

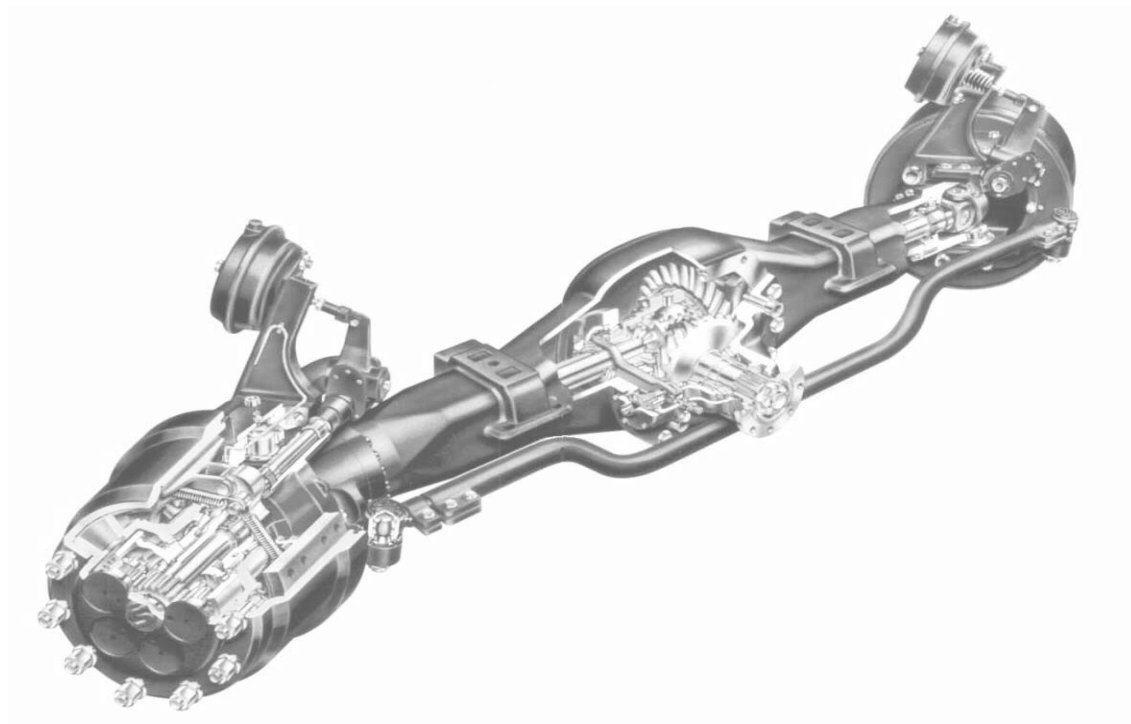
# SISU AXLES

## MAINTENANCE MANUAL

**FSDP & FSMP - 09/10**

**SSDP - 10/12 Drive Steer Axles**

Brakes and Differential Carriers Included





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***NOTE ! This Manual is intended for use by experienced mechanics using safe procedures in properly equipped shops. Safety precautions should always be followed such as wearing safety glasses, using adequate lifting aids, and using tools and equipment in good condition. Sisu Axles, Inc., its agents, associates or representatives are not responsible for damage or injury occurring while working on their components.***



# 1 DESIGN AND FUNCTION

## 1.1 XSDP AXLE DESIGN

The axle primary gearing is composed of a pair of bevel wheels located among the drive gear between the axles.

Power from the drive gear is transmitted by an axle shaft equipped with two universal joints to the wheel hub, which has a five-planet type planetary gear to act as a secondary gearing.

The sun wheel connected to the end of the axle shaft rotates the planet wheel carrier by means of the planet wheels, which are connected to the wheel hub. The ring gear is locked to the swivel axle. The drive gear and differential, gear, together with bearings, are lubricated with oil from the drive gear housing. The hubs of the wheels have their own separate oil reservoirs to lubricate the planetary gears.

### **These axles are used as follows:**

- Low ratio axle in industrial applications : SSDP-10/12
- High ratio axle in automotive applications: FSDP-09/10

**Drive gear is in separate manual.**

**WDB brakes are in separate manual.**

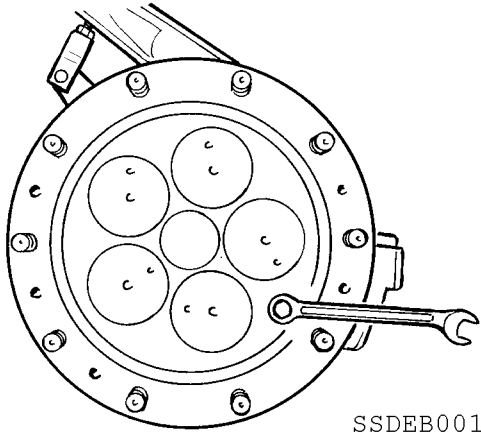


## 2 DESCRIPTION OF THE SERVICE AND REPAIR WORKS

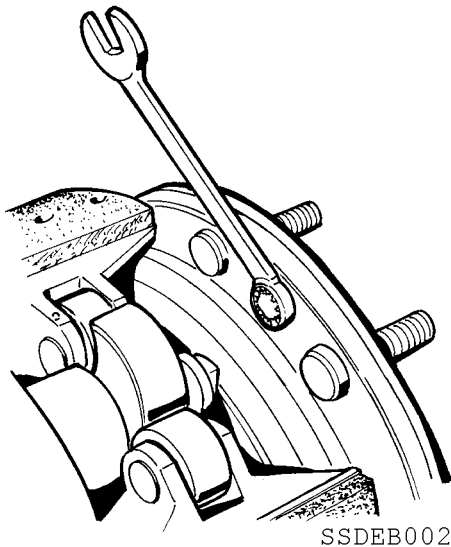
### 2.1 PLANETARY HUBS - DISASSEMBLY

Raise the wheels off the ground. Release the wheel and brake drum.

1. Open the oil plugs and let the oil drain out of the hub.



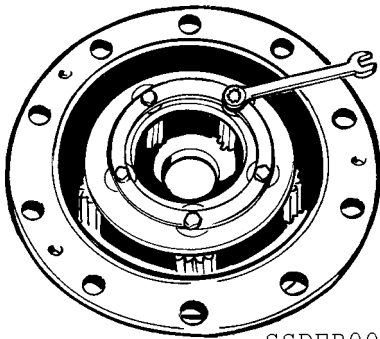
Picture 1



Picture 2

2. Release the planet wheel carrier by opening the four bolts on the inside of the hub. Take off the planet wheel carrier by pulling it out. If necessary, turn extractor bolts in screw threads located on the carrier flange.

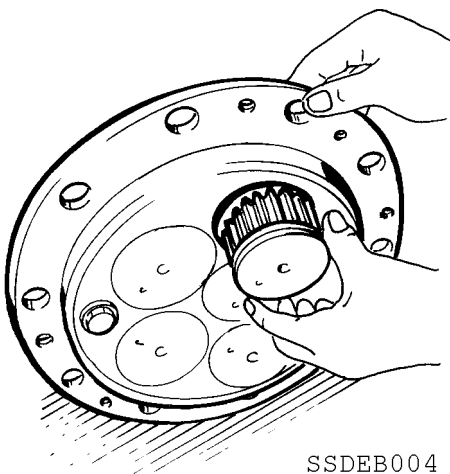
3. Unfasten the bolts on the planet wheel carrier and remove the lock washer.



SSDEB003

Picture 3

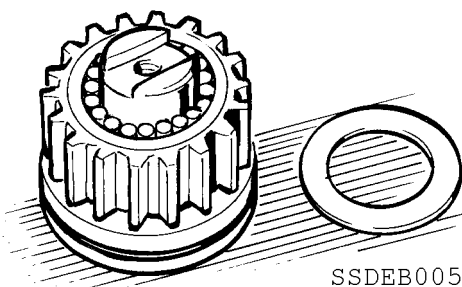
4. Unfasten the planetary wheel axles from the planet wheel carrier, taking care not to drop the gear wheels.



SSDEB004

Picture 4

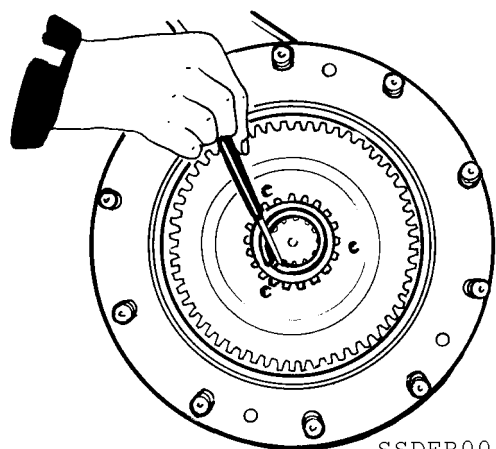
5. Take off the upper shim plate and lift up the gear wheel, taking care not to lose the bearing rollers (they are loose!) Also remove the lower shim plate.



SSDEB005

Picture 5

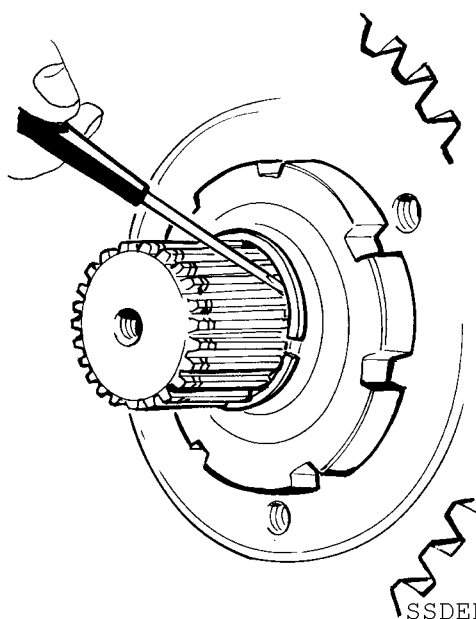




SSDEB006

6. Unfasten the circlip at the end of the axle shaft, and remove the sun wheel by pulling it outward.

Picture 6

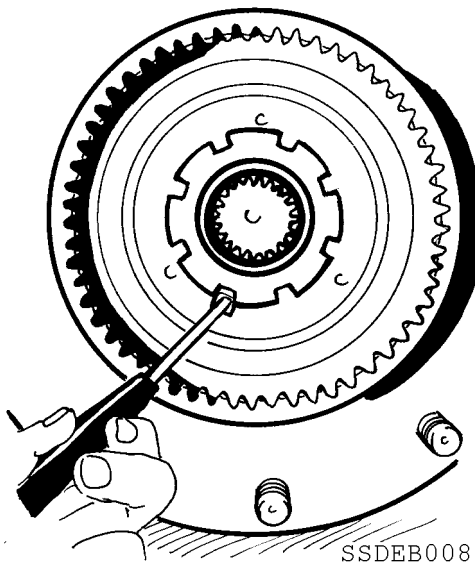


SSDEB007

7. Remove the inner lock washer.

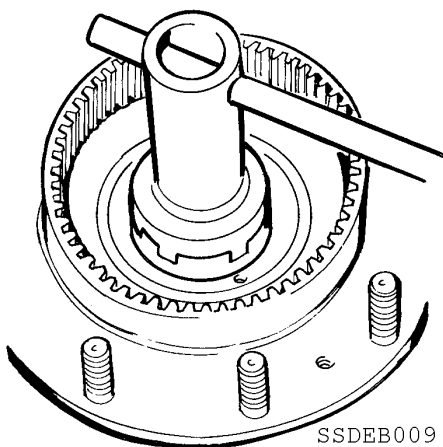
Picture 7

8. Open the hub nut lock with a suitable tool or with a drift.



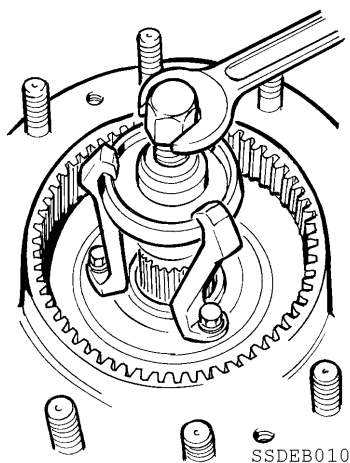
Picture 8

9. Open the hub nut with special tool no. 7141-014-020. Remove the nut, washer and locking washer.

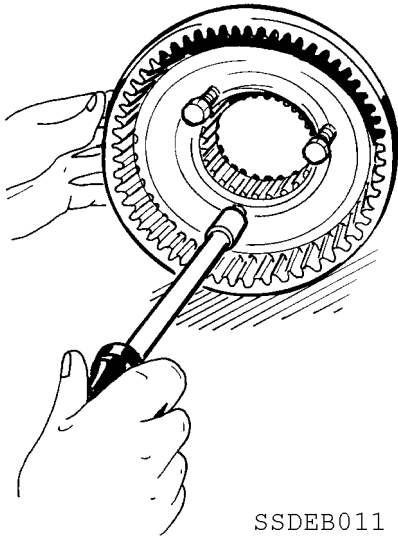


Picture 9

10. Unfasten the ring gear by tapping it lightly with a hammer and pulling it outward at the same time. If necessary, use an extractor.

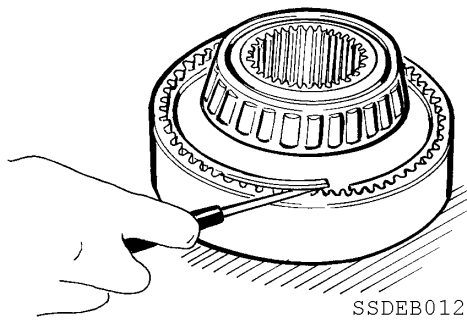


Picture 10



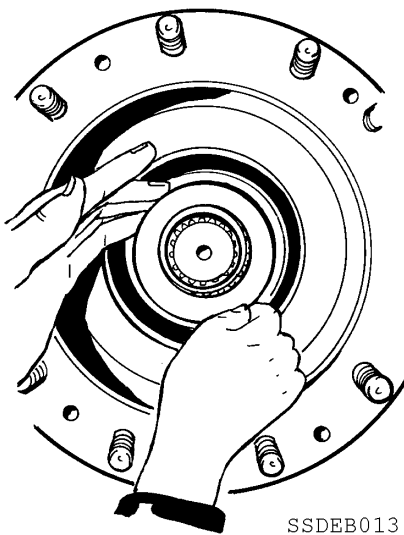
Picture 11

11. Unfasten the ring gear by screwing three M10 bolts into the hub of the ring gear.  
Tighten the bolts evenly in turn.



Picture 12

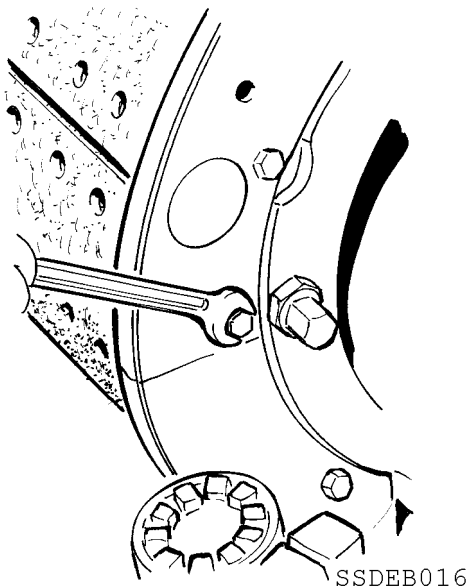
12. Unfasten the ring gear hub lock washer. Separate the ring gear and the hub by tapping lightly with a hammer.



Picture 13

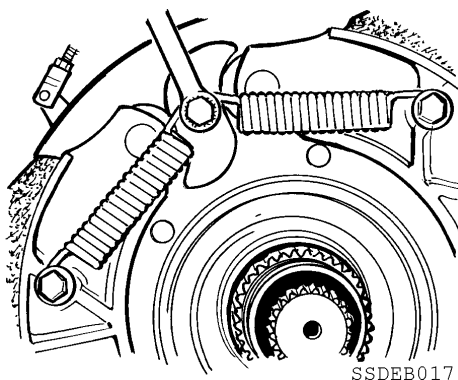
13. Remove the shim plates and spacer. Remove the hub by pulling it out.
14. Press the sealing ring and inner bearing of the hub away from the hub.
15. Unfasten the outer bearing by pressing the outer race.

16. Unfasten the two halves of the brake plate.



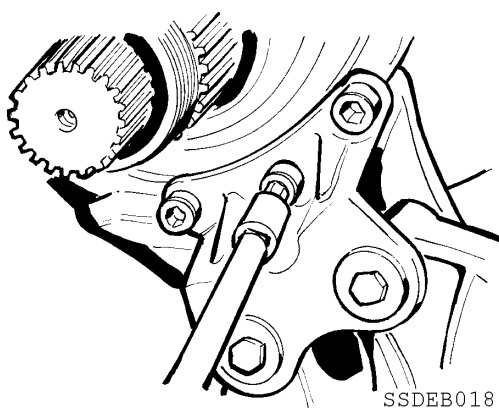
Picture 14

17. Release the brake shoe springs by unfastening the bolt which anchors the springs.



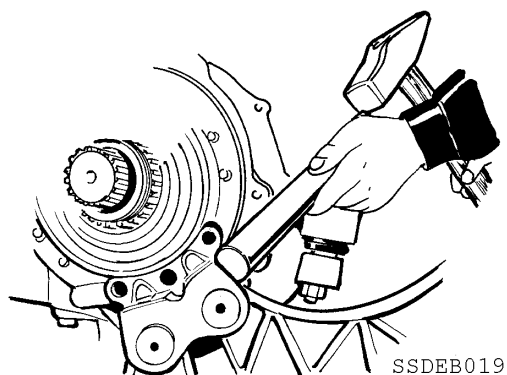
Picture 15

18. Unfasten the three Allen head bolts holding the lug securing the brake shoes and the two bolts at the end of the anchor pins.



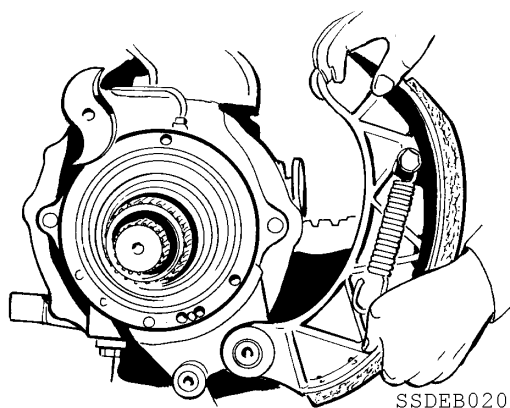
Picture 16

19. Unfasten the fastening lug of the brake shoes by tapping carefully.



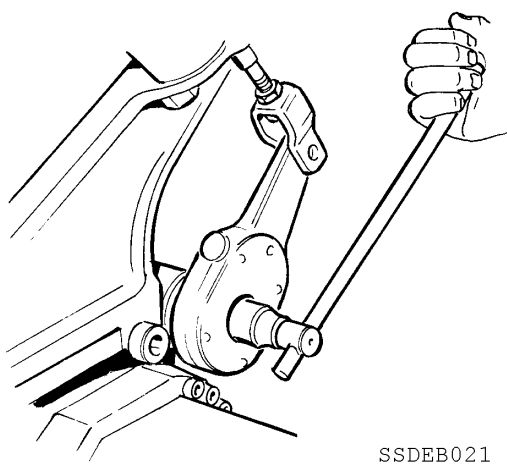
Picture 17

20. Unfasten the brake shoes.

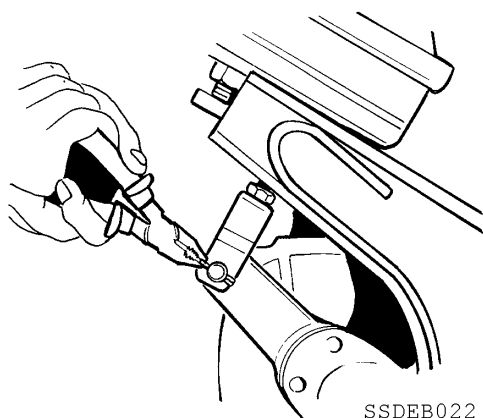


Picture 18

21. Loosen the fastening nut on the brake lever.

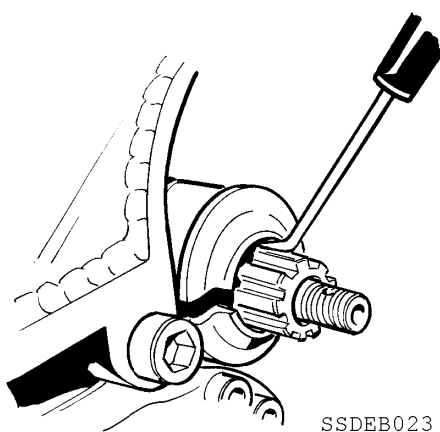


Picture 19



22. Unfasten the pin and cotter pin. Remove the brake lever.

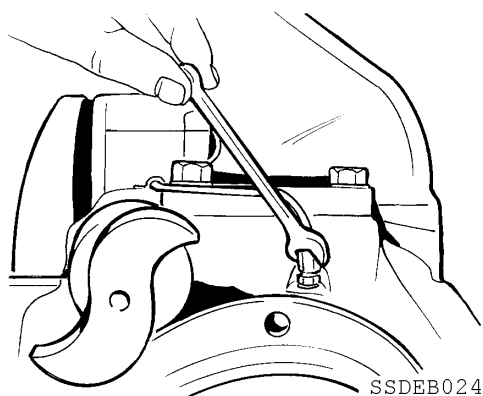
Picture 20



23. Unfasten the two halves of the locking plate. Remove the spreader shaft by pulling outward from the side facing the cam.

Picture 21

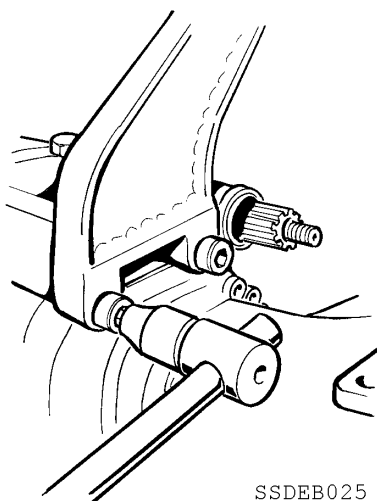
## 2.2 DISASSEMBLY - STEERING KNUCKLES



1. Unfasten the breather tube.

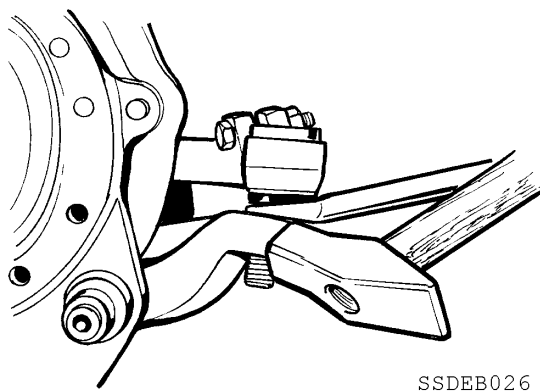
Picture 22

2. Unfasten the brake cylinder bracket.



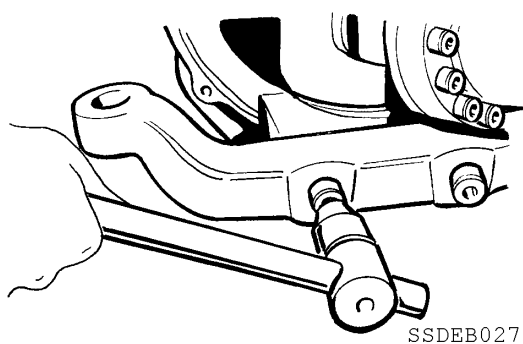
Picture 23

3. Open the nut on the tie rod swivel joint. Unfasten the swivel joints with an extractor or, if no such tool is available, as in the illustration. Unfasten the arms of the steering cylinder from the track arm.

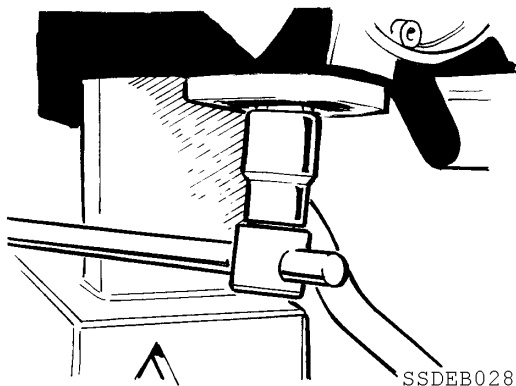


Picture 24

4. Unfasten the track arm.

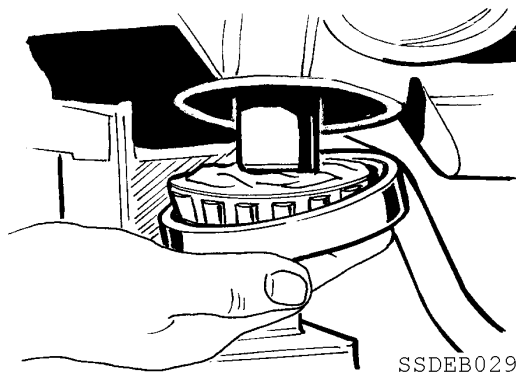


Picture 25



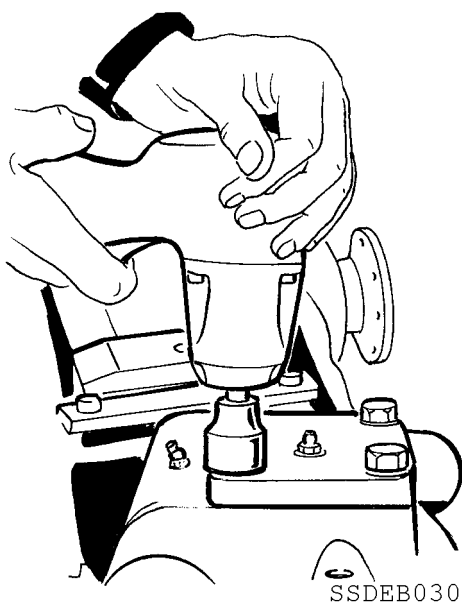
Picture 26

5. Unfasten the cover plate of the lower steering pivot pin by opening the four bolts. Unfasten the lower steering pivot pin. This can be made easier by heating the swivel head to approx. +150°C, whereupon the adhesive in the thread will melt.



Picture 27

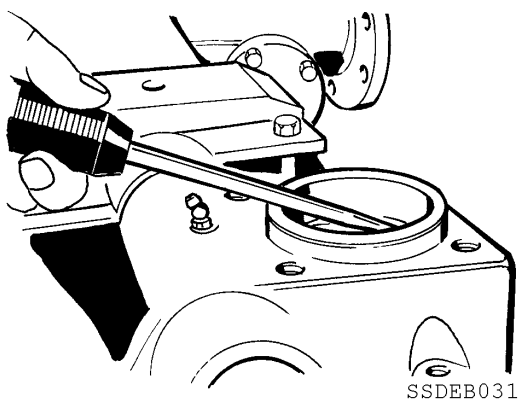
6. Remove the lower steering pivot pin and bearing.



Picture 28

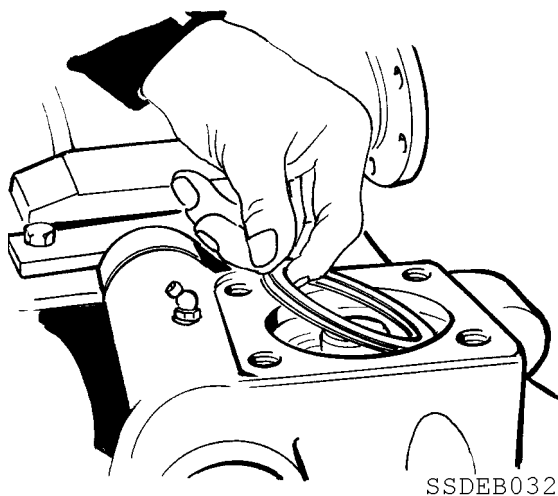
7. Unfasten the cover plate of the upper steering pivot pin by opening the four bolts.





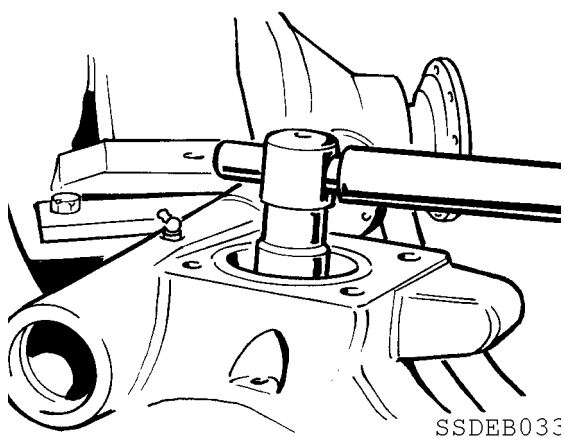
8. Clean the grease out of the steering pivot pin housing and remove the spacer.

Picture 29



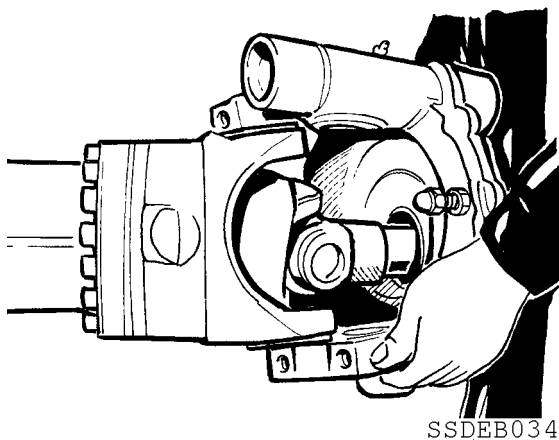
9. Remove the shim plates.

Picture 30



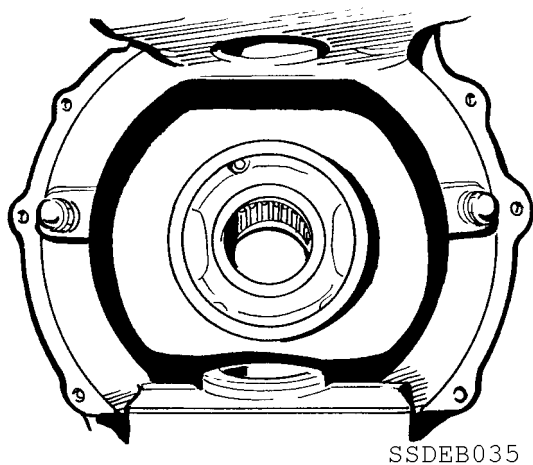
10. Unfasten the upper steering pivot pin and bearing.

Picture 31



Picture 32

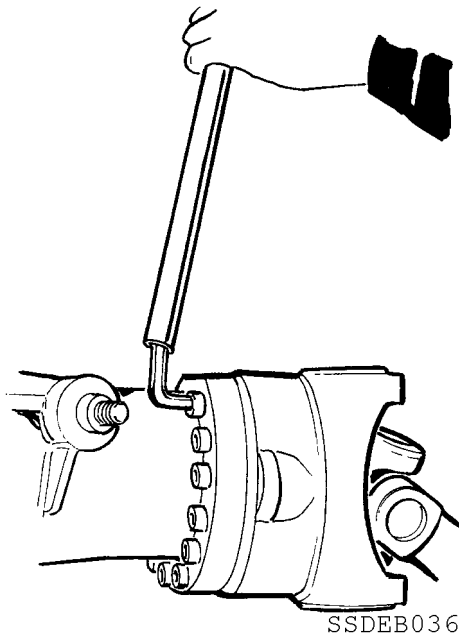
11. Unfasten the swivel axle by pulling it out. This can be done more easily if the sealing plate of the lower steering pivot pin is tapped down with a drift.



Picture 33

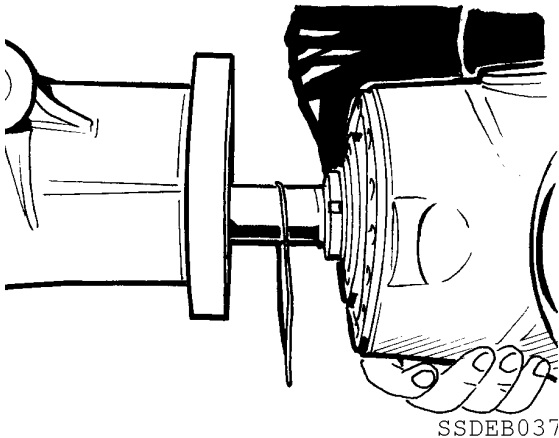
12. Unfasten the lock washer of the swivel axle housing. Unfasten the sleeve, the sealing ring and the needle bearing by pressing them.

13. Open the Allen bolts from the axle housing end.



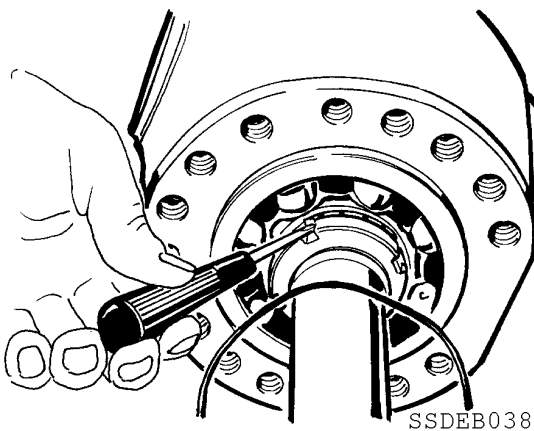
Picture 34

14. Remove the swivel head and the axle shaft by pulling them out.

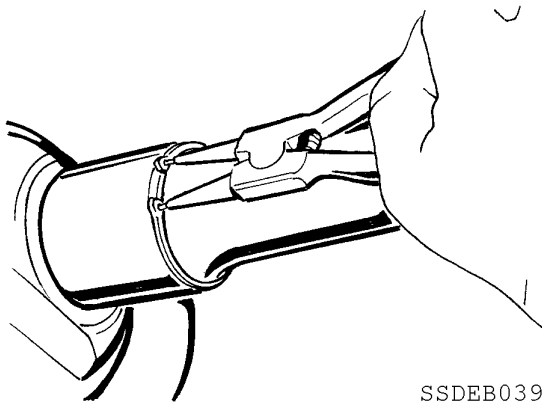


Picture 35

15. Unlock the nut on axle shaft. Open the nut with suitable spanner wrench. Unfasten the axle from the swivel head by pressing outwards. Unfasten the bearing and the sealing ring.



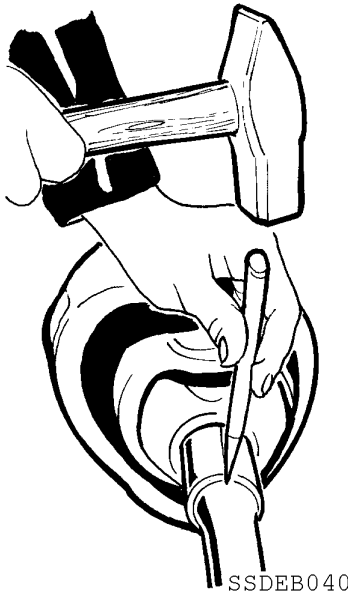
Picture 36



SSDEB039

✓ 16. Unfasten the axle shaft ring.

Picture 37



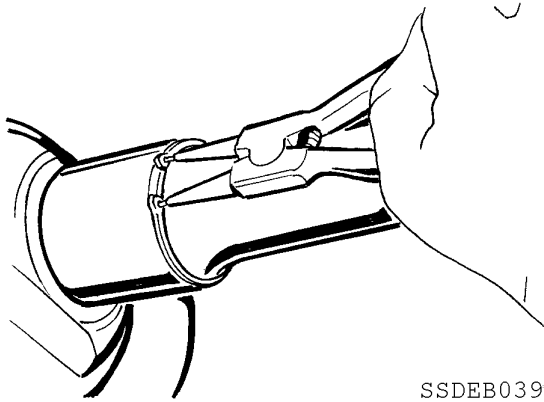
SSDEB040

17. Remove the inner race of the needle bearing from the axle shaft by making a groove in it with a cutting wheel and splitting the bearing with a chisel.



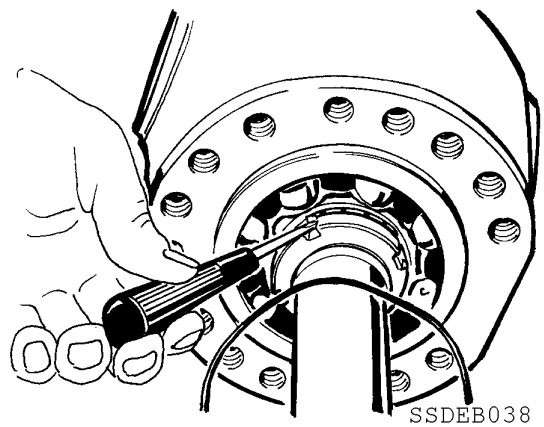
*Use protective goggles and ensure that the axle does not get damaged.*

## 2.3 ASSEMBLY- STEERING KNUCKLES



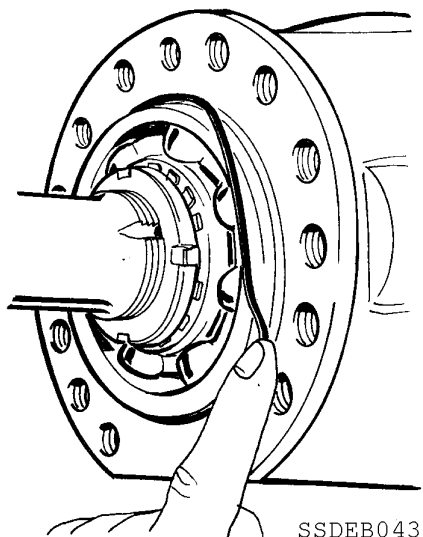
1. Press the inner race of the needle bearing onto the axle shaft and fit a lock washer.

Picture 38



2. Fit the swivel head with a new sealing ring and bearing. Fit the axle shaft, washer and locking plate in the swivel head. Tighten the nut with a torque of 110 Nm (11 kgm). Lock the nut by bending the lock washer.

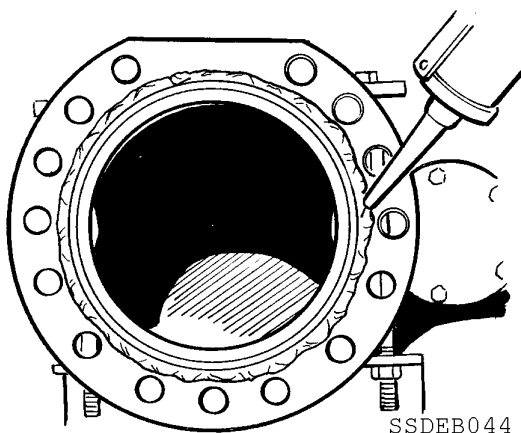
Picture 39



SSDEB043

3. Fit a new O-ring to the outer race of the swivel head bearing.

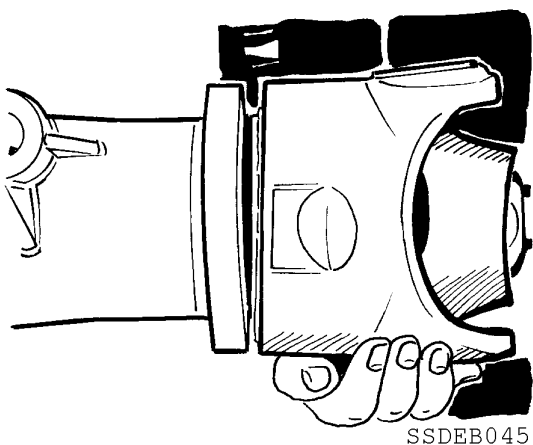
Picture 40



SSDEB044

4. Apply sealing compound to the axle housing flange.

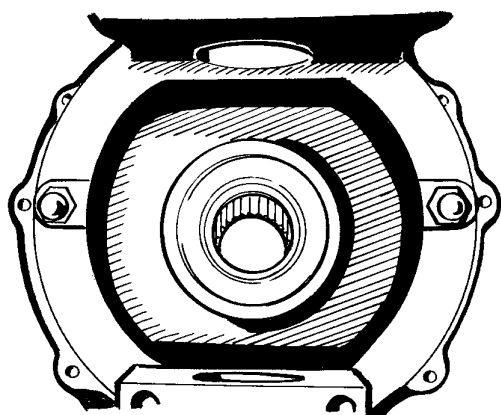
Picture 41



SSDEB045

5. Fit the swivel head and axle shaft to the axle housing. Fit washers, and tighten the Allen bolts with 210 Nm torque.

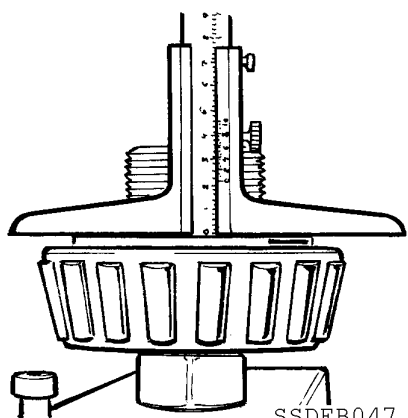
Picture 42



SSDEB046

Picture 43

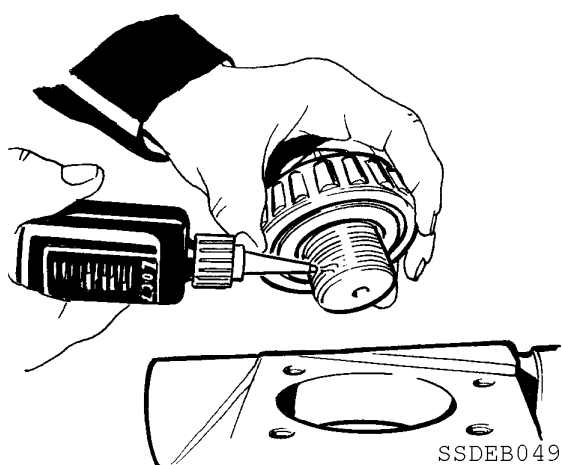
6. Fit the axle shaft housing with a new needle bearing, a new sealing ring and sleeve. Fit a new lock washer. Fit the steering pivot pins' bearings with new seals. Also replace the sealing plates.



SSDEB047

Picture 44

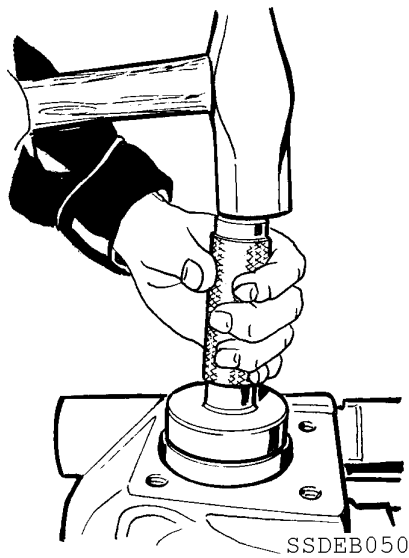
7. Fit the steering pivot pins with new bearings in such a way that the surface of the bearing's inner race is approx. 1 mm higher than the lower edge of the steering pivot pin face. Lubricate the bearing.
8. Fit the swivel axle to the swivel head. Take care not to damage the seals of the steering pivot pins.



SSDEB049

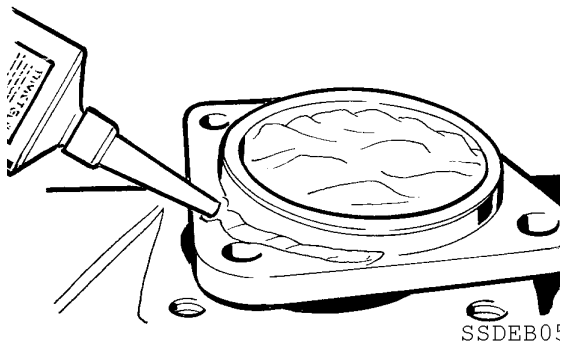
Picture 45

9. Put Loctite or equivalent on the screw threads of the steering pivot pins and screw the pins in place a few turns short of the bottom.



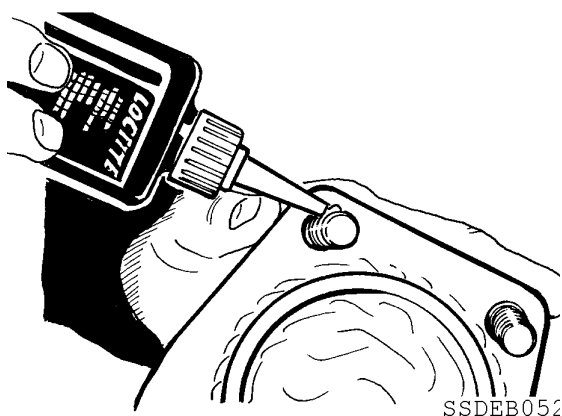
10. Fit the outer races of the steering pivot pin bearings tapping carefully with suitable drift. Tighten the steering pivot pins with 900 Nm torque.

Picture 46



11. Put sealing compound on the surfaces of the seals on the pivot pin covers.

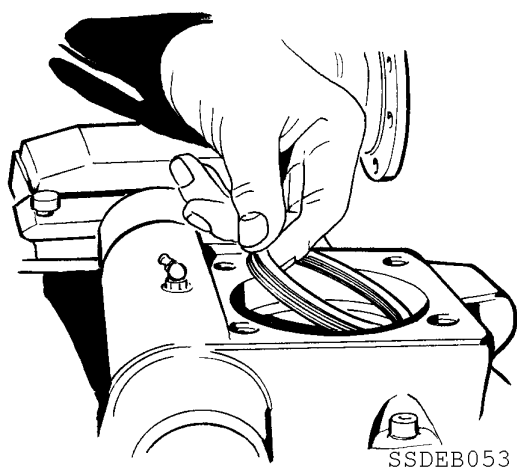
Picture 47



12. Put Loctite or equivalent on the screw threads of the bolts and fit the lower steering pivot pin cover. Tighten the bolts with 240 Nm torque.

Picture 48





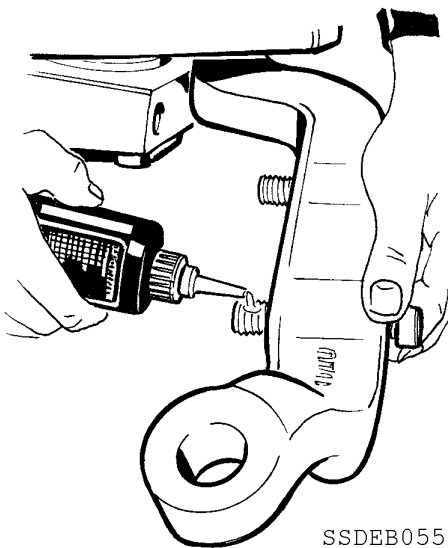
13. Put the original shim plates and sleeve back in the upper steering pivot pin housing.

Picture 49



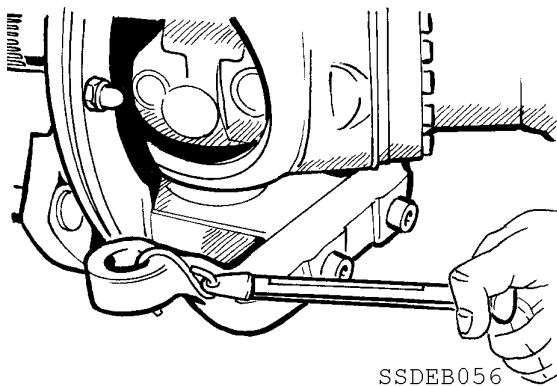
14. Put Loctite or equivalent on the screw threads of the bolts and fit the upper steering pivot pin cover. Tighten the bolts with 240 Nm torque.

Picture 50



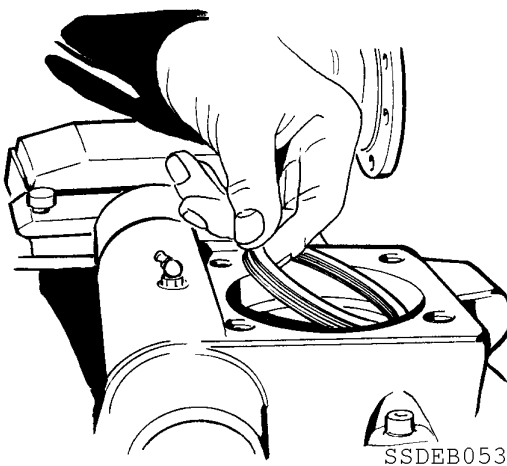
15. Apply Loctite or equivalent to the screw threads of the track arm bolts. Fit the track arm and tighten the earlier M20 bolts with 630 Nm torque and later (1991 onwards) M24 bolts with 940 Nm torque.

Picture 51



16. Measure the resistance of the steering pivot pins' bearing mounting with a spring balance. Fix the balance to the tie rod fulcrum pin ring and draw it horizontally against the beam. The resistance should be approx. 200 N (20 kg) while moving.

Picture 52

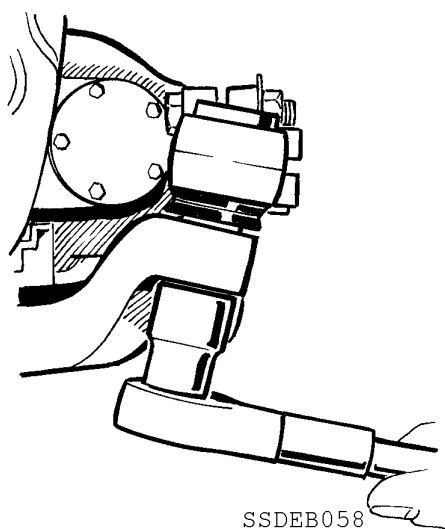


17. If necessary, adjust the bearing clearance by changing the shim plates in the upper steering pivot pin housing.

**Table 1: Shims**

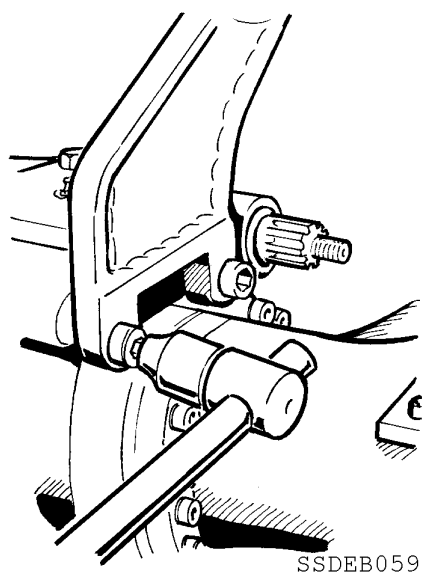
Spare no.	thickness/ mm
099 518 0010	0,05
099 518 0011	0,10
099 518 0012	0,20
099 518 0013	0,50

Picture 53



Picture 54

18. Fit the arms and tie rod of the steering cylinders. Tighten the nuts with 300 Nm torque and secure with a cotter pin.



Picture 55

19. Fit the brake cylinder bracket, apply Loctite or equivalent to the bolt threads and tighten bracket/ steering arm M20 retaining bolts with 630 Nm torque. Fit the breather tube.

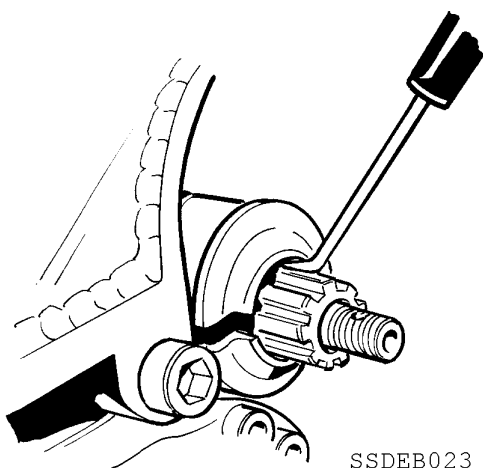
## 2.4 PLANETARY HUBS - ASSEMBLY

Before assembly, carefully clean all the parts. Check the condition of the threads especially carefully.

**Table 2: Shims**

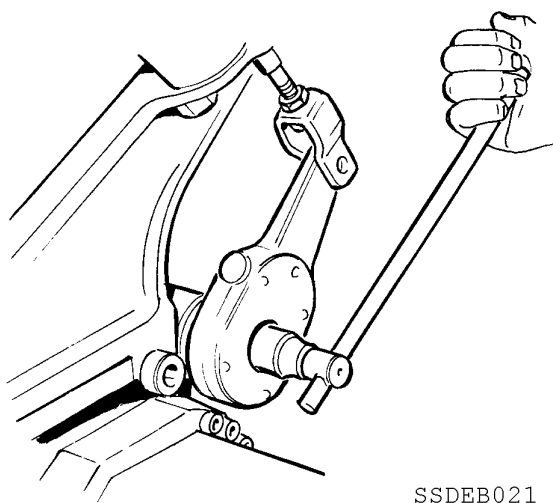
Spare no.	Thickness/ mm
099 519 1000	0,05
099 519 1001	0,10
099 519 1002	0,20
099 519 1003	0,50

1. Lubricate the S-camshaft carefully and fit it in place. Fit the lock washers.

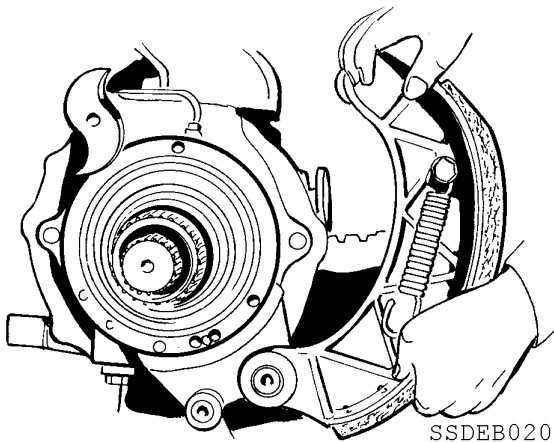


Picture 56

2. Fit the brake lever and tighten the nut until the S-camshaft torsion resistance is 40-60 N (4-6 kg) when measured with a spring balance.

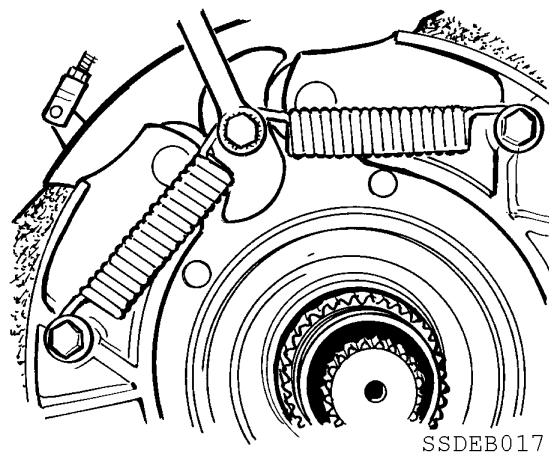


Picture 57



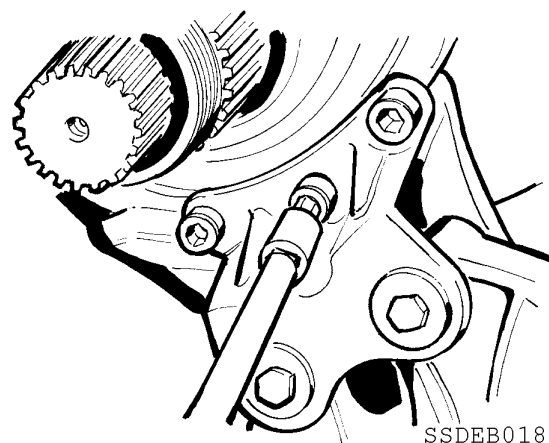
Picture 58

3. Lubricate the anchor pins with heat-resistant grease and fit the brake shoes.



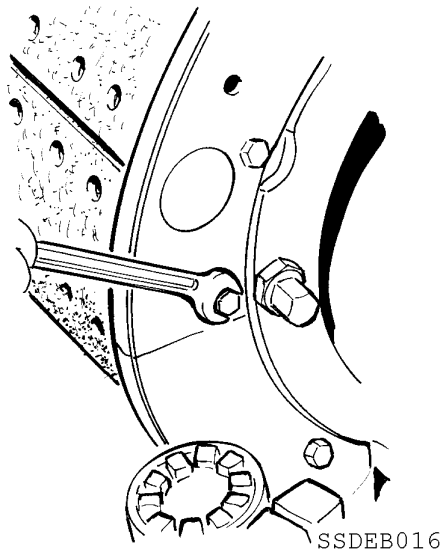
Picture 59

4. Fit the brake shoes' spring pivot.  
The spring pivot screw in the middle of the s-cam shaft and spring retaining screws in the brake shoes shall be tightened to 67 Nm torque. Apply Loctite or equivalent to the screw threads.



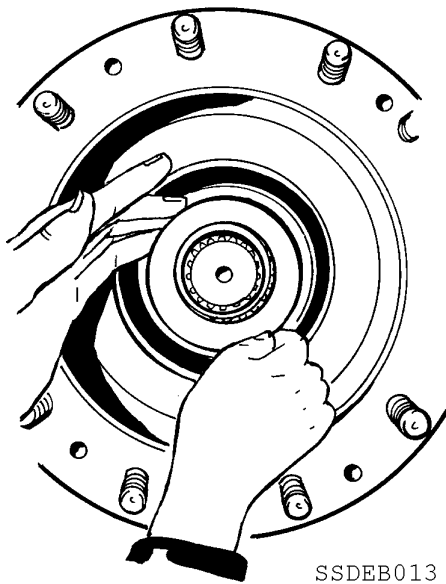
Picture 60

5. Fit the brake shoes fastening lug. Tighten the Allen bolts with 320 Nm torque and the anchor pin bolts with 70 Nm torque. Use Loctite or equivalent.



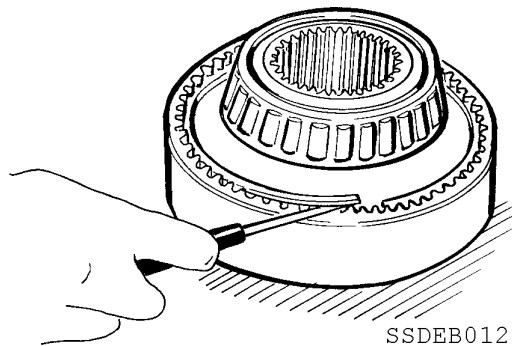
Picture 61

6. Fit the halves of the brake plate.
7. Fit the bearing outer races to the hub.
8. Lubricate the hub inner bearing with oil and the sealing ring with grease.
9. Fit the hub inner bearing and sealing ring to the hub.



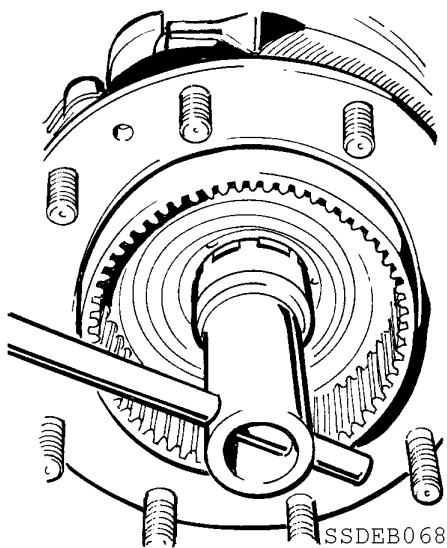
Picture 62

10. Fit the hub to the swivel axle. Fit the spacer and the shim plates that were removed from the hub previously.



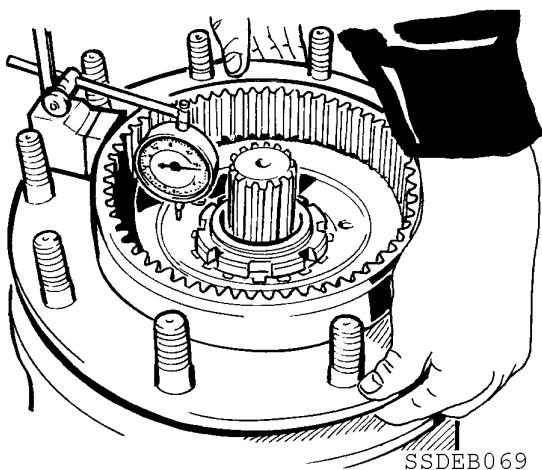
Picture 63

11. Fit a new bearing on the hub of the ring gear. Fit the ring gear on the ring gear hub. Attach a lock washer.



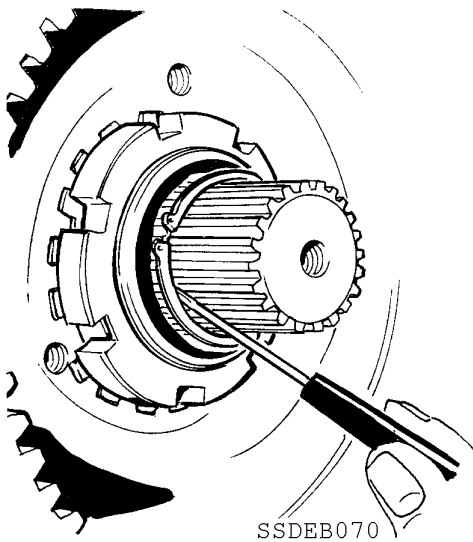
Picture 64

12. Lubricate and fit the hub outer bearing. Attach the hub to the swivel axle. Fit the washer and lock washer, and tighten the nut with special tool 7141-014-020 while rotating the hub at the same time. If the hub rotation is heavy, open the nut and put more shim plates on the axle. Tighten the nut with 1000 Nm torque.



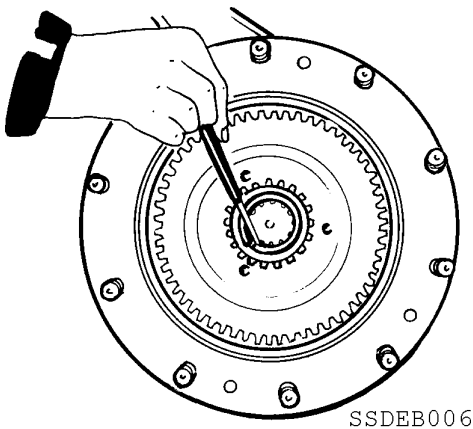
Picture 65

13. Attach a dial gauge by its magnetic holder to the hub, and place the tip of the gauge against the ring gear hub. Move the hub in the direction of the axle and read the bearing clearance on the dial. The correct clearance is 0.00-0.10 mm. Adjust the clearance, if necessary, by changing the shim plates. Thicker plates increase the clearance.



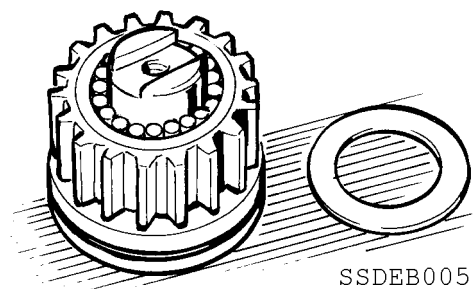
Picture 66

14. Fit the half shaft inner locking washer. Bend the hub nut locking washer dog into the groove with suitable tool.



Picture 67

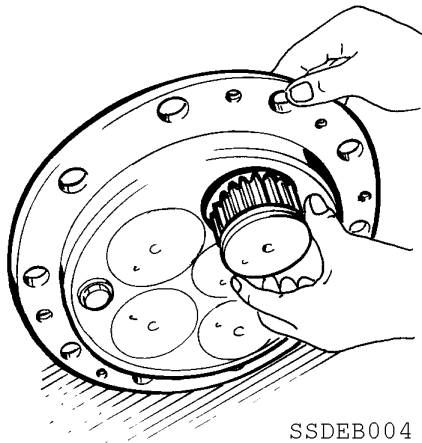
15. Fit the sun wheel and the outer lock washer.



Picture 68

16. Assemble the planet wheels' axle:
- 16/1 Shim plate, smooth side towards the gear wheel (the other edge is bevelled)
  - 16/2 Gear wheel
  - 16/3 26 Bearing rollers
  - 16/4 Shim plate, smooth side towards the gear wheel
  - 16/5 O-ring

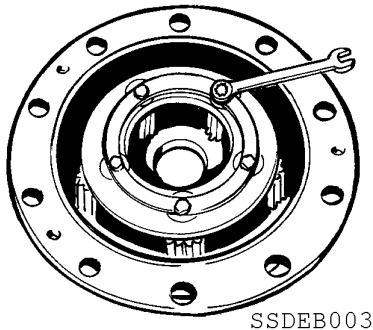




SSDEB004

17. Fit the planet wheels' axles onto the planet wheel carrier so that the tension washer fits in place.

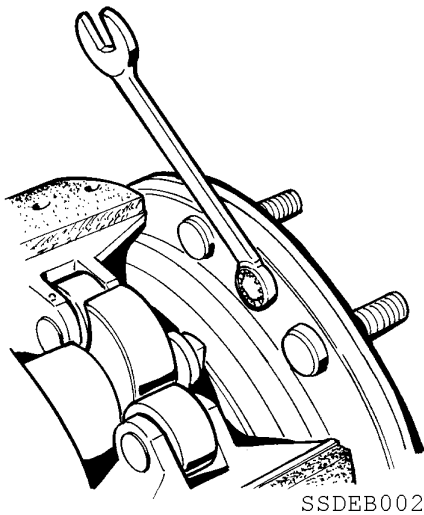
Picture 69



SSDEB003

18. Apply adhesive to the bolts' screw threads and tighten the bolts with 40 Nm torque, tapping the axles at the same time. Make sure that the gear wheels rotate freely.

Picture 70

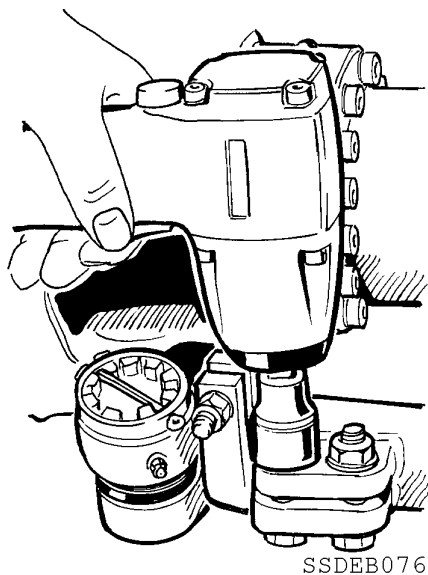


SSDEB002

19. Fit a new O-ring to the planet wheel carrier and fit the carrier on the hub. Spread adhesive on the bolts' screw threads. Tighten the bolts with 70 Nm torque. Fit the brake drum and wheel.

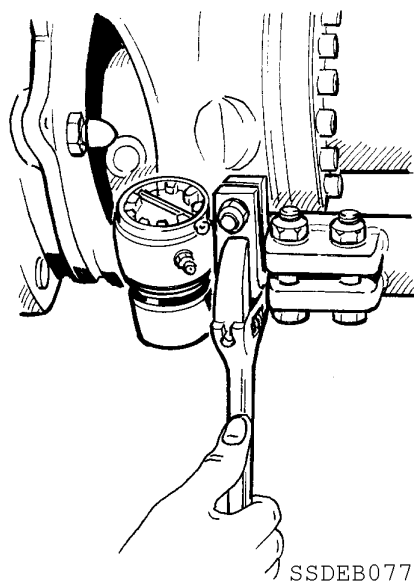
Picture 71

## 2.5 TOE-IN ADJUSTMENT



Picture 72

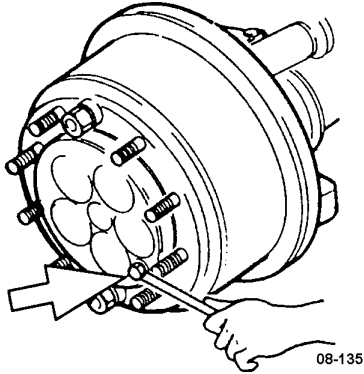
1. Clean the screw threads of the adjustment nut on the left side of the tie rod.
2. Open the locking bolts both from the adjustment nut and from the tie rod.
3. The toe-in is measured from the tire tread.  
Guideline value 0...+1 mm.



Picture 73

4. Adjust the toe-in by turning the adjustment nut.
5. Tighten the locking bolts with 140 Nm torque.

## 2.6 WHEEL HUB - OIL LEVEL CHECK



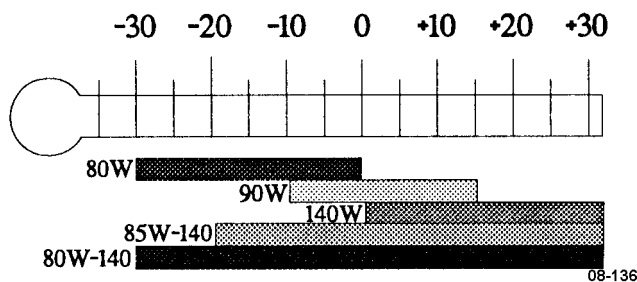
Picture 74

1. Turn the wheel so that the oil plug is in the "4 o'clock" position.
2. The oil level must be even with the lower edge of the oil plug bore.
3. OIL CHANGE The oil should be changed immediately after driving, before the oil cools.
4. Turn the wheel so that the plug is turned downward.
5. Open the plug and drain the oil out of the hub. Turn the wheel so that the oil plug is upward, and fill with approx. 0.6 l of a recommended grade of oil.
6. Check the oil level by turning the wheel so that the oil plug is in the "4 o'clock" position.

## 2.7 OIL RECOMMENDATION

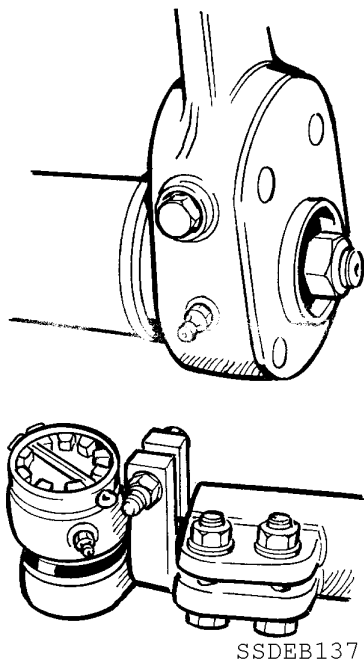
Oil grade: API GL 5

Viscosity: selected from the following chart according to the ambient atmospheric temperature. The same oil is to be used for both the drive gear and the hubs.



Picture 75 Recommended oil viscosity (SAE) according to the ambient atmospheric temperature.

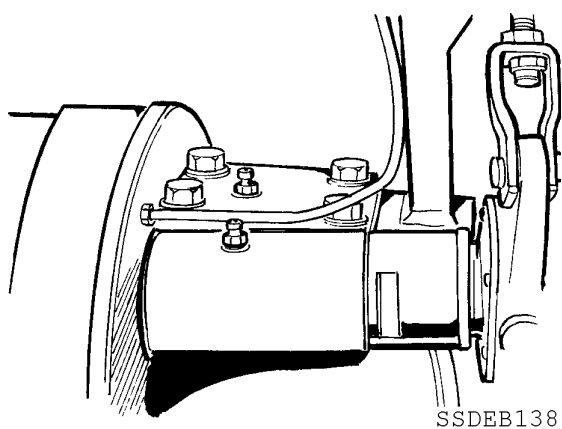
## 2.8 GREASING



Use general purpose grease. Apply with a hand gun. There are grease nipples in the following places on the axles.

1. Brake lever (1 nipple/side)
2. Tie rod coupling (1 nipple/side)

Picture 76



- 3. Steering pivot pin covers (2 nipples/side)
- 4. S-camshaft (1 nipple/side)

Picture 77



## 3 Brakes

### 3.1 SERVICING

#### 3.1.1 Lubrication

To ensure long, trouble-free operation, it is essential to service the brakes carefully and at regular intervals. The service required is presented below.

Use a good grade of chassis grease. At each service, squeeze grease into the brake slack adjusters and S-camshaft bearings. Before greasing, clean the nipple heads carefully to prevent any dirt getting into the bearings.

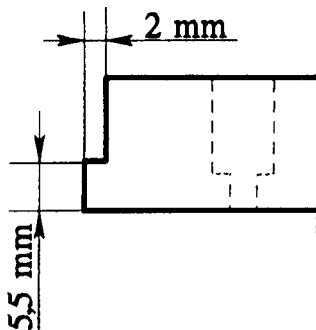
While greasing the S-camshaft bearings, it is advisable to depress and release the brake pedal so that the grease spreads more evenly on the bearing surfaces.

Over-greasing must be avoided, as the excess grease may get into the brake drum.



*Note! From beginning 1997 the anchor bolts don't have grease nipples. The anchor bolts have to be greased only when servicing brake shoes.*

#### 3.1.2 Inspection



DEB01

Checking and adjusting the brakes at regular intervals will ensure safe brakes. Wear to the brake linings can be checked through the inspection hole in the dust shield.

It is advisable to make this check before adjusting the brakes. Brake linings have a 2 mm wide and 5.5 mm deep wear indicator on the leading surface of the brake lining.

The brake assembly must be dismantled, checked and cleaned at least once a year. The brake linings must be changed in good time before the rivet heads begin to touch the brake drum.

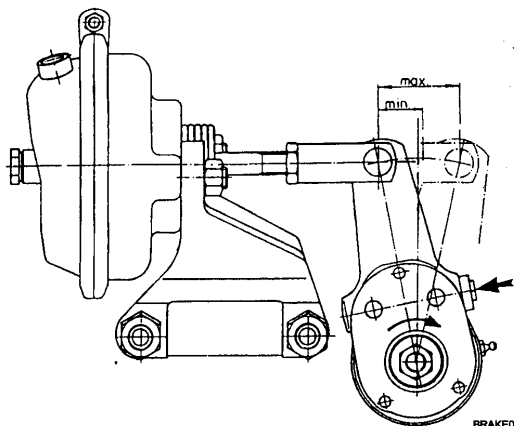
Picture 78 Brake lining wear indicator

### 3.1.3 Adjustment with manual adjusters

The brakes must be adjusted at the latest when the brake chamber push rod stroke exceeds the values shown in the table below.

**Table 3: Brake lever travel**

Brake lever travel on braking with a pressure of 600 kPa (6 kp/cm <sup>2</sup> )		
Brake cylinder	Adjust if travel exceeds	Adjustment (min. travel)
30"	52 mm	32 mm
24"	45 mm	25 mm
20"	45 mm	25 mm



Picture 79 Brake lever travel adjustment

1. The recommended method to adjust the linings to the drag limit is as follows:
2. Raise the wheel concerned off the ground.
3. Depress the adjustment screw locking sleeve of the brake slack adjuster to release the screw.
4. Using the adjustment screw, tighten the linings against the brake drum so that the wheel is prevented from turning.
5. Slacken the adjustment screw until the wheel rotates freely.
6. Make sure the adjustment screw is locked.



**NOTE:** A brake pressure of 600 kPa (6 kp/cm<sup>2</sup>) must be applied when the lever movement is measured.

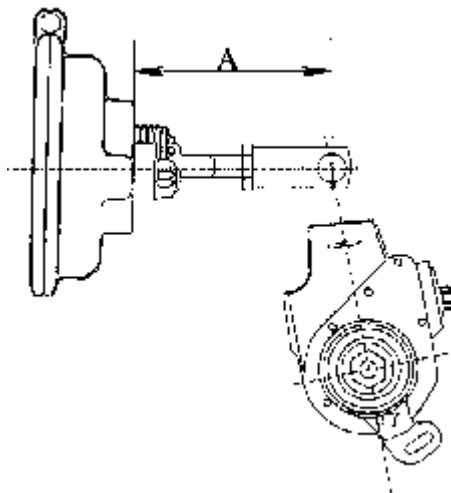
7. If the wheel cannot be jacked up for the adjustment to be made, use the movement of the lever as the basis for the adjustment. Turn the brake lever adjustment screw until the movement of the lever reaches its minimum; this is then close to the drag limit (the point where the brake shoes just touch the drum).





**NOTE:** When turning the adjustment screw, note the direction of rotation of the S-camshaft in the middle of the brake slack adjustment lever. The brakes become tighter when the end of the S-camshaft rotates in the same direction as during the braking movement.

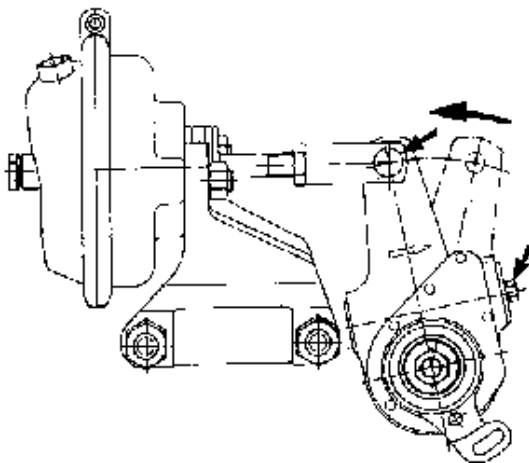
### 3.1.4 Adjustment with automatic adjusters



Picture 80 Brake lever travel adjustment

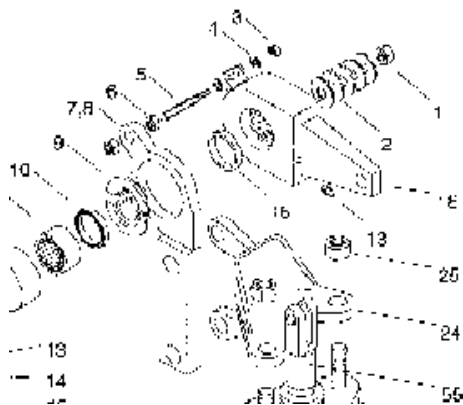
#### Installation

1. Check that the brake cylinder pushrod is in its rest position, as in Picture 80. Adjust the length if necessary.
2. Check that bushing halves (9 in Picture 83) and nylon bush (16) are in position before installation of the brake adjuster lever. Install the brake adjuster lever (18) and five Belleville springs (2) on the S-cam shaft as instructed in – section „S-Cam shaft adjustment in front axles - Belleville spring adjustment“ on page -42.



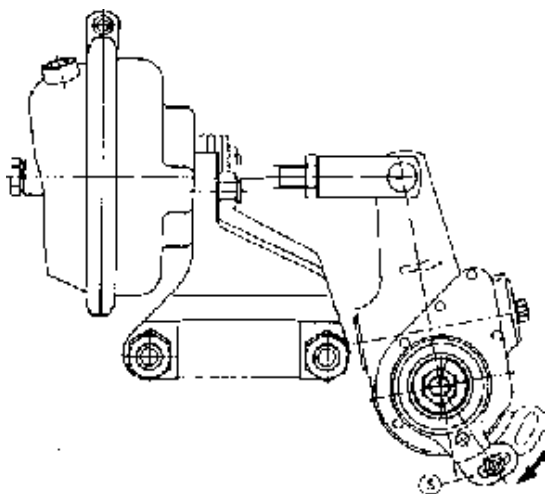
Picture 81 Adjuster installation to the push rod

3. Adjust the pre-tension of the belleville springs and the S-cam shaft by means of the nut (1 Picture 83).
4. Tighten the nut until the S-cam shaft does hardly return by means of the brake shoe return springs.
5. Leave the self locking nut (1) in this position.
6. Pls. Note that this adjustment shall be done before the installation of the of the brake cylinder push rod.
7. Place the anchor pin (5 in fig 3) loosely into its hole.
8. Brake adjuster lever shall be installed so that the arrow on the lever arm indicates the direction of braking, with the arm in front of the pushrod fork (Picture 81).
9. Turn the hexagonal-head adjustment screw clockwise until the holes in the lever arm and pushrod fork are in line, and the fork pin slides easily into place. Lock the pin with a cotter (Picture 81).



Picture 82 Adjuster installation details

10. **IMPORTANT!** Turn the control arm (s) in the direction of the arrow on the lever arm as far as it will go. Do not hammer the control arm! Tighten the nuts to secure the anchor pin in its hole and fix the control arm onto the anchor pin using a nut and washer. Make sure the arm is not deflected sideways. Also check to see that this procedure does not change the set position (Picture 83).
11. Adjust the clearance between the friction blocks and the brake drum as follows: Turn the adjustment screw until the brake clearance is zero, either by measuring or by feeling the wheel turn against the drum. Now turn the screw 3/4 of a turn back (loud ratchet noise).



Picture 83 Fastening of the control arm

12. Check the operation of the brake slack adjuster by braking several times in succession. Anti-clockwise rotation of the adjustment screw during the return stroke shows that the adjuster is working. Continue braking until the correct clearance of 0.4 - 0.8 mm is obtained. Also check the stroke of the brake chamber pushrod at a pressure of 6.5 - 7 bar: the rod should move 23-40 mm.

### 3.1.5 Brake inspection (in use)

About every 40,000 km, check that the movement of the pushrod has not changed greatly from its normal value.

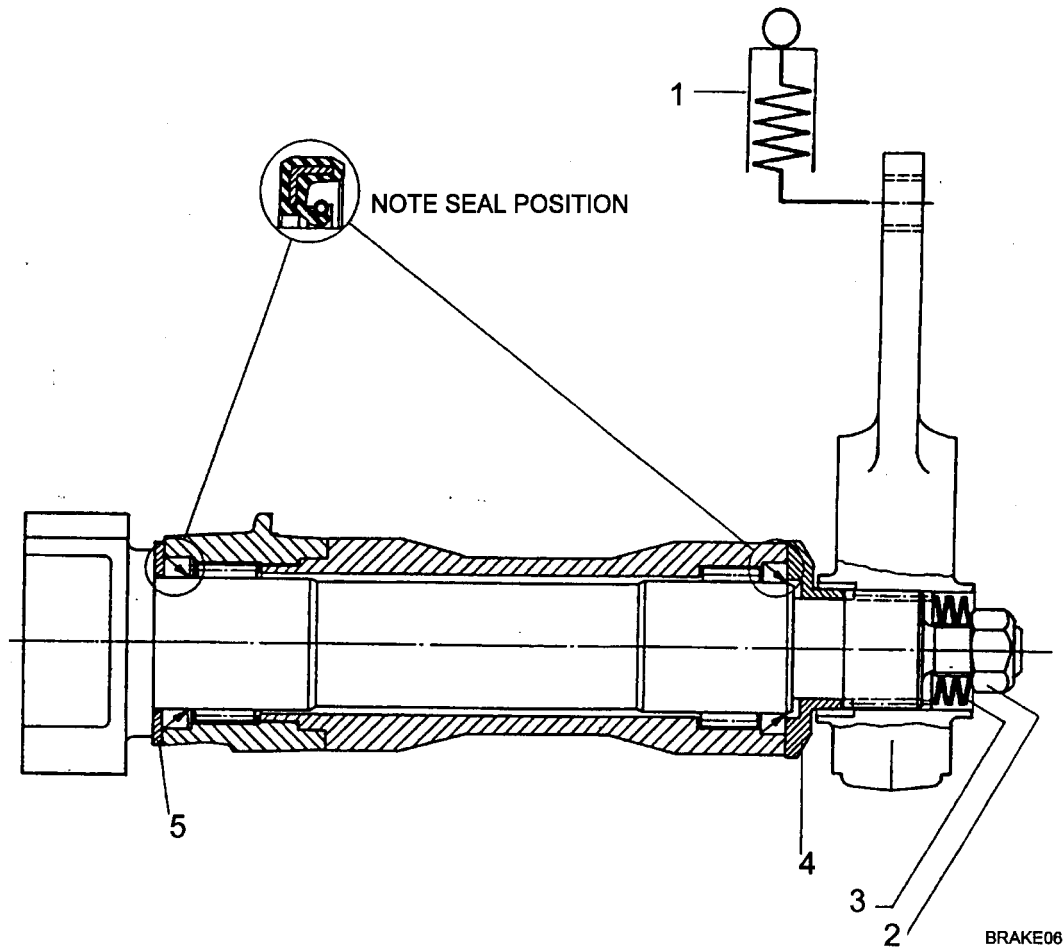
Check the adjustment resistance of the lever once a year. Measure the resistance by turning the hexagonal head of the adjustment screw with a torque wrench. Turn the wrench anti-clockwise and check that the one-way clutch or conical clutch does not slip at torque below 18 Nm. Carry out the measurement three times with the same slack adjuster. If slippage occurs, change the slack adjuster.

If there is any suspicion of greater than normal wear to the friction blocks, possibly caused by the action of the adjuster, measure the brake clearance with the brakes cool twice during 1000-2000 km. If the clearance is less than 0.25 mm (minimum value) check the position of the adjustment arm according to the instructions and repeat the clearance measurement.

The brake clearance varies from one braking to another from 0.25 mm (min.) to 1.0 mm (max.), depending on the force with which the brakes are applied, the braking frequency and the brake drum temperature.

### 3.1.6 S-Cam shaft adjustment in front axles - Belleville spring adjustment

S-cam shaft resistance shall be adjusted as follows:



Picture 84 S-cam shaft installation and adjustment details

1. Spring scale for measurement
2. Adjustment/retaining nut
3. Belleville springs
4. Bushing halves
5. Support ring

1. Place the support ring (5 in Picture 84) on the shaft and install the shaft.
2. Install the bushing halves (4) around the shaft and place the slack adjuster on the splines of the shaft.
3. Place 5 pcs Belleville springs (3) on the shaft end according the illustration.
4. Tighten self locking nut (2) until the resistance of the s-cam shaft is 40 - 60 N when measured by a spring scale (1).  
The turning resistance of the slack adjuster shall measured at the most outside pin hole.

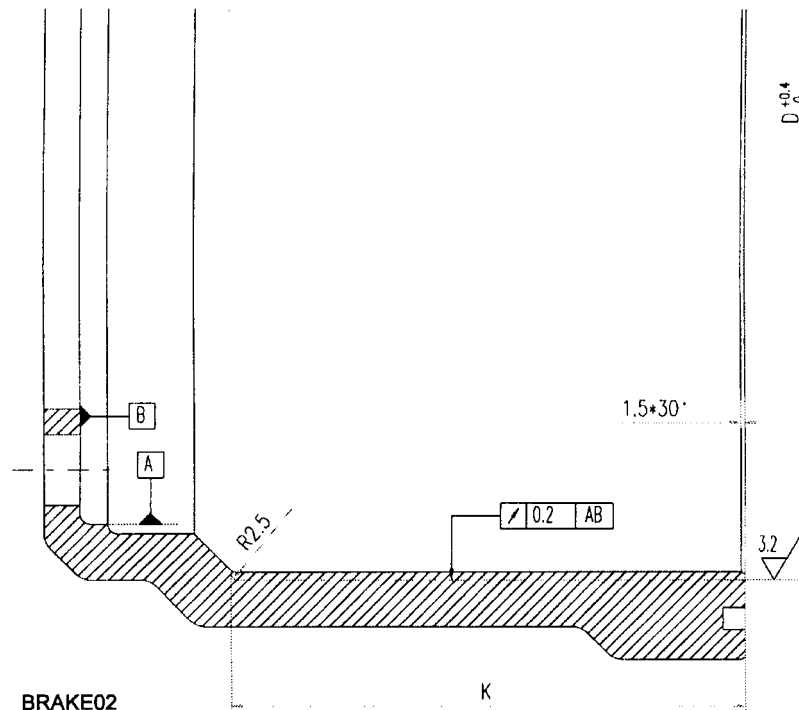
## 3.2 BRAKE DRUM

**Table 4: Brake drum diameters “D”**

Nominal diameter	410 mm
Nominal diameter for over-sized linings	414 mm

**Table 4: Brake drum diameters “D”**

Largest permitted turning diameter	416 mm
Rejection limit	418 mm



Picture 85 Brake drum measure details

### 3.2.1 Brake drum machining

Machine the drum as shown in Picture 85. Standard size brake linings are used for brake drum diameters of 410-413.5 mm. It should be remembered, however, that brake linings do not “sit” against a re-machined drum and must be carefully “run in” by braking.

We recommend a hub lathe for machining the linings to the correct radius when the size is over 412 mm.

Oversize linings must be used for drum diameters of 414-416 mm.

With oversize linings, machining the friction blocks is not necessary.

### 3.2.2 Brake linings

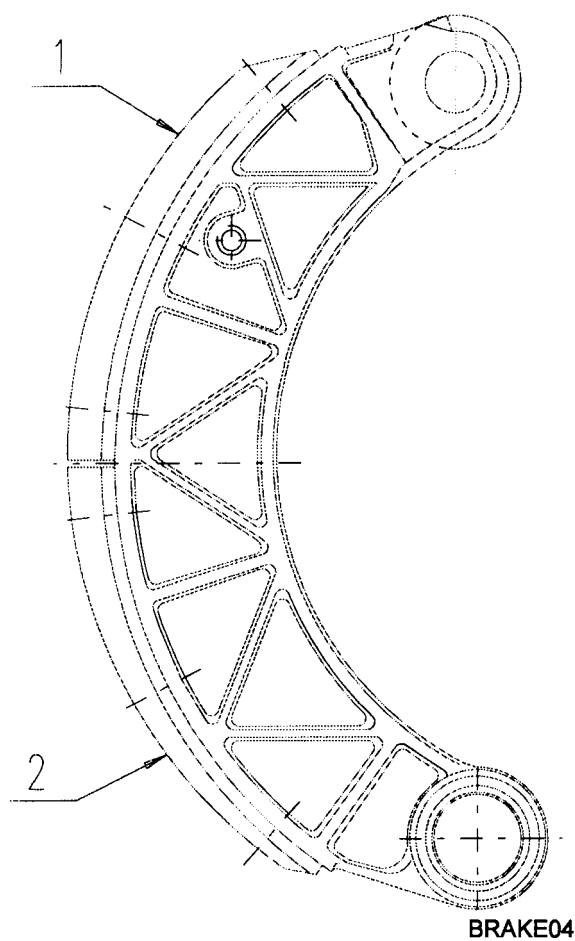
Brake linings shall be ordered according to the respective spare part manual.

All linings are asbestos free.

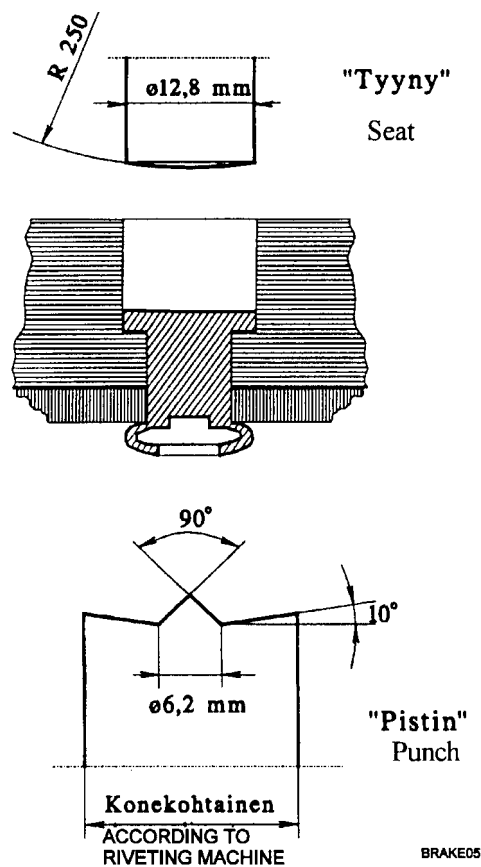
In linings, the lining wear indicator is marked on the leading surface of the lining with a 5,5 x 2 mm shoulder.

### 3.2.3 Riveting brake linings

Note that friction blocks differ, and must be mounted with the thinner block (2) on the anchor pin side and the other block (1) on the expander roll side.



Picture 86 Brake shoe with the linings



Picture 87 Riveting tools

To rivet the linings, use tools like those shown in the above diagram.

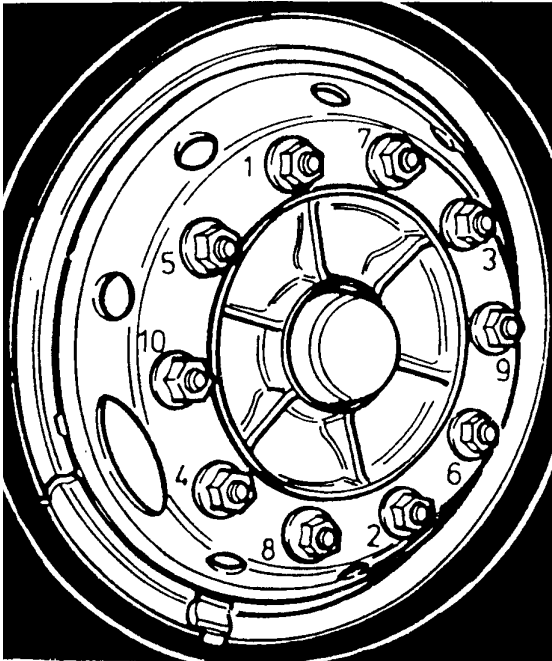
### 3.2.4 BRAKE VIBRATIONS

During braking, the brakes may develop noise and vibration. Should this be serious enough to warrant repairs, a clear explanation must be given to the workshop to avoid unnecessary work.

Find out which wheel or pair of wheels is causing the problem, and establish the nature of the vibration (frequency, intensity and conditions under which it occurs, e.g. speed, braking force).

1. During braking, a jerky type of vibration that varies with speed indicates out-of-roundness of the brake drums.
2. This defect can be checked by inserting a dial gauge through the inspection hole without removing the disc wheel. The maximum permitted reading on the gauge is 0.20 mm. If a corresponding defect is not found with the drum detached, check the fastening of the drum and disc wheel. The wrong torque in the wheel fastening screws can cause this defect.
3. Very high-frequency vibration or noise in the front axle brakes can often be rectified by shortening the friction blocks at the end of the anchor pin side by about 50 mm. This results in a smaller opening angle, which reduces the pressure at this end, making the brake shoes less susceptible to vibration.
4. Strong low-frequency vibration in the driving axle brakes and affecting the entire vehicle may occur at low speeds just before the vehicle stops. The vibration is caused by masses outside the wheel brakes being brought onto the same vibration frequency.
5. To rectify this, adjust the turning resistance of the S-camshaft by adjusting the tension in the Belleville springs
6. In brakes with bearing bushings in S-cam shaft there brake vibrations are rare.

### 3.2.5 Attaching the wheel



BRAKE07

Check that the wheel nuts and bolts are clean and undamaged. Lubricate the bolt threads with a little oil. The tightening torque of the nuts is 550...650 Nm. Check the tightness of the nuts again at the latest after one day's driving.

Picture 88 Wheel nut tightening sequence

## 3.3 BRAKE MAINTENANCE - Dismatling

(Items in text refer to Picture 89)

### 3.3.1 Removing the brake shoes

Raise the wheels off the ground.

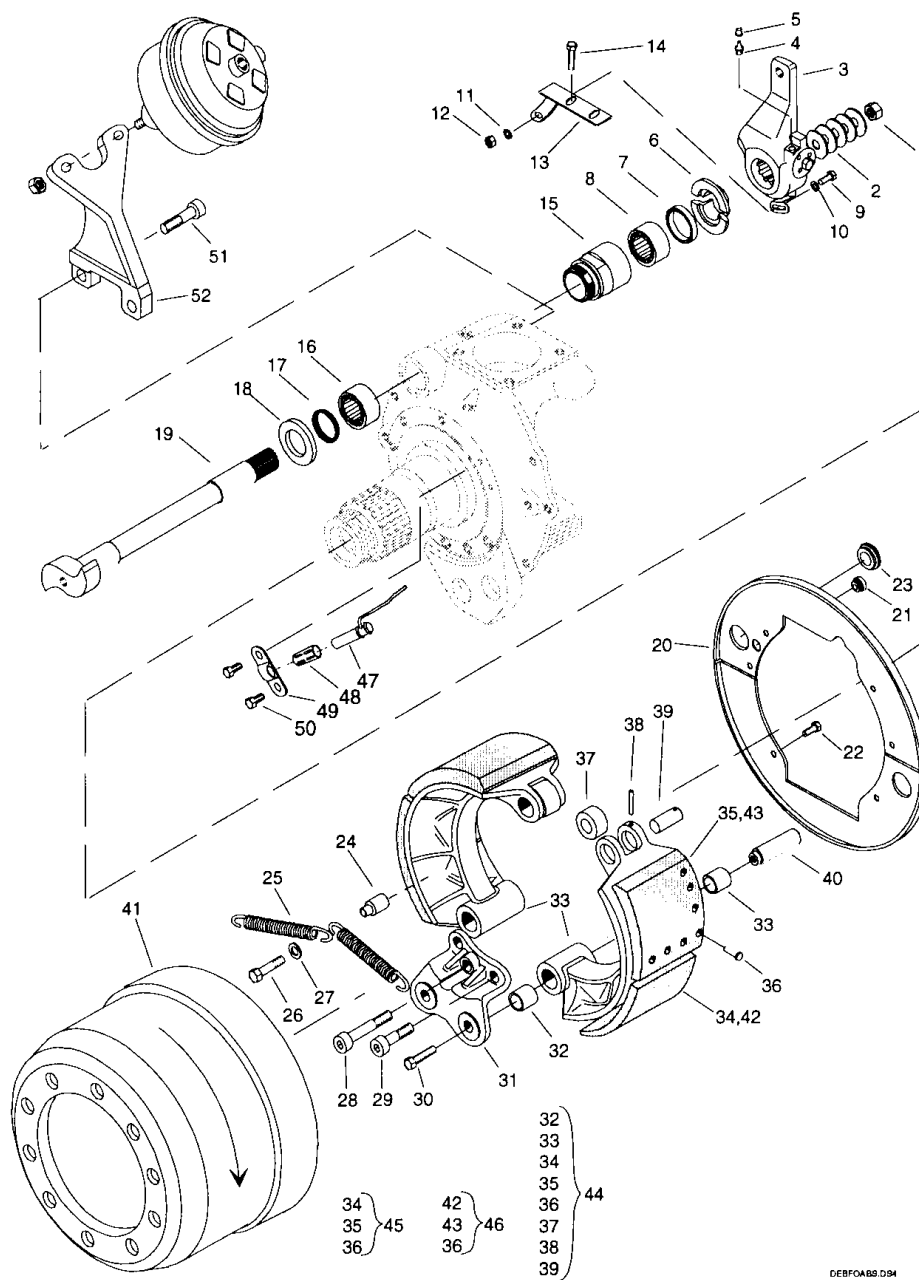
Remove the wheels.

1. Remove the brake drum by pulling outwards. Utilize pulling screws if necessary. Clean the brake drum centring surface with abrasive tape.
2. Release the brake shoe springs by removing the spring pivot screw (26).
3. Remove the anchor bolt screws (30).
4. Remove the brake shoe anchor bolt support (31) by unscrewing the screws (28 and 29). Use suitable Allen key. Turn the hub until the extension arm goes into the hole in the hub flange.
5. Carefully remove the support by tapping with a bar.
6. Remove the brake shoes by pulling outwards.

### 3.3.2 Attaching the brake shoes

Grease the anchor bolts (40) and mount the brake shoes.

1. Mount the brake shoe springs using the anchor screws (26). Apply thread securing medium (Loctite 242 or equivalent) to the threads and tighten the screws to a torque of 67 Nm (also the screws in the brake shoes).
2. Mount the brake shoe anchor bolt support (31) and tighten the screws (28 and 29) to a torque of 320 Nm.
3. Apply thread securing medium (Loctite 242 or equivalent) to the anchor bolt screw (30) threads and tighten to a torque of 70 Nm.



DEBFOAB8.D94

Picture 89 Brake parts exploded (typical)



## 4 TECHNICAL DATA

### Wheel Hub

Oil volume approx.	0,6	l
Wheel hub bearing clearance	0,00...0,10	mm
Tightening torques		
Wheel hub nut	1000	Nm
Planet wheel carrier bolts	70	Nm
Planet wheel pin bolts	40	Nm (cement)
Wheel nut	550...650	Nm
Oil plugs	50...70	Nm

### Steering pivot pins - swivel heads - half shafts

Steering pivot pin bearing clearance (torsional resistance measured at the perforation in the tie rod coupling)	200	N
Tightening torques		
Steering pivot pins	900	Nm (cement)
Steering pivot pin covers	240	Nm (cement)
Swivel head flange bolts	210	Nm (cement)
Track arm bolts (earlier design M20 bolts)	630	Nm (cement)
Track arm bolts (later design M24 bolts)	940	Nm (cement)
Steering arm bolts	630	Nm (cement)
Axle shaft nut	110	Nm

### Steering angles

Camber	0°	
Steering pivot pin camber KPI	6°	
Caster	1,5°	
Toe-in measured from tread	0...+1	mm



## 5 SPECIAL TOOLS

Number: 7141 014 020

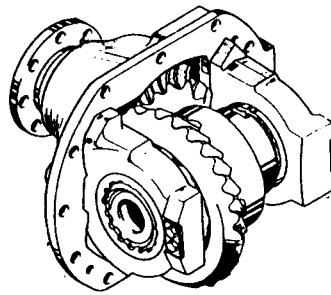
Name: Wheel hub wrench



# Axles

## MAINTENANCE MANUAL

### DP-265 Drive Gears





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**NOTE !** *This Manual is intended for use by experienced mechanics using safe procedures in properly equipped shops.*

*Safety precautions should always be followed such as wearing safety glasses, using adequate lifting aids, and using tools and equipment in good condition. Sisu Axles, Inc., its agents, associates or representatives are not responsible for damage or injury occurring while working on their components.*



# 1 DESIGN AND FUNCTION

## 1.1 DP265 DRIVE GEAR DESIGN

The axle primary gearing is composed of a pair of bevel wheels located among the drive gear between the axles.

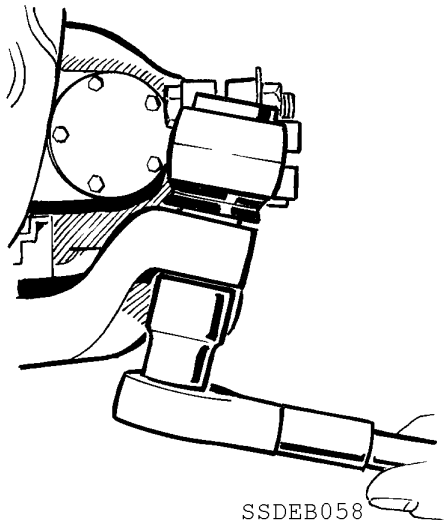
This drive gear is used in following axles:

- FSDP-09/10
- SSDP-10
- FRDP-10/12
- SRDP-14

## 1.2 REMOVAL OF THE DRIVE GEAR UNIT

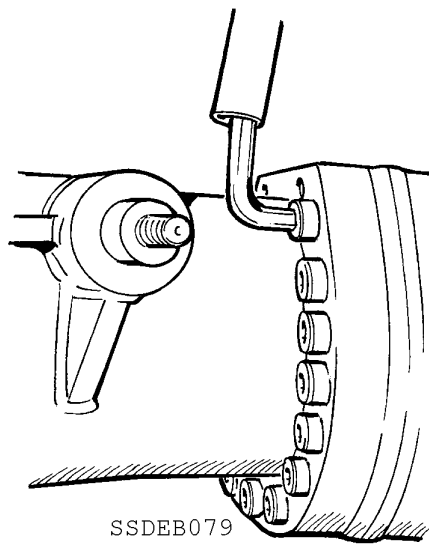
Supporting the vehicle with a trestle at the springs, raise the wheels off the ground. Unfasten the wheels. Let the oil drain out of the drive gear through the oil plug.

1. Unfasten the tie rod from the track arm. Unfasten the propeller shaft from the coupling flange.



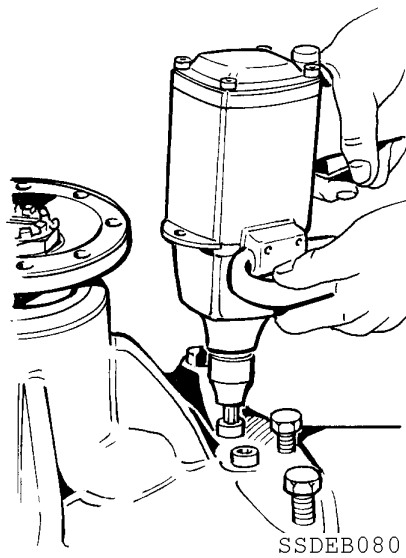
Picture 1





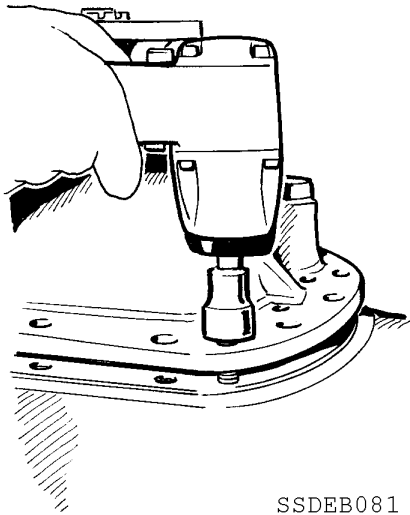
2. Unfasten the Allen bolts from the end of the axle housing and pull the swivel heads and hubs out about 200 mm.

Picture 2



3. Unfasten the drive gear housing anchor screws.

Picture 3



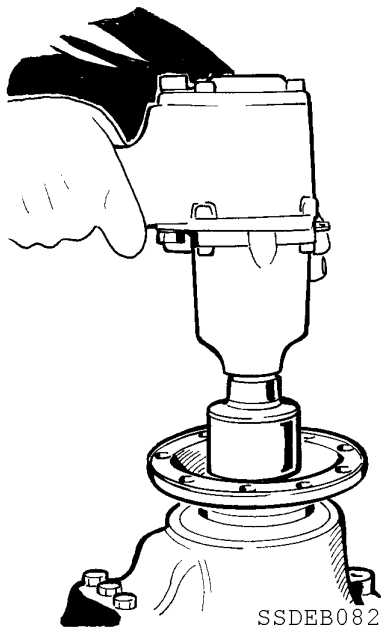
4. Unfasten the drive gear from the axle housing by turning the extractor bolts (M16) in the threads located in the housing (closed with a plastic plug).

Picture 4

## 1.3 DISASSEMBLY OF THE DRIVE GEAR UNIT

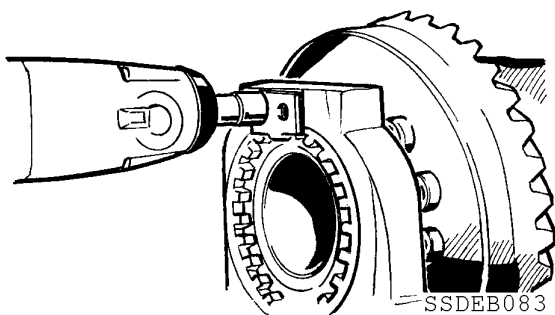
Fix the drive gear to a trestle.

1. Unfasten the coupling flange nut cotter pin and open the nut.



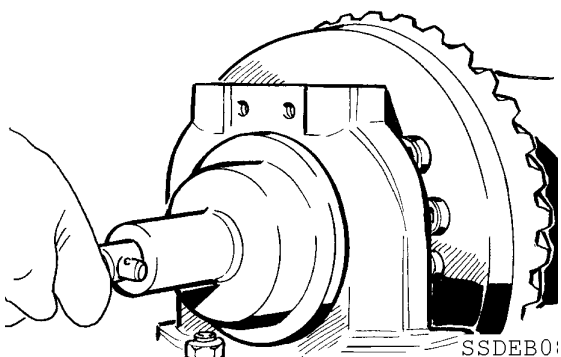
Picture 5

2. Unfasten the crown wheel bearings' lock washers.

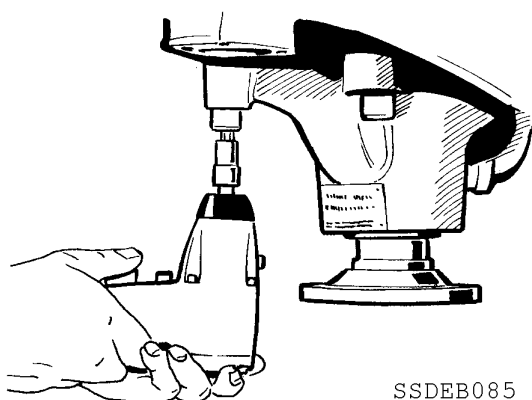


Picture 6

3. Using suitable drift and a hammer or special tool no. 7141-014-030, loosen the other crown wheel bearing by 3-4 cogs.

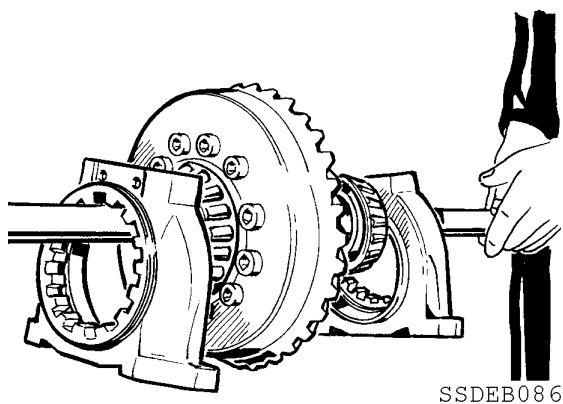


Picture 7



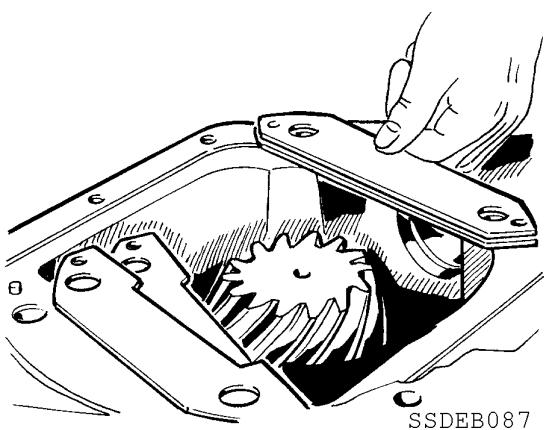
Picture 8

4. Unfasten the bearing housing anchor screws.



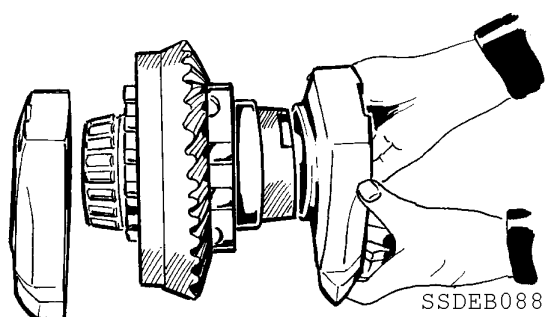
Picture 9

5. Lift the drive gear up and out of its casing.



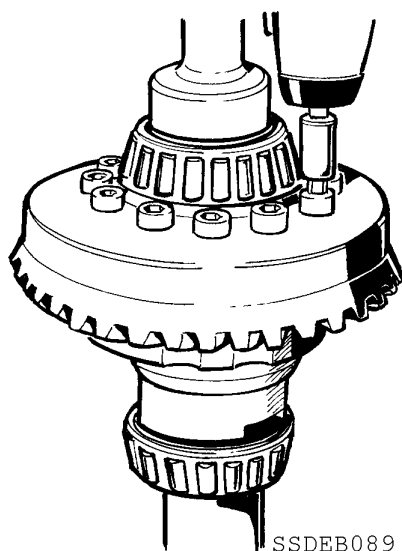
Picture 10

6. Unfasten the shim plates from the casing.  
Note! When reassembling, use the same shim plates (clean the plates and put them aside for use).



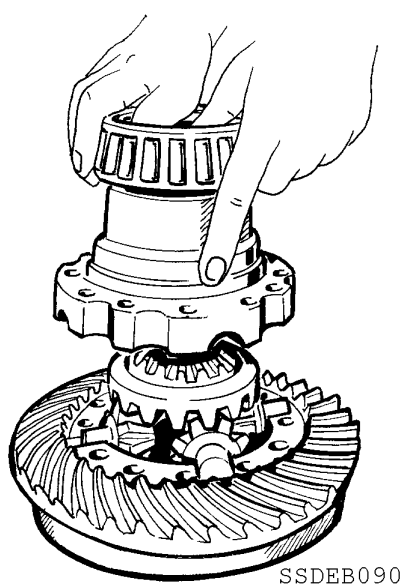
Picture 11

7. Unfasten the crown wheel bearing housing.



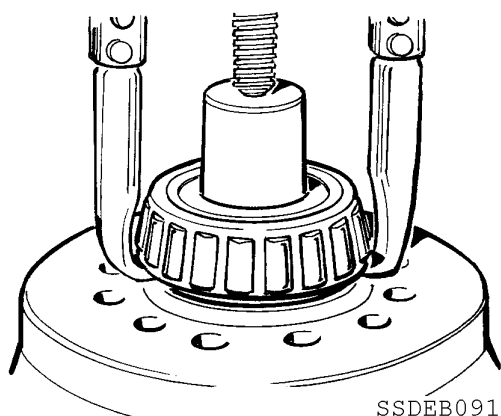
Picture 12

8. Attach the drive gear to the clamp, using suitable sleeves. Unfasten the crown wheel anchor screws.



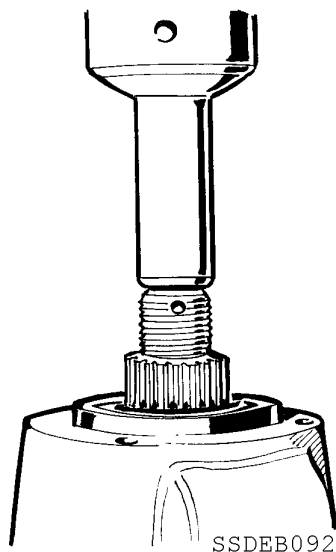
Picture 13

9. Split the differential gear housing.



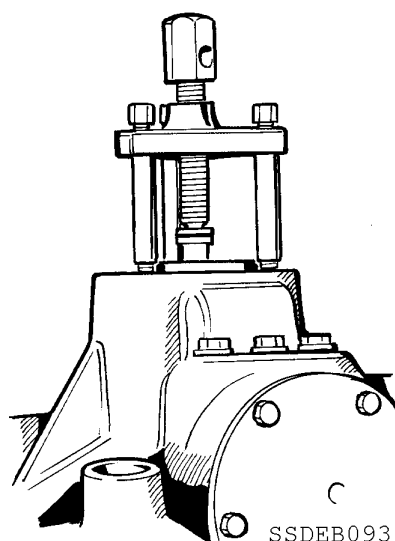
Picture 14

10. Unfasten the bearings from the halves of the differential gear housing, e.g. with a special extractor. Unfasten the crown wheel by compression.



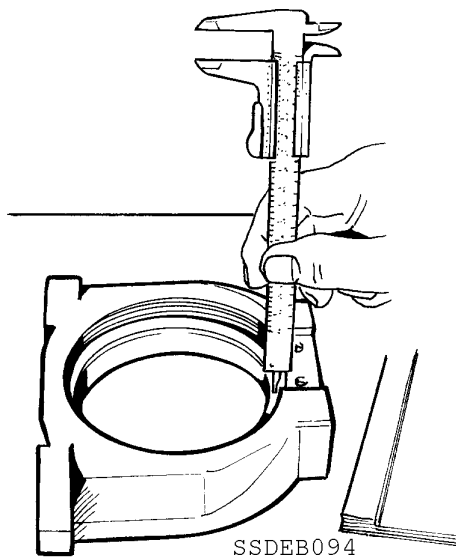
Picture 15

11. Unfasten the drive pinion by pressing. Make certain that the pinion is not damaged when it comes off. Remove the sleeve and spacers.



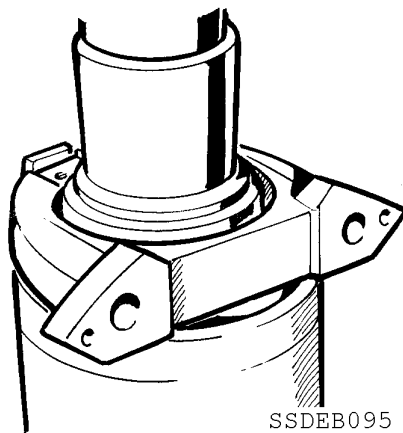
Picture 16

12. Unfasten the oil seal casing with an extractor. Press the outer races of the drive pinion bearings out of the casing.



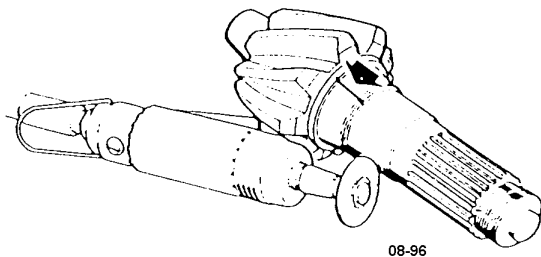
Picture 17

13. Measure the distance of the crown wheel bearings from the surface of the casing. Write down the measurement.



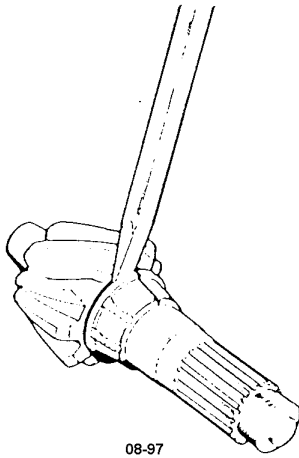
Picture 18

14. Press the bearing race out of the housing.



Picture 19

15. Remove the drive pinion bearing as follows: Split the bearing inner race with a cutting wheel.  
16. Unfasten the bearing inner race and rollers.  
17. Use the cutting wheel to make a groove in the surface of the bearing's inner race.



18. Split the bearing, either by striking it with a chisel or by welding a few nodes in the surface of the bearing, cooling it now and then with a damp cloth.

Picture 20



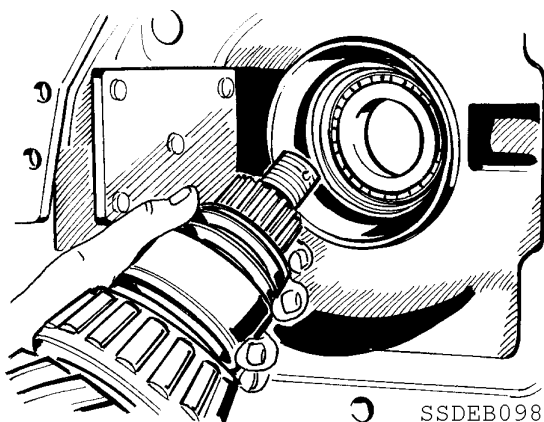
## 1.4 DRIVE PINION - ASSEMBLY

**Table 1: Shims**

Spare No.	SHIMS SPACERS Thickness/ mm
999 515 1066	0,30
999 515 1067	0,40
999 515 10668	0,50

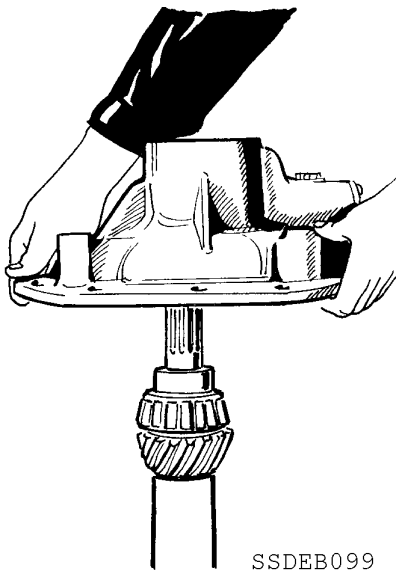
**Table 2: Spacers**

Spare No.	Length / mm
143 261 0111	31,20
143 261 0112	31,22
143 261 0113	31,24
143 261 0114	31,26
143 261 0115	31,28



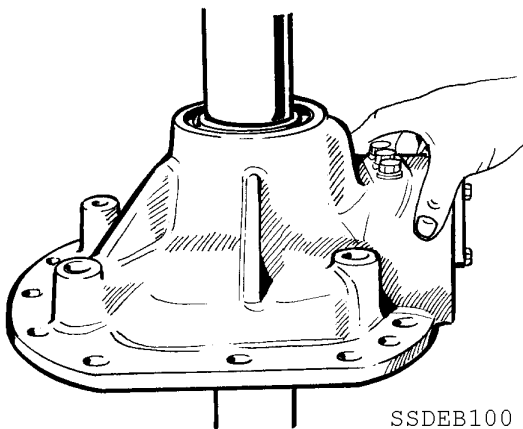
1. Press the drive pinion bearing into place. Press the outer races of the bearings into place in the drive gear housing.
2. Fit the spacer and shims on the drive pinion axle.

Picture 21



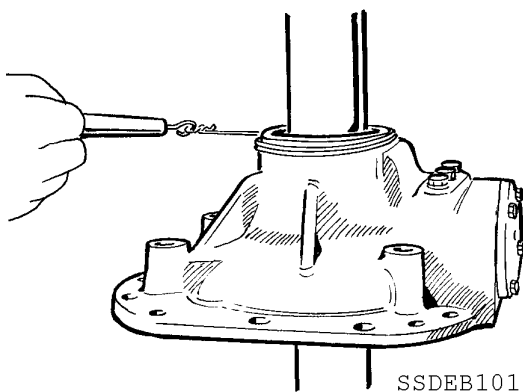
Picture 22

3. Set the drive pinion on top of a suitable counterpart (not a special tool) in a press. Fit the drive gear casing on the axle.



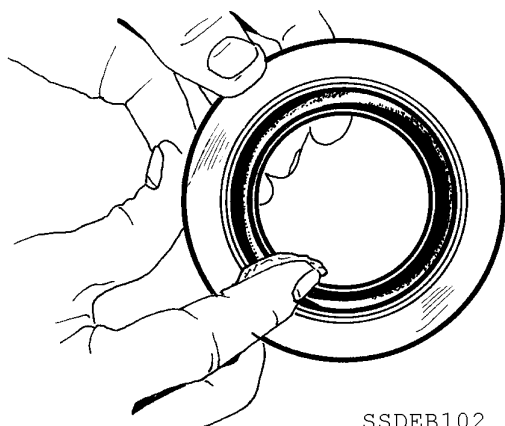
Picture 23

4. Fit the drive pinion axle bearing by compressing (special tool 7144-204-3200) turning the casing round at the same time. If it turns with difficulty, unfasten the drive pinion and fit more shim plates.



Picture 24

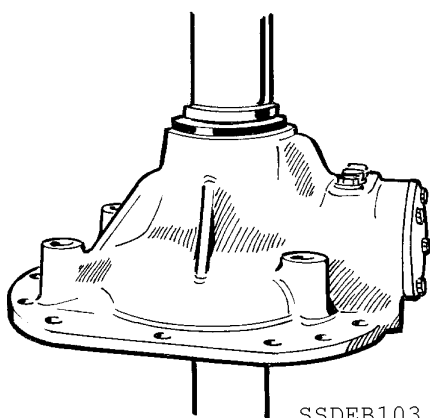
5. Compress the bearings, using a force of 160 kN, and measure the power required to turn the housing with a spring balance. The bearing clearance is OK when the power required is 65.....85 N. If necessary, adjust the clearance by changing the shim plates or sleeve.
6. If there is no press available, fit the coupling flange without gaskets and tighten the nut with 1200 Nm torque for taking resistance measurements.



SSDEB102

7. Fit a new gasket in the gasket housing and lubricate it carefully with grease. Put sealing compound around the housing.

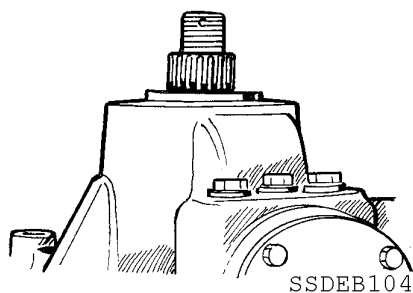
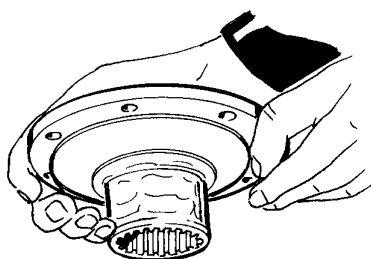
Picture 25



SSDEB103

8. Press the gasket housing into place.

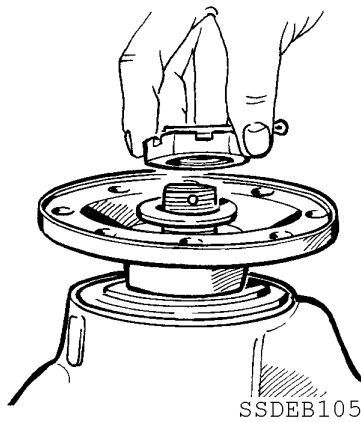
Picture 26



SSDEB104

9. Lubricate the seals of the coupling flange with grease and fit the flange. Use a press if necessary.

Picture 27



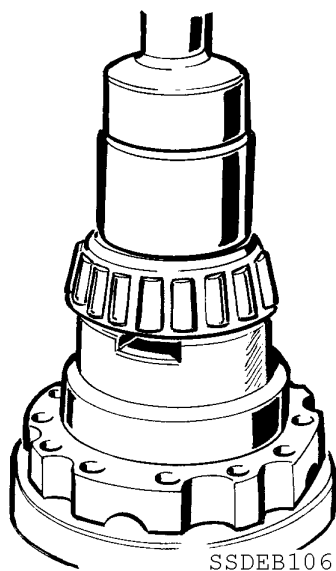
10. Fit the washer and tighten the nut with 1200 Nm torque. Secure with a cotter pin.

Picture 28

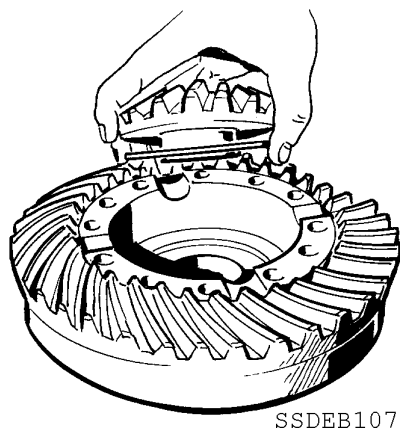
## 1.5 ASSEMBLY

Before assembly, clean and check the parts carefully.

1. Press the bearings into the halves of the differential gear housing.

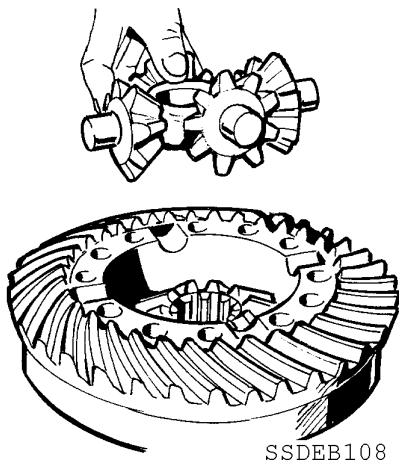


Picture 29



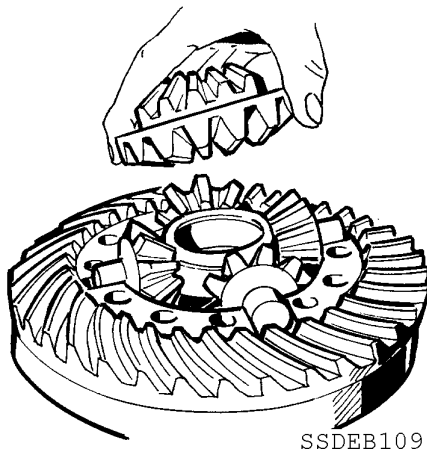
Picture 30

2. Begin the assembly of the differential gear with the half that has internal cogs (on the crown wheel side). Lubricate and fit the thrust washer. Fit the gear wheel.



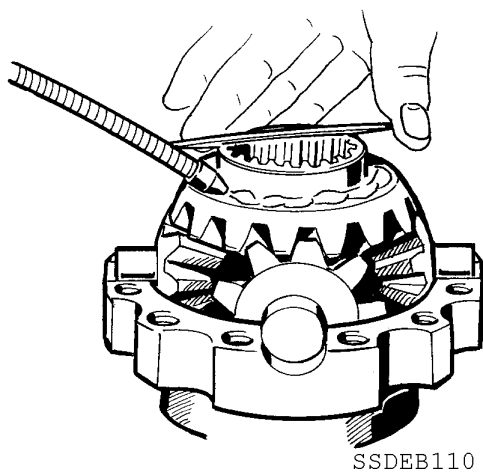
Picture 31

3. Fit the differential gear pinions on the differential spider, and fit the differential spider together with its cogwheels.



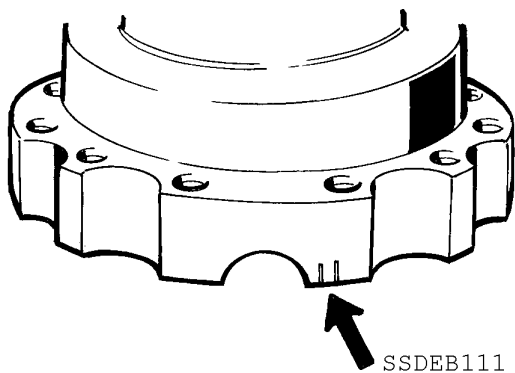
Picture 32

4. Fit the gear wheel.



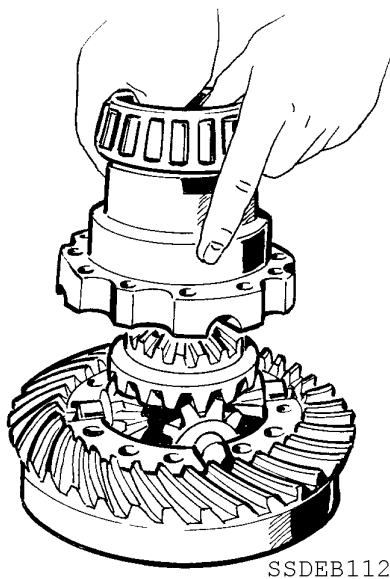
Picture 33

5. Lubricate the thrust washer carefully and fit it.



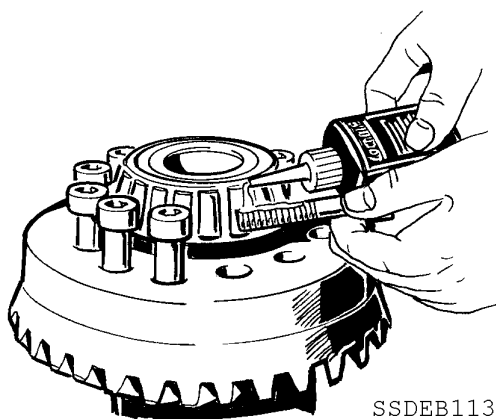
6. Note the positioning marks on the differential gear housing.

Picture 34



7. Fit the halves of the differential gear housing together.

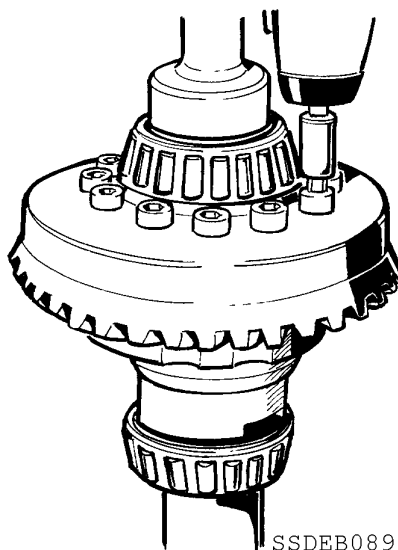
Picture 35



8. If the crown wheel has been off, heat it to approx. +150°C and fit it on by compressing. Use the locating pins. Spread adhesive on the threads of the bolt.

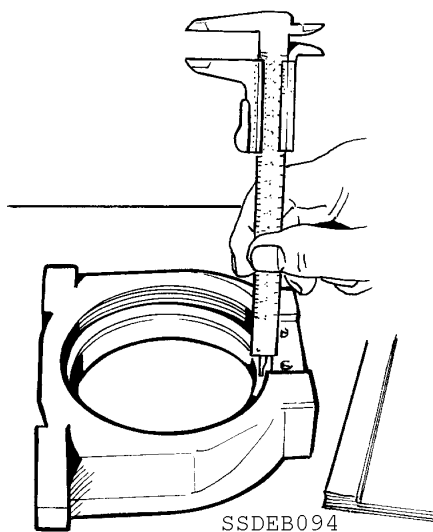
Picture 36

9. Tighten bolts with 320 Nm torque. Ensure that the differential gear wheels are able to rotate freely.



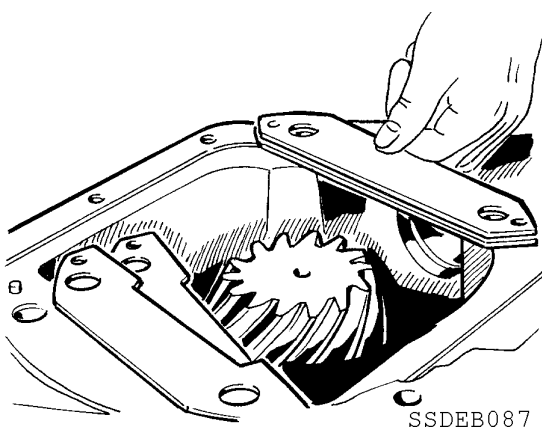
Picture 37

10. Clean the threads of the crown wheel bearing housings. Fit the outer race of the bearings about 1 mm higher than they were previously.



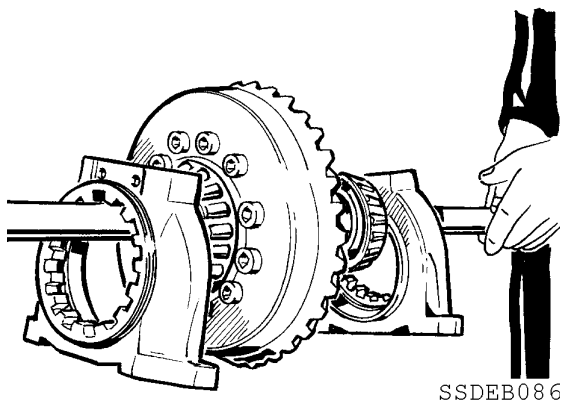
Picture 38

11. Fit the same shim plates as were used previously back into the drive gear housing.



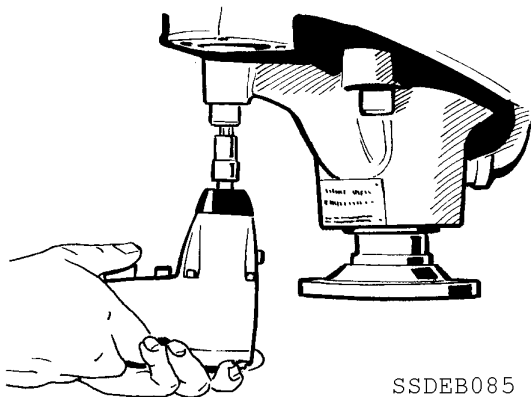
Picture 39





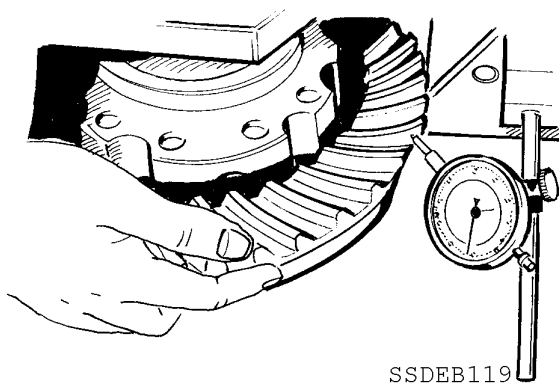
12. Fit the drive gear into the housing.

Picture 40



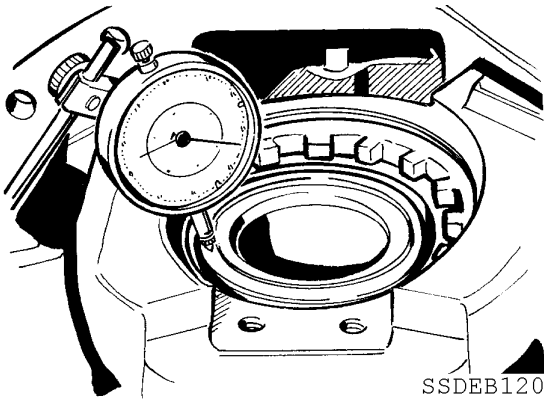
13. Tighten the crown wheel bearing housing bolts with 630 Nm torque, at the same time checking that the housings meet the locating pins.

Picture 41



14. Turn the drive gear on the trestle so that the bearing on the crown wheel side is underneath. Turn the axle, and tighten the bearing adjustment nuts with special tool no. 7141-014-030 at the same time. Attach the dial gauge vertically against the crown wheel cog, and adjust the backlash to 0,15-0,35 mm with the adjustment nuts.

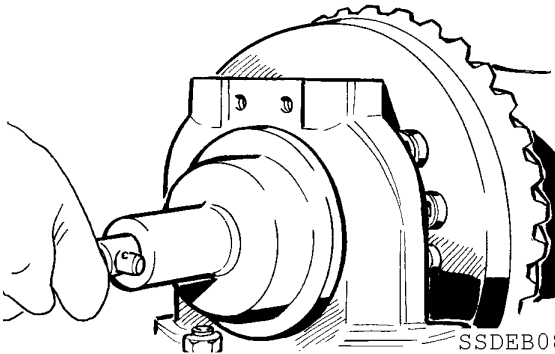
Picture 42



SSDEB120

Picture 43

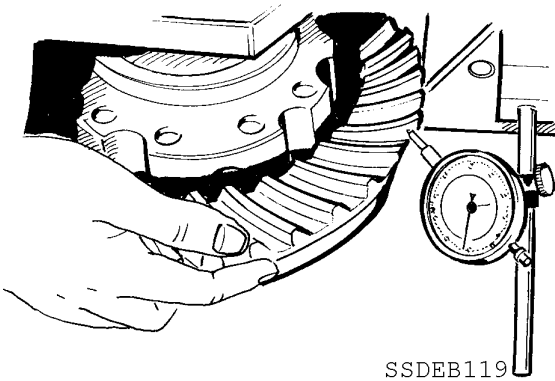
15. Place the indicator of the dial gauge against the inner race of the upper bearing. Turn the axle a couple of times and zero the dial. Turn the drive gear 180° on the trestle. If the bearings are loose, tighten them with the adjustment nuts. Once again, rotate the drive gear 180° and continue until the clearance has gone.



SSDEB01

Picture 44

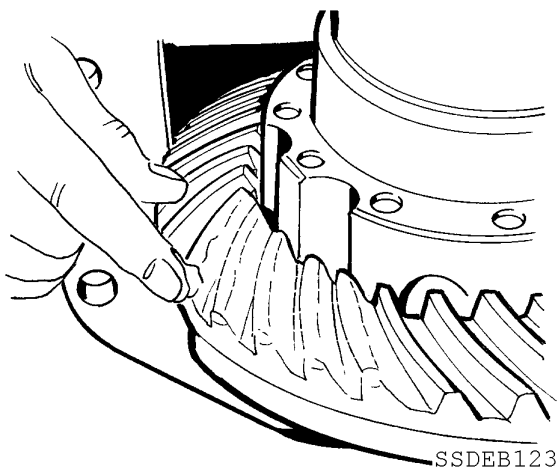
16. Tighten the bearings a little more by turning one of the adjustment nuts 0.5-1.5 cogs. Use for this suitable drift and a hammer (or tool no. 7141-014-030) Check that the nuts are in such a position that the lock washers can be fitted.



SSDEB119

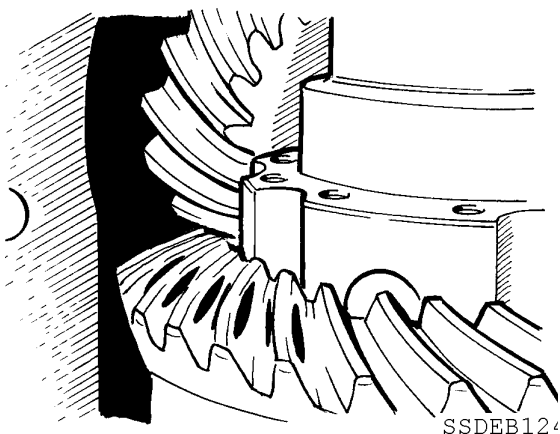
Picture 45

17. Check that the backlash is still 0.15-0.35 mm. If necessary, adjust by turning both adjustment screws an equal amount and in the same direction.



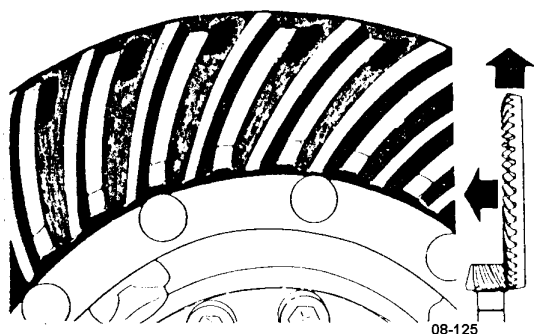
Picture 46

18. Check cog contact with a colour test. Mark 3-5 crown wheel cogs with colour and rotate the drive gear one complete revolution by turning it at the coupling flange.



Picture 47

19. Correct cog contact can be seen from the picture. Correct contact is at the centre of the cog, both on the tension side and on the trailing side.



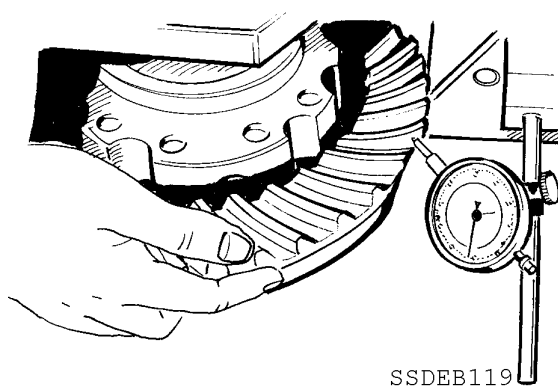
Picture 48

20. If contact is on the tension side of the crown wheel on the outer race (and on the trailing side on the inner race), the crown wheel must be shifted further from the drive pinion by changing to thicker shim plates under the crown wheel bearing housings. To maintain the correct backlash, the crown wheel bearings must be adjusted in such a way that the crown wheel comes closer to the drive pinion



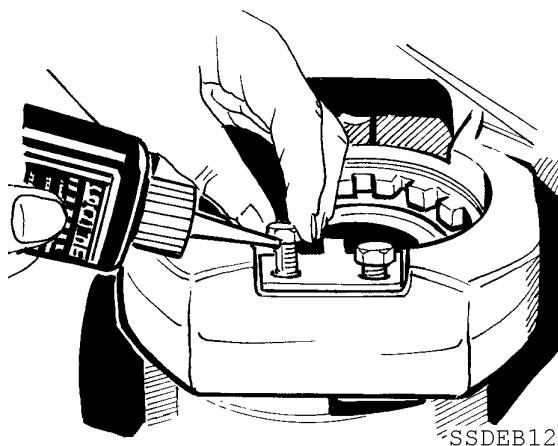
21. If contact is on the tension side of the crown wheel on the inner race (and on the trailing side on the outer race), the crown wheel must be shifted closer to the drive pinion by changing to thinner shim plates under the crown wheel bearing housings. To maintain the correct backlash, the crown wheel bearings must be adjusted in such a way that the crown wheel moves further away from the drive pinion.

Picture 49



22. If the drive gear cog contact has been adjusted, check that the backlash is still 0.15-0.35 mm.

Picture 50

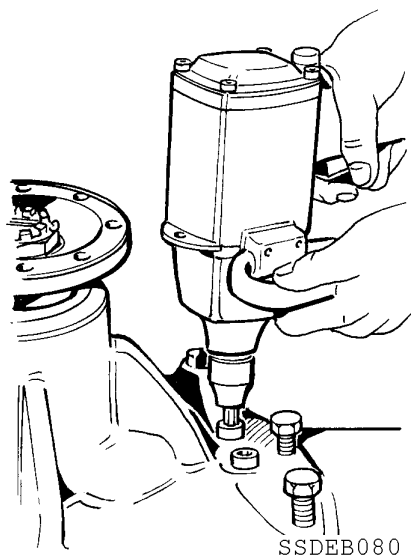


23. Fit the lock washers for the adjustment nuts, of the crown wheel bearings, apply adhesive to the bolt threads, and tighten the bolts with 21 Nm torque.

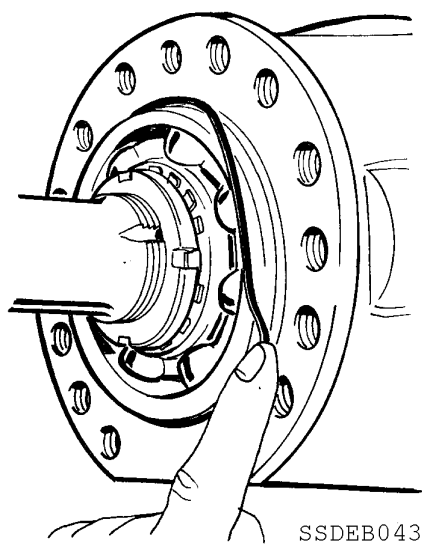
Picture 51

## 1.6 INSTALLATION OF THE DRIVE GEAR UNIT

1. Clean the old sealing compound off the surface of the seals carefully.
2. Apply sealing compound to the surfaces of the seals on the drive gear. Install the drive gear in the axle housing. Apply adhesive to the bolt threads and tighten the bolts with 240 Nm torque.

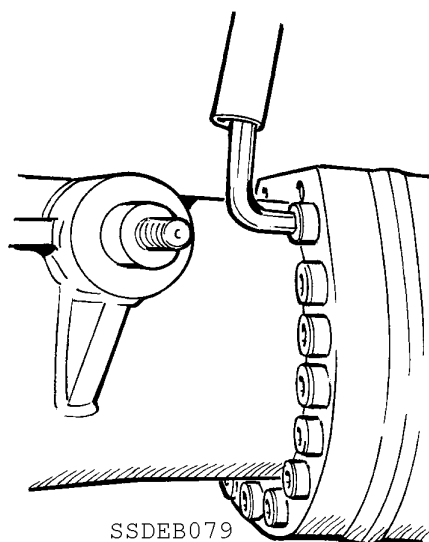


Picture 52



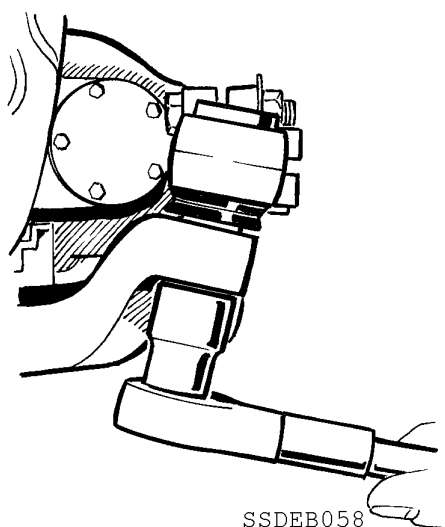
3. Fit a new o-ring to the outer race of the swivel head bearing. Spread sealing compound on the seals and install the swivel heads with their hubs in the axle housing.

Picture 53



4. Fit the washers, spread adhesive on the bolt threads and tighten the bolts with 210 Nm torque.

Picture 54



5. Fit the steering cylinder arms and the tie rod, tighten the ball joint nuts with 141 Nm torque. Secure with a cotter pin

Picture 55

## 1.7 DISMANTLING AND ASSEMBLY OF THE DIFFERENTIAL LOCK



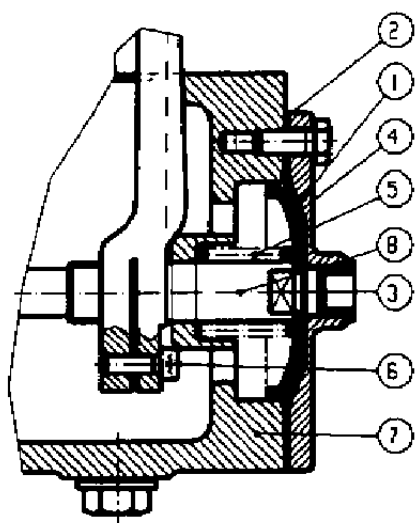
1. Remove the lock cylinder cover retaining screws (5 pcs) first and take the cover and the diaphragm under it away.

Picture 56



2. Undo the diaphragm support cup screw and remove the cup and the spring.

Picture 57



08-010

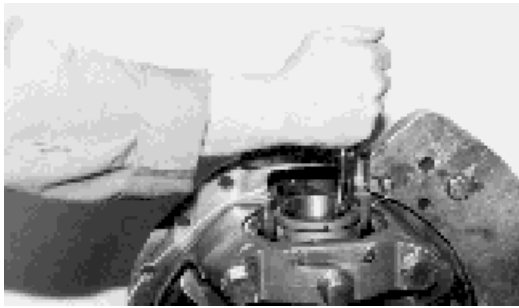
3. Loosen the fork lock screw (6) approx. 2 turns (access to screw trough casing hole under diaphragm).

Picture 58



4. Take the fork shaft out by rotating it anticlockwise by suitable open wrench.

Picture 59



Picture 60

5. When the shaft is removed loosen the slide bush lock screw and remove the snap ring.



Picture 61

6. Remove the fork and the slide bush with slide shoes.

Inspect that all lock components are in good condition and they are not excessively worn. Replace all damaged components. Assemble by carrying out in reverse order the operations described for dismantling.

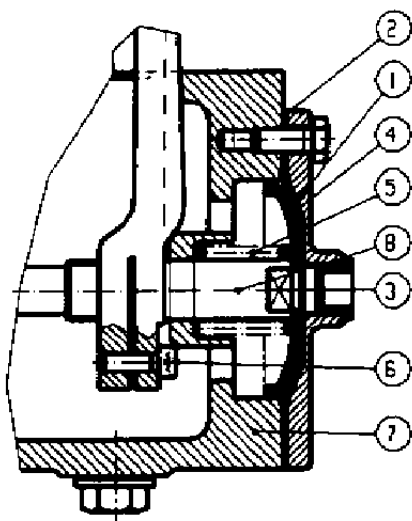


## 1.8 LOCK ADJUSTMENT

The operation mechanism of the differential lock have to be adjusted as follows:



*While adjustment parts 1...5 have to be removed: (see figure62 )*



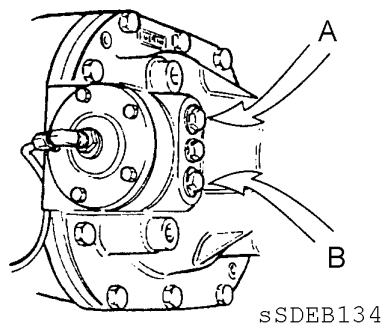
08-010

1. Engage the dog clutch of the differential lock by pushing the fork shaft all the way in.
2. Place the cup (4) on the shaft without retaining screw.
3. Adjust the fork shaft by rotating it so that the cup touches both the shaft end and the bottom of the casing.
4. Check again by rotating pinion and pushing the fork shaft (8) simultaneously if the shaft may go further in.
5. If the shaft and the fork went further in, pls. repeat operations from item 3.
6. Tighten the fork lock screw (6) to 35 Nm torque.
7. Install the cup and retaining screw and make sure that the cup rim touches the bottom of the casing.
8. So the adjustment is performed. Remove the cup once more and do assemble the lock. Tighten cup retaining screw to 30 Nm torque. Use sealant in the plug installation.

Picture 62

- |            |                    |
|------------|--------------------|
| 1. Cover   | 2. Diaphragm       |
| 3. Screw   | 4. Cup             |
| 5. Spring  | 6. Fork lock screw |
| 7. Housing | 8. Fork shaft      |

## 1.9 DRIVE GEAR - OIL LEVEL CHECK



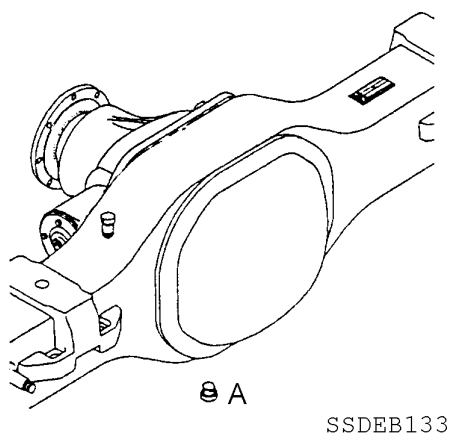
1. The oil level must be even with the lower edge of the level plug. The surface plug is the lowest of the three oil plugs.

Picture 63

A Refilling

B Level check

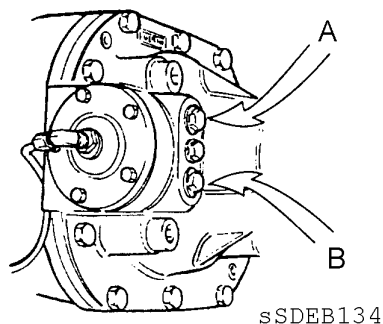
## 1.10 DRIVE GEAR - OIL CHANGE



1. Change the oil immediately after driving, before the oil goes cold.
2. When oil is drained through the plug underneath the axle housing. When the oil is changed, the bottom plug magnet and the drive gear breather must be cleaned without fail.

Picture 64

A Oil drain plug



3. When changing oil, open both the level plug and the filling plug. Fill the drive gear with approx. 12 l of a recommended grade of oil up to the lower edge of the surface plug.

Picture 65

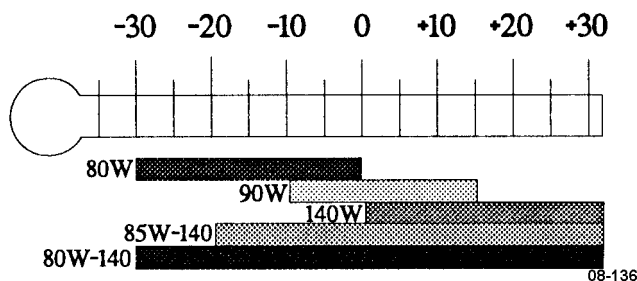
A Refilling

B Level check

## 1.11 OIL RECOMMENDATION

Oil grade: API GL 5

Viscosity: selected from the following chart according to the ambient atmospheric temperature. The same oil is to be used for both the drive gear and the hubs.



Picture 66 Recommended oil viscosity (SAE) according to the ambient atmospheric temperature.

## 2 TECHNICAL DATA

### Drive gear

Oil volume (approx.)	12	l
Bearing clearance of drive pinion (torsional resistance with the bearings compressed at 160 kN and the resistance measured from the radius (R=approx. 68 mm) of the gasket housing)	65...85	N
Crown wheel bearing clearance (0.5—1.5 notches compression when the clearance is eliminated) 0,5...1,5 adjustment-notches	0,15...0,35	mm
Gear back slash		

### Tightening torques

Coupling flange nut	1200	Nm
Crown wheel bearing casing bolts	630	Nm
Drive gear housing bolts	240	Nm (Locking liquid)
Crown wheel bearing adjustment nut lock washer bolts	21	Nm (Locking liquid)
Oil plugs	50 - 70	Nm



### **CAUTION - The use of the differential locks**

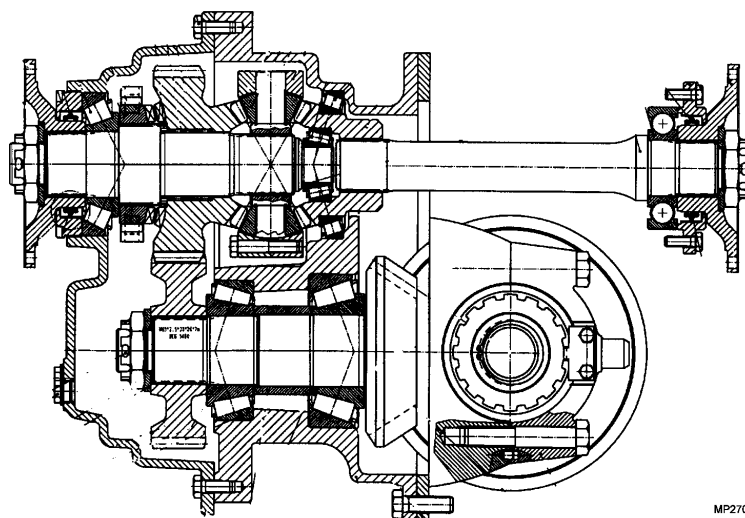
- Engage only under conditions of poor traction
- Do not engage during downhill operation
- Engagement will affect steering
- Do not engage at speeds above 40 km/h (25 MPH)



# Axles

## MAINTENANCE MANUAL

### MP270 Drive gear



MP270-01

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Fax int + 358 204 55 2900

MP270-DG 11/99



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**NOTE !** This Manual is intended for use by experienced mechanics using safe procedures in properly equipped shops.

Safety precautions should always be followed such as wearing safety glasses, using adequate lifting aids, and using tools and equipment in good condition. Sisu Axles, Inc., its agents, associates or representatives are not responsible for damage or injury occurring while working on their components.





# 1 SISU MP270 DRIVE GEAR

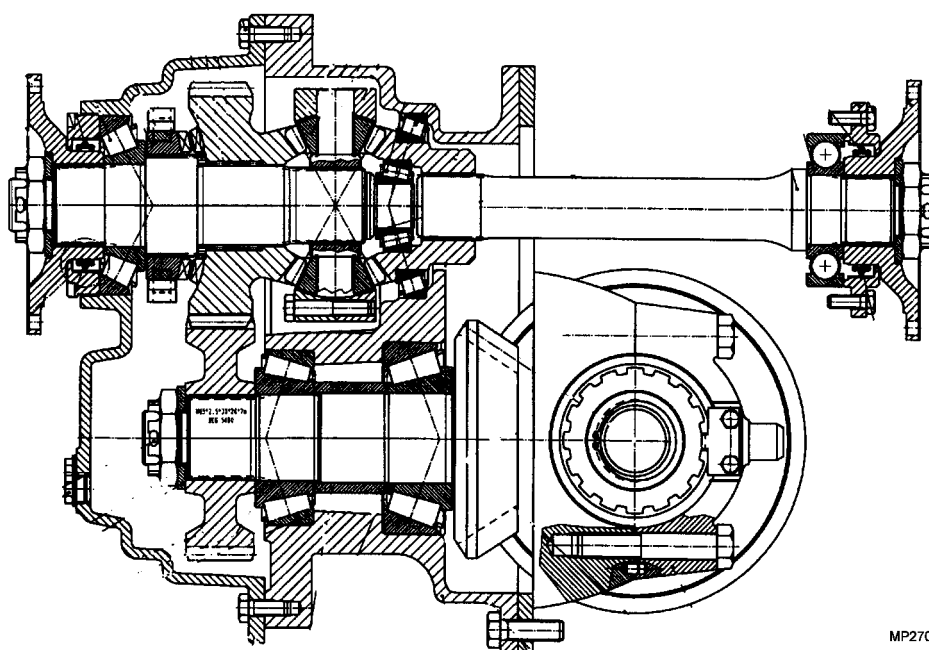
## 1.1 General

In this manual there are instructions only for foremost axle of light weight tandem drive.

Instructions for rearmost axle are in separate SISU DTB axle Workshop Manual.

Repair instructions for brakes and hub reduction gears are in separate manuals.

## 1.2 Axle design



Picture 1: Drive gear in sectional view

The axle casing is rectangular shaped and pressed of steel sheet material.

Power from transmission to the tandem drive rear axle goes through the foremost axle. Propeller shaft flange of foremost axle is installed onto drive gear input shaft and it drives the spider of the longitudinal differential through its splines and this rotates always when the propeller shaft is rotating.

The inter-axle differential divides the power between the foremost and the rearmost axles of the tandem. Power to the foremost axle is transmitted through the front side gear of the inter-axle differential that is integral with a spur gear. The spur gear drives a second spur gear which is installed on splines of the foremost axle pinion where the primary reduction takes place.

The second side gear of the inter-axle differential is splined onto the output shaft which transmits power to the rearmost axle of the tandem.

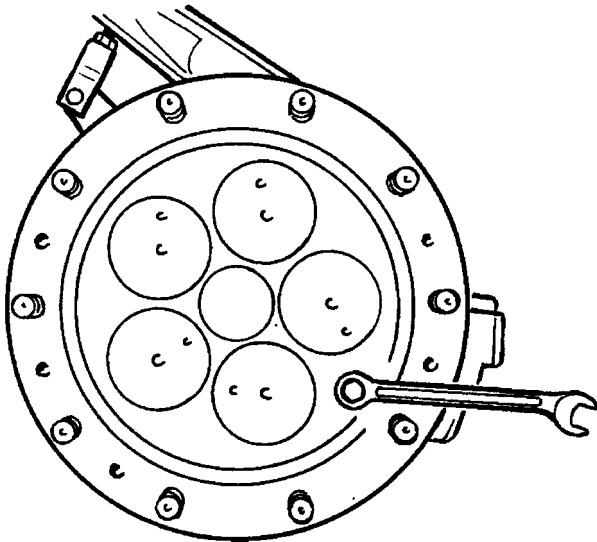
The bevel crown wheel and pinion gears provide the primary reduction in the axles with the final reduction being accomplished in the planetary gearing in the wheel hubs.

The drive gears, differentials and wheel hubs are all lubricated by the same oil, but checking of the oil levels as well draining and refilling must be done by using respective plugs of each component

## 1.3 Repairs

### 1.3.1 Axle removal:

1. Lift axle and support it on stands. Remove tire and wheel assemblies.
2. Remove hub drain plugs and drain oil from planetary gears.

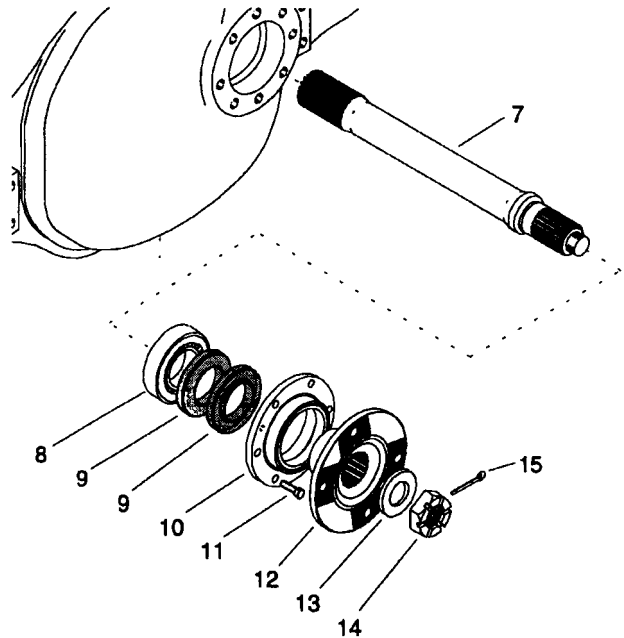


MP270-02

Picture 2: Wheel hub drain plug

3. Remove carrier drain plug and drain drive gear oil.
4. Remove input and output propeller shafts from flanges.
5. Remove axle from vehicle. (The carrier can be removed alone by using a special lift.)
6. Place the axle assembly on the repair stand.
7. Remove both brake drums.
8. Remove both wheel hub covers complete with planetary gears.
9. Dismantle both wheel hubs. (See separate maintenance manual for wheel hubs.)
10. Remove both half shafts from the axle housing..

### 1.3.2 Intermediate shaft removal



MP270-03

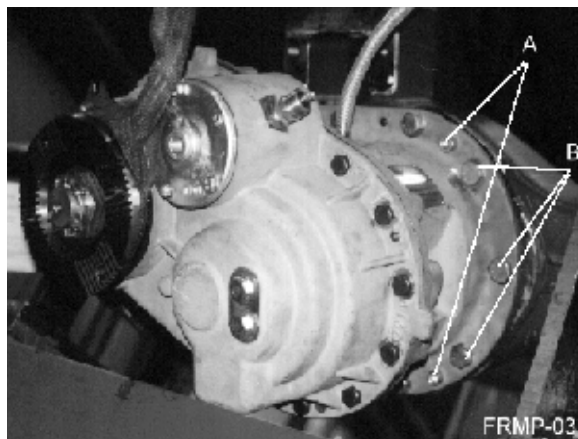
Picture 3: Intermediate shaft with installation parts.

1. Remove the intermediate shaft complete with the bearing from the rear side of the axle body as follows:
2. Remove the cotter pin (15).
3. Undo the flange retaining nut (14) and remove the washer (13) and the flange (12).
4. Unscrew screws (11) and remove the bearing flange (10) with the seal (9) and the shaft (7) with the bearing (8)

## 1.4 Removing carrier from axle housing

Remove eleven drive gear cap screws (B in Picture 4). While supporting the carrier in a suitable fixture, use two cap screws as extractors and screw them into the threaded holes in the case (Holes are protected by plastic plugs). Place carrier in repair stand or fixture with the input shaft pointed up.

**Warning!** Do not remove four Allen head screws (A in picture 4) in the connection flange, because these screws keep the spur gear and crown wheel housings together. If these screws are removed, these housing may come apart and it may cause a serious accident.



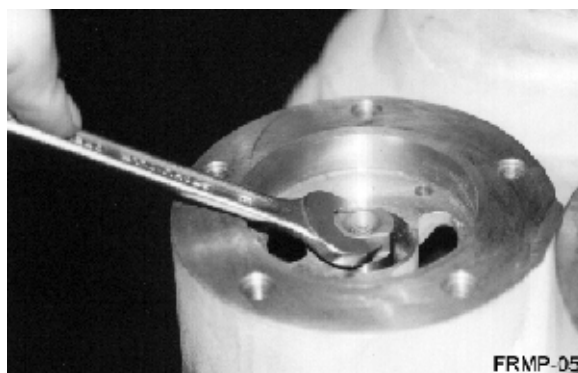
Picture 4: Removing of the drive gear unit from the axle body

## 1.5 Inter-axle differential lock

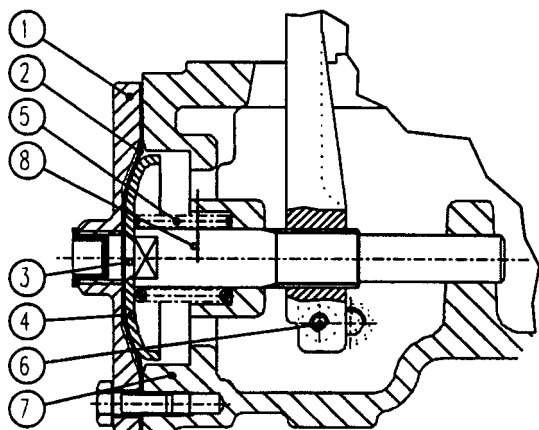
### 1.5.1 Dismantling:

Text references are found in picturepicture 5.

1. Remove differential lock engagement sender switch (Items 19 – 25 in Picture 7).
2. Remove the 5 lock cylinder cover screws to remove the cover (1) and diaphragm (2).
3. Remove the diaphragm support cup screw (3) and remove the cup (4) and spring (5).
4. Remove the plug (Item 26 in Picture7) and reaching through the hole, loosen the fork lock screw (6) approximately 2 turns. Remove the fork shaft by rotating it counterclockwise using a suitable open end wrench..

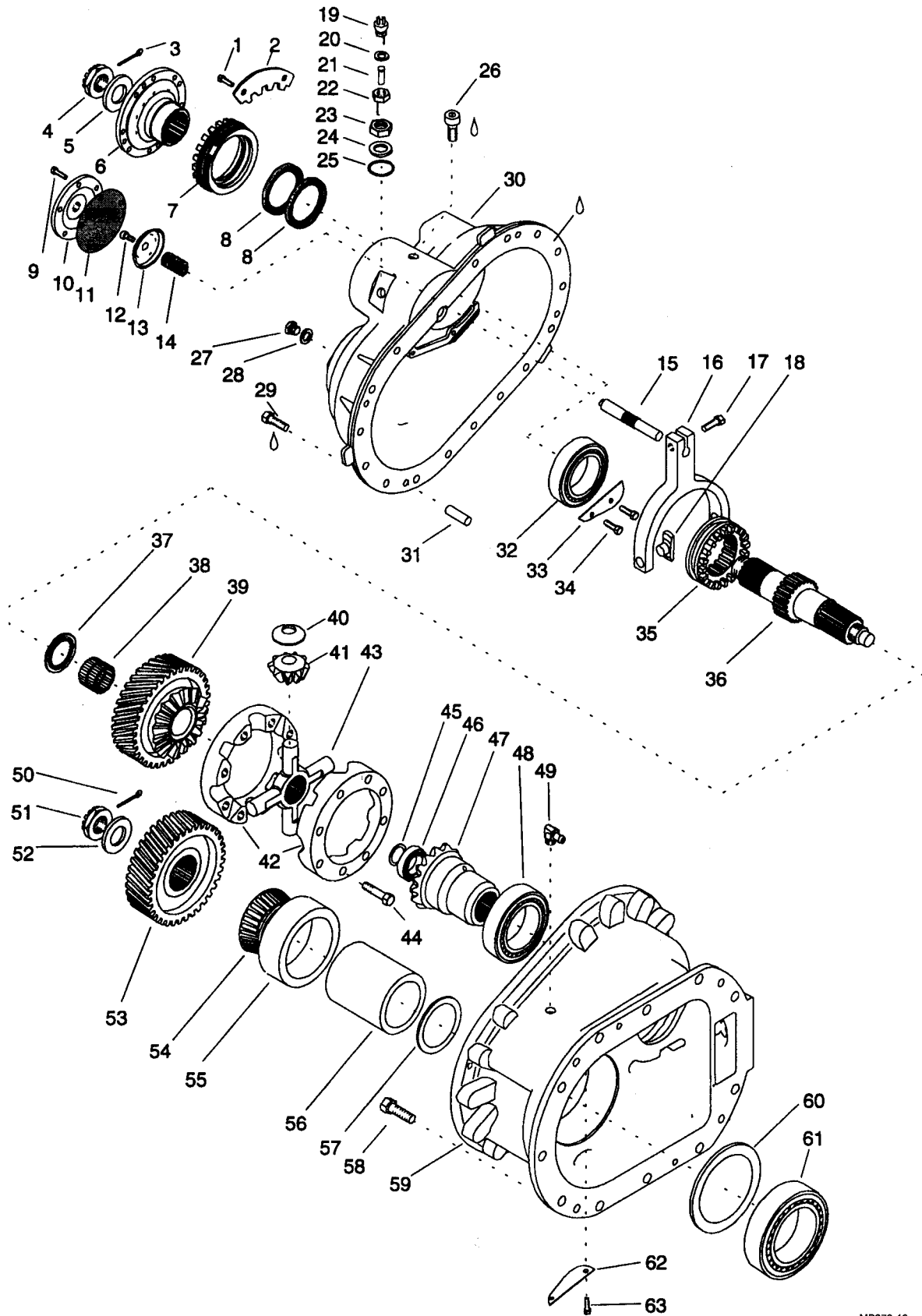


Picture 6: Removing of the differential lock fork shaft



Picture 5: Engagement mechanism of differential lock

5. When the shaft is removed you can remove the fork with slide shoes.



MP270-10

Picture 7: Spur gear housing with related parts

## 1.6 Spur gear unit

### 1.6.1 Dismantling

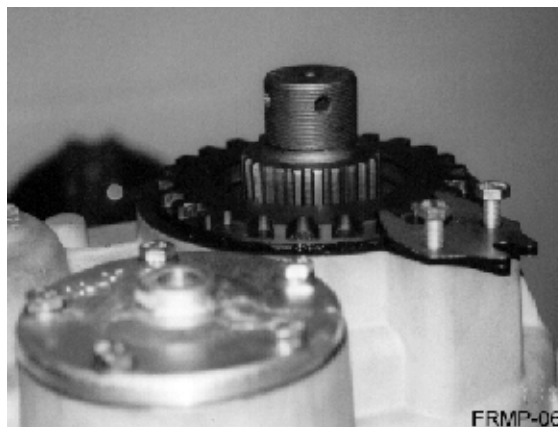
Text references are found in picture 7.

1. Remove cotter pin (3)
2. Remove the flange retaining nut (4), the washer (5) and the flange (6).
3. Remove screws (1) and locking plate (2) for the bearing adjustment nut (7).
4. Remove the bearing adjustment nut (7). The seals (8) remain in the adjustment nut.
5. Remove outer housing cap screws. Using cap screws as extractors, screw them into the threaded holes in the housing flange (Holes are protected by plastic plugs) and, tightening the screws evenly, pull the housing carefully off the dowels.
6. Remove the housing (30)..

**Note! The housing has to be tipped so that the oil collector plate (33) inside the housing clears the bearing (32) which remains on the shaft.**

When the housing has been removed, remove the differential lock fork (16) and shoes (18).

Remove the bearing cone (32) from the shaft (36). Use a puller with the legs inside the groove of the differential lock engagement bushing (35).



Picture 8: Input shaft without the drive flange and with loosened adjustment nut locking plate screws.



Picture 9: Input bearing adjustment nut removed and housing ready for dismantling



Picture 10: Housing and bearing removed; differential lock fork still in position.

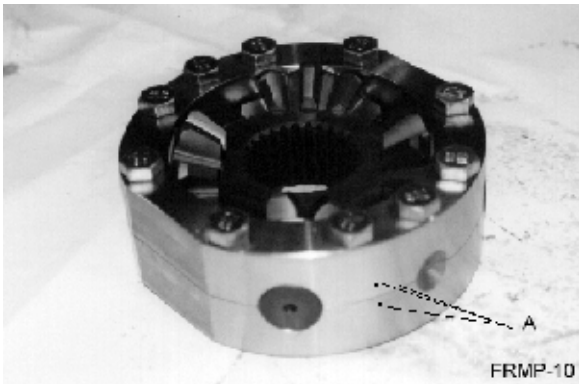


Picture 11: Input shaft complete with related parts

7. Remove the input shaft (36) and the following components will follow:

- Inter-axle differential (40-44), spur gear (39), bearing (38), thrust bearing (37) and the cone of the tapered roller bearing (46) and its shim(s) (45). The inner differential side gear (47) and the tapered roller bearing cup (46) will remain inside the housing but may be lifted out now. The tapered roller bearing cone (48) will follow with the side gear. The tapered roller bearing cup (59) will remain inside the housing.

### 1.6.2 Dismantling of Inter-axle differential



Picture 12: Inter-axle differential ready for dismantling (Note location markings A).

8. Mark differential case halves with a center punch (A in Picture 12) to ensure reassembly in the same relationship.

9. Remove the differential case retaining screws (44) and separate the halves (42). The spider (43) and gears (41) with thrust washers (40) will remain inside the lower half.

### 1.6.3 Assembly of the longitudinal differential

Assemble by carrying out in reverse order the operations described for dismantling.

Lubricate all parts within the assembly with engine oil within the assembly.

Tighten the retaining screws (44) to 80 Nm [50 lb-ft] torque.

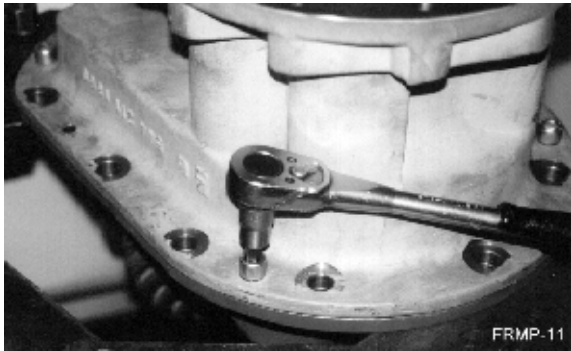
Use Loctite or equivalent thread locking liquid on these screws.

## 1.7 PINION UNIT

### 1.7.1 Dismantling

Text references are found in picture 7. The pinion itself is seen in picture 17.

1. Remove the socket head cap screws (Picture 13) and the crown wheel and differential assembly from the spur gear housing (59).



Picture 13: Removal of the retaining screws between the housings

2. Remove the cotter pin (50) the nut (51) and the washer (52).
3. Remove the spur gear (53) using a puller if required.
4. With a shop press, remove the pinion from the housing (59).  
The following parts will follow with the pinion: the inner bearing (61), the spacer bushing (56), and the shim (57). The tapered roller bearing cup (55) and the inner bearing cup (61) as well as the pinion engagement adjusting shims (60) under the bearing cup will remain inside the housing.



Picture 14: Removal of the spur gear housing

**Note!** Take care of the shims because if bearing and gears are not replaced with old shims, gear position and contact can be kept. (this is important for proper operation of the differential). If some parts are replaced, it is most convenient to start adjustment work with old shims, which in most cases are suitable too.

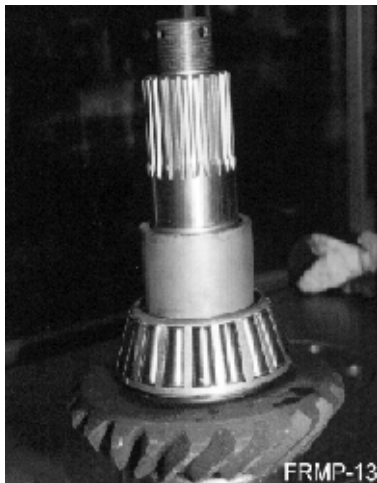
## 1.8 PINION UNIT

### 1.8.1 Assembly

Text references are found in picture 7. The pinion itself is seen in picture 17.

Prior to assembly, inspect to ensure that all components to be reused are in unconditionally sound condition. Only flawless bearings may be reused. If a new ring and pinion set are used, new bearings must be used.

1. Start assembly by pressing the inner bearing cone (61) onto the pinion. Place old shim(s) (57) and the spacer bushing (58) on the pinion.
2. Install bearing cups (61 and 55) in housing if they were removed. Use old shims (60) for the pinion engagement adjustment under the bearing cup (61).



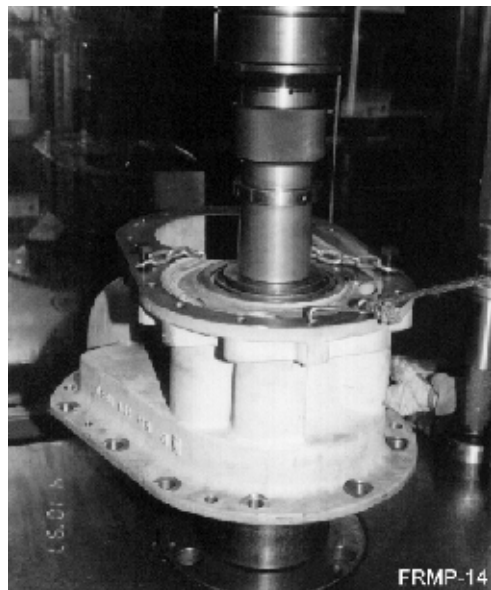
Picture 15: Pinion with inner bearing cone installed

3. Lift the housing (59) onto the pinion and place the outer bearing cone (54) on the pinion.
4. With a workshop press, press the outer bearing cone (54) onto the pinion using a suitable bushing while rotating the housing

5. Increase pressure up to 16 metric tons [35,000 lbs.]. If bearing resists rotation completely, press the pinion out and replace shims and/or spacer bushing to increase length and repeat the previous step

When bearings rotate properly, inspect the pinion rolling torque in the following way:

- Attach a length of string with a hook as shown in Picture 17 to a hole at the smallest diameter of the housing surface.
- Using a spring scale attached to the end of the string measure the force required to turn the housing. The correct force is 75 – 105 N [16.8 - 23.6 lbs.].
- Change adjustment shims or the spacer bushing (56 in Picture 7) as required until correct rolling torque value is achieved.



Picture 16: Pinion bearing installation and rolling torque check in the press

*Following spacers and shims are available for pinion bearing adjustment:*

Description	Part no.	Thickness
Spacer	599-557-2061	57.02 mm [2.2449 inches]
Spacer	599-557-1062	57.04 mm [2.2457 inches]
Spacer	599-557-1063	57.06 mm [2.2464 inches]
Spacer	599-557-1064	57.08 mm [2.2472 inches]
Shim	099-517-1000	0.3 mm [0.012 inches]
Shim	099-517-1001	0.4 mm [0.016 inches]
Shim	099-517-1002	0.5 mm [0.020 inches]

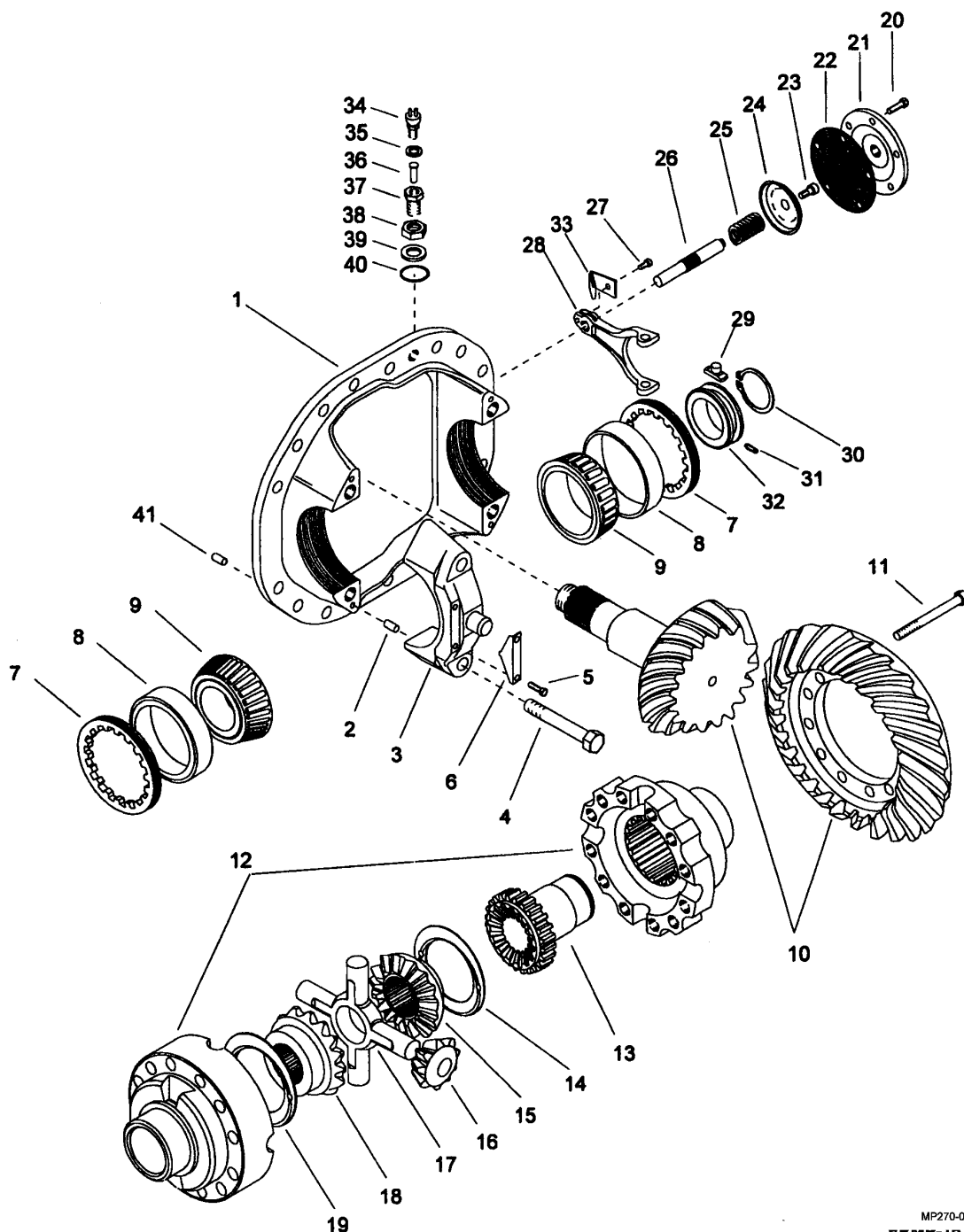


If a workshop press is not available for assembly, adjustment can be performed as follows:

Assembly as usual, but instead of pressing install spur gear, washer and nut, tighten the nut to 1300 Nm [960 lbs.-ft.] torque. Check the rolling torque as described earlier and adjust shims until desired value is reached.

When rolling torque is correctly adjusted, install spur gear, washer and nut. Finally, tighten the pinion nut to 1300 Nm [960 lbs.-ft.] and secure the nut with a cotter pin.

## 1.9 DIFFERENTIAL UNIT



Picture 17: Differential with crown wheel and pinion with transversal differential lock exploded to parts.

MP270-05

## 1.9.1 Dismantling

Text references are found in picture 17.

1. Remove the differential side bearing adjusting nut locking plates (6) and slacken the nut a little.
2. Mark side bearing covers (3) with center punch marks on adjacent points to ensure the bearing caps are not mixed.



Picture 18: Differential unit and bearing cover marking before dismantling

3. Remove bearing cap retaining cap screws (4) and remove caps. Remove dowels (2) if necessary.

4. Lift the differential and crown wheel assembly including the bearing cones (9) from the case. When lifting the differential and crown wheel assembly, retain the bearing cups (8) and the differential lock fork sliding shoes (29) as they are now loose.
5. Dismantle the differential lock engagement mechanism, if required, according to the following instructions.



Picture 19: Differential unit with the crown wheel; the engagement ring for differential lock and the locking ring are removed

## 1.10 Transverse differential lock

### 1.10.1 Dismantling

Text references are found in picture 17.

1. Remove differential lock engagement sender switch (34-40).
2. Remove lock cylinder cover retaining screws (20), the cover (21) and the diaphragm (22).
3. Remove the diaphragm support cup screw (23), the cup (24) and the spring (25).
4. Remove the plug from the case and reaching through the hole, loosen the fork lock screw (27) approximately 2 turns. Remove the fork shaft (27) by rotating it counterclockwise using a suitable open end wrench. The fork can be removed when the differential and crown wheel are first removed.

5. Remove the differential lock locking ring (30) and the engagement ring (33).
6. Make adjacent marks on the differential case halves with a center punch to ensure they are aligned properly during reassembly.
7. Mount the carrier housing in a vise or special repair stand.
8. Remove differential and crown wheel assembly nuts (11) from the cap screws and lift the upper half of the housing and the crown wheel off. Remove and inspect all the differential parts from the lower case half.

## 1.11 DIFFERENTIAL UNIT

### 1.11.1 Assembly

Text references are found in picture 17.

1. Inspect all parts carefully before assembly assuring that all parts that are to be reused are in good condition.

2. Start assembly by pressing the tapered outer bearing cones (9) onto the case halves (12) if they were removed.
3. Place the differential case half opposite the crown wheel side in a vise.

4. Lubricate the differential parts and place them into the lower case half. Place the thrust washer (19) and the side gear (18) without the dog clutch teeth first. Place the side gear with the dog clutch teeth (15) and the thrust washer (14) on top of the spider (17) and spider gears (16).
5. Install the differential lock engagement ring (13).
6. Install the upper differential case half, lining up the center punch marks made at disassembly, and install screws (11). Use Loctite locking liquid and tighten screws to 320 Nm [236 lb.-ft] torque.

## 1.12 Drive gear assembly and adjustment of gear backlash and contact

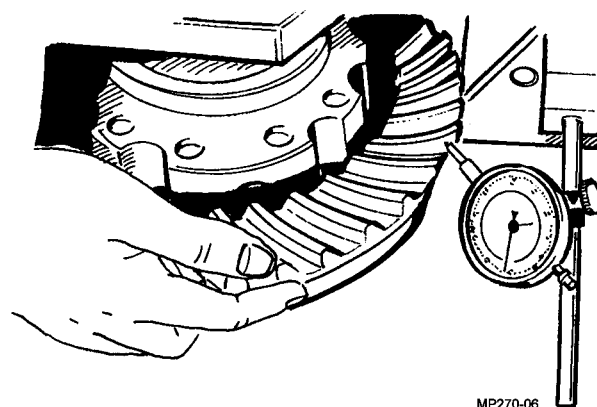
The pinion already assembled in the housing and the old shims for the pinion distance adjustment are used in bottom of the bearing bore:

### 1.12.1 Installation of the differential assy:

1. Place drive gear housing in a suitable fixture with the differential bearing supports facing up.
2. Using suitable lifting gear, position differential and crown wheel assembly with bearing cups in the housing.
3. Install the bearing caps with the center punch marking lined up. Use Loctite on the cap screws and install them to exert light pressure on the bearing caps. Install the bearing adjusting nuts and adjust so that the nut on the differential lock side is flush with the bearing cap surface.
4. Tighten the cap screws to 480 Nm [354 lb.-ft] of torque.
5. Turn the housing over so the crown wheel is down.
6. Lift the spur gear housing lower half with the pinion installed onto the housing and install four cap screws (58). Tighten cap screws to 100 Nm [74 lb.-ft] of torque.
7. Adjust the position of the crown wheel so that the gear backlash is approximately 0.15 –0.30 mm [0.006 - 0.012 inches].
8. Adjust differential bearing to zero clearance again. Monitor clearance with a dial indicator. Using screwdrivers, move the differential assembly in the bearings. When zero clearance is reached, tighten the bearing adjusting nut on the crown wheel toothed side further ½ to 1-1/2 lock slots.
9. Perform adjustments with suitable drift and a hammer.
10. Adjust gear backlash by moving the crown wheel in or out by turning both adjusting nuts equally to maintain bearing preload.
11. Check to ensure that backlash remains at 0.15 –0.30 mm [0.006 - 0.012 inches].



Picture 20: Installing of the spur gear housing



Picture 21: Checking of gear backlash

## 1.13 Replacement of pinion / crown wheel pair and necessary measures

When a new pinion/crown wheel assembly is installed, it is necessary to note the information marked on the pinion and the crown wheel in order to determine the correct location of the pinion.

1. Part number
2. Number of teeth
3. Pinion/crown wheel pair number
4. Variation value which is needed for correct positioning of the pinion.

Part number and tooth combination number are die cut in the outer surface of all pinions.

On crown wheels these numbers are marked on outside diameter.

Tooth combination number (for example 28/16) indicates that the pinion has 16 teeth and the crown wheel 28, equal to a drive ratio of 1.75 : 1.

*Available pinion/crown wheel assemblies and respective drive ratios:*

Part No.	No. of Teeth	Drive Ratio
543 240 3229	28/16	1.75

*All pinion/crown wheel assemblies are supplied in matched sets and both parts have the same part number.*

On pinions this number is die cut in the inner end of the pinion.

On crown wheels these numbers are marked on outside diameter.

***Never use a pinion and crown wheel together which do not have the same pair number.***

Each pinion is marked with a true installation distance or with a variation value, which indicates the correct installation distance compared to nominal installation distance (173 mm).

Variation value = True installation distance subtracted by 173 mm.

This variation value will be used in calculating the shims to placed between the intermediate housing and the drive gear housing.

Variation number (for example +0.1 or -0.1) is marked on the either end of the pinion.

To calculate the thickness of the shims:

1. Measure the thickness of previously used shim (s) by a micrometer.
2. Note the variation number on the new pinion. If this number has a plus value (+) subtract it from measurement calculations below. If this number has a minus value (-) add it to measurement calculations below.

Take note of this measurement.

## CALCULATION EXAMPLES

### Example 1

- Thickness of original shim(s)	0.75 mm [0.030 inches]
- Variation value on original pinion +0.05	-0.05 mm [0.002 inches]
- Measurement obtained	0.70 mm [0.028 inches]
- Variation number on new pinion +0.10	+0.10 mm [0.004 inches]
- Thickness of new shim(s) to be used	0.80 mm [0.032 inches]

### Example 2

- Thickness of original shim(s)	0.65 mm [0.026 inches]
- Variation value on original pinion -0.05	+0.05 mm [0.002 inches]
- Measurement obtained	0.70 mm [0.028 inches]
- Variation number on new pinion +0.15	+0.15 mm [0.006 inches]
- Thickness of new shim(s) to be used	0.85 mm [0.034 inches]

### Example 3

- Thickness of original shim(s)	0.70 mm [0.028 inches]
- Variation value on pinion +0.05	-0.05 mm [0.002 inches]
- Measurement obtained	0.65 mm [0.026 inches]
- Variation number on new pinion -0.05	-0.05 mm [0.002 inches]
- Thickness of new shim(s) to be used	0.60 mm [0.024 inches]

### Available shims for determining the location of the pinion

Description	Part No.	Thickness
Shim	90731-12010	0.1 mm [0.004 inches]
Shim	90731-12020	0.2 mm [0.008 inches]
Shim	90731-12050	0.5 mm [0.020 inches]
Shim	90731-12010	1.0 mm [0.040 inches]

Use these shims singly or in combinations as required

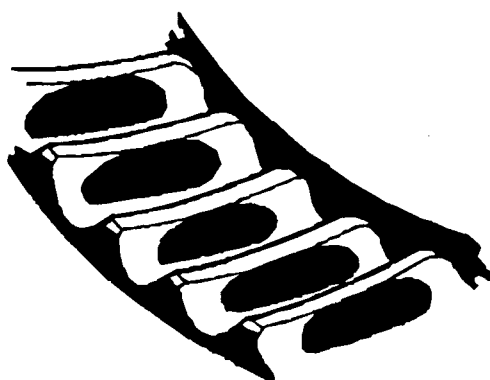
NOTE: Check the tooth contact and correct it as required. To obtain the correct contact pattern it may be necessary to move the pinion which changes gear backlash. All adjustments have to be made together to obtain the correct backlash and contact pattern.

Correct tooth contact is most important while the gear backlash allows a tolerance within 0.15 – 0.30 mm [0.006 - 0.012 inches] with a new pinion/crown wheel assembly.

With an old assembly, the tooth contact and the gear backlash have to be set as they were prior to dismantling.

Check tooth contact using lead oxide paint (red lead).

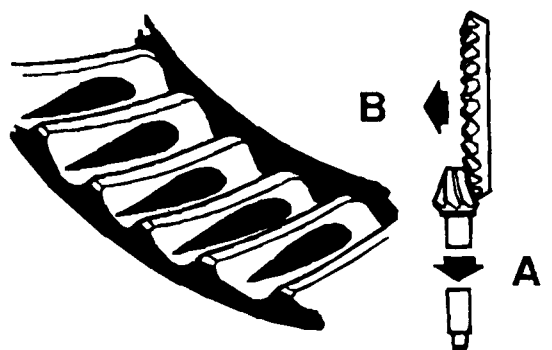
The following pictures illustrate tooth contact unloaded



MP270-07

Picture 22: Correct tooth contact

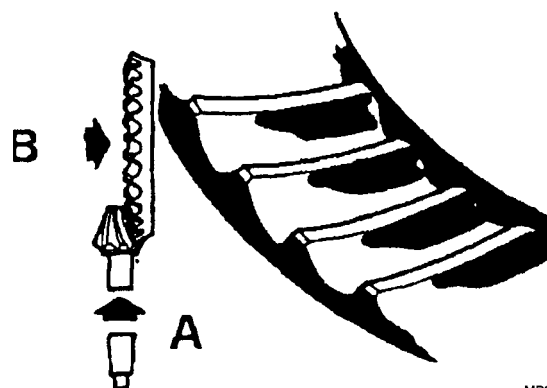
Picture 22 indicates that the pinion is set correctly. This gives the quietest drive and the longest life.



MP270-08

Picture 23: Poor tooth contact

Picture 23 indicates that the pinion is set too deeply. This causes a noisy drive, excessive wear, and damage to the gears. To correct the setting, add shims under the intermediate housing to move the pinion out and move the crown wheel in (direction of arrow B in picture). The correct backlash is 0.15 – 0.30 mm [0.006 - 0.012 inches]



MP270-09

Picture 24: Poor tooth contact

Picture 24 indicates that the pinion is set too far out. This also causes a noisy drive, excessive wear, and damage to the gears. To correct the setting remove shims under the intermediate housing to move the pinion in and move the crown wheel out (direction of arrow B in picture).

1. When the differential side bearings are finally adjusted, lock the adjustment nut with their lock plates and tighten the lock plate retaining screws to 21 Nm [16 lb-ft] of torque. Set the lock plate tabs into the groove of the nut with a hammer.
2. When the adjustments are complete, remove the spur gear housing and coat both surfaces with Silmate Silicone Rubber RTV 1473 or a similar room temperature curing sealant and reassemble the housing. Install four M12 x 20 cap screws (58) using Loctite and tighten them to 130 Nm [96 lb-ft] of torque.

## 1.14 Assembly of the spur gear unit including longitudinal differential

### 1.14.1 Assembly of the spur gear unit

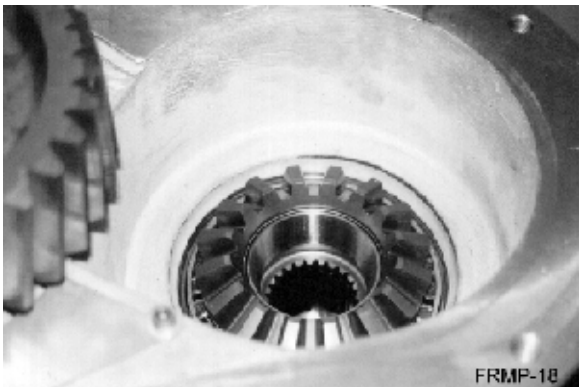
In this situation, the adjustment of the crown wheel/pinion contact is performed and the housings are installed together, crown wheel down on the work bench or in a repair stand.

### 1.14.2 Inspection of the components

Wash all gear unit components and inspect them carefully. Discard any faulty or excessively worn parts. Check bearings very carefully. Replace all bearings if there is any doubt about their condition.

Text references are found in picture 7.

1. Install the cup of tapered roller bearing (48) into the housing (59) and the cup of the input shaft inner end bearing (46) inside the side gear (47).



Picture 25: Differential side gear (47) installed inside the housing

2. Install the cone of the tapered roller bearing (48) onto the differential side gear (47).
3. Install the differential side gear (47) into the housing.
4. Place the input shaft (36) into a vise or on the work bench vertically, threaded end downwards.



Picture 26: Input shaft partially assembled, without inside tapered roller bearing

5. Place the thrust bearing (37) against the shaft shoulder.
6. Lift the spur gear (39) complete with the bearing (38) on the shaft. Lubricate the bearing with engine oil before assembly.
7. Assemble the inter-axle differential as follows:
  - Place one housing half (42) on the work bench, install lubricated planet gears (41) and thrust washers (40) onto the spider (43) and place this assembly in the housing half.
  - Install the other housing half with the center punch marks made at disassembly lined up and install the retaining cap screws (44).
  - Tighten cap screws to 80 Nm [60 lb-ft] torque.
8. Lift the differential assembly (40-44) onto the input shaft splines so that the assembly engages the spur gear (39) teeth.
9. Place the old or similar differential backlash adjustment shim(s) (45) on the shaft shoulder.



Picture 27: Installation of the adjustment shim underneath the bearing

10. Install the bearing cone (46) onto the shaft with a press.
11. Lift the input shaft assembly onto the side gear (47) in the housing.



Picture 28: Installation of the inside tapered roller bearing cone

12. Measure the axial clearance of the differential with a feeler gauge between the shoulder of the shaft (36) and the thrust bearing (37) (See Picture 30). The axial clearance in the inter-axle differential should be 0.8 – 0.12 mm [0.031 – 0.005 inches]. This corresponds to 0.2 – 0.3 mm [0.008 – 0.012 inches] in actual gear backlash.

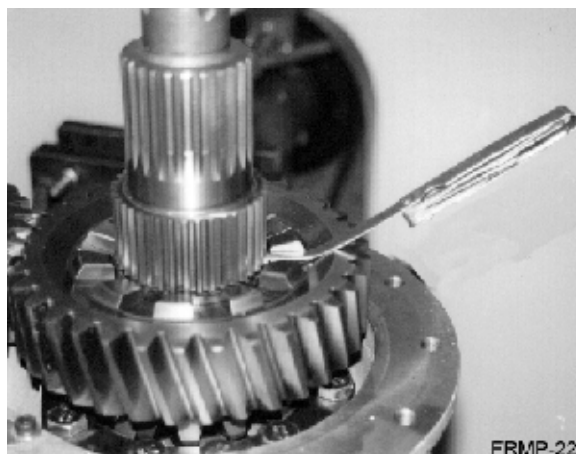
If the clearance is not within the given limits, the bearing cone (46) must be removed and the thickness of the shim(s) changed accordingly.

*Available shims for adjustment of the axial clearance of the inter-axle differential*

<i>Description</i>	<i>Part No.</i>	<i>Thickness</i>
Shim	90731-03510	0,1 mm [0.004 inches]
Shim	90731-03520	0,2 mm [0.008 inches]
Shim	90731-03550	0,5 mm [0.020 inches]
Shim	90732-03510	1,0 mm [0.025 inches]

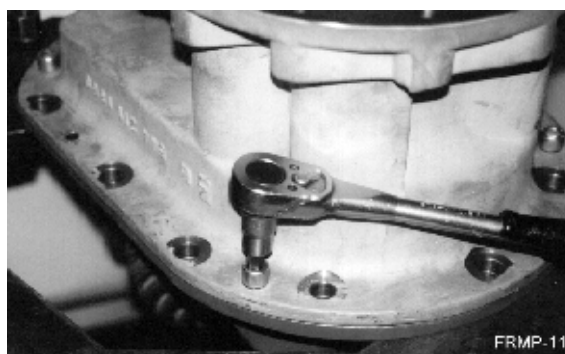


Picture 30: Assembled spur gear unit, but without the outer bearing



Picture 29: Clearance check by a feeler gauge

13. When the axial clearance of the inter-axle differential is measured and adjusted as required, place the differential lock engagement sleeve onto the shaft.
14. Place the engagement fork (16) with the glide shoes (18) onto the spur gear and into the engagement sleeve groove as shown in Picture 30
15. Heat the outer tapered bearing cone (16) up to a temperature of approximately 100° C [212° F] and install it against the shoulder of the input shaft..

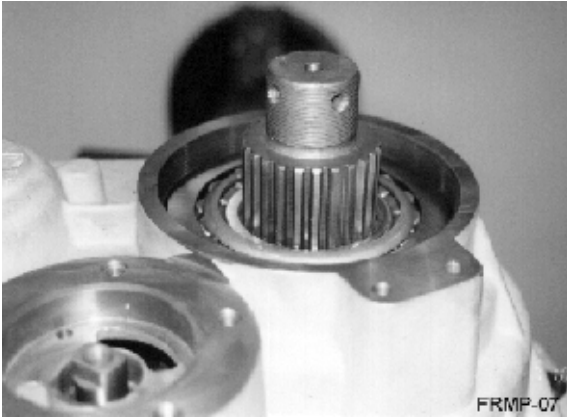


Picture 31: Installation of the spur gear housing

16. Spread the housing contact surfaces (30 and 59) with Silmate Silicone Rubber RTV 1473 or similar room temperature curing sealant.
17. Lift the outer housing (30) and place it on the spur gear housing (59). Apply Loctite locking liquid on the cap screws and tighten them evenly to 130 Nm [96 lb-ft] torque.

### 1.14.3 Installation and adjustment of the input shaft bearing

Install the outer tapered roller bearing cup (32) into the bearing bore using a soft drive or a suitable installation bushing.



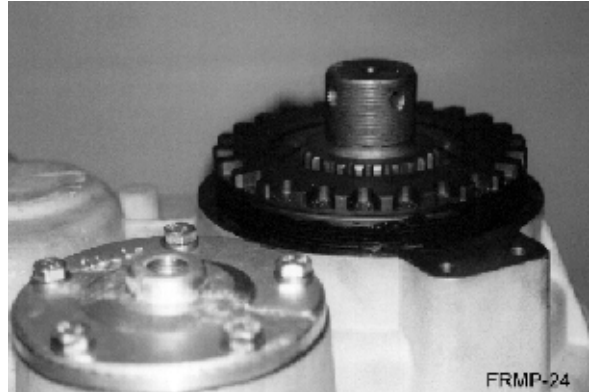
Picture 32: Installed cup of the input shaft outer bearing

1. Replace the seals (8) inside the input shaft adjustment nut (7) and fill the cavity between the seals with Mobil Grease MP or other NLG1 OR 2 lithium based grease.



Picture 33: Input shaft bearing adjustment nut with its seal.

2. Apply Silmate Silicone Rubber RTV 1473 or similar room temperature curing sealant to the threads of the adjusting nut and screw the nut up against the bearing cup.



Picture 34: Input shaft bearing adjustment nut/seal housing smeared with sealant, partially installed

3. Tighten the nut (7) with the special tool until there is no clearance in the bearing. Slacken the nut to the nearest locking position. Note that the locking plate (2) can be installed in two positions. Apply Loctite locking liquid to the screws (1) and tighten to 21 Nm [16 lb-ft] torque.



Picture 35: Special tool for the adjustment nut

4. Install the propeller shaft flange on the shaft splines, place the washer on the shaft and tighten the nut to 600 Nm [440 lb-ft] torque and secure the nut with a cotter pin. This tightening can be done in the vehicle if desired.



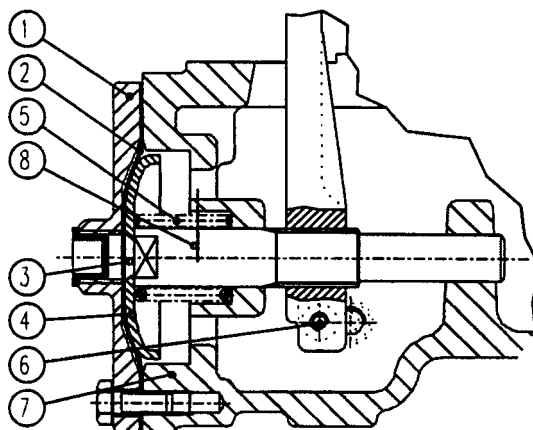
## 1.15 Assembly and adjustment of the differential locks

### 1.15.1 Assembly:

Inspect that all lock components are in good condition and that they are not excessively worn. Replace all damaged components.

Assemble in reverse order to the operations described for dismantling. (See Section 1.5.1)

1. Lock cylinder cover
2. Diaphragm
3. Support cup retaining screw
4. Support cup
5. Releasing spring
6. Fork lock screw
7. Lock housing
8. Fork shaft



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Picture 36: Differential lock parts in sectional view

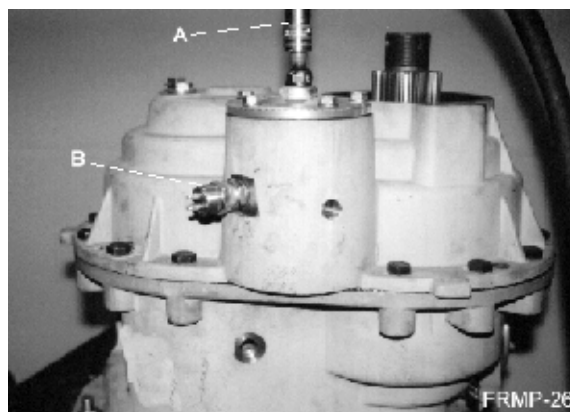
To adjust, the following parts must be removed:

1. Cover
2. Diaphragm
3. Screw
4. Cup
5. Spring

### 1.15.3 Installation and adjustment of differential lock indicator light senders

Text numbers refer to the inter-axle differential lock, but the measures are the same for the axle differential lock, if installed..

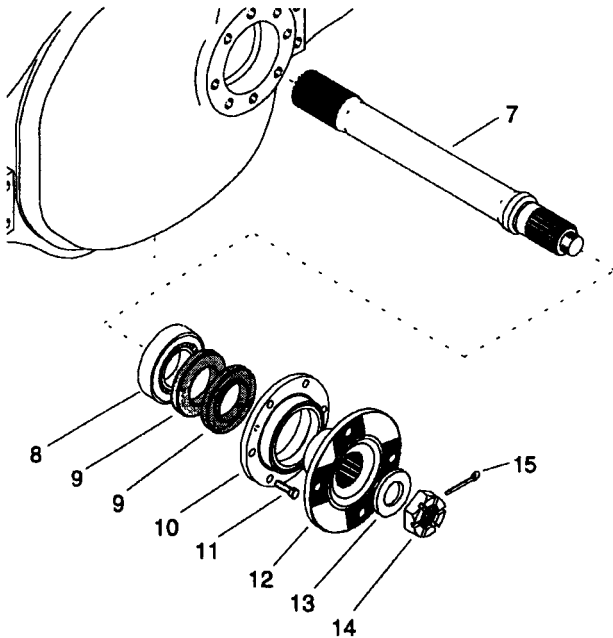
1. Install the sender unit and related parts (19-25 in Picture 7 and B in Picture 37) into the threaded bore in the housing.
2. Adjust the sender switch as follows
3. Engage the differential lock by applying air pressure (A in Picture 37) and rotate the sender switch (20) clockwise until the switch closes. (This can be checked with a multimeter or a batter powered indicator light).
4. Rotate the sender an additional ½ turns clockwise and lock the sender switch with its lock nut (23) in this position.
1. Release the air pressure and perform the engagement once more to ensure that the sender is working properly.



Picture 37: Inter-axle differential lock light sender

## 1.16 Installation of intermediate shaft

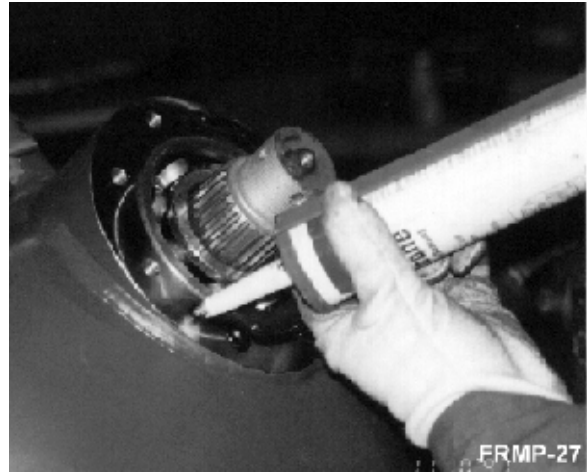
1. Assemble intermediate shaft as required by new spares and fill cavity between the seals by Mobil-Grease MP or by other NLG1 or 2 lithium based grease.



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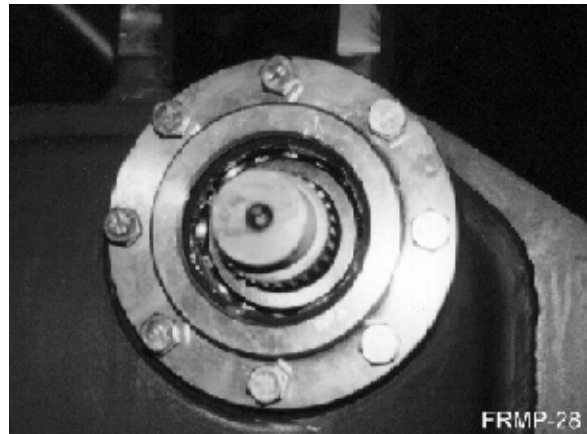
Picture 38: Intermediate shaft with installation parts.

2. Carefully install the shaft assembly making sure that the shaft end enters the splines properly.
3. Apply Silmate Silicone Rubber RTV 1473 or similar sealant to the contact surface (10 in Picture 38).
4. Install the sealing flange and tighten the retaining screws (11 in Picture 38) to 45 Nm [29 lb-ft] torque.



Picture 39: Application of the sealant

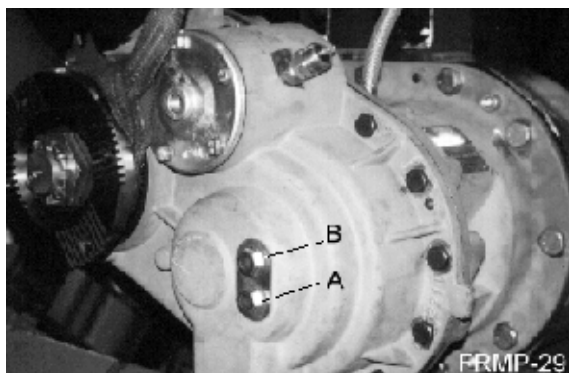
5. Install the propeller shaft flange on the shaft splines, place the washer on the shaft and tighten the nut to 600 Nm [440 lb-ft] torque and secure the nut with a cotter pin.



Picture 40: Installed intermediate shaft without the propeller shaft flange

## 1.17 Oil Checks And Oil Changes

### 1.17.1 Differential



Picture 41: Level plug of the drive gear

Vehicle must be on level ground when oil level checks are made.

1. Check that the oil level is at the lower inspection plug (A in Picture 41) opening.
2. If the vehicle is operating in very difficult or very hilly terrain, the oil level may be raised to the upper inspection (B in Picture 42). NOTE: Oil level must not be raised to the upper level if the vehicle is operating at highway speeds to avoid excessive oil temperature.
3. Tighten the inspection plug to 50-70 Nm [37 – 52 lb-ft] torque.

## 1.18 Special tools

Adjustment wrench for input shaft bearing

7544-201-010

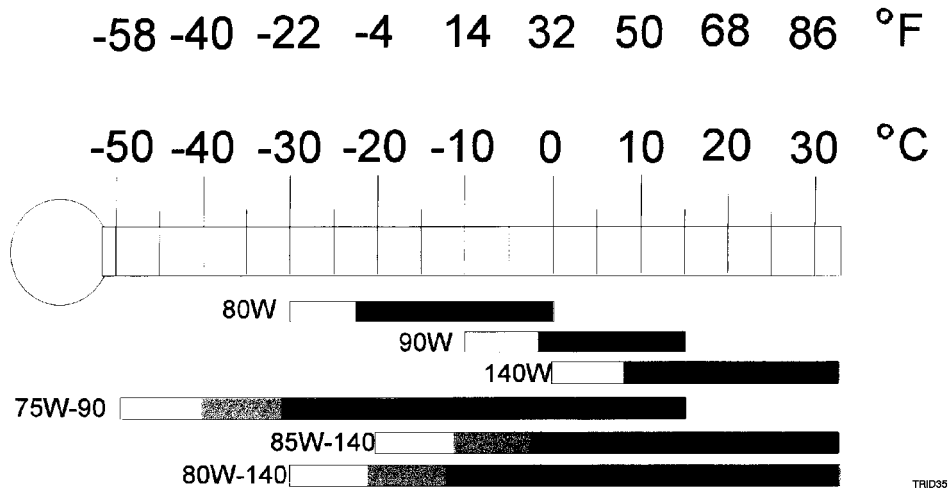
## 1.19 Torque

<i>Description</i>	<i>Nm</i>	<i>[lb-ft]</i>
Propeller shaft flange nuts . . . . .	600	[442]
Pinion nut . . . . .	1300	[960]
Differential side bearing cover screws . . . . .	480	[354]
Differential housing halves and crown wheel screw nuts . . . . .	320	[236]
Drive gear unit M16 screws to axle housing . . . . .	240	[177]
Allen head screws M12x20 between the differential housing and spur gear housing . . . . .	130	[96]
Screws of spur gear drive cover . . . . .	130	[96]
Retaining screws of the longitudinal differential halves . . . . .	80	[59]
Differential lock cylinder cover screws . . . . .	21	[15,6]
Differential lock cylinder diaphragm support cup screw . . . . .	30	[22]
Lock plate screws of differential side bearing adjustment nut . . . . .	21	[15,6]
Retaining screws of the intermediate shaft sealing flange . . . . .	45	[33,2]

## 1.20 Lubrication

Axle oil quality API GL - 5, also synthetic oils are approved

Viscosity according to prevailing ambient temperature as indicated in enclosed table.



TRID35

### 1.20.1 Oil volumes:

(axles in level position)

MP270 Drive gear

approx. 17 litres

[36 US Pints]

*Maintenance recommendation for Sisu Axles in automotive use*

*Initial oil change after 10.000 km, further changes with 60.000 km or 12 month intervals*

### 1.20.2 Use of the differential locks

- Use differential locks in slippery conditions only
- Do not use differential locks in down hill operations
- Engaged differential locks makes steering difficult
- Do not use differential locks within speeds over 40 km/h