward. Ensure that side load is within KUBOTA's specs.

2) Available load

Determine by referring to "Table of PTO" in page 10-2 and Fig. 10-5.

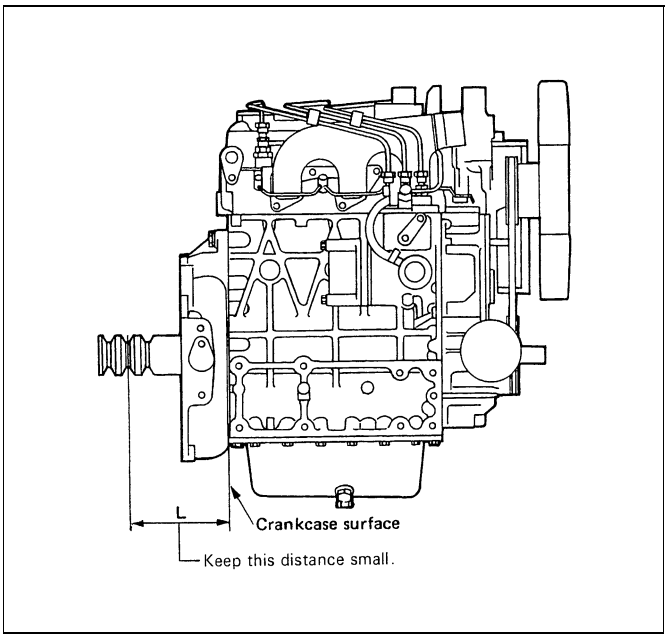


Fig. 10-5

3) When using belt

When belt driving is used, careful consideration must be given to the amount of overhang and size of load, allowable load must be strictly observed, belt tension also greatly influences load. Belt must be tightened as specified.

3. FRONT OF CRANKSHAFT (Radiator side)

(1) Taking off in axial direction

a) Take off from the same shaft center via a flange coupling (concentric).

Note :

1. PTO should be able to be dismounted easily when replacing the fan belt.

2. Since spline is formed at the crancshaft end, an adapter suitable to the spline required.

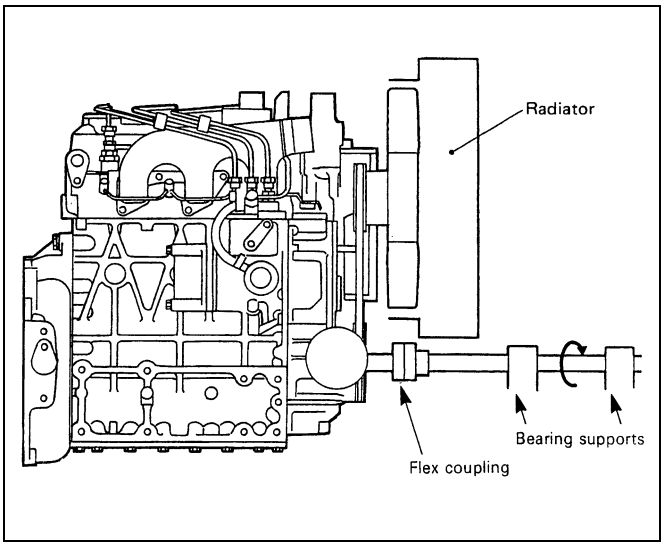


Fig. 10-6

b) An example of front PTO for 03-M series.

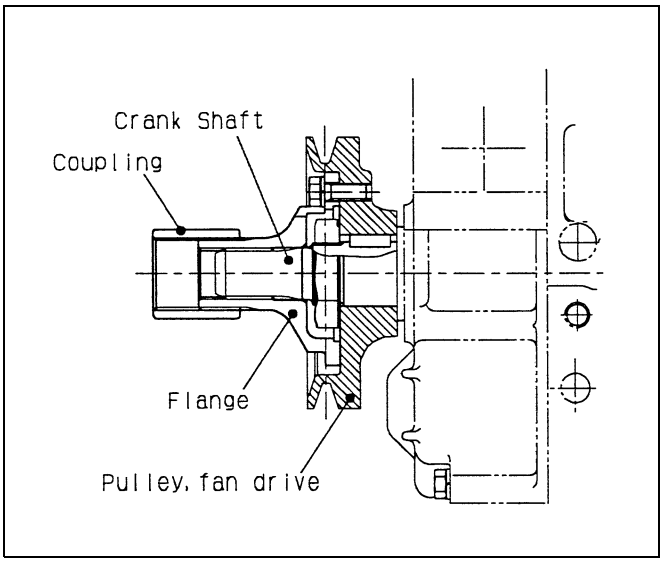


Fig. 10-7

(2) For using belt

1) Direction

a) When taking power off in two directions, arrange so that the tension is offset.

b) When taking power off in one directions, take it off downward. Ensure that side load is within KUBOTA's specs.

2) Available load

Determine by referring to "Table of PTO" in page 10-2 and Fig. 10-8.

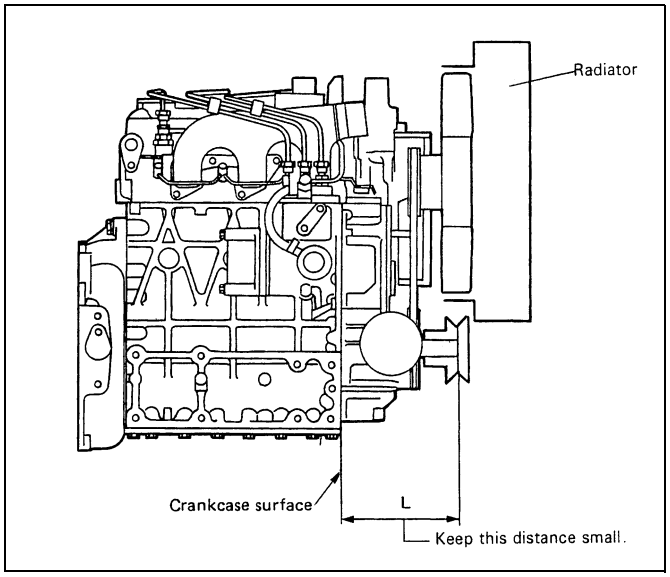


Fig. 10-8

[Power Take-off Recommendations]

1. If PTO shaft length are too long, an outboard bearing must be added.
2. Flexible couplings allow a little miss alignment between engine and drive device.
   They also dampen inertial loads, they must be used, along with outboard bearing, for front PTO drives.
3. Power disconnects (Clutches, Hydraulic unloader valve, etc.) reduce the load on the engine when being started.
   Using them may eliminate the cost of adding a heavy duty starter.
4. SAE housings allow direct coupling of industry standard generators, clutches and pumps.
5. To minimize the possibility of excessive overhang when driving two separate loads through two separate belts, it is best to place the two loads as directly opposite each other as possible.
6. To reduce overhang, belt drive pulleys must be as close to the engine as possible.

(1) Side load calculation for V-belt drive application

When V-belt pulley is used for PTO according to the following procedure, confirm that the position of the pulley is within the allowable limit.

Even if it is located within the limit, minimize the overhang as much as possible to avoid any side load problems.

Also, tension of the belt is very important for the life of the bearing of the engine and the belt.

Follow the recommendation of the belt manufacture for tensioning the belt.

The following calculation method is only a reference for designing. Therefore, it is important to eventually carry out the actual operation test or the endurance test using the actual machine to check for problems.

(2) Procedure to determine the allowable side load

1) Find the design horsepower Pd

a) Select the service factor Ks from Table No.1 depending on the type of the driven machine and the service cycle.
   If can not find you machine on Table No.1 use 1.3 as the service factor.

b) Calculate the Design Horsepower according to Formula No.1.

   $Pd = Ks \times Pr$ ··· (Formula No.1)
   Pd : Design Horsepower (HP)
   Pr : Required Horsepower for the machine (HP)
   Ks : Service Factor

2) Find the shaft load

a) Calculate Ψ or (D-d) / c

   $\Psi = 180 - 57 (D-d) / c$ ··· (Formula No.2)
   Ψ : Arc of contact on small sheave (deg)
   D : Diameter of large sheave (mm or in.)
   d : Diameter of small sheave (mm or in.)
   c : Center distance between both sheave (mm or in.)

b) Find the Arc correction factor K Ψ from Fig. 10-9.

c) Calculate the belt speed.

V = (d × N) / 3.82 ··· (Formula No.3)
V : Belt speed (ft/min)
d : Diameter of small (large) sheave (in.)
N : Small (large) sheave speed (rpm)
or
V = (d × N) / 318.3 ··· (Formula No.3)
V : Belt speed (m/min)
d : Diameter of small (large) sheave (mm)

d) Calculate the shaft load Fd.

Fd = 33000 × [(2.5-KΨ) / KΨ] × (Pd/V) ··· (Formula No.4)
Fd : Shaft load (lbs)
or
Fd = 4500 × [(2.5-KΨ) / KΨ] × (Pd/V) ··· (Formula No.4)
Fd : Shaft load (kg)

(3) Find the allowable overhang from the engine according to Fig. 10-10 and design the position within the allowable limit.

For reference, attached the information about the dimension from the crankcase to the flywheel and the fan drive pulley. (Table No.2)

ARC CORRECTION FACTOR KΨ

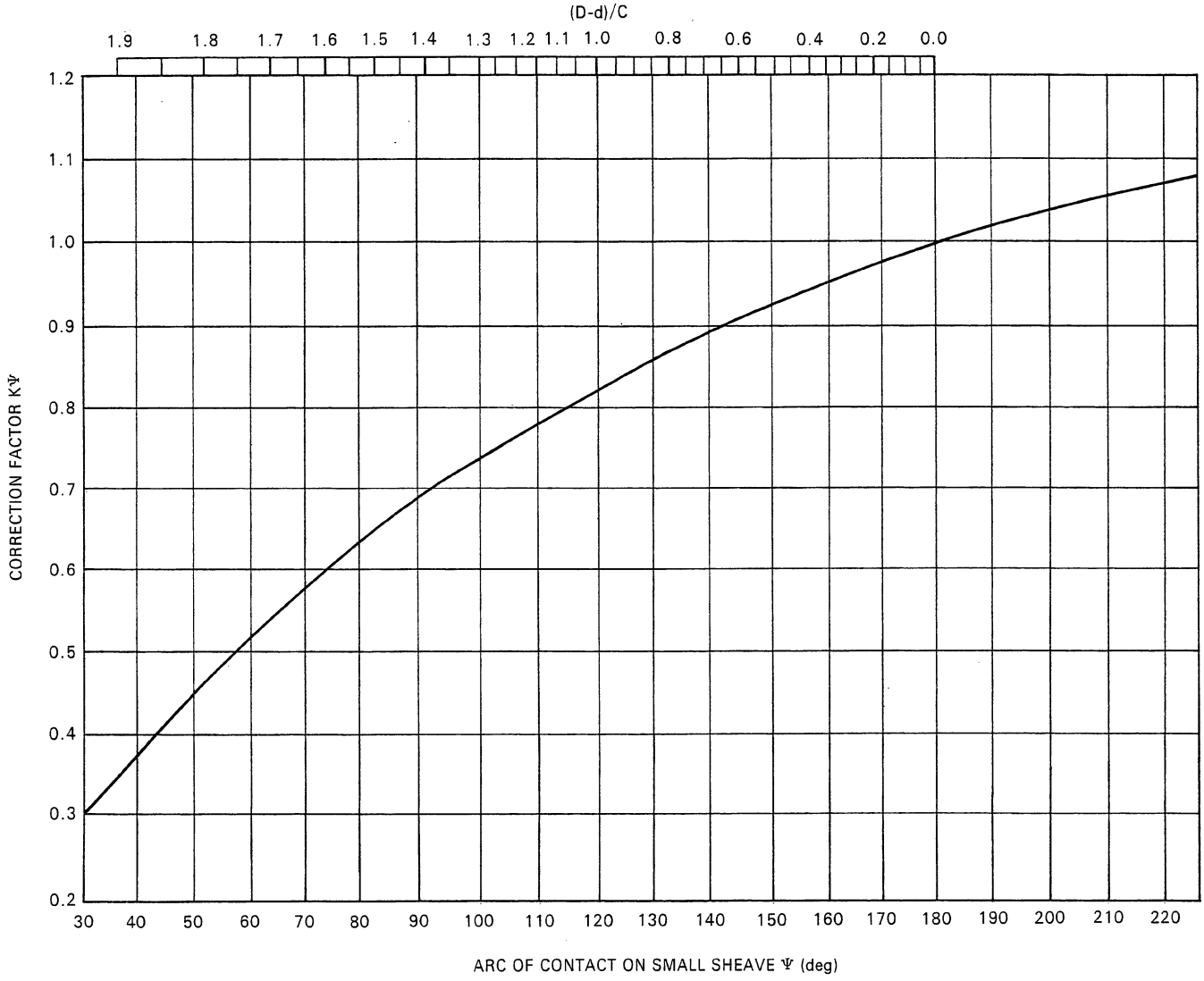


Fig. 10-9

TABLE NO.1 SERVICE FACTORS

Driven Machine	Type of Service		
	Ⅰ	Ⅱ	Ⅲ
Agitators for Liquids	1.0	1.1	1.2
Blowers and Exhausters			
Centrifugal Pumps & Compressors			
Fans up to 10 Horsepower			
Light Duty Conveyors			
Belt Conveyors for Sand, Grain, etc	1.1	1.2	1.3
Dough Mixers			
Fan Over 10 Horsepower			
Generators			
Line Shafts			
Laundy Machinery			
Machine Tools			
Punches - Presses - Shears			
Printing Machinery			
Positive Displacement Rotary Pumps			
Removing and Vibrating Screens			
Brick Machinery	1.2	1.3	1.4
Bucket Elevators			
Exciters			
Piston Compressors			
Conveyors (Drag - Pan - Screw)			
Hammer Mills			
Paper Mill Beaters			
Piston Rumps			
Positive Displacement Blowers			
Pulverizers			
Saw Mill and Woodworking Machinery			
Textile Machinery			
Crushers (Syratory - Jaw - Roll)	1.3	1.4	1.5
Mills (Ball - Rod - Tube)			
Hoists			
Rubber - Extruders - Mills			

TYPE OF SERVICE

Ⅰ : Intermittent Service	3-5 Hours Daily or Seasonal
Ⅱ : Normal Service	8-10 Hours Daily
Ⅲ : Continuous Service	16-24 Hours Daily

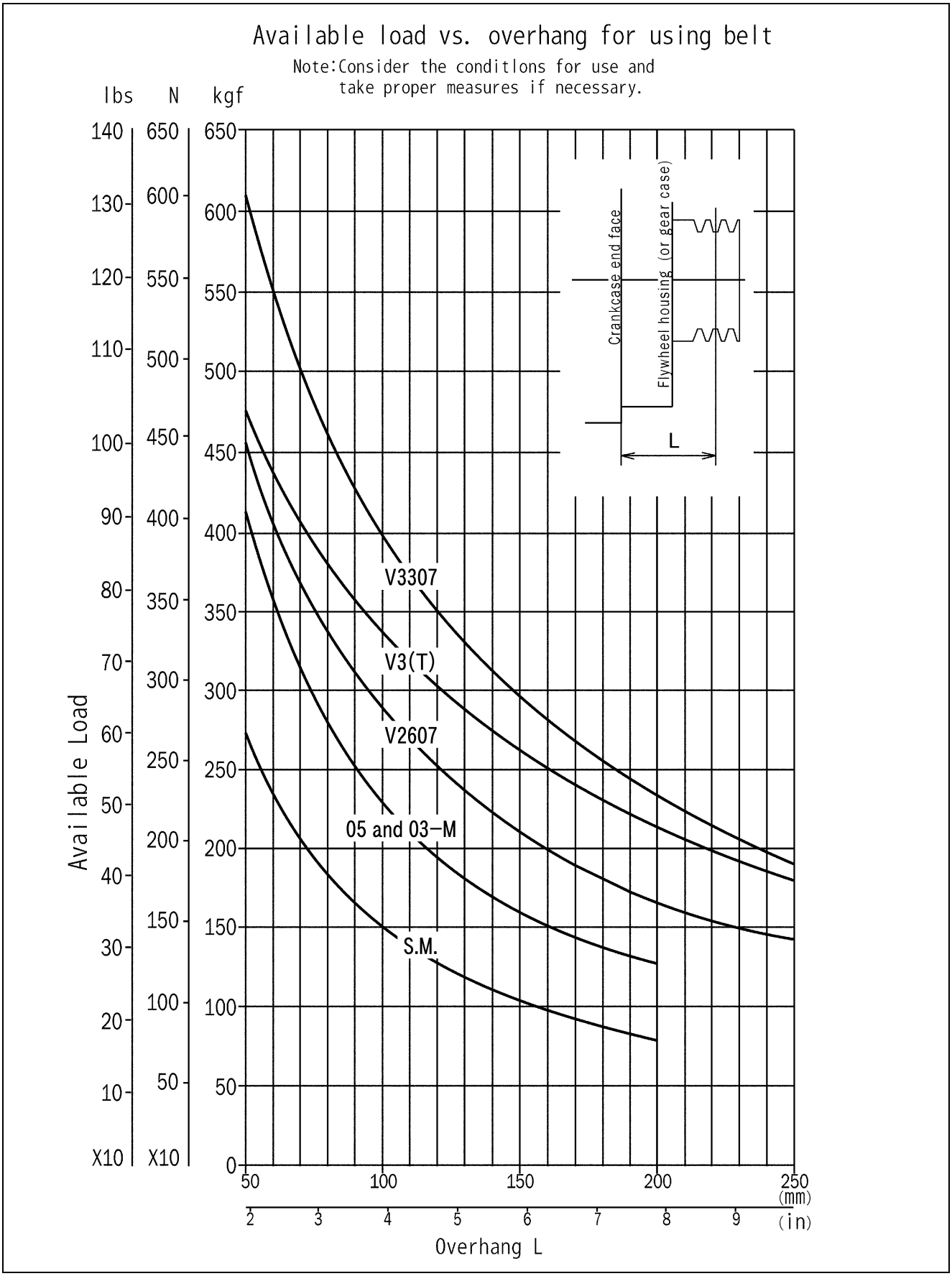

Available load vs. overhang for using belt
Note:Consider the conditions for use and
take proper measures if necessary.
lbs
N
kgf
Available Load
Overhang L
(mm)
(in)
V3307
V3(T)
V2607
05 and 03−M
S.M.
Crankcase end face
Flywheel housing (or gear case)
L

Fig. 10-10

4. FRONT AND REAR OF FUEL CAMSHAFT

(1) Front of fuel camshaft or camshaft

Driving a tachometer or small pump, the small amount of power required can be taken off by making a connection with slot fitting of camshaft's end face.
Connect with bolts at the flange joint face.

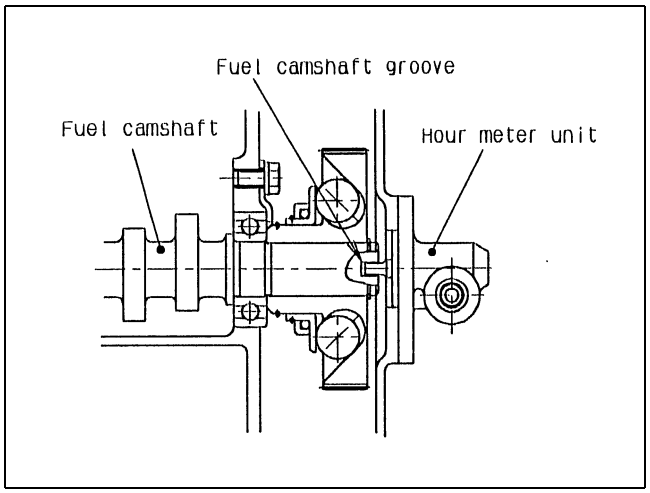


Fig. 10-11

(2) Rear of fuel camshaft

The hydraulic pump is mounted here by a holder and driven by an arrangement of gears.

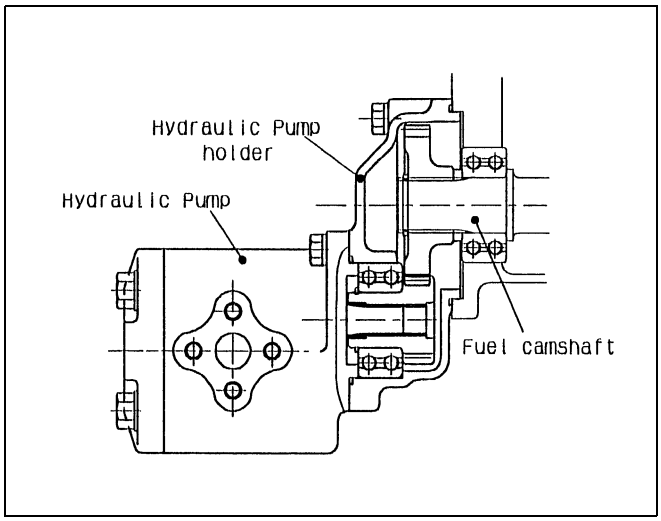
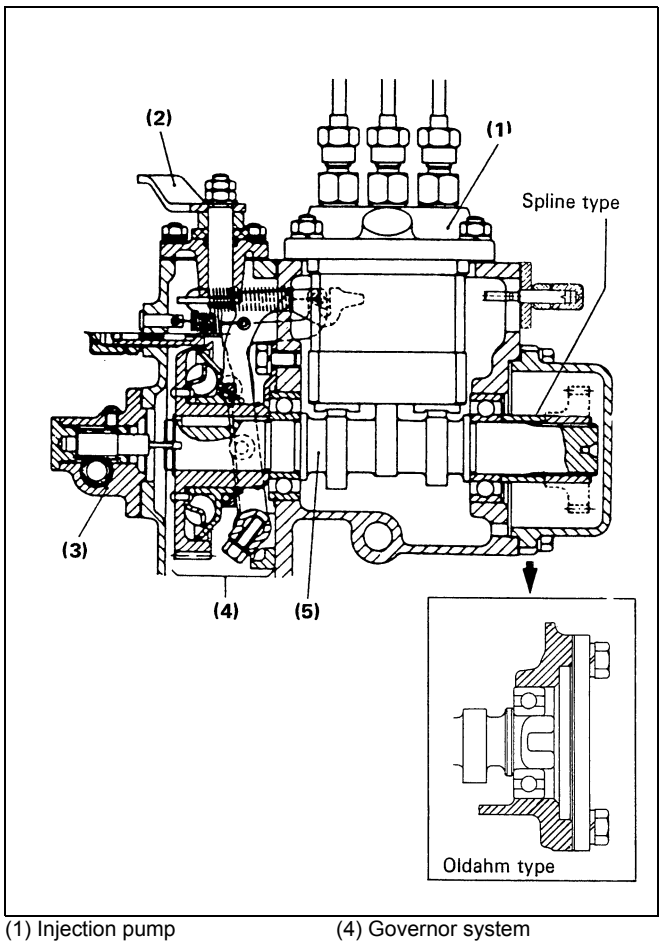


Fig. 10-12



(1) Injection pump
(2) Speed control lever
(3) Hour meter unit
(4) Governor system
(5) Fuel camshaft

Fig. 10-13

5. GOVERNOR SHAFT FOR 05 SERIES

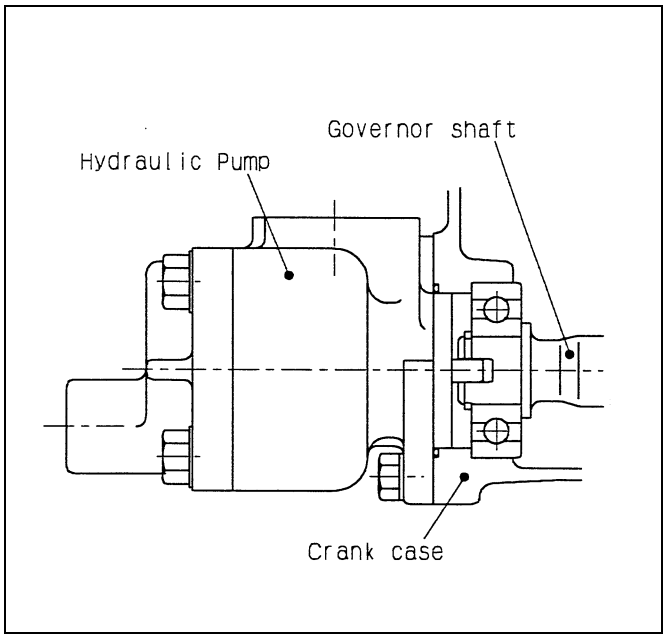


Fig. 10-14

6. SIDE PTO FOR 07 SERIES (Option)

1) V2607

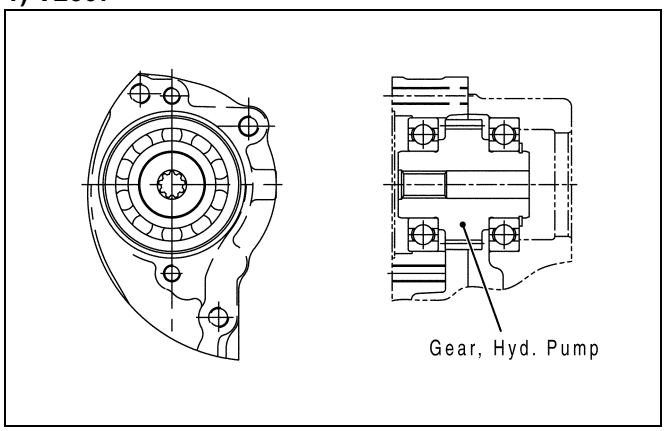


Fig. 10-15

2) V3307

A Type PTO

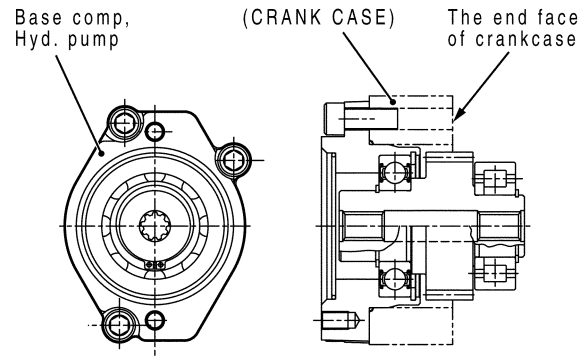


Fig. 10-16

B Type PTO

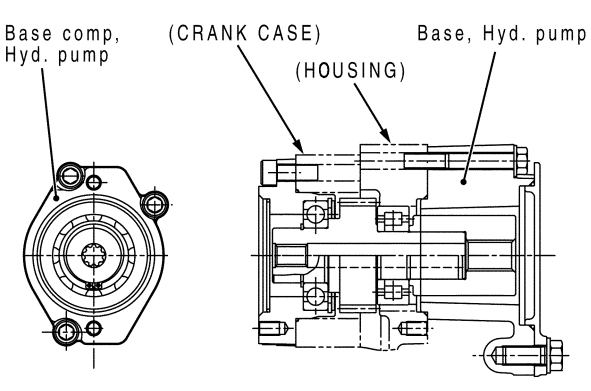


Fig. 10-17

7. GEAR CASE DRIVE KIT FOR V3 SERIES

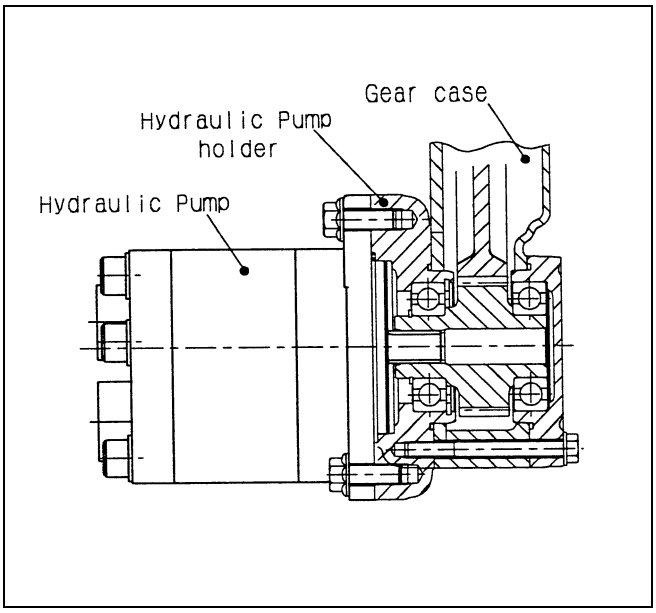


Fig. 10-18