ISO

# SATOH BEAVER

## MODEL S-370

## REPAIR MANUAL

## CHAPTER 3

## CLUTCH SYSTEM

# CONTENTS

### Clutch Release Mechanism

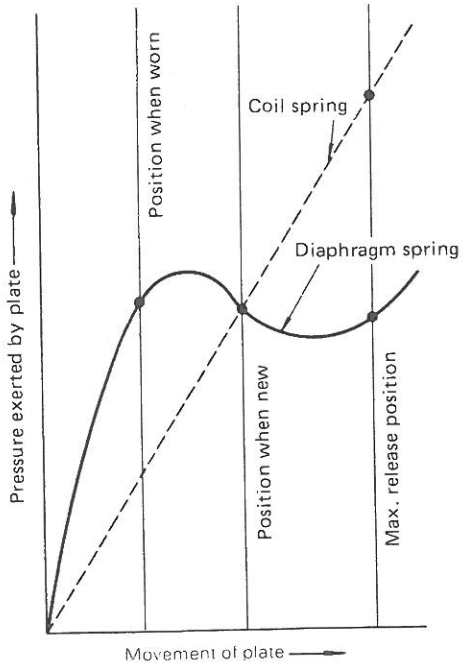
1. The clutch uses a one-piece tapering finger diaphragm that has a series of tapering fingers pointed inward toward the center of the clutch.
2. The ends of the fingers are brought into direct contact with the clutch release bearing.
3. The clutch release bearing is fitted through oilless bushing to the clutch release collar.
4. The entire assembly is pulled lightly toward the ends of the tapering fingers by springs.

### Clutch Cover

1. The clutch cover consists of a clutch cover, a diaphragm spring, a pressure plate and two wirings (pivot rings).
2. The diaphragm spring is connected to the clutch cover with two pivot rings (wirings).
3. The spring is also connected to the pressure plate with clips at the outer circumference.
4. The action of the diaphragm spring is somewhat like the flexing action as experienced when we depress the bottom of an oil can.
5. When the clutch release bearing moves in against the ends of the tapering fingers, the diaphragm is forced against the pivot rings (wirings). As this takes place, the diaphragm is dished inward.
6. The clutch cover is bolted to the flywheel with a total of six bolts, two of which are of a reamer type.

### Tapering-Finger Diaphragm

1. The pressed diaphragm is a solid ring on the outer diameter and has a series of tapering fingers as shown.



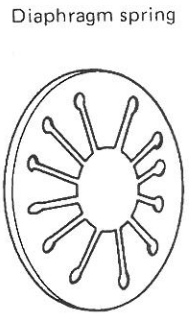




**Fig. 2 Diaphragm spring**

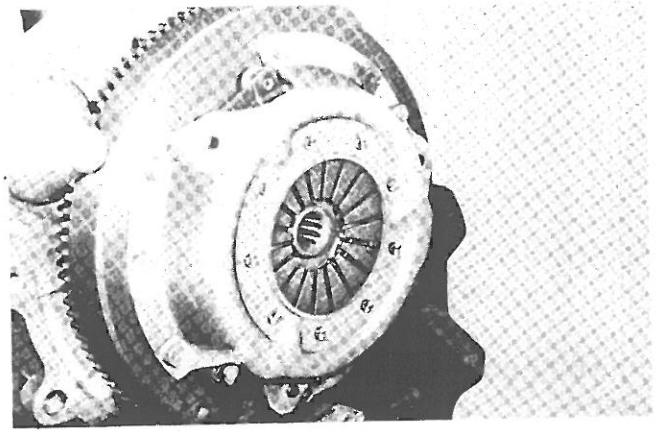
2. It is made of high quality spring steel and is heat-treated to provide optimum flexing action.
3. The Table above shows a relationship between the diaphragm spring and coil spring clutches regarding the movement of the pressure plate and the resultant pressure.
   a. In the diaphragm clutch, the spring pressure increases as the clutch disc wear, in the coil spring clutch, vice versa.
   b. The clutch requires less pedal effort at the maximum release position.

## REMOVING THE CLUTCH

To remove the clutch, the engine must be removed first from the clutch housing. For the procedure for engine removal, refer to "1-1. Removing the engine."

After removing the engine from the clutch housing, loosen the six bolts securing the main clutch to the flywheel, and remove the pressure plate assembly and clutch disc from the flywheel. The bolts must be loosened evenly.

When loosening the bolts, care should be taken so that no extremely heavy load is imposed on a bolt.

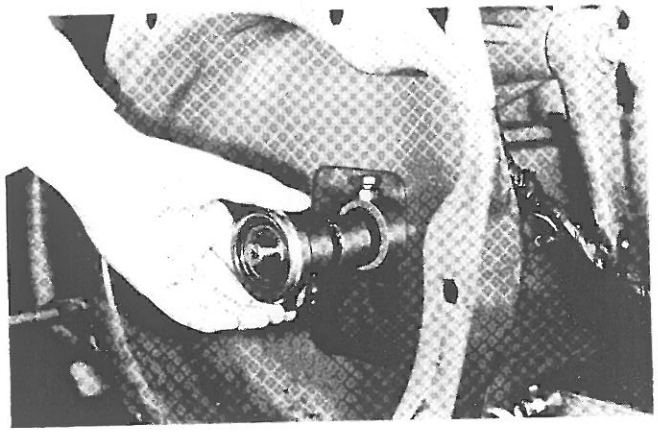


**Note:**

The pressure plate assembly is not designed to be disassembled. If the pressure plate is worn more than the specified limit, the entire assembly must be replaced.

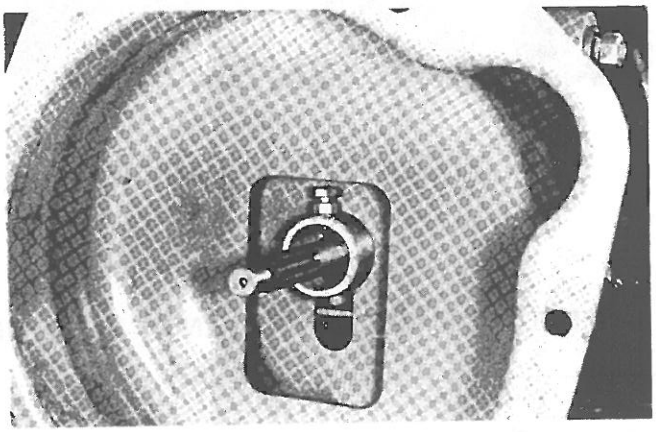
### Removing the Release Bearing

Remove the return spring, and remove the release bearing together with the boss.

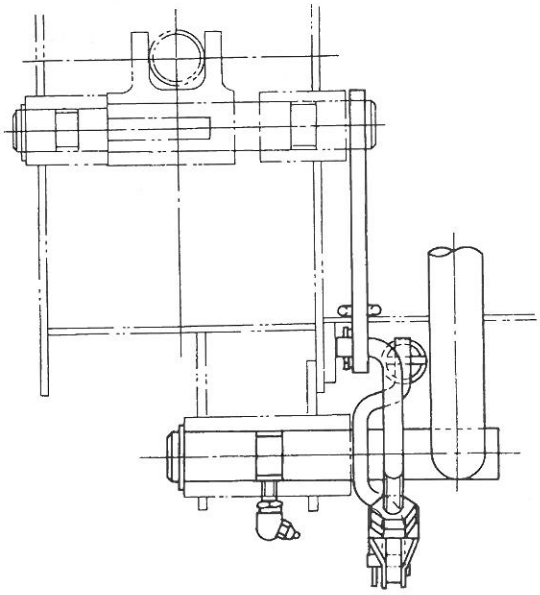


**Notes:**

1. Except when either the release bearing or the clutch boss is defective, don't attempt to disassemble them.
2. The clutch housing bolt and lock nut are so adjusted that the release bearing boss operates smoothly. Don't loosen or remove them unnecessarily.



### Disassembling the Clutch Pedal



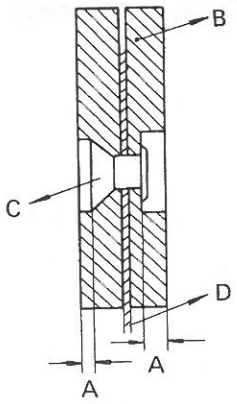
Disassembly of the clutch release shaft should be carried out after removing the clutch housing from the transmission case.

1. Remove the cotter pin on the clutch pedal side of the rod.
2. Remove the release shaft circlip, and remove the release shaft and fork.

## ASSEMBLING AND ADJUSTING THE CLUTCH

### 1. Assembling the Clutch

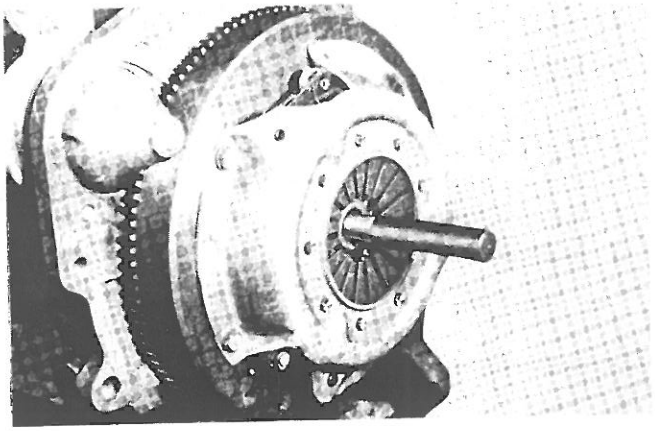
1. Thoroughly wipe off the oil or grease on the flywheel or on the contact surface of the pressure plate assembly with the lining.
2. If the facings are worn down excessively so that the recession of the rivet heads from the facing is 0.0078 in. (0.2 mm), discard the disc and install a new one.
3. When a new disc is to be installed, make sure that the recession is 0.039 – 0.047 in. (1.0 – 1.2mm).

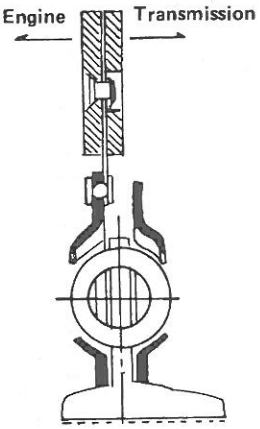



A: Wear limit 0.0078 in. (0.2 mm)
New disc 0.039 in. ~0.047 in. (1.0 ~1.2 mm)
B: Clutch lining
C: Rivet
D: Cushion plate

Apply a thin coat of grease to the flywheel pilot bearing.

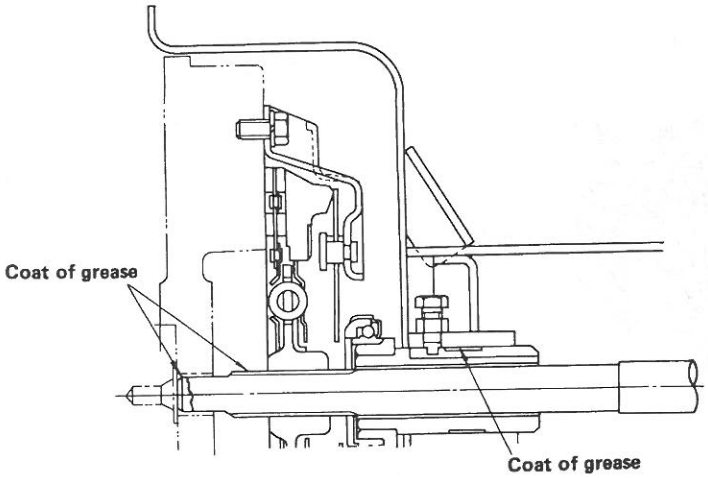
Place the clutch disc with the longer clutch disc splined boss on the transmission side, and center the clutch disc using the clutch idsc center tool, and install the pressure plate to the flywheel.






While watching the two reamer bolt positions, tighten the six bolts evenly.

Tightening torque: 8.67 – 12.3 ft-lb
(1.2 – 1.7 kg-m)



bearing in against the diaphragm spring. The correct pedal free-play is 0.98 ~ 1.18 in. (25 ~ 30mm)

### Pedal Free Play Adjustment

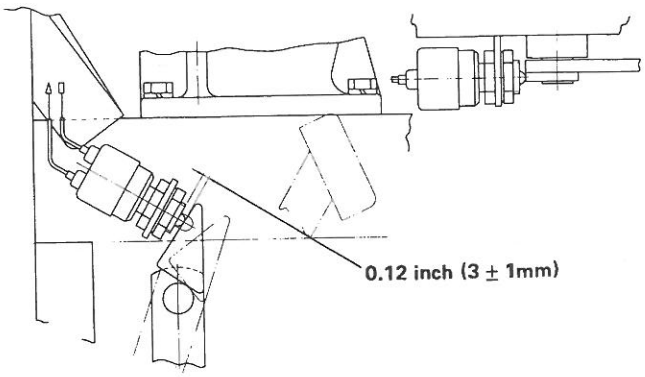
Adjust the rod length so that the free play (A) becomes to be 0.98 – 1.18 in. (25 – 30mm).

### Pedal Effective Stroke Adjustment

Adjust the stopper bolt so that, when the pedal is depressed and the full effective stroke became 3.54 – 3.94 in. (90 – 100mm), the release shaft lever firmly rests on the stopper head, and lock with the lock nut.

After the adjustment is complete, make sure that the power from the engine is interrupted as the pedal is fully depressed and that no abnormal noise is generated in the clutch system.

### 5. Adjusting the Safety Starter Switch




After adjusting the clutch pedal, depress the clutch pedal. When the release shaft arm comes to contact with the stopper bolt, make an adjustment with lock nut C as shown in Fig. to become 0.12 in. (3±1mm), and lock the nut.

## MOUNTING THE ENGINE

Mounting the engine should be carried out in the reverse order to its removal.

ISO

# SATOH BEAVER

## MODEL S-370

## REPAIR MANUAL

# CHAPTER 4

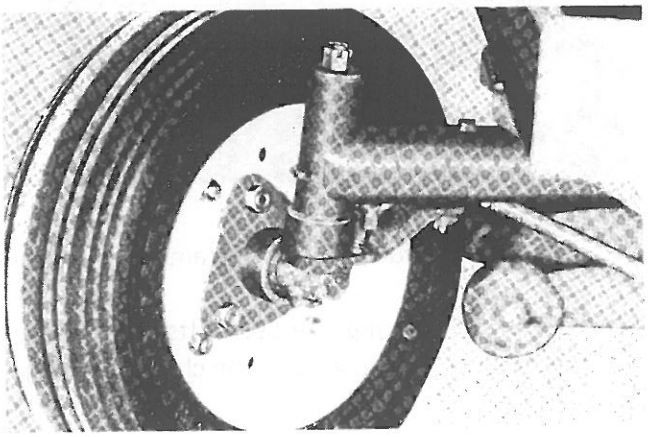
# STEERING LINKAGE SYSTEM

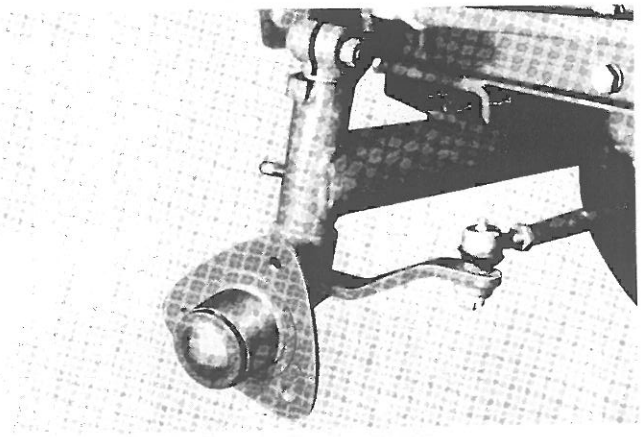
# CONTENTS

## DISAMMEMBLING THE STEERING SYSTEM

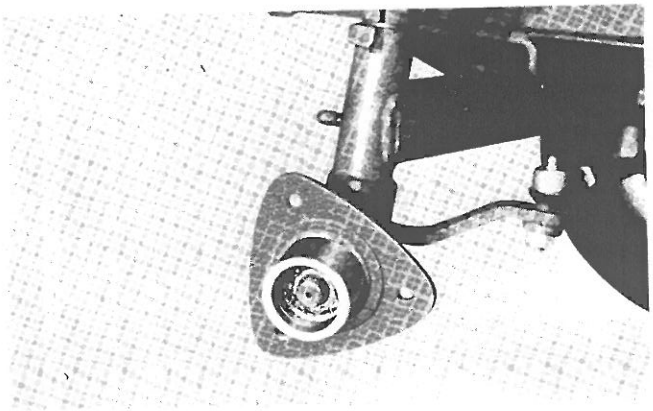
### Front Wheel Hub Disassembly

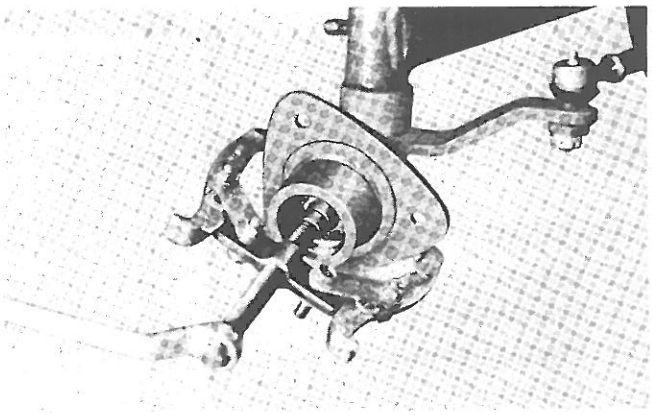
1. Loosen the front wheel mounting bolt lock nuts, and lightly loosen the three front wheel mounting bolts.





2. Jack up the front axle, loosen the front wheel mounting bolts, and remove the front wheels.
3. Remove the front wheel hub cap, straighten the tab of the lock washer, and remove the sleeve nut.





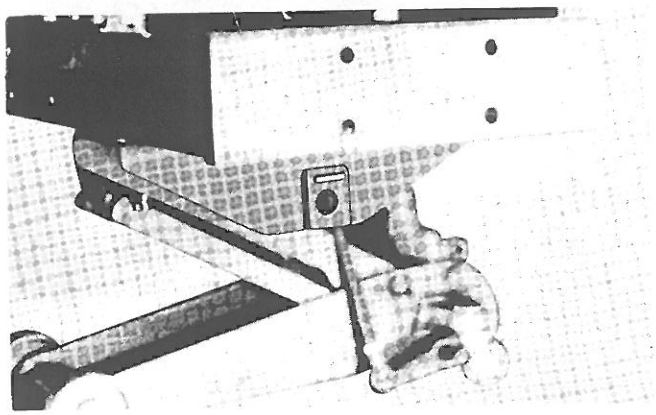
4. Remove the front wheel hub using the gear puller, and remove the oil seal.
5. Remove the ball bearing from the front wheel hub.

### King Pin Disassembly

1. Remove the cotter pin locking the castle nut on each end of the tie rod, loosen the castle nut, and remove the tie rod.
2. Loosen the knuckle arm bolt, and remove the knuckle arm while taking care so that the king pin does not fall.
   Remove the drag link from the knuckle arm, as required.
3. By tapping the top end of the king pin, pull out the king pin.
4. Remove the right hand castle nut, and remove the king pin.
   For the right side king pin, remove the castle nut and the king pin.

### Front Axle Removal

1. Pull out the cotter pin from the center pin nut, and remove the castle nut.



### Disassembling the Steering Gear Box

1. Remove the steering column from the steering gear box, and remove the worm shaft.
   **Note:**
   There is a shim for clearance adjustment between the steering gear box and steering column.
   Take special care not to lose it.
2. Remove the pitman arm from the sector shaft.
3. Remove the cover from the steering gear box, and remove the sector shaft.
   **Note:**
   There is a collar, thrust liner, O-ring. Take special care not to lose them.

## INSPECTION

Wash all the disassembled parts with cleaning oil and blow them dry with compressed air. Check for excessive wear or damage.
Replace with new one if defective or excessively worn.

1. Grease nipple and grease passage for clogging
2. Tire setting tap for damage.
3. Smooth rotation of ball bearing

Center Pin outside diameter:
0.866 inch (22 mm $^{-0.065}_{-0.098}$)

Front axle center pin hole diameter:
0.866 inch (22mm $^{-0}_{+0.052}$)

King Pin outside diameter:
0.98 inch (25mm $^{-0.020}_{-0.053}$)

King Pin bushing inside diameter:
0.984 inch (25mm $^{+0.073}_{+0.040}$)

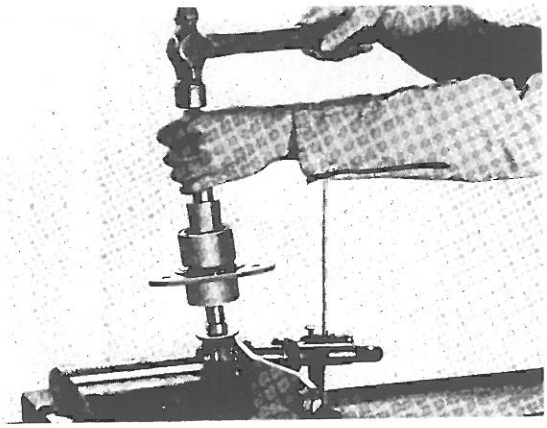
Measure the shaft outside diameter and bushing inside diameter. If measurements exceed the above limits, replacement of parts is necessary.
Install the king pin bushing, and measure the inside diameter. If the measurement is smaller than specified above, correct the diameter using a reamer very carefully.
After this operation, thoroughly clean the metal dust.
Always use new O-rings and oil seals.

## ASSEMBLY

Apply oil or grease to contact surfaces of moving parts, and assemble them carefully so that they maintain the specified dimensions.

### 1. Assembling the Front Wheel Hub

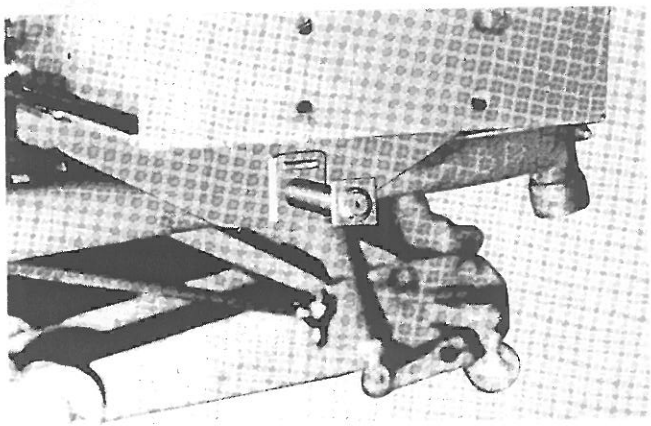
1. Install the washer to the king pin. Install the grease-coated oil seal.
2. Install two circlips to the front wheel hub, and insert the ball bearing into the hub.
3. Install the front wheel hub to the king pin, pack with Alvania grease, and insert the ball bearing into the hub.

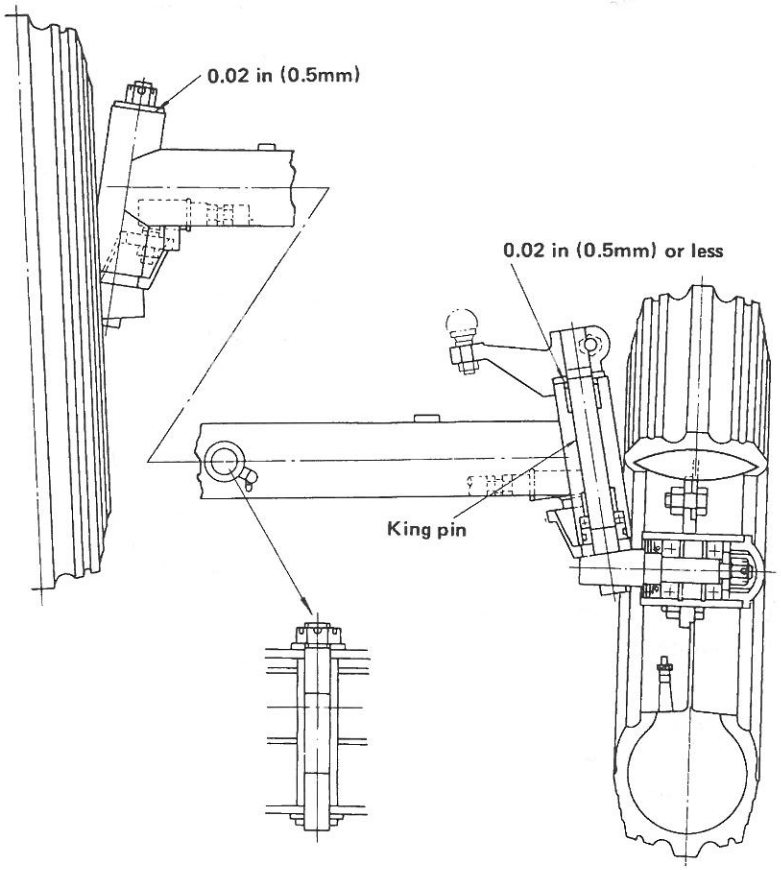


4. Install the lock washer, and tighten the sleeve nut.
   Front wheel hub starting torque:
   10.1 – 11.6 ft-lb (0.04 ~ 0.06 kg.m)
5. After tightening the nut with starting torque, make sure that the front wheel hub rotates smoothly, and lock with the lock washer. Apply a bond to the cap, and install it to the front wheel hub.

### 2. Assembling the Front Axle

1. Clean the center pin hole in the fornt axle and holes in the chassis, and install the front axle to the chassis with the longer boss facing forward.






5. Make sure the gap between the knuckle arm lower side and the washer is 0.02 inch (0.5mm) or less.
6. Install the washer to the right hand king pin, tighten the castle nut, and lock with the cotter pin.

   Tightening torque: 32.5 – 39.7 ft-lb (4.5 – 5.5kg.m)
7. Make sure the king pin operates smoothly, and grease it as required.

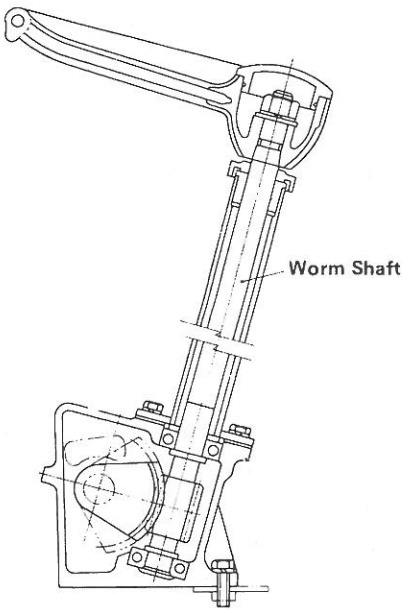
### 4. Assembling the Steering Gear Box

1. Push the two ball bearings into the worm shaft.
2. Install the steering column, and make an adjustment using a shim so that worm shaft end play is 0 – 0.079 inch (0 – 0.2mm).

   Worm shaft end play: 0 – 0.079 inch (0 – 0.2mm)

   Adjusting shim

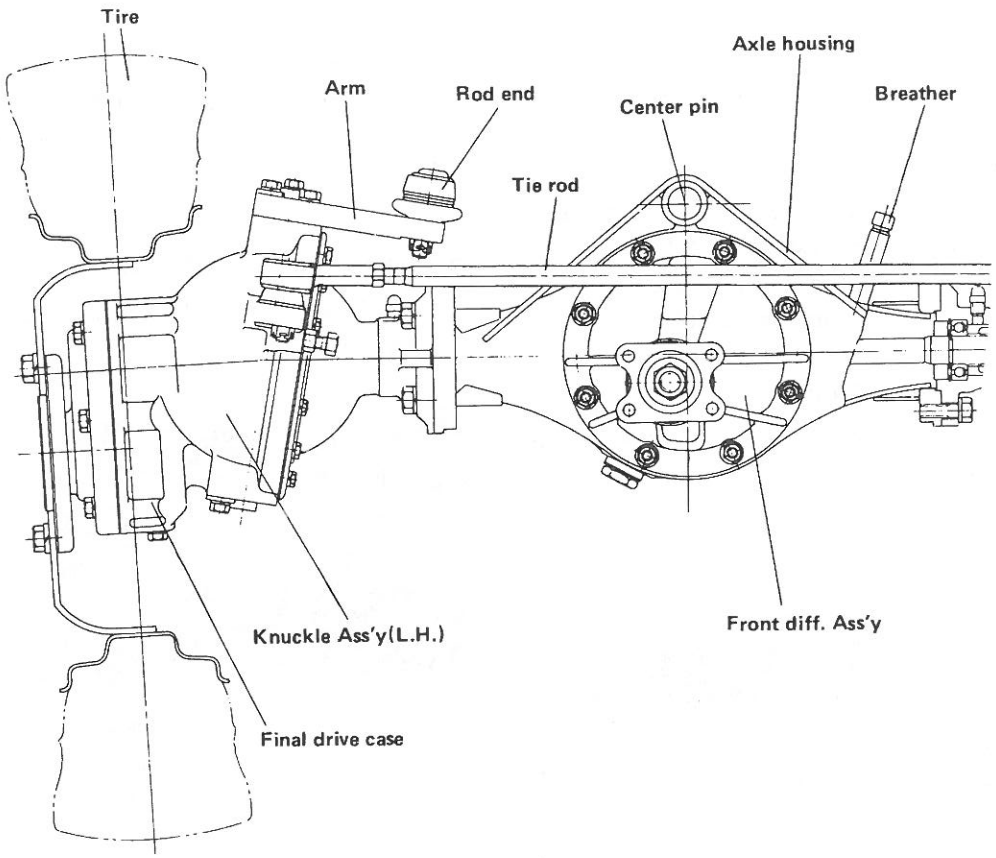
   1135-2120-000: 0.0039 inch (0.1mm)
   1135-2121-000: 0.0079 inch (0.2mm)



tractor, especially during traction operations, will be fairly improved since the capacity of the engine can be effectively converted into traction. Also, the climbing capacity of its front axle is designed to be heavier than that of a 2-wheel tractor; therefore, the tractor is capable of stably operating in sloping arears.

## CONSTRUCTION

Power from the engine is trasmitted through a mid P.T.O. installed in the lower portion of the transmission case and a universal joint to the differential gear case of the front axle, and then the power is transmitted through the knuckles at the left and right sides to the front tires.




Front Drive

### Mid P.T.O.

This power-take-off unit is installed at the lower portion of the transmission case. The mid P.T.O. gear is caused to slide by operating the shift lever installed at the left step and meshes with an idle gear installed in the P.T.O. shaft in the transmission. Then transmitted to universal joint installed on the mid P.T.O. shaft.

### Universal Joint

This is a shaft for transmitting power from the mid P.T.O. shaft to the front differential. The P.T.O. shaft end has a spline and the front end is fixed to the flange with bolts. This is a pipe having adequate strength with little eccentricity to transmit power with smooth rotation. Protection is provided by a steel cover to prevent weeds from becoming entangled and for safety purposes.

### Front Differential

Power from the universal joint is transmitted to a pinion gear, ring gear, differential case pinion gear, differential side gear and differential shaft. This mechanism is sufficiently sturdy and it is easy to maintain due to the block construction.

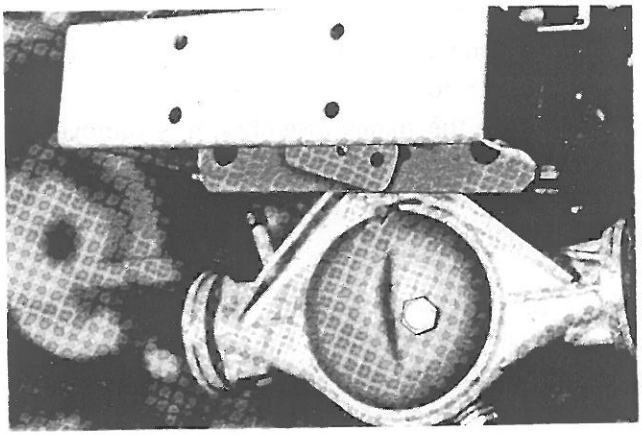
### Knuckle

A knuckle unit is composed of a king pin case and final gear case which are connected together with 2 upper and lower king pins. The final gear case is driven by a yoke and joint.

A long shaft is held to the knuckle assembly at one end. When removing the shaft, hold it carefully until it is completely pull out.

### Removing the Axle Housing

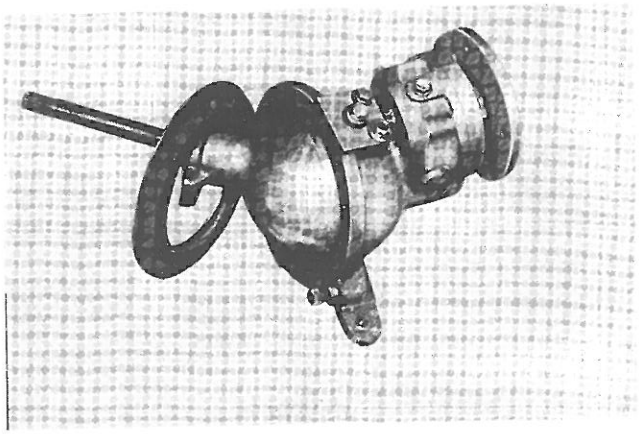
1. Remove the center pin grease nipple, and loosen the two bolts securing the center pin to the chassis.
   Pull out the center pin, and remove the axle housing from the chassis.

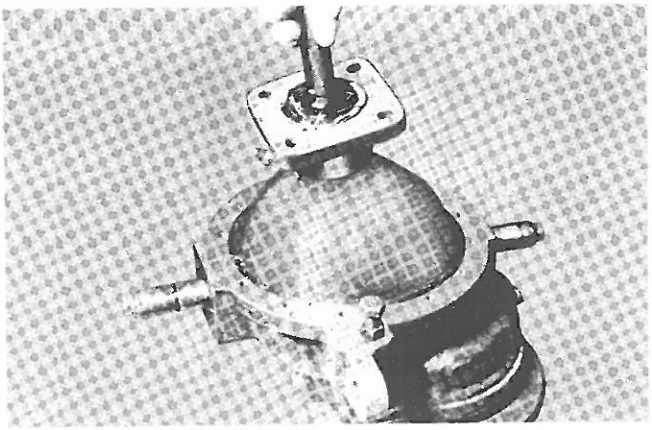


**Note:** There is a shim between the chassis and axle housing.

### Disassembling the Knuckle Assembly

1. Loosen the oil seal retainer plate holding bolt on the spherical part, and remove the oil seal felt and oil seal.





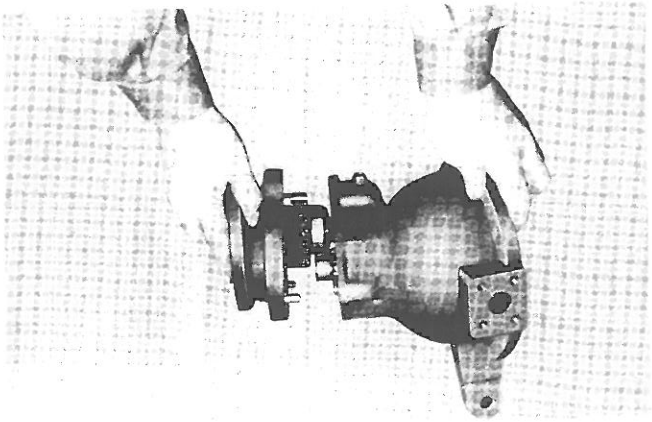
2. Loosen the king pin bolt on both upper and lower parts of the knuckle arm, and remove the key plate.
   Insert a screwdriver into the key plate, and pull out the king pin gently, and remove the king pin case and final gear case.

**Note:**
There is a shim on the top of the king pin case and in the final gear case.

3. Remove the oil seal from the king pin case (the oil seal can not be reused), and remove the circlip on the king pin case side. Pull out the shaft with the ball bearing installed.
4. Remove the circlip from the shaft, and remove the ball bearing.

### Disassembling the Final Gear Case

1. Loosen the bolt securing the final gear case (B), and remove the final gear case (B) from the final gear case (A).



Backlash adjustment should be made by changing the thickness of thrust washer installed, together with the side gear.

Thickness of thrust washer:

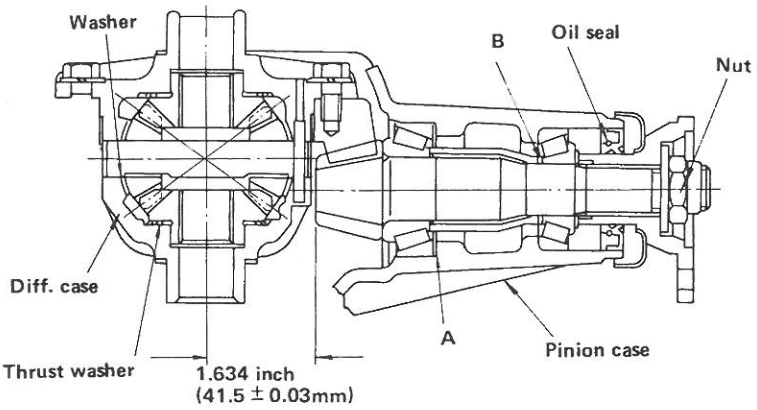
0.035 inch (0.9mm)
0.04 inch (1.0mm)
0.043 inch (1.1mm)
0.047 inch (1.2mm)
0.051 inch (1.3mm)

When the backlash is correctly adjusted, lock the center pin with the lock pin, and further clinch the lock pin with the center punch.

2. Install the ring gear to the differential case, and tighten it with the mounting bolt.

   Tightening torque: 21.7 – 28.8 ft-lb (3 – 4kg-m)

3. Install the taper roller bearing collar and taper roller bearing to the pinion shaft, in that order and install the pinion shaft in the pinion gear case. Adjust the cone center to 1.634 inch (41.5 ± 0.03mm) using a shim or shims of A portion.



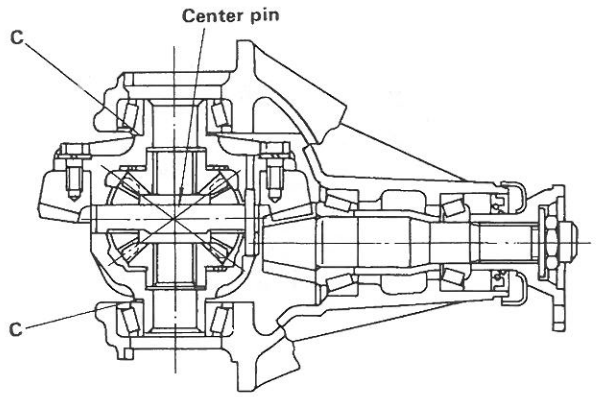

Shime thickness: 0.002 inch (0.05mm)
0.017 inch (0.07mm)
0.004 inch (0.10mm)
0.008 inch (0.20mm)
0.012 inch (0.30mm)
0.02 inch (0.50mm)

After adjusting the cone center to 1.634 inch (41.5±0.03mm), install the pinion shaft to the pinion shaft case, and install the flange. Tighten the self-lock nut to 72.2 – 86.7 ft-lb (10 – 12 kg-m) and adjust the pinion shaft pre-load to 21.7 – 43.3 ft-lb (3 – 6 kg-m) using the shim of the B portion.

Thickness of shim

0.0669 inch (1.70mm)
0.0681 inch (1.73mm)
0.0693 inch (1.76mm)
0.0705 inch (1.79mm)
0.0717 inch (1.82mm)
0.0728 inch (1.85mm)
0.0740 inch (1.88mm)
0.0752 inch (1.91mm)
0.0764 inch (1.94mm)
0.0776 inch (1.97mm)
0.0787 inch (2.00mm)

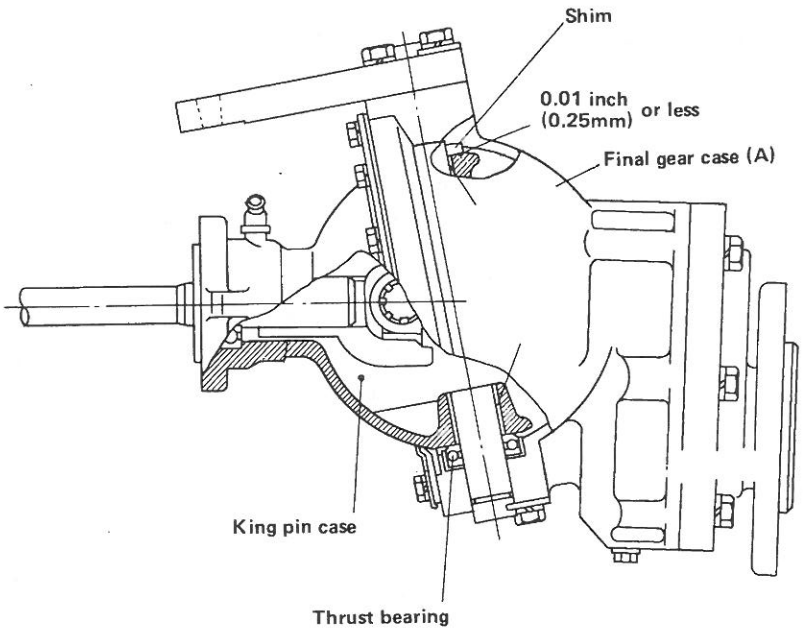
4. Install the differential gear to the pinion case, and adjust the backlash between the ring gear and pinion gear to 0.004 – 0.006 inch (0.10 – 0.15mm) using the shim of the C portion.




Back lash: 0.004 – 0.006 inch (0.10 – 0.15mm)

Apply pre-load of 0.18 ft-lb (0.025 kg-m) to the taper roller bearing.

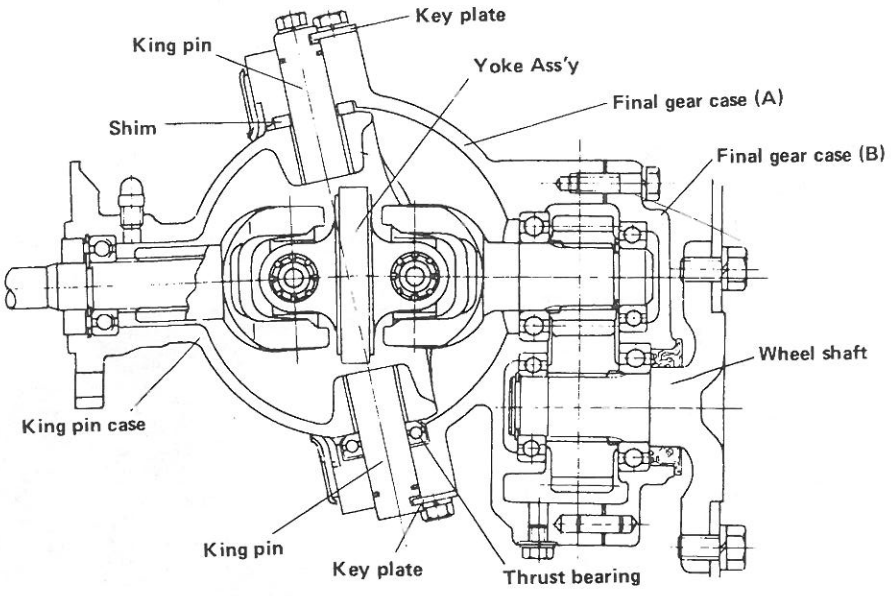
Thickness of shim: 0.002 inch (0.05mm)
0.0028 inch (0.07mm)
0,004 inch (0.10mm)
0.008 inch (0.20mm)
0.012 inch (0.30mm)
0.02 inch (0.50mm)




Thickness of shim
1119-0682-000: 0.177 inch (4.5mm)
1119-0682-100: 0.187 inch (4.75mm)
1119-0682-200: 0.20 inch (5.0mm)
1119-0682-300: 0.207 inch (5.25mm)
1119-0682-400: 0.217 inch (5.5mm)

3. Install the thrust bearing in the king pin hole on the bottom (inside) of the final gear case (A) paying attention to the direction of the thrust bearing, as illustrated.

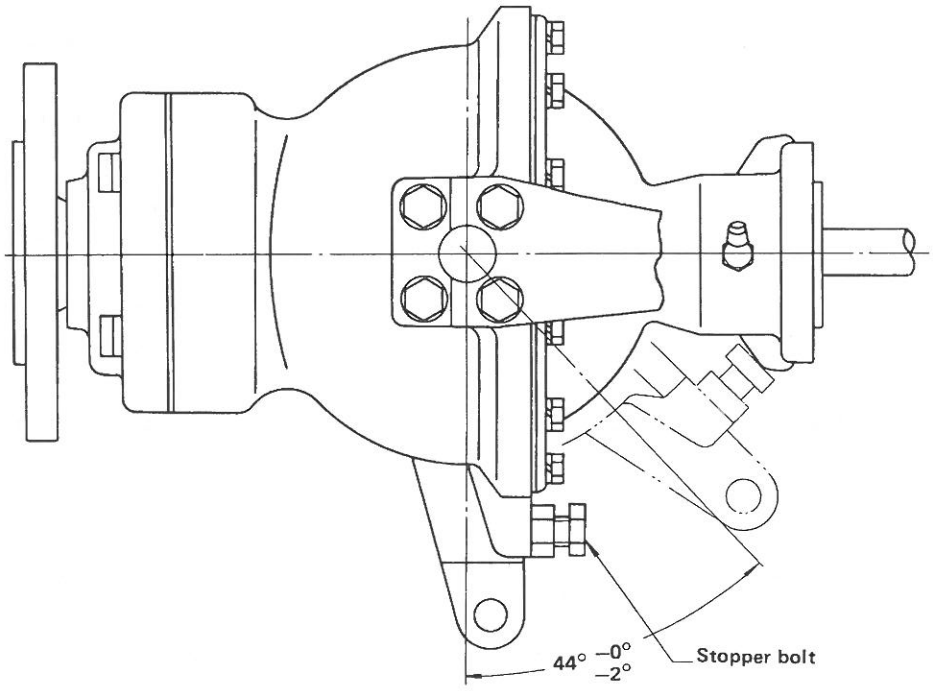
4. Adjust the clearance between the final gear case and king pin case to 0.01 inch (0.25mm) or less using a shim.




*Next, set the king pin case and final gear case with the king pin.

### Installing the Universal Joint

1. Apply oil to the mid P.T.O. felt on the universal joint assembly, and install it to the P.T.O. shaft, and fully push it downward.
2. Install the front part of the universal joint to the flange assembly of the axle housing.
   Tightening torque: 14.4 ~ 18.1 ft-lb
   (2 ~ 2.5 kg-m)
3. Make sure that the universal joint rotates smoothly.
4. Install the universal joint cover. Make sure that the universal joint does not contact with
5. Install the tie rod, and set the castle nut with the cotter pin.
6. Install the drag link.
7. Adjust the toe-in to 0.23 inch (6±2mm) with the tie rod, and lock the tie rod.
8. Adjust the steering angle of the front wheels to $44° {}^{0°}_{-2°}$ by turning the stopper bolts.




### Steering Gear Box

Disassembly and assembly of the steering gear box. Refer to the disassembling procedure of the steering gear box for the 2-wheel drive tractor.

Front tire (ES tire)

| | |
|---|---|
| Tire size and ply rating | 18 x 700-8 2PR |
| Tire pattern | Pillow Dia |
| Tire pressure | 14.22 lb/in$^2$ (1.0 kg/cm$^2$) |
| Outside diameter | 17.99 in (457mm) |
| Tire width | 6.69 in. (170mm) |
| Loaded radius | 451.5 lb (205 kg) |
| Type of valve | TR-413 |
| Rim | 5.50 x 8 |