



# SERVICE MANUAL

CARS AND VANS

PV 444, 445, 544

Part 5

REAR AXLE

*Export Service Department*

AKTIEBOLAGET

**VOLVO**

GÖTEBORG . SWEDEN

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## DESCRIPTION

This Service Manual deals with rear axles fitted on PV 444, 445 and 544. There are two types of rear axle. The first of these (type I, ENV, see Illustration II) is characterized by the fact that it is fitted in a special housing removable from the rear axle casing. The other type (type II, Spicer, Salisbury, see Illustration III) is distinguished by the fact that the rear axle housing and rear axle casing are combined in one unit.

PV 444 up to chassis number 8377 are fitted with rear axles with spirally cut teeth and with the pinion journaled at the same level as the center of the crown wheel.

PV 444 from chassis number 8378 onwards, PV 445 and PV 544 are fitted with hypoid drive, that is to say, the pinion is journaled at a lower level than that of the center of the crown wheel. This design has enabled the level of the propeller shaft to be lowered. This design means, however, that the stresses on the teeth of the pinion and crown wheel are greater. In addition to the pressure to which the teeth in a gear drive are normally subjected, the teeth in a hypoid drive have to withstand a sliding action. This means that the oil used must have increased properties of adhesion. A special lubricating oil, called hypoid oil, must therefore be used for hypoid gears. This oil has excellent properties of adhesion and the use of the wrong type of oil leads to rapid wear of the gear drive.

The rear axle consists of pinion, crown wheel and differential. The rear axle gears are of slightly varying design. Type I rear axles are fitted with adjusting nuts for taking up play in the differential carrier bearings and for adjusting the tooth flank clearance. These are not fitted on type II rear axles where the tooth flank clearance and taking up the differential bearings is effected by means of shims within the differential carrier bearings.

The differential carrier with crown wheel is journaled in the rear axle housing and rear axle

casing respectively by means of two taper roller bearings. The crown wheel is fitted to the differential carrier by means of bolts which are locked with tab washers.

The differential gear drive in the differential carrier consists of two small bevel gears running on a spindle and two larger bevel gears into which the drive shafts are inserted in internal splines. By virtue of their journaling, these gears can rotate and permit the drive shafts to rotate at varying speeds when the car is being driven round curves. There is a washer fitted under each differential gear and the pinion is journaled in taper roller bearings. The axial position of the pinion relative to the crown wheel is adjusted by means of shims under the rear pinion bearing outer ring. Pinion bearing adjustment is carried out by means of shims under the front pinion bearing inner ring.

The outer end of each drive shaft is journaled in a taper roller bearing. The bearing clearance is adjusted by means of shims under the brake backing plate. On the inside of each drive shaft bearing there is a sealing ring which, together with a felt ring on the outside of the bearing, prevents the oil in the rear axle from penetrating to the brake linings.

The rear axle on PV 444 and PV 544 is suspended on two inclined support arms. On PV 445 it is suspended on the two longitudinal leaf springs. On early production PV 444 the rear axle housing is bolted to the support arms. In later production the housing is flexibly mounted in two rubber bushings which are attached to the support arms. There are two torque rods to prevent the rear axle housing from twisting relative to the longitudinal axis of the car. These are rubber-mounted in attachments which are fitted to the upper side of the rear axle housing and to the bottom plating of the body. The principle of the rear axle suspension on PV 444, late production, and PV 544 is shown in Illustration I.

## REPAIR INSTRUCTIONS

Work which can be carried out with the rear axle fitted in position

### Replacing drive shaft sealing ring

1. Remove the wheel and pull off the hub, see fig. 1. Use puller SVO 1446 for hubs with four bolts and SVO 1791 for hubs with five bolts. Remove the brake backing plate after having placed a wooden block under the brake pedal and removed the brake pipe lines from the backing plate.

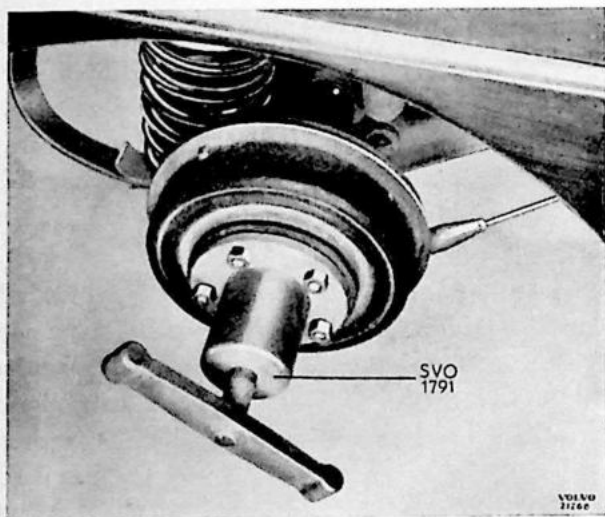


Fig. 1. Removing wheel hub.

2. Pull out the drive shaft, see fig. 2. Use puller SVO 2204 (SVO 1804 can be used on type I rear axles).
3. Pull out the sealing ring with the help of SVO 4078, see fig. 3.
4. Drive in the new sealing ring. Ensure that it is driven in correctly. Use tool SVO 1803, see fig. 4.
5. If necessary, wash off oil and grease from the brake backing plate. If any oil or grease has got onto the brake bands they must be replaced.
6. Fit the drive shaft and brake backing plate together with a new felt seal.
7. Check the axial clearance of the drive shafts. See under heading "Assembling".
8. Fit the key if it was removed and then the wheel hub and wheel.

9. Bleed the brake pipe lines and adjust the brakes. Follow the instructions given in Part. 7.
10. Check the oil level in the rear axle.

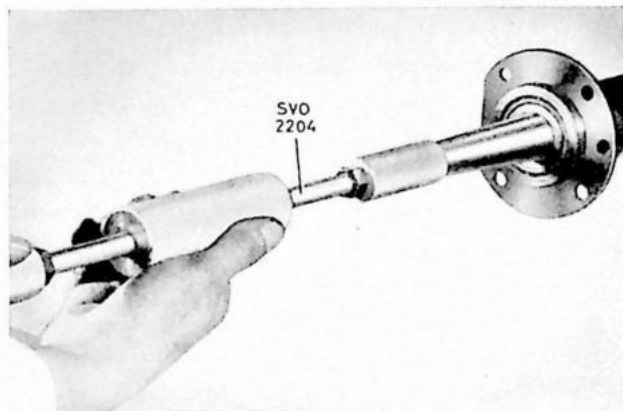


Fig. 2. Removing drive shaft.

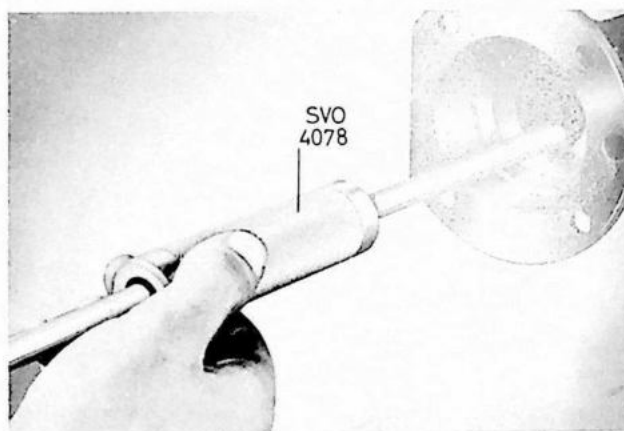


Fig. 3. Removing sealing ring.

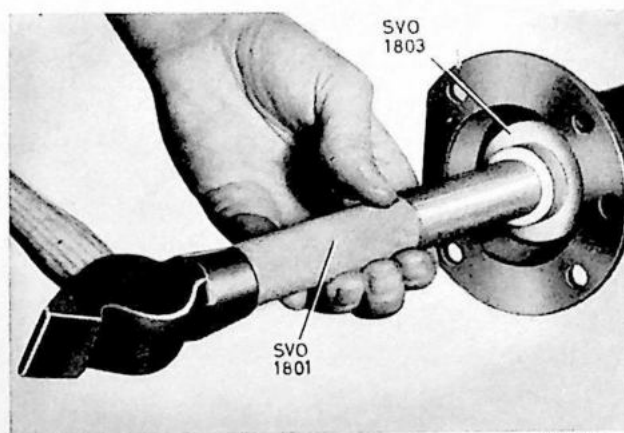


Fig. 4. Fitting sealing ring.

## Replacing sealing ring on pinion

1. Disconnect the rear propeller shaft from the flange on the pinion. Feel whether there is play in the pinion bearings. Any play should be taken up before the new sealing ring is fitted.
2. Remove the nut on the flange and then pull this off with SVO 2261. See fig. 5. Remove the old sealing ring with SVO 4030, see fig. 6.

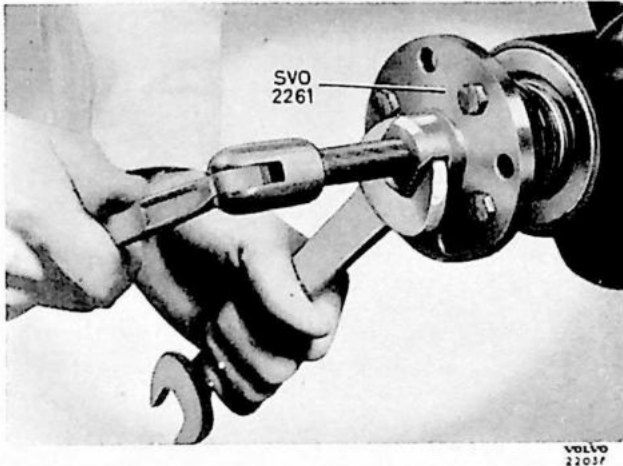


Fig. 5. Removing flange.

3. Place in a new paper gasket and fit the new sealing ring with the SVO tool, fig. 7 (concerning SVO tool numbers for the different rear axles, see the tool list on page 22).
4. Press on the flange with SVO tool, see fig. 8.
5. Fit on the propeller shaft.

## Replacing drive shaft and/or bearings

1. Remove the wheel and pull off the wheel hub, see fig. 1. Use puller SVO 1446 for hubs with four bolts and SVO 1791 for hubs with five studs. Remove the brake backing plate after having placed a wooden block under the brake pedal and removed the brake pipe lines from the brake backing plate.
2. Pull out the drive shaft, see fig. 2. Use tool SVO 2204 (SVO 1804 can be used on type I rear axles). Check and if necessary replace the sealing ring.
3. Press off the bearing, see fig. 9 and then fit the new one (concerning SVO tool numbers

for the different rear axles, see the tool list on page 22).

4. Fit the drive shafts, shims and brake backing plate.

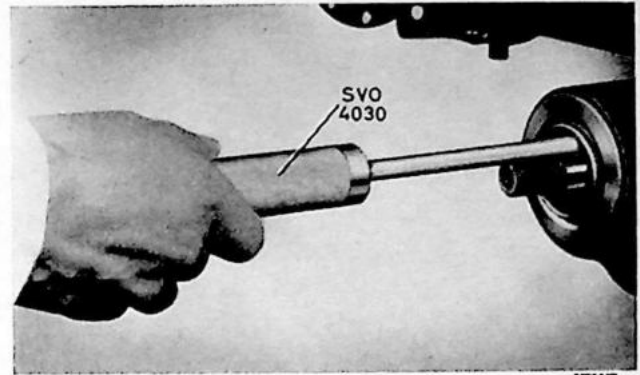


Fig. 6. Removing sealing ring.

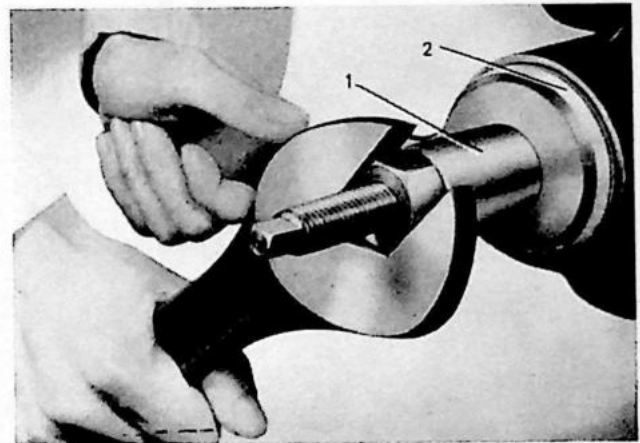


Fig. 7. Fitting sealing ring.

1. Press tool, see tool list.
2. Wrench, see tool list.

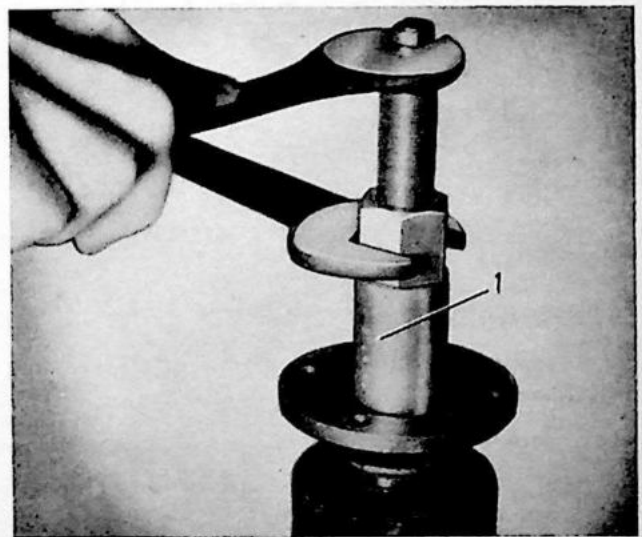


Fig. 8. Fitting flange.

1. Press tool, see tool list.

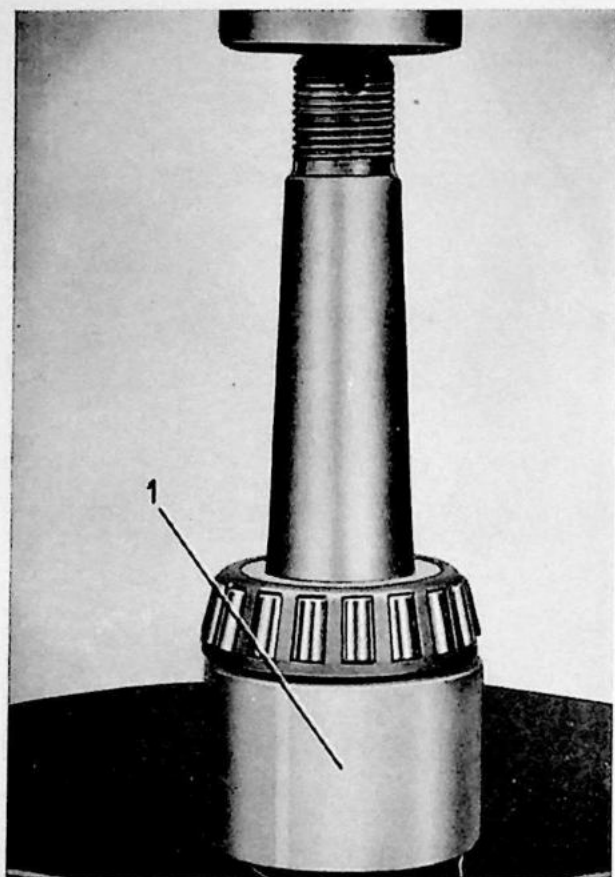


Fig. 9. Removing drive shaft bearing.

1. Support ring, see tool list.

5. Check and if necessary adjust the drive shaft axial clearance. Follow the instructions under the heading "Assembling".
6. Fit the key, wheel hub and wheel.
7. Bleed the brake pipe lines and adjust the brakes. Follow the instructions given in Part 7.
8. Check the oil level in the rear axle.

## Repair instructions for rear axle, type I

### Removing the rear axle

(For removing and fitting the complete rear axle, see pages 9 and 17 respectively).

1. Slacken the rear wheel nuts (7, Illustration II) slightly, jack up the car and block up so that the wheels are about  $\frac{3}{8}$ " clear of the floor. Unscrew the drain plug on the underside of the rear axle housing and let the oil run out while the shafts are removed.

2. Lift off the rear wheels and unscrew the rear axle nuts (2).
3. Pull off the rear wheel hubs (6) with drums. Use puller SVO 1446 for hubs with four studs and SVO 1791 for hubs with five studs, see fig. 1. (Handbrake released, brake shoes adjusted down if necessary).
4. Disconnect the brake fluid pipe lines at the brake backing plates (place a wooden block under the brake pedal so that it cannot be depressed).
5. Unscrew the four bolts (46) which hold the brake backing plates and remove these. Ensure that no shims (47) are lost or damaged.
6. Pull out the drive shafts (11) with tool SVO 2204 (SVO 1804 can be used), see fig. 2.
7. Disconnect the propeller shafts from the pinion flange (21).
8. Unscrew the bolts (13) which hold the rear axle housing (14) and remove same.

### Disassembling

1. Set up the rear axle in fixture SVO 4110. Check that the caps (37) for the differential carrier have coinciding marks with the housing. If not, mark one of the sides with a center punch. Unscrew the bolts (44) for the caps and remove these.
2. Remove the adjusting nuts (34) and bearing rings. Lift out the differential with ring gear.
3. Unscrew the nut (22) and pull off the flange (21) with tool SVO 2261, see fig. 5. Press out the pinion (18).
4. Pull out the sealing ring (20) with puller SVO 4030 from the front end of the pinion housing, see fig. 6. Remove the paper gasket, washer (19) and roller bearing (25).
5. If necessary, drive out the bearing outer rings, see fig. 10. Use SVO 4063 for the front and SVO 4064 for the rear bearing ring together with standard handle SVO 1801. Preserve the shims (28).
6. If necessary, pull the rear bearing (29) off the pinion, see fig. 11. Use puller SVO 2231 for PV 544. For PV 444, 445, use puller 2231 or SVO 4091, see table below.

There are two different types of pinion bearing. Since it is not possible to know in advance which bearing is fitted, this must first be carefully checked. If the wrong puller is used the bearing can be damaged so that it is impossible to remove.

	Volvo part number	SKF part number	Tool
Early type	181221	32207 W	SVO 4091
Late type	181233	231508	SVO 2231

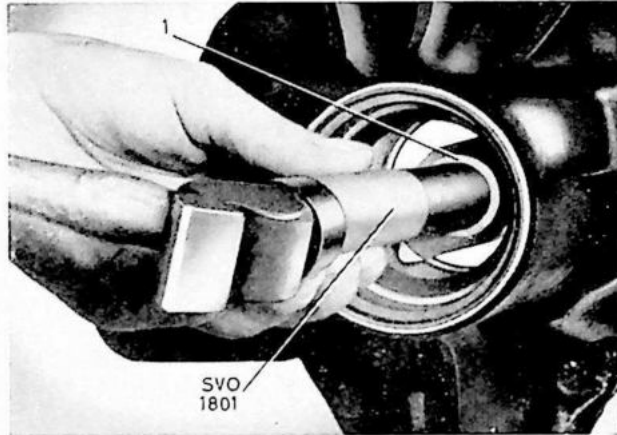


Fig. 10. Removing bearing ring.

1. Drift, see text.

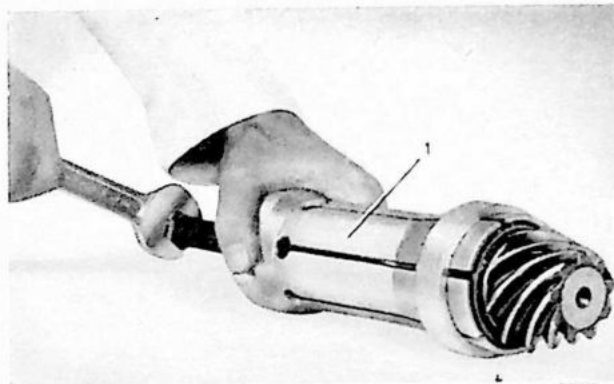


Fig. 11. Removing rear pinion bearing.

1. Puller, see text.

### Disassembling differential

1. Remove the bolts for the ring gear (17) and take it out.
2. Drive out the locking pin for the differential gear shaft (31), see fig. 12. Then drive out the shaft with the help of a suitable drift and remove the thrust block (32). The differential gears (38, 41) can now be removed together with the thrust washers (39, 42).



Fig. 12. Removing locking pin.

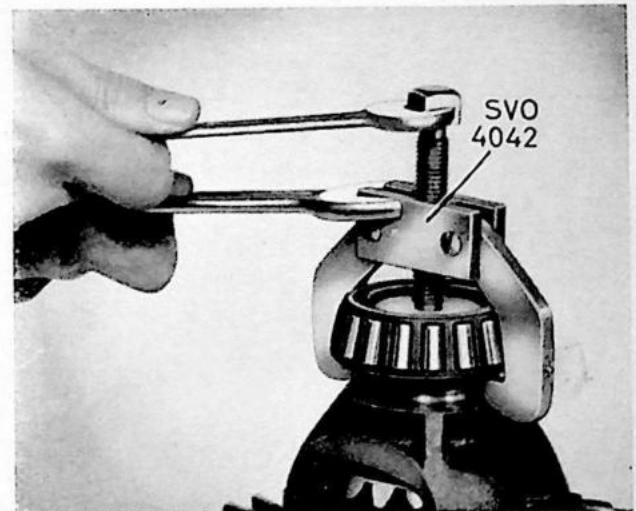


Fig. 13. Removing differential bearing.

3. Pull off the differential bearings if necessary (33). Use puller SVO 4042, see fig. 13.

### Inspection

In order to examine the various parts they must first be thoroughly cleaned. All bearing races and bearings should be examined. There should be no scratches or damage on races, rollers or roller retainers. All damaged bearings and bearing races must be replaced. Also thoroughly examine the pinion and ring gear to see that the teeth are not damaged. Cracks in the teeth surfaces can cause pieces to loosen while

driving. These small pieces can get between the gears and cause serious damage to the rear axle. If the gears are damaged or scratched, then both should be replaced with new ones. The rear axle drive gears (pinion and ring gear) are sold only in complete sets since they are manufactured together in special machines so that the correct tooth contact and silent running is obtained.

The differential gears should be examined for cracks and damage on the teeth. The differential gears should be refitted into the differential carrier in a clean and dry condition together with shaft and thrust washers, so that any play and wear can be determined more easily.

If any play is found, the parts concerned should be replaced. The thrust washers should be free from rough spots.

Also check to see whether the cylindrical portion of the flange which goes into the sealing ring is worn or scratched. If so, replace the flange together with the sealing ring.

Inspect the drive shafts. If these are bent or otherwise damaged, they should be replaced with new ones.

Examine the sealing rings and replace them if they are worn or damaged.

See that there are no cracks in the rear axle housing. Check that the brackets for the suspension arms and track rods are intact.

## Assembling

### Assembling the differential

1. If the differential has been disassembled the differential side gears (38) with thrust washers (39) are first placed in the differential carrier (43). Then "roll" in the small differential gears (41) (both together) with the dished thrust washers (42), see fig. 14.
2. Place in the thrust block (32) and drive in the shaft (31).
3. Set up the differential carrier in a vise and insert a drive shaft into one of the differential side gears. The differential should now go so stiffly that it can only with difficulty be turned by hand on this shaft. If it turns too easily, fit new thrust washers (39). The flat washers are available in oversizes. Note that washers of the same

thickness should be placed under two opposite gears. When adjustments have been completed, fit the locking pin (30) for the shaft.

4. Fit the ring gear (17), ensuring that the contact surfaces are clean and smooth. Tighten the bolts (15) to the torque mentioned in the specifications and lock with tab washers (16).
5. Press on the differential carrier bearings (33), see fig. 15. Use drift SVO 4112 and standard handle SVO 1801 for the bearings.

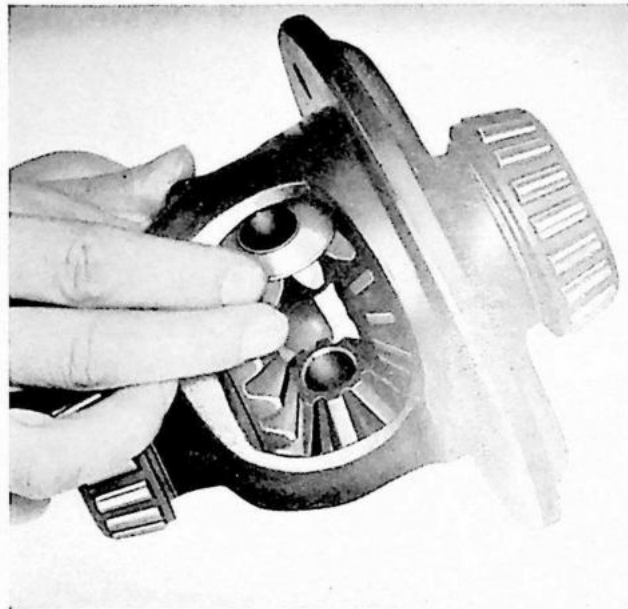


Fig. 14. Fitting differential gears.

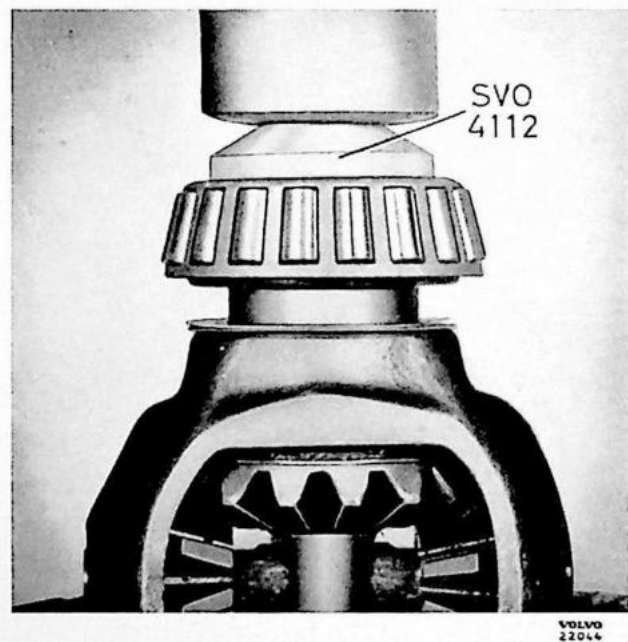


Fig. 15. Fitting differential carrier bearing.

## Assembling rear axle

1. Place in position the number of shims (28) which there were under the rear pinion bearing outer ring when disassembling, see fig. 16. Then press in the front and rear outer rings with press tool SVO 4047, see fig. 17. Ensure that the rings do not bind or come skew in the housing.
2. Press the rear pinion bearing (29) on the pinion (18). Use tool SVO 4097, see fig. 18.
3. Insert the pinion into the housing and fit on spacing ring (27), the number of shims (26) that there were when disassembling and the front pinion bearing (25). Place on the intermediate ring SVO 4069, wrench SVO 4061 and fit press tools SVO 2304 and SVO 4049 respectively on the front end of

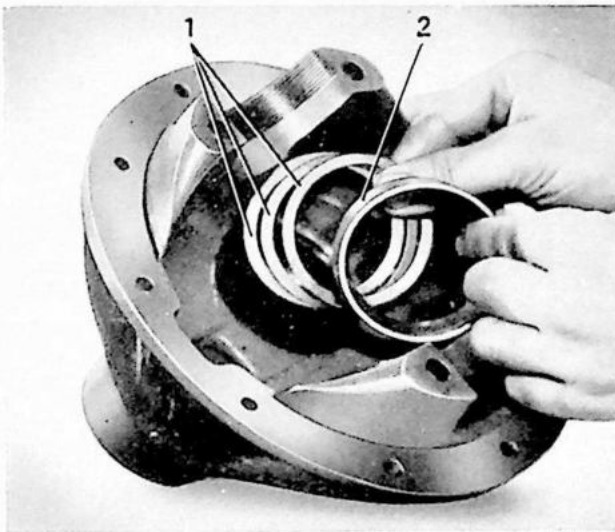


Fig. 16. Fitting shims.  
1. Shims. 2. Bearing ring.



Fig. 17. Fitting bearing rings.  
1. Press tool SVO 4047.

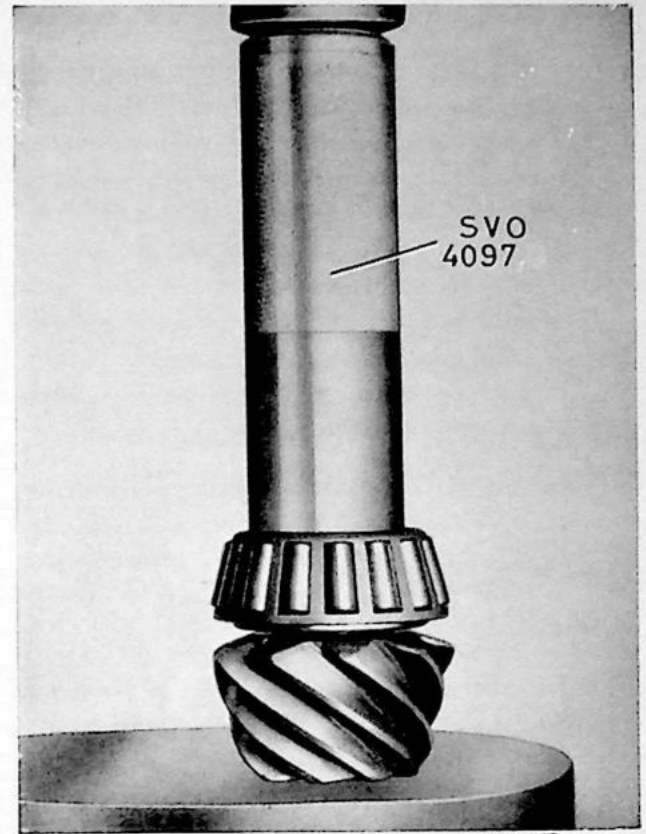


Fig. 18. Fitting rear pinion bearing.

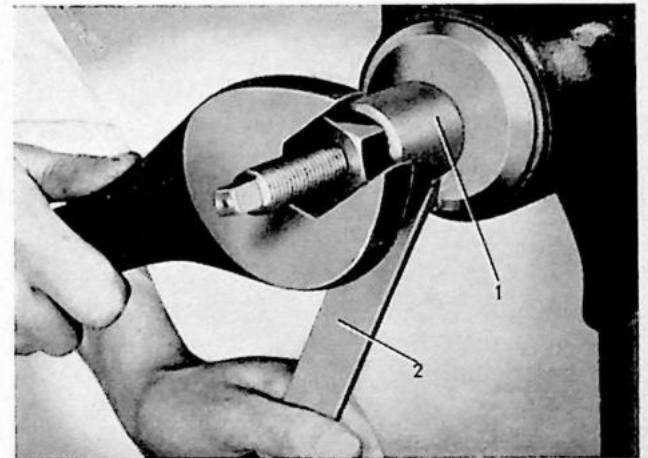


Fig. 19. Fitting pinion.  
1. Press tool, see text. 2. Wrench SVO 4061.

the pinion, see fig. 19. (SVO 2304 is used for pinions with 5/8"—18 thread and SVO 4049 for pinions with 18×1.5 mm thread). The simplest way of checking whether a pinion is of earlier or later type is to look at the flange nut. Earlier type pinions with 18×1.5 mm thread are fitted with a castle nut and split pin while later type pinions with 5/8"—18 thread have a "Nyloc" type

locknut). Pull in the pinion with the help of the press tool.

4. After the pinion has been fitted, check and, if necessary, adjust the pinion bearing take-up. It should be relatively easy to turn the pinion round (2—4 kgcm = 1.75—3.5 lb.in.). There must, however, be no play. If the pinion turns too stiffly, the front bearing is taken off by pressing the pinion out and placing more shims there. If there is play or if the pinion turns too easily, shims are removed.
5. Fit the differential with ring gear together with bearing races, caps (37) and adjusting nuts (34). Do not tighten the cap bolts (44) so hard that the adjusting nuts cannot be turned.
6. The rear axle is now ready for adjusting of tooth contact and tooth flank clearance. Follow the instructions under the heading "Adjusting the rear axle", page 17.
7. After adjusting has been completed, remove press tool SVO 4049, wrench SVO 4061 and intermediate ring SVO 4069.
8. Fit flat washer (19) and sealing ring (20) with gasket. For the sealing ring, use press tools SVO 2304 and SVO 4049 respectively and wrench SVO 4061, see fig. 7. Then the flange is pressed on with the help of the press tool, see fig. 8. Fit washer (24) and nut (22), which should be tightened to the torque stated in the specifications.
9. Adjust finally the differential carrier bearings and lock the adjusting nuts. Taking up is done as follows: tighten up the cap bolts and then unscrew them  $\frac{1}{4}$  of a turn. Place a dial indicator gauge against the rear side of the ring gear. Tighten the adjusting nuts so that the play just disappears. Then tighten the adjusting nut on the tooth side of the ring gear a further  $1\frac{1}{2}$ —2 notches. Check the tooth flank clearance which should be 0.1—0.2 mm (0.004—0.008").
10. When the adjusting nuts and cap bolts have been locked, the rear axle is ready for fitting into the rear axle housing.

## Fitting

1. Lift the rear axle into position in the rear axle housing. First ensure that the gasket is intact and that the sealing surfaces are flat and clean. Tighten the bolts evenly all the way round.
2. Connect up the propeller shaft to the pinion flange.
3. Pack ball bearing grease into the rear axle bearings and insert the drive shafts (11). Drive in the outer bearing rings with fitting sleeve SVO 1807, see fig. 20.
4. Fit the brake backing plates, see fig. 21, all shims (47) which were taken out when removing and the felt sealing rings (8) on both sides and tighten the bolts (46) for

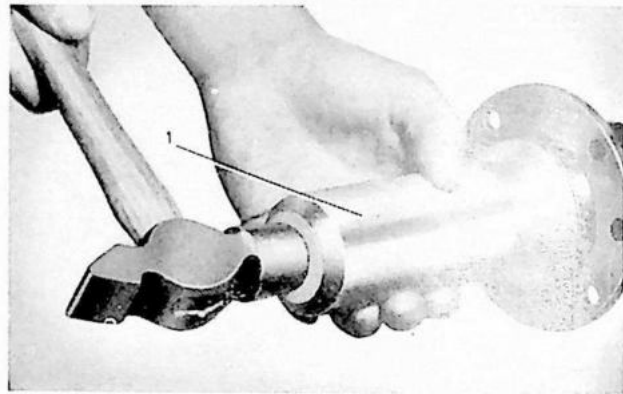


Fig. 20. Fitting bearing ring.  
1. Fitting sleeve SVO 1807.

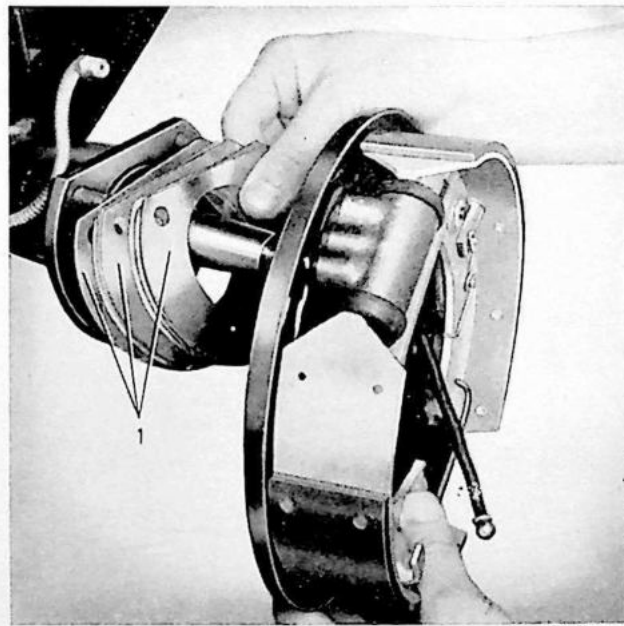


Fig. 21. Fitting brake backing plate.  
1. Shims.

- good. Examine the rubber sleeve which seals the handbrake cable at the brake backing plate. Replace with a new one if necessary. Strike a few blows with a mallet on both drive shaft ends so that the bearing outer rings assume the correct position.
- On late production the right-hand side shims are replaced by a 1.5 mm (0.060") thick washer. Adjusting must therefore be done on the left-hand side. Place a dial indicator gauge on this side on the retaining device SVO 4054 and SVO 4148 which is secured to the brake backing plate. Place the measuring point of the dial indicator gauge against the end of the drive shaft and zero the indicator, see fig. 22.

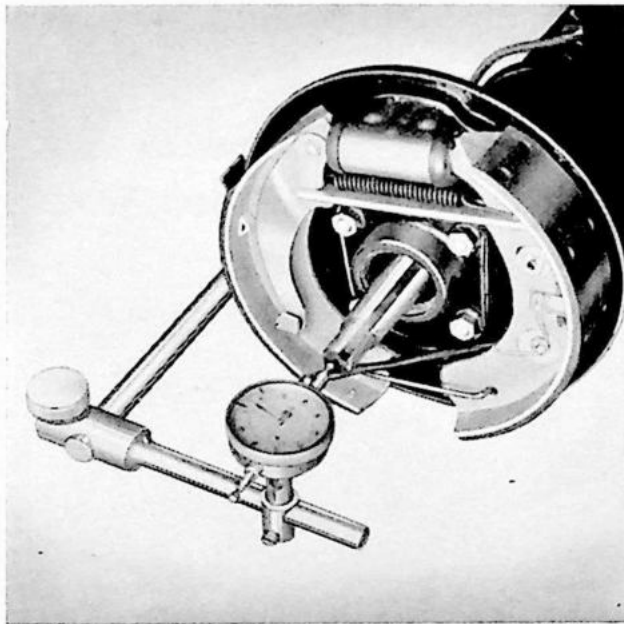


Fig. 22. Measuring axial clearance on drive shafts.

- Pull the shaft in and out once or twice and note the indicator reading. This should be between 0.02 and 0.12 mm (0.008—0.047"). If it exceeds or is less than these limits, adjust with shims (47). These are available in the following thicknesses: 1.0, 0.35 and 0.1 mm (0.0394", 0.0138" and 0.0039").
- When adjustment of the drive shaft clearance has been completed, the brake fluid pipe line and handbrake cable is connected up on both sides. The hubs (6) and drums are fitted, after which the wheels are placed on. The brakes should be bled and

adjusted in accordance with the instructions given in Part 7.

- Fill up the rear axle with oil.  
*Use only hypoid oil.*

## Repair instructions for rear axle, type II

### Removing

When working on the rear axle it is generally best to remove the whole assembly. The instructions below apply principally to PV 444 and PV 544 but also apply for PV 445 where appropriate.

- Slacken the rear wheel nuts (1, Illustration III) and nuts (3) on the drive shafts (11). Lift up the rear end of the car fairly high by placing a jack under the rear axle. Place chocks at the front wheels. Place blocks under the body in front of the rear wheels (on PV 445, the frame). Remove the rear wheels.
- Disconnect the rear portion of the propeller shaft from the flange (20) on the pinion (16) and disconnect the brake pipe line from the master cylinder to the rear axle level with the rear universal joint (place a wooden block under the brake pedal).
- Remove the track rods, shock absorbers, shock absorber bands and suspension arms from the rear axle and the handbrake cable from the body. On PV 444, chassis numbers 131918 onwards and PV 544 the torque rods are also removed, preferably at the body.
- Lower the jack and remove the spring from the rear axle. Remove the rear axle.
- Wash off the rear axle externally and drain out the oil from the rear axle housing.

### Disassembling

Before disassembling it is best to measure up the drive shaft axial clearance and ring gear tooth flank clearance since in this way any defects can be discovered and remedied more easily.

- Place the rear axle on a stand or a pair of trestles at suitable working height. Pull off the rear wheel hubs with puller SVO 1791, see fig. 1.

2. Disconnect the brake pipe lines on the shaft from the brake backing plates. Remove the brake backing plates from the rear axle housing. Preserve the shims.
3. Remove the drive shafts (11). Use puller SVO 2204, see fig. 2. If necessary, press the roller bearing (9) off the shafts. When doing this, use support ring SVO 1806, see fig. 9.
4. Remove the sealing rings (10) with the help of puller SVO 4078, see fig. 3.
5. Remove the inspection cover (42) from the rear axle housing.
6. Check the markings on caps (32, 41) and housing. If these are lacking or have become obliterated, mark one side with a center punch. Remove the caps.
7. Fit tool SVO 2285 in the holes in the rear axle housing as shown in fig. 23. Screw out the tensioning nut by hand as far as it will go and then turn it with a wrench until the differential carrier can be lifted out easily. Do not tighten the nut too much as otherwise the rear axle housing can be deformed. Lift out the differential carrier with ring gear.

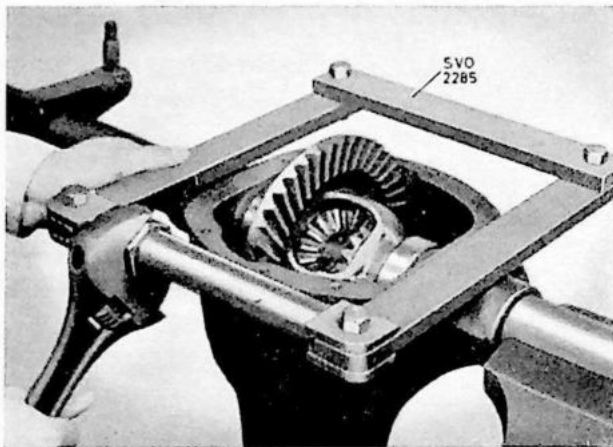


Fig. 23. Removing the differential.

8. Remove the nut (21) for the flange (20) and pull this off with puller SVO 2261, see fig. 5. Press out the pinion (16).
9. Remove the sealing ring (18) with the help of SVO 4030, see fig. 6. Then remove washer (17), front pinion bearing (23) and shims (24).

10. If necessary, drive out the bearing outer rings, see fig. 24. Use standard handle SVO 1801 and drift SVO 4064 for the front and SVO 2207 for the rear ring. Preserve the shims (25) under the rear ring.
11. If necessary, pull the rear bearing (26) off the pinion (16) with puller SVO 2164, see fig. 25.

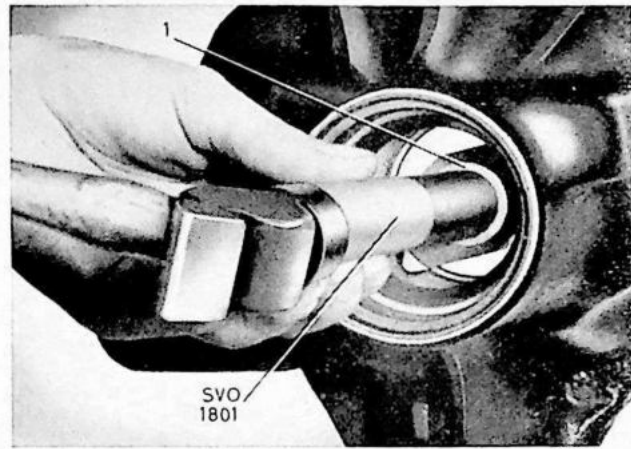


Fig. 24. Removing bearing ring.

1. Drift, see text.

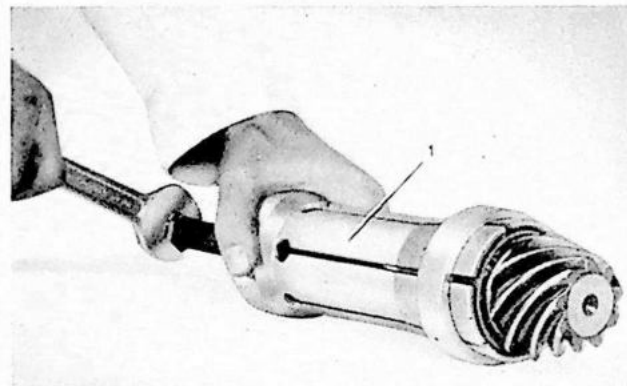


Fig. 25. Removing rear pinion bearing.

1. Puller SVO 2164.

## Disassembling the differential

1. Remove the bolts (38) and take out the ring gear (15).
2. Drive out the locking pin (27), see fig. 26 and then the shaft (28) for the differential gears. Take out the thrust block (29). Take out the differential gears (33, 36) and thrust washers (34, 37).
3. Pull off the differential carrier bearings (13, 31) with puller SVO 4042, see fig. 27. Preserve the shims (14, 30).

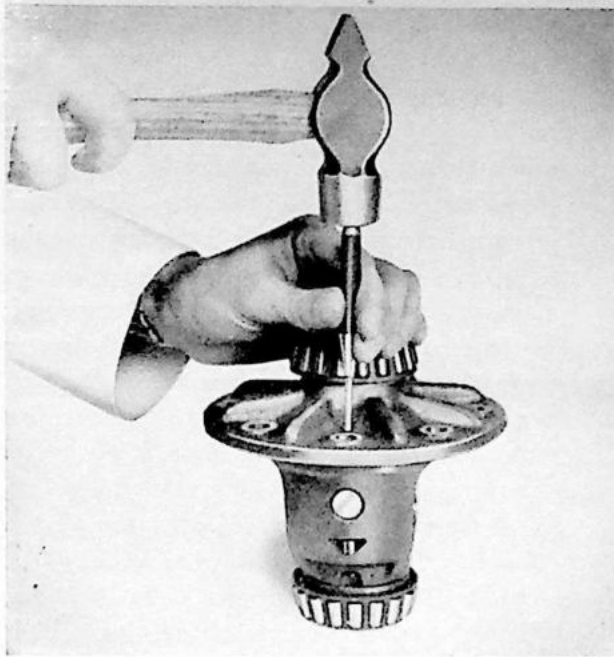


Fig. 26. Removing locking pin.

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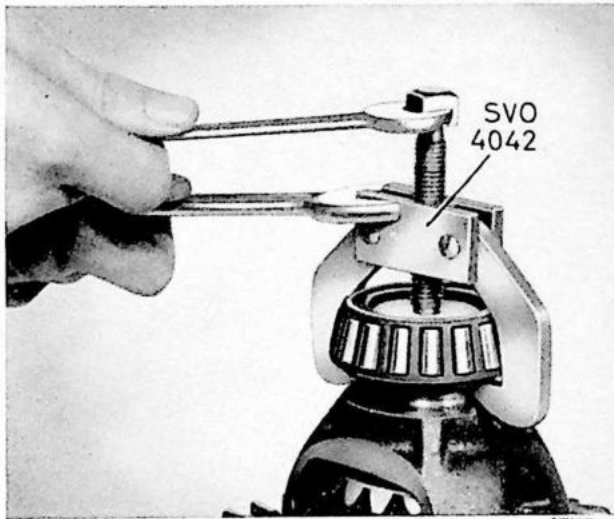


Fig. 27. Removing differential carrier bearing.

SVO  
4042

VOLVO  
22943

## Inspection

In order to examine the various parts they must first be thoroughly cleaned. All bearing races and bearings should be examined. There should be no scratches or damage on races, rollers or roller retainers. All damaged bearings and bearing races must be replaced. Also thoroughly examine the pinion and ring gear to see that the teeth are not damaged. Cracks in the teeth surfaces can cause pieces to loosen while driving. These small pieces can get between the gears and cause serious damage to the

rear axle. If the gears are damaged or scratched, then both should be replaced with new ones. The rear axle drive gears (pinion and ring gear) are sold only in complete sets since they are manufactured together in special machines so that the correct tooth contact and silent running is obtained.

The differential gears should be examined for cracks and damage on the teeth. The differential gears should be refitted into the differential carrier in a clean and dry condition together with shaft and thrust washers, so that any play and wear can be determined more easily. If any play is found, the parts concerned should be replaced. The thrust washers should be free from rough spots.

Also check to see whether the cylindrical portion of the flange which goes into the sealing ring is worn or scratched. If so, replace the flange together with the sealing ring.

Inspect the drive shafts. If these are bent or otherwise damaged, they should be replaced with new ones.

Examine the sealing rings and replace them if they are worn or damaged.

See that there are no cracks in the rear axle housing. Check that the brackets for the suspension arms and track rods are intact.

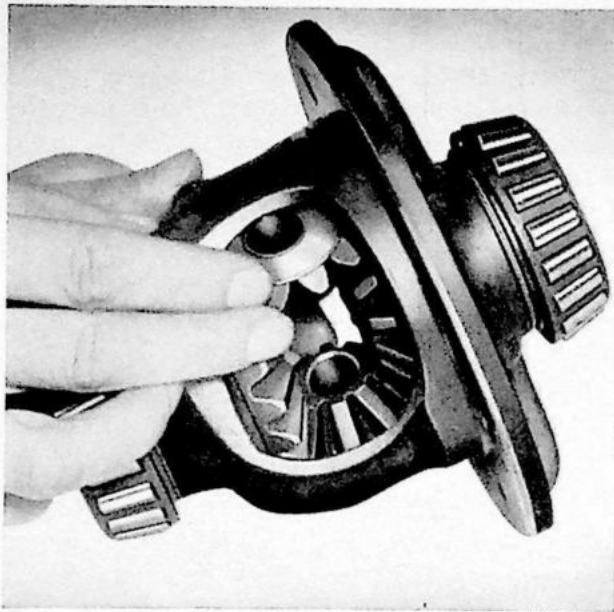
## Assembling

### Assembling the differential

1. Place the differential side gears (33) with thrust washers (34) in the differential carrier (40). Then "roll" in the small differential gears (36) and the dished thrust washers (37) (both gears at the same time), see fig. 28.
2. Place in the thrust block (29) and drive in the shaft (28).
3. Check the differential. If there is any play, fit new thrust washers. The flat thrust washers (34) can be replaced either by oversize washers or spring type thrust washers. Fit the spring type thrust washers correctly. The "back" should face the differential carrier, see fig. 29.

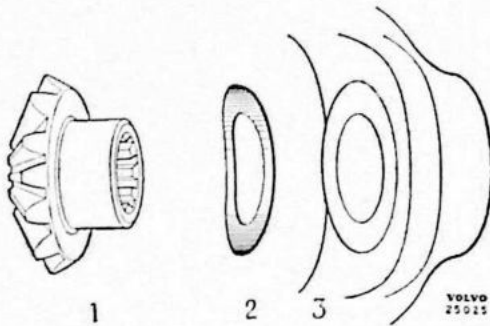
After checking and having fitted new washers if necessary, fit the locking pin (27).

4. Fit the ring gear (15). Ensure that the contact surfaces are clean and free from burr. Tighten the bolts (38) to the torque shown in the specifications and lock with tab washers (39).



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Fig. 28. Fitting differential gears.



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Fig. 29. Fitting spring type thrust washers.

1. Differential gear.
2. Thrust washer.
3. Differential carrier.

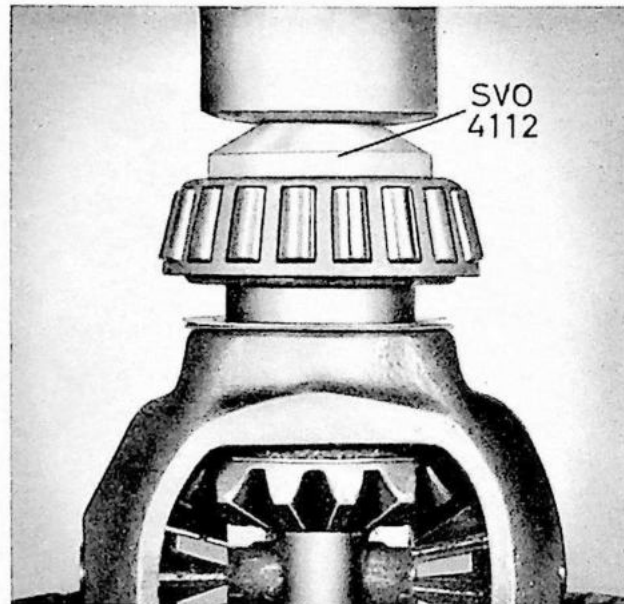
### Assembling rear axle

1. Press on the differential carrier bearings (13, 31) without shims. Use drift SVO 4112, see fig. 30.

Place the differential carrier with ring gear and roller bearings in the housing. Measure the axial clearance. This can be done in two ways, either with a dial indicator gauge or feeler gauge. Whichever method is used, measuring must be carried out with the utmost precision in order for the correct result to be obtained. If an

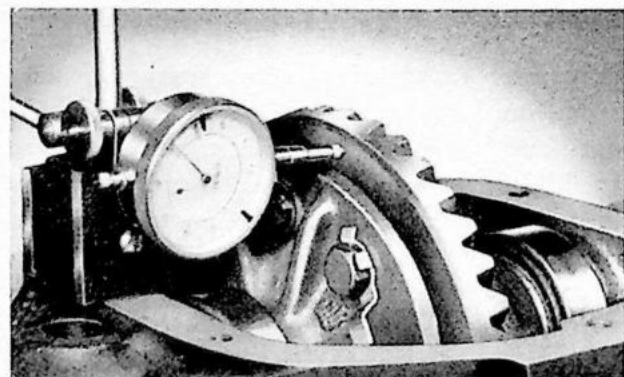
indicator is used, this should be placed against the back side of the ring gear, see fig. 31. The differential (also the bearing outer rings) should first be moved over in one direction after which the indicator should be set to zero. Then the differential is moved over in the other direction and the clearance read off. If the feeler gauge method is used, two gauges are required. These are inserted between one of the outer rings and the bearing position in the carrier. Add 0.2 mm (0.008") to the reading obtained which gives the total thickness of the shims to be used when assembling.

2. Press the rear bearing (26) onto the pinion (16). Use drift SVO 4097, see fig. 32.
3. Replace the same number of shims (25) for the rear pinion bearing outer ring which were there when disassembling, into the



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Fig. 30. Fitting differential carrier bearing.



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Fig. 31. Measuring differential axial clearance.

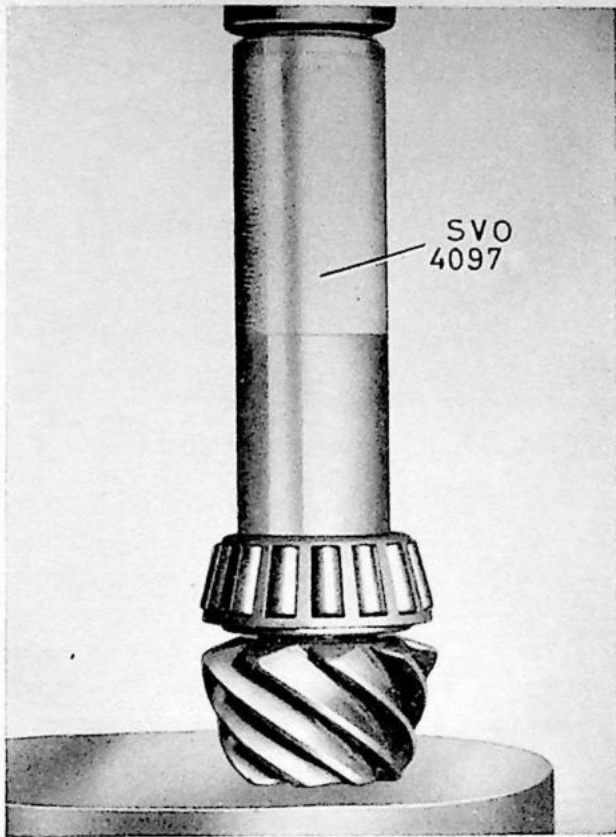


Fig. 32. Fitting rear pinion bearing.

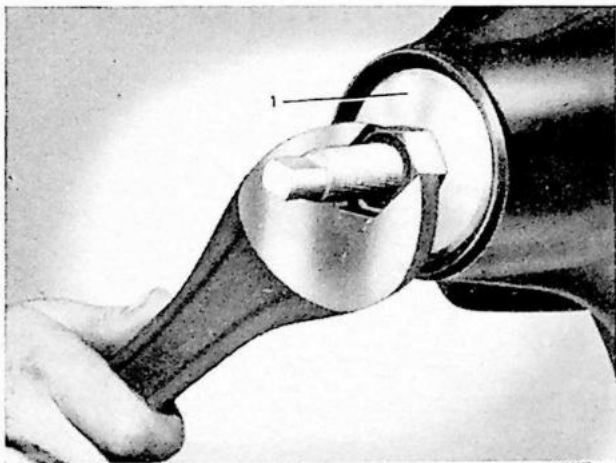


Fig. 33. Fitting bearing rings.

1. Press tool SVO 2206.

- housing and then press in the outer rings using drift SVO 2206, see fig. 33. Ensure that the rings do not bind or lie skew.
4. Insert the pinion into the housing and place on the same number of shims (24) which were there when disassembling, the front pinion bearing (23) and washer (17). Fit wrench SVO 2208 and press tool SVO 1845 on the front end of the pinion and tighten in the pinion, see fig. 34.

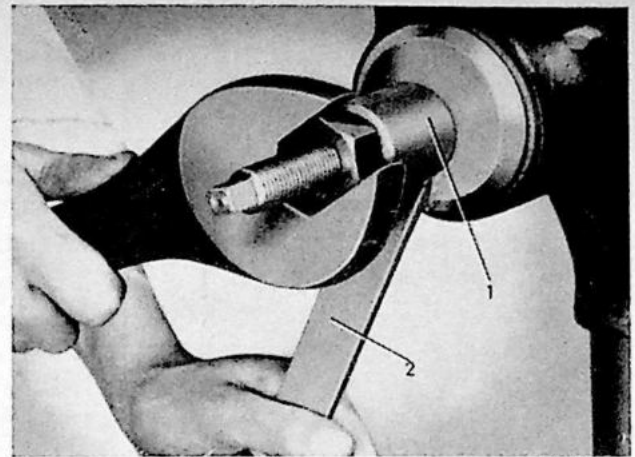


Fig. 34. Fitting pinion.

1. Press tool SVO 1845 2. Wrench SVO 2208

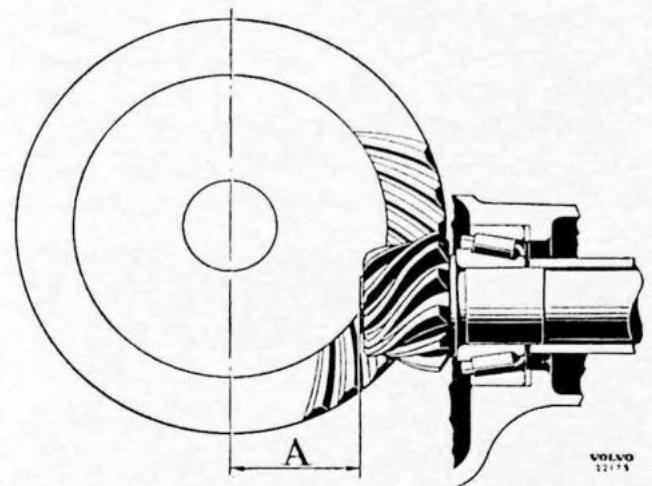


Fig. 35. Pinion position.

A. Nominal measurement = 2.25".

5. Check the adjustment of the pinion bearings. The pinion should be relatively easy to turn (9—14 kgem = 8—12 lb in.), but there must be no play. Adjustment is carried out by means of shims (24) on the front pinion bearing.
6. The pinion should have a certain nominal measurement (A, fig. 35) to the center line of the ring gear. Due to manufacturing tolerances, however, deviations from the nominal measurement occur. The deviation applying is indicated on the ground surface of the pinion by a figure and plus or minus sign. If there is a plus (+) sign, then the nominal measurement must be increased but if there is a minus (—) sign, the nominal measurement should be decreased. The figure marked on the pinion indicates the

deviation in thousandths of an inch and, where necessary, must first be converted to mm, see conversion table.

The pinion position is checked by using a dial indicator gauge, an indicator retainer SVO 2284 and measuring tool SVO 2283 which consists of two parts, a pinion gauge and adjusting jig.

Checking is carried out as follows:

Place the pinion gauge on the ground surface of the pinion and the adjusting jig in the differential bearing positions, see fig. 36. Place the indicator retainer on the rear axle housing and set the indicator to zero against the adjusting jig, see fig. 37. Then move over the indicator retainer so that the indicator comes up against the pinion gauge, see fig. 38. If the pinion is marked "0", the adjusting jig and pinion gauge should come level with each other, if it is marked with a minus (-) sign, the pinion gauge should come higher than the adjust-

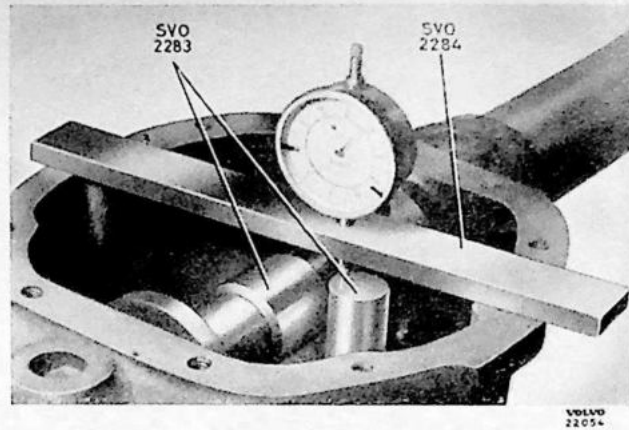


Fig. 38. Measuring pinion position.

ing jig and if it is marked with a plus (+) sign, the pinion gauge should come lower than the jig for correct adjustment. Adjustment is carried out by adding or removing shims under the rear pinion bearing outer ring. If the pinion bearings had the correct adjustment, the same number of shims must at the same time be added or removed under the front pinion bearing.

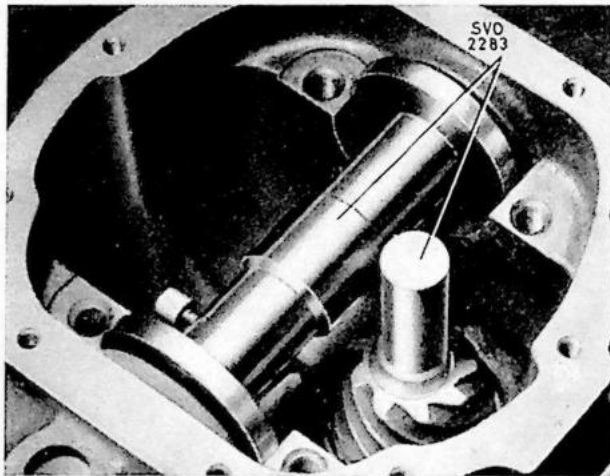


Fig. 36. Positioning the measuring tools.

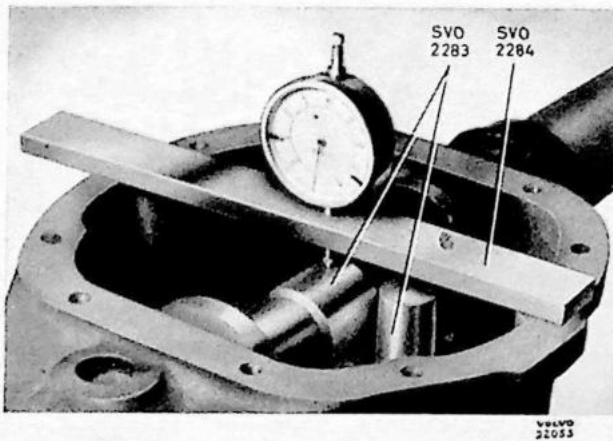


Fig. 37. Setting the indicator gauge to zero.

Conversion table for inches to mm	
inches	mm
0.001	0.025
0.002	0.051
0.003	0.076
0.004	0.102
0.005	0.127
0.006	0.152
0.007	0.178
0.008	0.203
0.009	0.229

Example: The pinion is marked +2. The pinion gauge should then come  $0.002'' = 0.051$  mm under the adjusting jig. Measuring shows that the pinion gauge on the pinion comes 0.15 mm over the adjusting jig. The pinion should thus be lowered  $0.15 + 0.05 = 0.20$  mm so that shims corresponding to this thickness (measured with a micrometer) should be removed from under the rear pinion bearing outer ring.

- After the pinion position has been checked and adjusted if necessary, the tension on the pinion bearings should be checked once again.

3. Place the differential (without shims for the bearings) in the rear axle housing. Measure the differential axial clearance (clearance between the pinion and outer positions of the differential). This can be done either with an indicator gauge on the back side of the ring gear or with two feeler gauges. Note the clearance obtained.
9. The clearance obtained in accordance with the measurement carried out under point 8 should be decreased by the tooth flank clearance (backlash). In some cases this is stamped on the ring gear (for example, B/L .004). It is given in thousandths of an inch and, if necessary, must first be converted to mm, see conversion table. The examples given below assume the use of the metric system but the same method also applies for measurements in inches except that no conversion will be necessary and assuming that the thickness of the shims used is also measured in inches.

Example: The ring gear is marked B/L .004 which according to the table corresponds to 0.10 mm. Shims required in accordance with point 1:

Measured clearance 1.5 mm + tension 0.2 mm = 1.7 mm.

Measured clearance in accordance with point 8 = 1 mm.

Shim thickness on ring gear side =  $1 - 0.10 = 0.9$  mm.

Shim thickness on opposite side =  $1.7 - 0.9 = 0.8$  mm.

If the tooth flank clearance (backlash) is not marked on the ring gear, use instead the average value (0.15 mm) of the clearance (0.10–0.20 mm).

Example: Measured clearance 1.4 mm + tension 0.2 mm = 1.6 mm.

Measured clearance in accordance with point 8 = 0.95 mm.

Shim thickness on ring gear side =  $0.95 - 0.15 = 0.8$  mm.

Shim thickness on opposite side =  $1.6 - 0.8 = 0.8$  mm.

10. Pull off the differential carrier bearings with puller SVO 4042. Place shims of the thickness calculated under the bearings and press these on again.

11. Fit tool SVO 2285 and a dial indicator gauge on the rear axle housing, see fig. 39. Tighten the tensioning nut so that the rear axle housing is expanded max. 0.3 mm (0.012"). Remove the indicator. Place in the differential with bearings. Then remove tool SVO 2285.
12. Fit the caps (32, 41) with bolts and tighten the bolts. Place a dial indicator gauge against the back side of the ring gear, see fig. 40. Pull the ring gear round and measure the run-out. This must not exceed 0.08 mm (0.003").
13. Check the backlash as shown in fig. 41. This should agree with the value given in the specifications or with the value stamped on the ring gear. This should be at least 0.10 mm (0.004").
14. Check the setting by marking up the tooth contact in accordance with the instructions under "Adjusting the rear axle" on page 17.
15. After final adjustment, remove wrench SVO 2208.

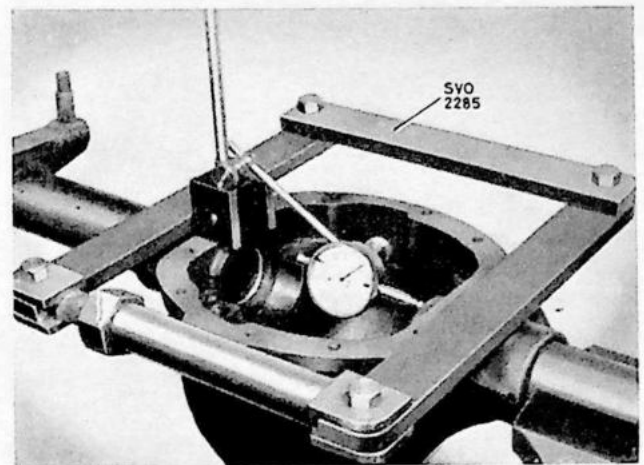


Fig. 39. Expanding rear axle housing.

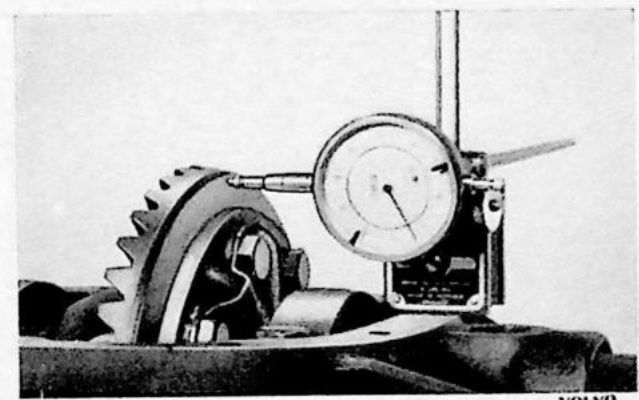


Fig. 40. Measuring ring gear run-out.

16. Fit the flat washer (17) and sealing ring (18) together with paper gasket. Use press tool SVO 1845 and wrench SVO 2208 for the sealing ring. Then press on the flange (20) using SVO 1845. Fit washer (22) and nut (21). Tighten the nut to the torque shown in the specifications.
17. Remove the cap bolts. Then smear the threads on the bolts and in the holes with sealing compound — Permatex 3 Form — A — Gasket or corresponding. In this way sealing of the through-going holes and securing of the bolts is obtained. Tighten the bolts in accordance with values shown in specifications.
18. Fit the inspection cover and gasket.

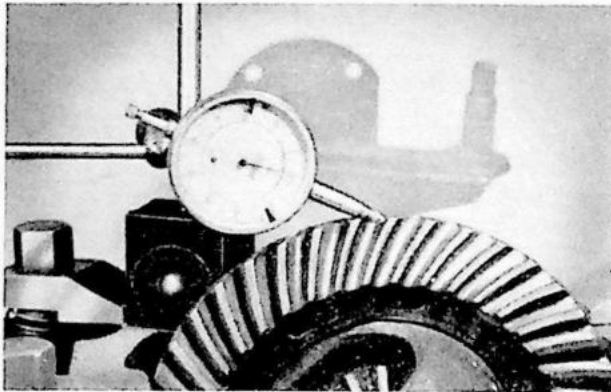


Fig. 41. Measuring backlash.

### Assembling rear axle

1. Drive in the sealing rings (10) for the drive shafts (11) with drift SVO 1803, see fig. 4.
2. Press the bearings (9) onto the drive shafts if they have been removed. Use SVO 1805, see fig. 42. Ring SVO 1806 can be used as a counterhold if the smaller diameter of the hole is turned to face the flange on the shaft.
3. Pack the bearings with heat-resistant grease. Insert the drive shafts into the rear axle housing. Drive in the bearing outer rings with fitting sleeve SVO 2205 for PV 444, 544 and SVO 1807 for PV 445, see fig. 43.

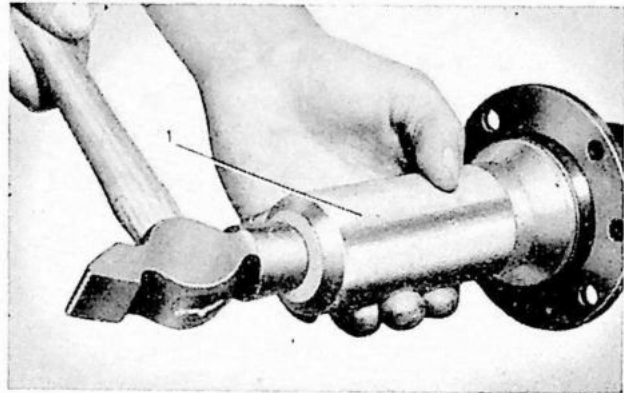


Fig. 43. Fitting bearing ring.

1. PV 444, 544: Fitting sleeve SVO 2205.  
PV 445: Fitting sleeve SVO 1807.

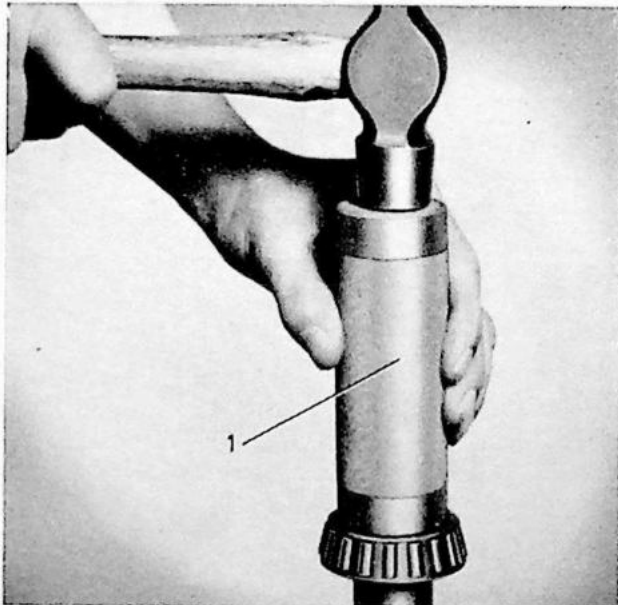


Fig. 42. Fitting drive shaft bearing.

1. Fitting sleeve SVO 1805.

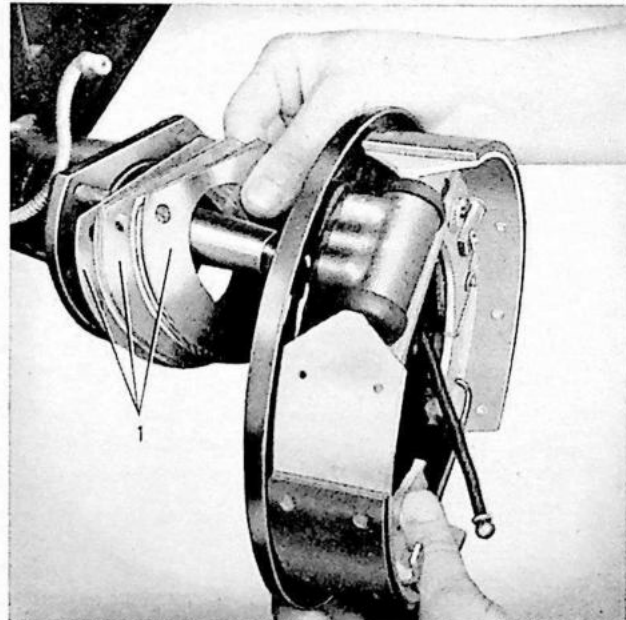


Fig. 44. Fitting brake backing plate.

1. Shims.

4. Fit the brake backing plates with shims (46) and retainer (8) with felt seal, see fig. 44. Check and if necessary adjust the drive shaft axial clearance, see fig. 45. The clearance is given in the specifications.
5. Fit the brake pipe lines at the brake backing plates and then the hubs and brake drums.

## Fitting

The instructions given below apply mainly to PV 444 and 544 but also concern PV 445 where appropriate.

1. Place the rear axle under the vehicle and lift it up slightly with a jack.
2. Bolt on the suspension arms and track rod. On PV 444, chassis numbers 131918 onwards and PV 544 the torque rods are also fitted.

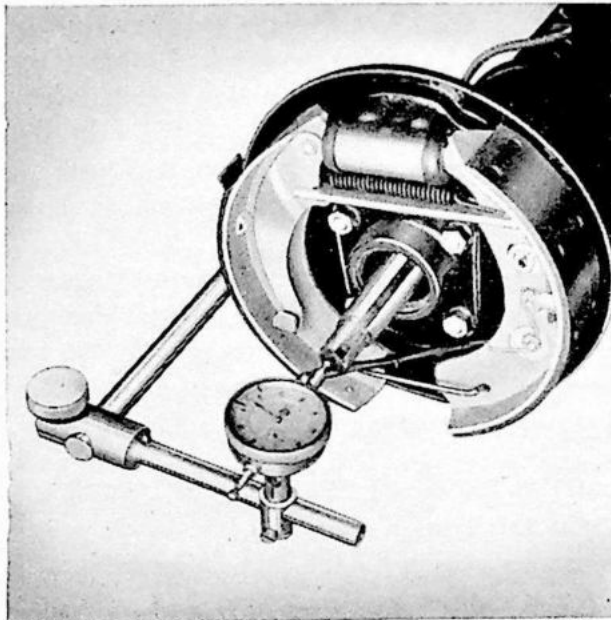


Fig. 45. Measuring axial clearance of drive shafts.

3. Bolt on springs, shock absorber bands and shock absorbers.
4. Connect the propeller shaft at the flange on the pinion and connect the brake pipe lines and handbrake cable.
5. Bleed the brake system, fill up with oil, fit the wheels and lower the vehicle. Tighten the wheel nuts (1) and nuts (3) on the drive shafts. Fit the split pins (4).

Use only hypoid oil.

## Adjusting the rear axle

When the rear axle gears are assembled it is extremely important to ensure that the ring gear and pinion are correctly fitted in relation to each other. This concerns not only backlash but also tooth contact. When the tooth contact is correct the stresses to which the teeth are subjected when the car is driven are distributed over the greater part of the tooth surfaces. In this way tooth breakage and excessive gear wear are avoided and the gears run quietly. The instructions given below can serve as a guide when this work is carried out.

First check the ring gear run-out with a dial indicator gauge. The run-out must not exceed the value given in the specifications.

In order to describe tooth contact in a simple manner, the various parts of the teeth have been given different names. See fig. 46 which shows a tooth on the ring gear. Note. Adjustment is carried out on the basis of the contact obtained on the ring gear teeth.

The driving side is the side subjected to pressure from the pinion when the car is driven forwards.

The reverse side is the side which is subjected to pressure when the car is reversed and when the engine is used to brake the car in forward travel.

The narrowest and broadest ends of the tooth are called the toe and heel respectively. The toe lies nearest the center while the heel is furthest out on the ring gear.

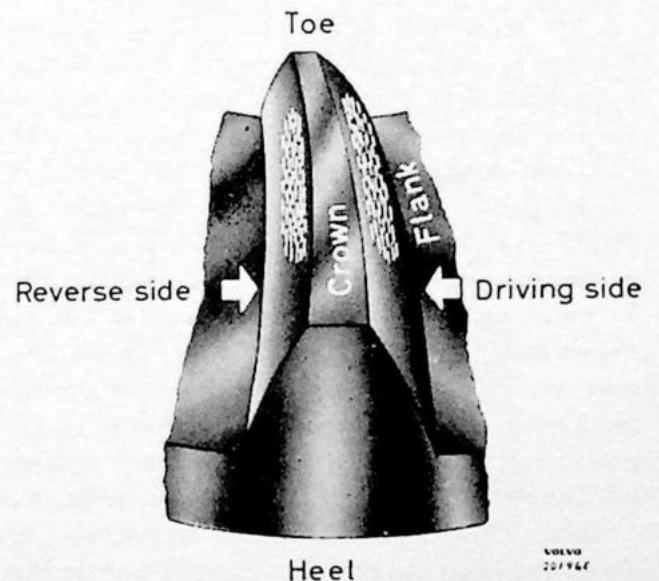


Fig. 46. Correct tooth contact.

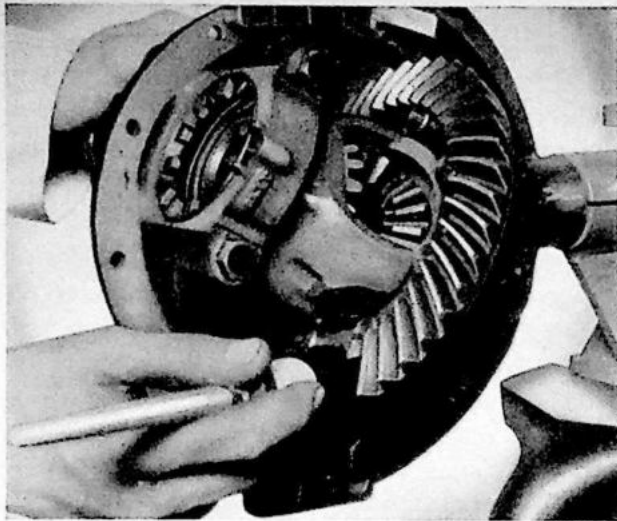


Fig. 47. Coating the teeth with marking paint.

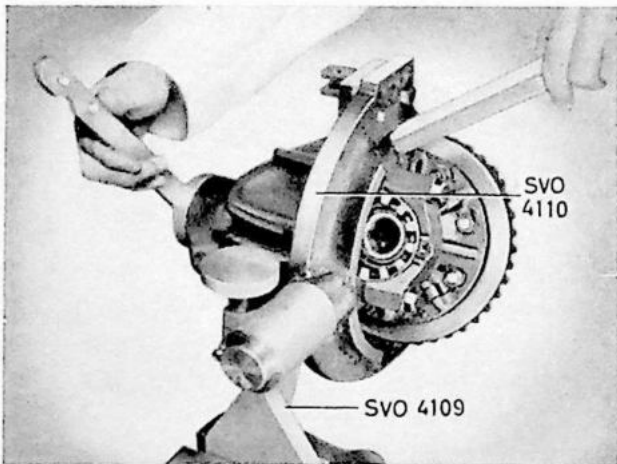


Fig. 48. Rotating the rear axle gears.

In order to obtain a clear picture of the tooth contact, both sides of the ring gear teeth are coated with marking paint consisting of a mixture of red lead and engine oil. The marking paint must not be too thinly mixed since this can cause a faulty impression of tooth contact. All the teeth should be coated with a thin coating of marking paint, see fig. 47. The pinion should then be rotated 10—12 turns in each direction at the same time as the ring gear is braked hard by using a wooden wedge or similar device as shown in fig. 48. The marking paint on the ring gear teeth is thus removed where the pinion teeth make contact so that a clear picture of the extent and position of the tooth contact is obtained. The correct tooth contact is shown in fig. 46.

*Note.* The pattern is almost rectangular in shape and is, on the driving side, half-way up the tooth but nearer the toe than the heel. On the

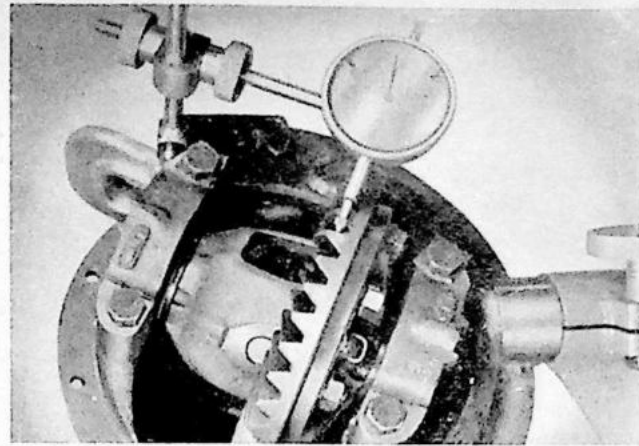


Fig. 49. Measuring backlash.

reverse side it is rather higher than on the driving side but otherwise similar.

Tooth contact adjustment is carried out by altering the position of the pinion relative to the ring gear. This is done by adding or removing shims at the rear pinion bearing outer ring. At the same time, however, an equal number of shims must be added or removed at the front pinion bearing so that the pinion bearing adjustment is not altered.

Every time the pinion position is altered, the backlash must be checked and adjusted, see fig. 49.

The movement of the tooth contact pattern is somewhat different on spiral bevel gears (as fitted on the very first series of PV 444 cars produced) and on hypoid gears, so that both types are treated separately.

### Adjustment of spiral bevel gears

On this type of rear axle, the tooth contact pattern moves in the same direction on both the driving and reverse sides.

If the pinion is moved inwards, the contact pattern moves from a high position (fig. 50) to a low position (fig. 51) on the tooth.

If the pattern comes too high on the tooth, the pinion should be moved inwards and if it comes too low, then the pinion should be moved outwards.

When the pinion is moved away from its correct position, the pattern gradually assumes the shape of a narrow mark. It is thus easy to see when the gear is correctly adjusted since the tooth contact pattern then has the correct position on the teeth and the largest possible vertical width.

### Adjustment of hypoid gears

On a hypoid gear the tooth contact pattern moves diagonally over the teeth and in different directions on the driving and reverse sides.

When the pattern has come into the correct position on the driving side, the pattern on the reverse side is noted. If the gear is correctly adjusted, then the two patterns should come opposite each other.

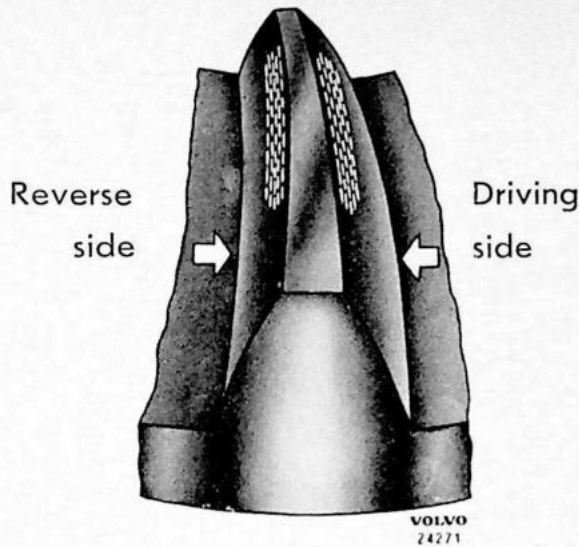


Fig. 50. Faulty tooth contact, spiral bevel gear.

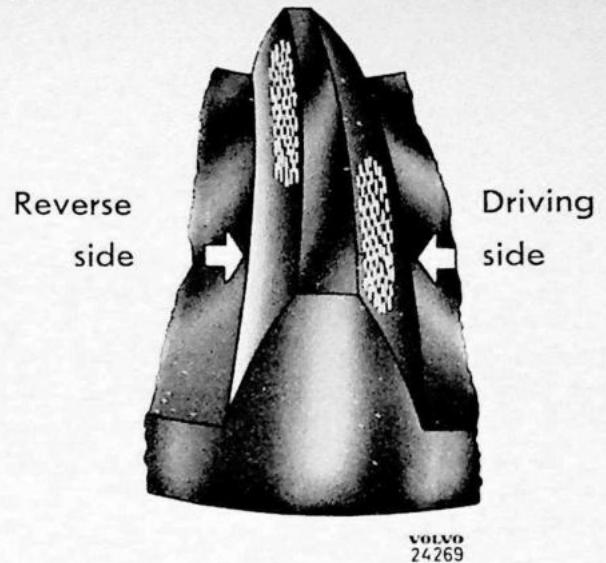


Fig. 52. Faulty tooth contact, hypoid gear.

If the pinion is moved from outside and inwards, the contact pattern moves from a high position at the heel on the driving side, fig. 52, to a low position at the toe, fig. 53. On the reverse side the pattern moves at the same time from a high position at the toe, fig. 52, to a low position at the heel, fig. 53.

The adjustment procedure is carried out as follows:

The tooth contact pattern on the driving side thus moves in the same direction as the pinion. If the pattern comes too near the heel, the pinion is moved inwards, and if it comes too near the toe, then the pinion is moved outwards.

1. Adjust the backlash to the value stated in the specifications.
2. Coat the teeth with marking paint and rotate the pinion while the ring gear is braked.
3. Note the position of the tooth contact pattern and adjust as described above. Every time the position of the pinion has been altered, the backlash should be checked and adjusted.

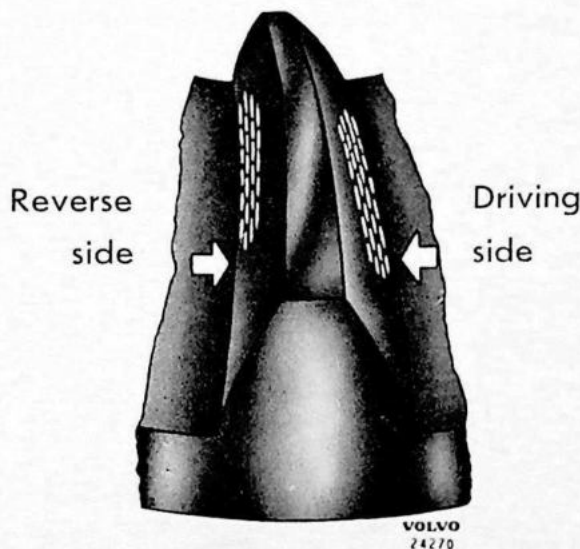


Fig. 51. Faulty tooth contact, spiral bevel gear.

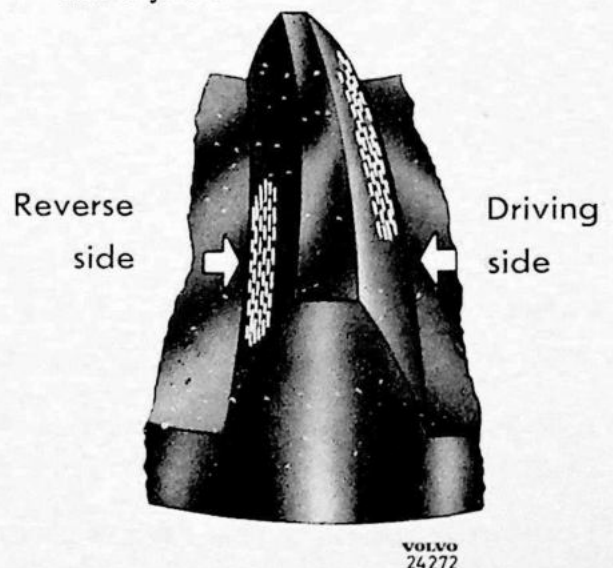


Fig. 53. Faulty tooth contact, hypoid gear.



## FAULT TRACING

The faults in a rear axle become apparent as noise, overheating leakage or drive shaft breakage. The noise is usually in the form of a growling or whining sound.

FAULT	
CAUSE	REMEDY

### Noise possibly accompanied by excessively high temperature

<p>Wrong type of oil in rear axle.</p> <p>Oil level too low.</p> <p>Excessive bearing tension on gears or drive shafts.</p> <p>Faulty backlash.</p> <p>Faulty tooth contact.</p> <p>Worn bearings.</p> <p>Distorted rear axle housing.</p> <p>Distorted rear axle.</p>	<p>Drain off all the oil. Examine the rear axle gears. Flush out the rear axle housing. Fill with hypoid oil.</p> <p>Top-up with oil.</p> <p>Remove the gears (drive shafts) and adjust the bearings.</p> <p>Remove the gears, adjust the backlash and tooth contact in accordance with instructions.</p> <p>Remove the rear axle gears and replace worn bearings.</p> <p>Replace.</p> <p>Replace.</p>
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### Thumping sound in rear axle gears when accelerating or decelerating

Examine first to ensure that this is not caused by worn universal joints.

<p>Worn washers on differential gears.</p> <p>Worn differential gears or differential shaft.</p> <p>One of the drive gears is loose on its hub.</p> <p>Worn splines on shafts or in gears.</p>	<p>Fit new dished washers and oversize plain washers.</p> <p>Replace worn parts.</p> <p>Tighten loose nuts.</p> <p>Replace worn parts.</p>
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### Leakage

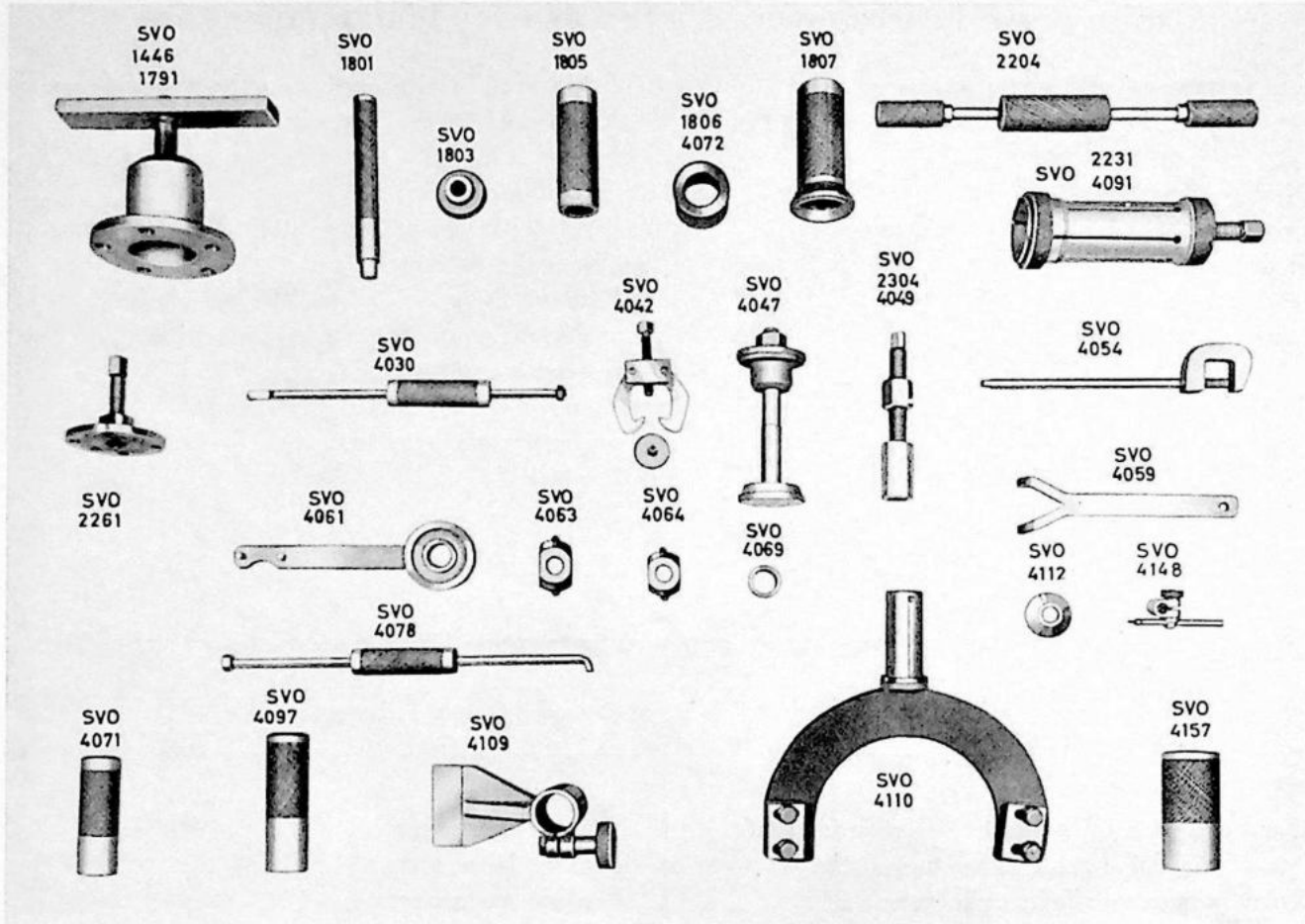
If leakage occurs, check first that the ventilation hole in the rear axle housing is not blocked.

<p>Leakage at drive shafts (oil on brake linings).</p> <p>Leakage at the pinion.</p> <p>Leakage between the rear axle housing and rear axle gear housing.</p>	<p>Replace the sealing ring inside the bearing and the felt washer.</p> <p>Replace the sealing ring and the paper gasket. If necessary, adjust or replace the pinion bearing.</p> <p>Check that the sealing surfaces are clean and even, replace the gasket.</p>
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# TOOLS

The following tools are required for carrying out repairs on the rear axle.

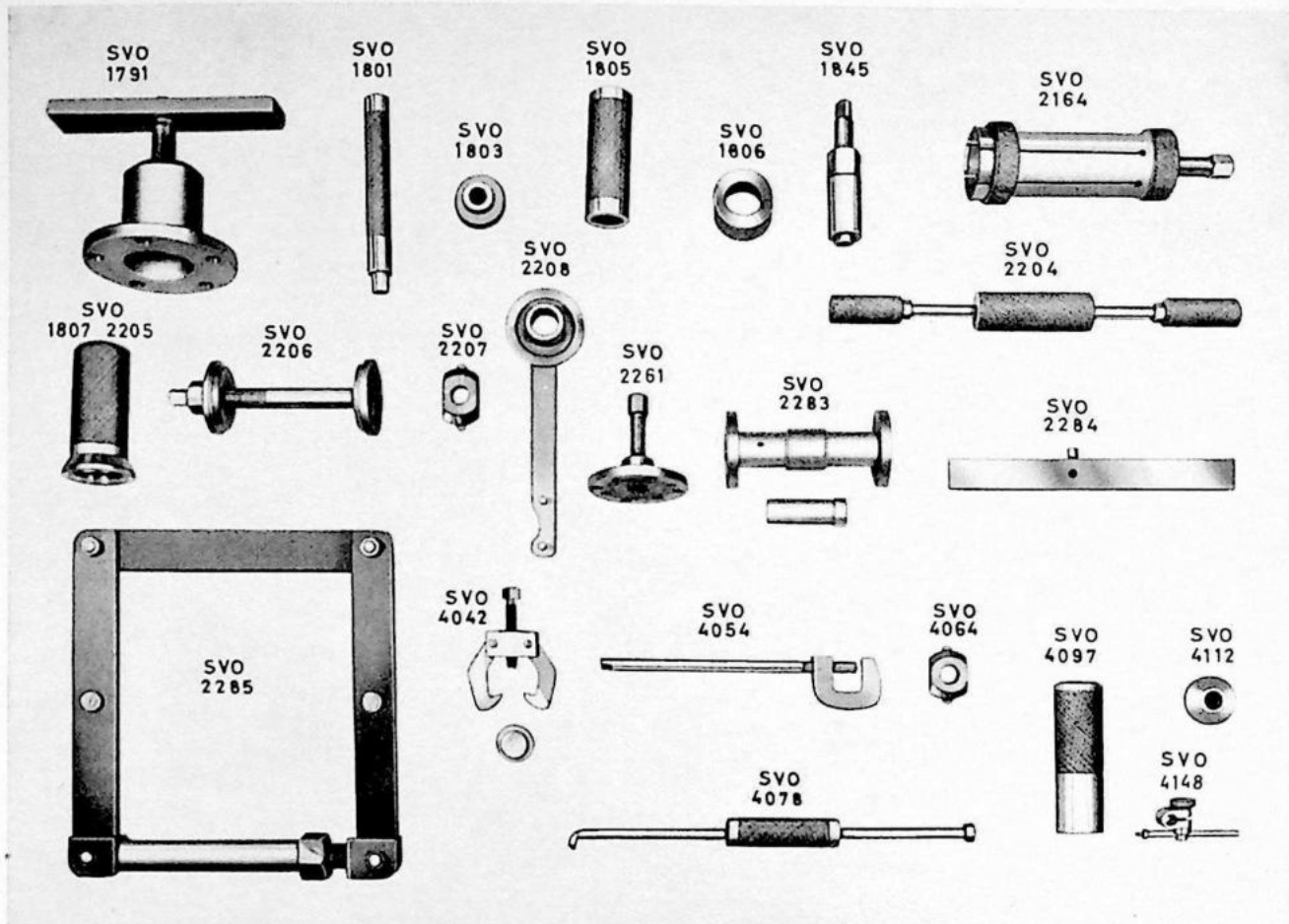
## Tools for rear axle, type I



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Number	Description	Remarks
SVO 1446	Puller for wheel hub	PV 444 chassis nos. 1—20004
SVO 1791	Puller for wheel hub	PV 445 chassis nos. 1—1600
		PV 444 with effect from chassis no. 20005 onwards
		PV 445 with effect from chassis no. 1601 onwards, PV 544
SVO 1801	Standard handle 18×200 mm	
SVO 1803	Tool for fitting drive shaft sealing rings	
SVO 1805	Drift for fitting drive shaft bearings	PV 444 with effect from chassis no. 20005 onwards, PV 445, PV 544
SVO 1806	Counter-ring for removing and fitting drive shaft bearings	PV 444 with effect from chassis no. 20005 onwards, PV 445, PV 544
SVO 1807	Fitting sleeve for drive shaft bearing outer ring	PV 444 with effect from chassis no. 20005 onwards, PV 445, PV 544
SVO 2204	Puller for drive shaft	
SVO 2231	Puller for rear pinion bearing	For late production bearings, see page 5—4
SVO 2261	Puller for flange	
SVO 2304	Press tool for flange	For pinions with $\frac{5}{8}$ "—18 thread
SVO 4030	Puller for pinion sealing ring	
SVO 4042	Puller for differential carrier bearings	
SVO 4047	Fitting tool for pinion bearing outer rings	SVO 4047A can be used for early production sealing rings
SVO 4049	Press tool for fitting flange	For pinions with 18×1.5 mm thread
SVO 4054	Attachment for dial indicator gauge	Used together with SVO 4143 and indicator gauge
SVO 4059	Wrench for adjusting nut	
SVO 4061	Wrench for flange and for fitting sealing ring and pinion	
SVO 4063	Drift for removing front pinion bearing outer ring	
SVO 4064	Drift for removing rear pinion bearing outer ring	
SVO 4069	Packing ring for adjusting rear axle gears	
SVO 4071	Fitting sleeve for drive shaft bearings	PV 444, chassis nos. 1—20004
SVO 4072	Counter-ring for removing and fitting drive shaft bearings	PV 444, chassis nos. 1—20004
SVO 4078	Puller for drive shaft sealing ring	
SVO 4091	Puller for rear pinion bearing	For late production bearings, see page 5—4
SVO 4097	Fitting sleeve for rear pinion bearing	
SVO 4109	Attachment for fixture SVO 4110	
SVO 4110	Fixture for rear axle gears	Used together with SVO 4109
SVO 4112	Drift for fitting differential carrier bearings	
SVO 4148	Retainer for dial indicator gauge	Used together with SVO 4054
SVO 4157	Fitting sleeve for drive shaft bearing outer ring	PV 444 chassis nos. 1—20004

Tools for rear axle, type II



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Number	Description	Remarks
SVO 1791	Puller for wheel hub	
SVO 1801	Standard handle 18×200 mm	
SVO 1803	Drift for fitting drive shaft sealing ring	
SVO 1805	Fitting sleeve for drive shaft bearing	
SVO 1806	Counter-ring for removing and fitting drive shaft bearing	
SVO 1807	Fitting sleeve for drive shaft bearing outer ring	PV 445
SVO 1845	Press tool for fitting flange	Used together with SVO 2208 when adjusting backlash and fitting sealing ring
SVO 2164	Puller for rear pinion bearing	
SVO 2204	Puller for drive shaft	
SVO 2205	Fitting sleeve for drive shaft bearing outer ring	PV 444, 544
SVO 2206	Fitting tool for pinion bearing outer rings	
SVO 2207	Drift for removing rear pinion bearing outer ring	
SVO 2208	Wrench for flange and for fitting pinion sealing ring	
SVO 2261	Puller for flange	SVO 4068 can be used
SVO 2283	Measuring tool for adjusting pinion	
SVO 2284	Retainer for dial indicator gauge	
SVO 2285	Expanding frame for removing and fitting differential	
SVO 4042	Puller for differential carrier bearings	
SVO 4054	Dial indicator gauge attachment	Used together with SVO 4148 and indicator gauge
SVO 4064	Drift for removing front pinion bearing outer ring	
SVO 4078	Puller for drive shaft sealing ring	
SVO 4097	Fitting sleeve for rear pinion bearing	
SVO 4112	Fitting sleeve for differential carrier bearings	
SVO 4148	Retainer for dial indicator gauge	Used together with SVO 4054

## SPECIFICATIONS

Rear axle, type .....	Semi-floating
Track width, PV 444 chassis nos. 1—20004, PV 445 chassis nos. 1—1600 .....	1300 mm (51 11/16")
PV 444 with effect from chassis no. 20005 onwards, PV 445 with effect from chassis no. 1601 onwards, PV 544 .....	1315 mm (51 49/64")
Axial clearance for drive shafts, type I rear axles .....	0.02—0.12 mm (0.0008—0.0047")
II rear axles .....	0.07—0.20 mm (0.003—0.008")

### Rear axle gears

#### PV 444 early production between chassis nos. 1—8377

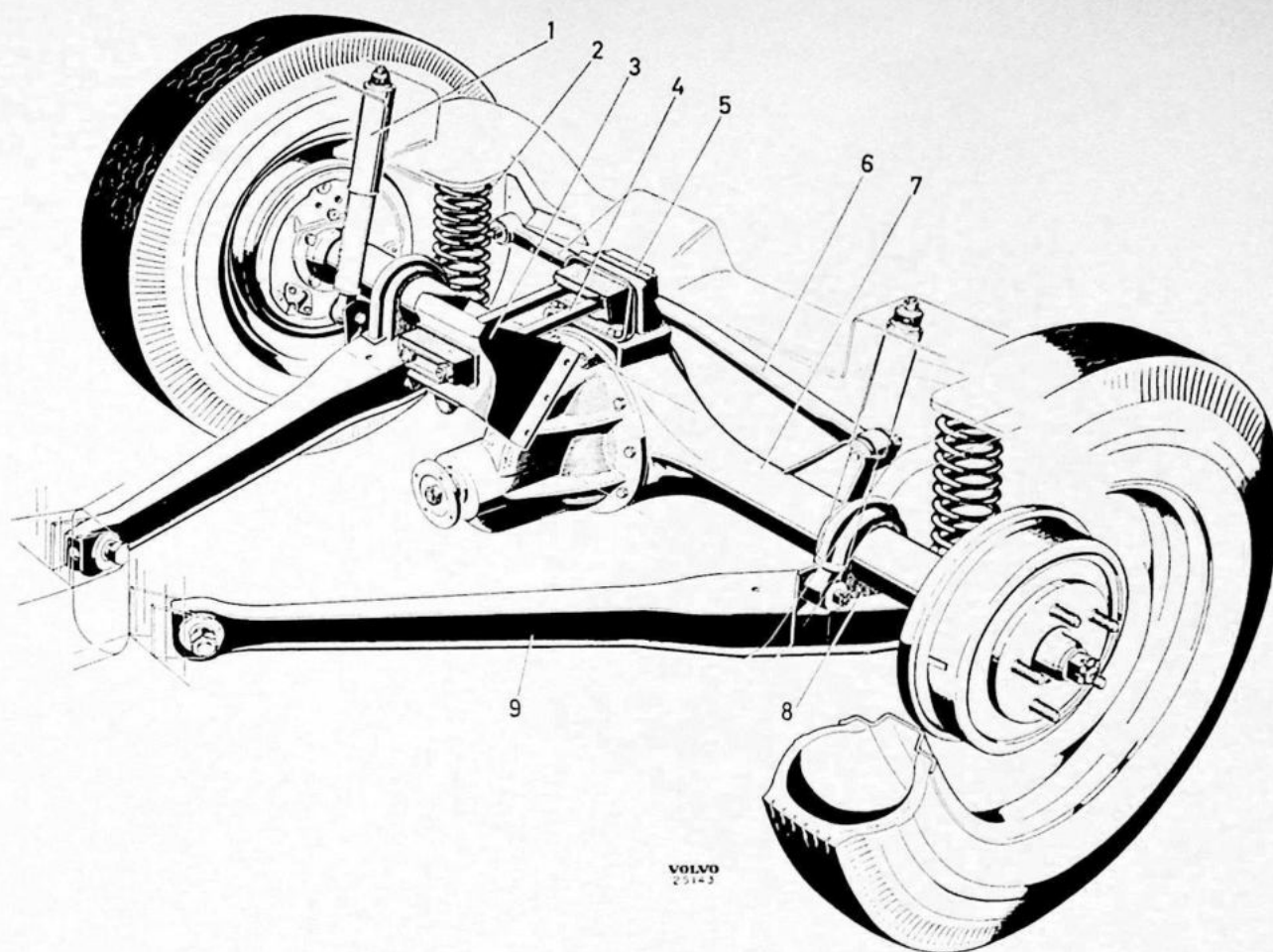
Type .....	Spiral bevel gears (ring gear and pinion)
Reduction ratios, alternatives .....	4.57: 1 (7: 32) 4.63: 1 (8: 37)
Run-out, ring gear, max. ....	0.08 mm (0.003")
Tooth flank clearance (backlash) .....	0.10—0.20 mm (0.004—0.008")
Pinion bearing tension .....	2—4 kgcm (1.75—3.5 lb.in.)
Lubricant .....	Hypoid oil
viscosity .....	SAE 80
Oil capacity .....	1.3 liters (2 3/4 U. S. pints)

#### PV 444 chassis nos. 8378 onwards, PV 445, PV 544

Type .....	Spiral bevel gears (ring gear and pinion) (hypoid)
Reduction ratios, PV 444, PV 544 .....	4.56: 1 (9: 41) or 4.1: 1 (11: 45)
PV 445, chassis nos. 1—500 and 1601 onwards, early production .....	5.43: 1 (7: 38)
PV 445 chassis nos. 1601 onwards, late prod. and PV 445 G, L .....	5.63: 1 (8: 45)
PV 445—1957, early prod. ....	5.13: 1 (8: 41)
PV 445—1957, late prod., P 4450 M .....	4.56: 1 (9: 41 or 11: 50)
Run-out, ring gear .....	max. 0.08 mm (0.003")
Tooth flank clearance (backlash) .....	0.10—0.20 mm (0.004—0.008")
Pinion bearing tension, type I rear axle .....	2—4 kgcm (1.75—3.5 lb.in.)
type II rear axle .....	9—14 kgcm (8—12 lb.in.)
Lubricant .....	Hypoid oil
viscosity .....	SAE 80
Oil capacity, type I rear axle, PV 444 chassis nos. 1—131917 ....	0.9 liter (2 U. S. pints)
type I rear axle, PV 444 chassis nos. 131918 onwards, PV 544 .....	1.3 liters (2 3/4 U. S. pints)
type II rear axle .....	1.3 liters (2 3/4 U. S. pints)
PV 445 .....	1.3 liters (2 3/4 U. S. pints)

### Tightening torques

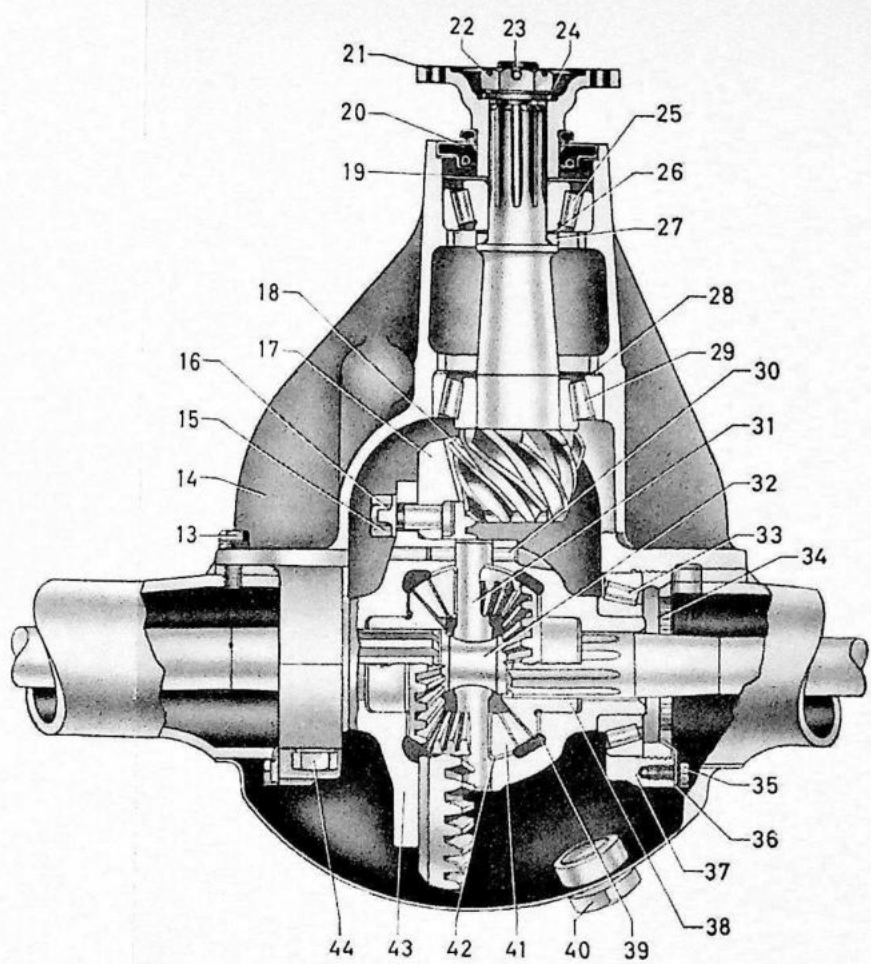
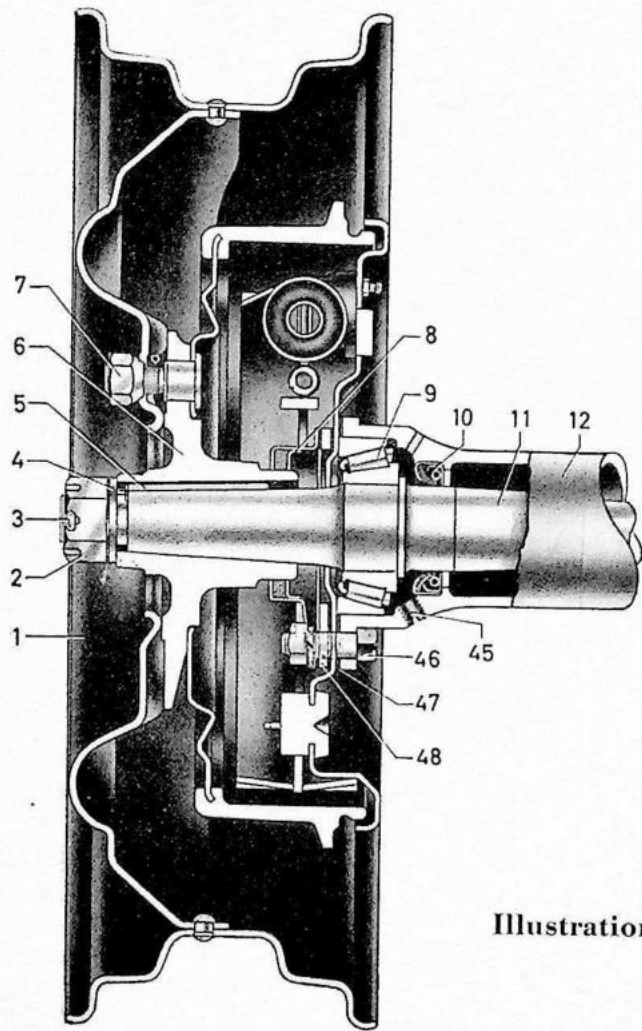
	kgm	lb. ft.
Flange (thread 18×1.5 mm and 5/8"—18) .....	max. 20	max. 150
(thread 3/4"—16) .....	28—30	200—220
Cap (thread 11×1.5 mm) .....	5.5—6	40—45
(thread 1/2"—13) .....	10—11	70—80
Ring gear (thread 10×1 mm) .....	5.5—6	40—45
(thread 10×1.25 mm) .....	5.0—5.5	36—40
(thread 3/8"—24) .....	5.5—7	40—50
(thread 7/16"—20) .....	7—8.5	50—60



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Illustration I. Rear axle suspension, PV 444 late production and PV 544

1. Shock absorber
2. Spring
3. Attachment in body
4. Torque rod
5. Rubber cushion
6. Track rod
7. Rear axle
8. Rubber bushing
9. Suspension arm



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Illustration II. Rear axle, type I (ENV)

- |                            |                             |                          |                                  |                                     |
|----------------------------|-----------------------------|--------------------------|----------------------------------|-------------------------------------|
| 1. Rim                     | 11. Drive shaft             | 21. Flange               | 31. Shaft                        | 41. Small differential gear         |
| 2. Castle nut              | 12. Rear axle housing       | 22. Castle nut           | 32. Thrust block                 | 42. Thrust washer, dished           |
| 3. Split pin               | 13. Bolt with spring washer | 23. Split pin            | 33. Differential carrier bearing | 43. Differential carrier            |
| 4. Washer                  | 14. Rear axle gear housing  | 24. Washer               | 34. Adjusting nut                | 44. Bolt for bearing cap            |
| 5. Key                     | 15. Bolt with nut           | 25. Front pinion bearing | 35. Bolt                         | 45. Plug (early prod.)              |
| 6. Wheel hub               | 16. Locking washer          | 26. Shim                 | 36. Locking washer               | 46. Bolt with nut and spring washer |
| 7. Wheel nut               | 17. Ring gear               | 27. Spacing ring         | 37. Cap for bearing              | 47. Shim                            |
| 8. Retainer with felt seal | 18. Pinion                  | 28. Shim                 | 38. Differential side gear       | 48. Washer                          |
| 9. Roller bearing          | 19. Washer                  | 29. Rear pinion bearing  | 39. Thrust washer, flat          |                                     |
| 10. Sealing ring           | 20. Sealing ring            | 30. Locking pin          | 40. Plug, oil filling            |                                     |

