

SERVICE MANUAL

VOLVO
P 1800

Export Service Department

AKTIEBOLAGET

VOLVO

GÖTEBORG · SWEDEN

WHEEL ALIGNMENT

If the car is to have good steering properties and minimum tire wear, the front wheels must have certain pre-determined settings. These are known as wheel alignment and include caster, camber, king-pin inclination, toe-out and toe-in.

Caster

Caster usually refers to the longitudinal (forwards or backwards) inclination of the king-pin. On this car, which does not have a king-pin, camber consists of the deviation from the vertical of a center line through the ball joints (A, Fig. 6-33).

Camber causes the wheels to maintain a straight-forward position and so to facilitate steering.

Camber

This refers to the inward or outward inclination of the wheel. Camber is reckoned to be positive if the wheel is inclined outwards (see Fig. 6-34) and negative if the wheel inclines inwards. Faulty camber causes uneven tyre wear.

King-pin inclination

This refers to the inward inclination of the king-pin. Since this car does not have a king-pin, inclination is reckoned to be the deviation from the vertical of a center line through the ball joints. (B, Fig. 6-34).

King-pin inclination means that the center line of the king-pin and the wheel approach each other towards

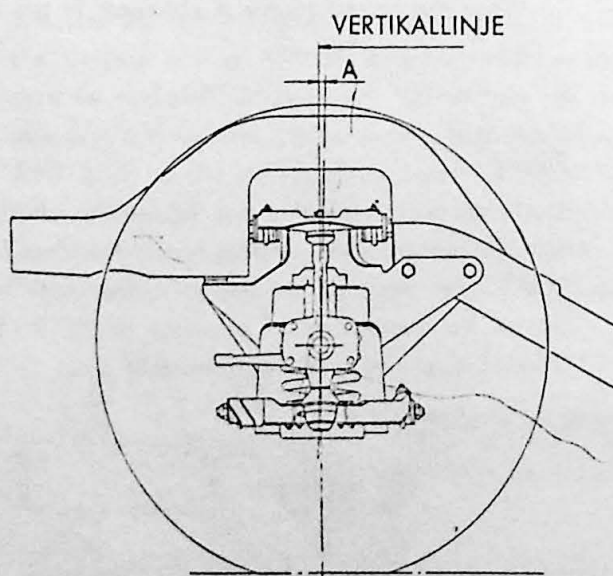
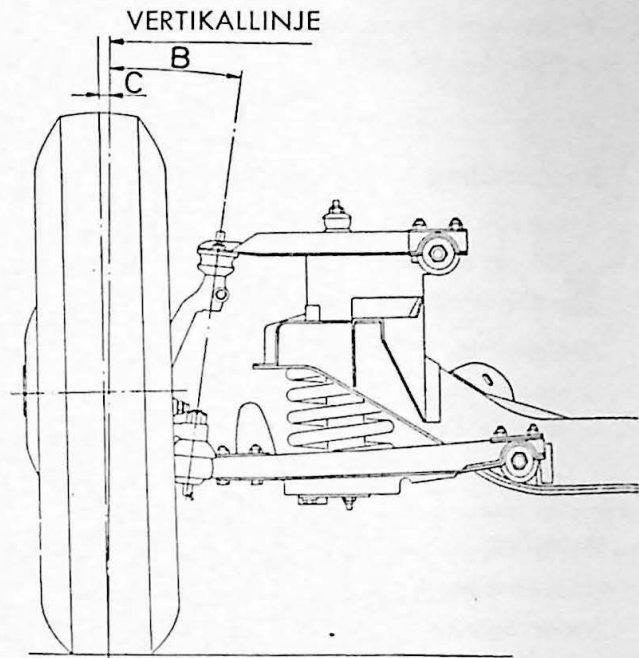


Fig. 6-33. Caster
Vertikallinje = Vertikal line

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Fig. 6-34. Camber and king-pin inclination
Vertikallinje = Vertikal line

the road surface. The wheel is thus easier to turn. King-pin inclination also influences the tendency of the wheels to remain in a straight-forward position since the car is lifted slightly when the steering wheel is turned.

Toe-out

When driving round a curve, the wheels will have different radii of rotation. In order for them to have the same pivoting center and, as a result of this, have minimum tire wear, the front wheels must be turned to different extents. This relationship, the toe-out, is determined by the construction of the steering rods and steering arms. See Fig. 6-35.

Toe-in

The difference in the distances (A and B, Fig. 6-35) between the wheels measured at hub level across the front and rear of the tires, is called toe-in. The purpose of toe-in is to reduce tire wear.

MEASURING AND ADJUSTING WHEEL ALIGNMENT

Wheel alignment is measured by means of special instruments of which many different types are available. For this reason, no general instructions concern-

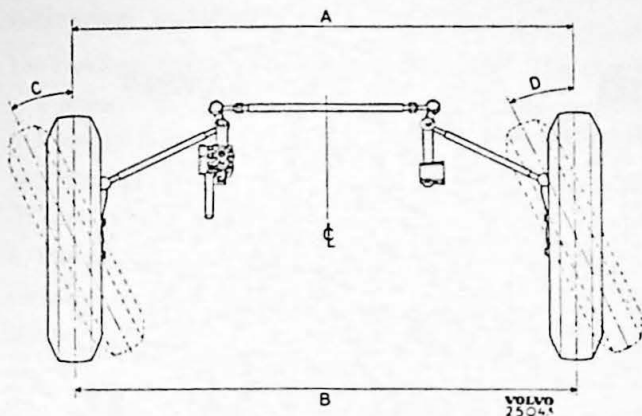


Fig. 6-35. Toe-out

ing procedure are given. Camber is measured directly, with the wheels in the straight-forward position. Caster and kin-pin inclination cannot be measured directly. Instead, measurements are carried out of the angular differences on the instrument when the wheels are turned from 20° outwards to 20° inwards.

When carrying out wheel alignment measurements, always follow the instructions given with the individual instruments being used.

Precautions to be taken before adjusting wheel alignment

When checking wheel alignment, the car must be standing on an absolutely flat and level surface. In addition, the following checks should be carried out and any defects remedied.

1. Check the tire pressure on all wheels.
2. Check that the front wheel tires are worn down equally on both sides. If not, change them round with the rear wheels or spare wheel.
3. Check that the wheels do not have a greater run-out than 0.1" (2.5 mm).
4. Check that there is no excessive play in the wheel bearings, ball joints, control arms or steering mechanism.
5. Check that there is no visible damage on springs, steering rods or control arms.
6. Ensure that the car has normal equipment (oil, water, gasoline, and tools) but is otherwise unloaded.

Adjusting caster

Caster should be 0° to +1°. If it is the same on both sides but of the wrong value, this is adjusted by means of shims (1, Fig. 6-5) between the front axle member and side member. When carrying out adjust-

ment, the front end is lifted and blocks placed under the body at the jacking points. When the front axle member attaching bolts (2, 3 and 4) have been slackened, a sufficient number of shims are added or removed as may be necessary to obtain the correct caster. Tighten the attaching bolts before making a new measurement.

Shims for adjusting caster (front axle member — side member) are available in thicknesses of 2 and 3 mm. The amount by which caster can be adjusted by these shims is shown in Fig. 6-37. NOTE. The same amount of alteration must be done on both sides in order to avoid extra strain on the front axle member.

When caster is different on the right and left-hand side, adjustment is done at the upper control arm shaft (Fig. 6-36). Bend up the locking plate (3) and slacken the attaching bolts (2) so that the shims (1) can be lifted up. These shims are available in thicknesses of 0.15, 0.05, 1, 3 and 6 mm. The amount by which these alter the caster is shown in Fig. 6-37. The same amount of alteration is obtained if one shim is removed from one of the attaching bolts or if it is added to the other. In both cases the camber is altered slightly and the procedure therefore partly depends on how much it is desired to alter this. Always tighten the attaching bolts before making new measurements. When the correct caster is obtained, the attaching bolts are locked with a locking plate (3).

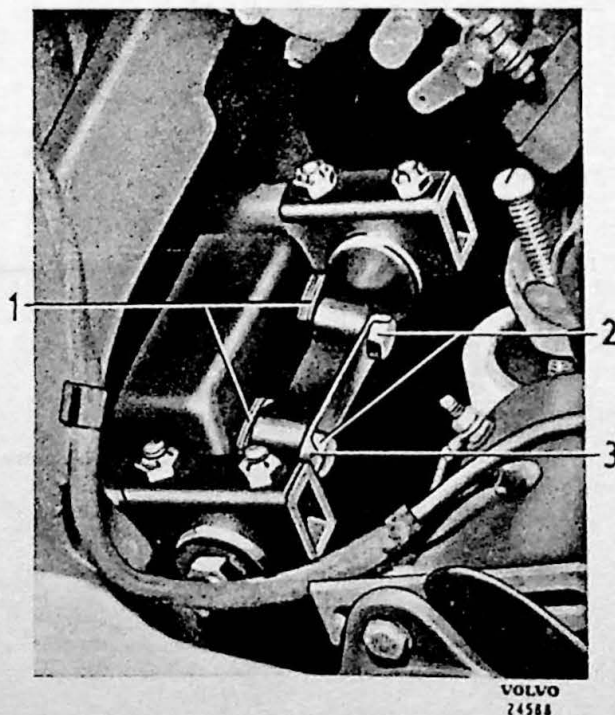


Fig. 6-36. Upper control arm attachment

1. Shims 2. Attaching bolts 3. Locking plate

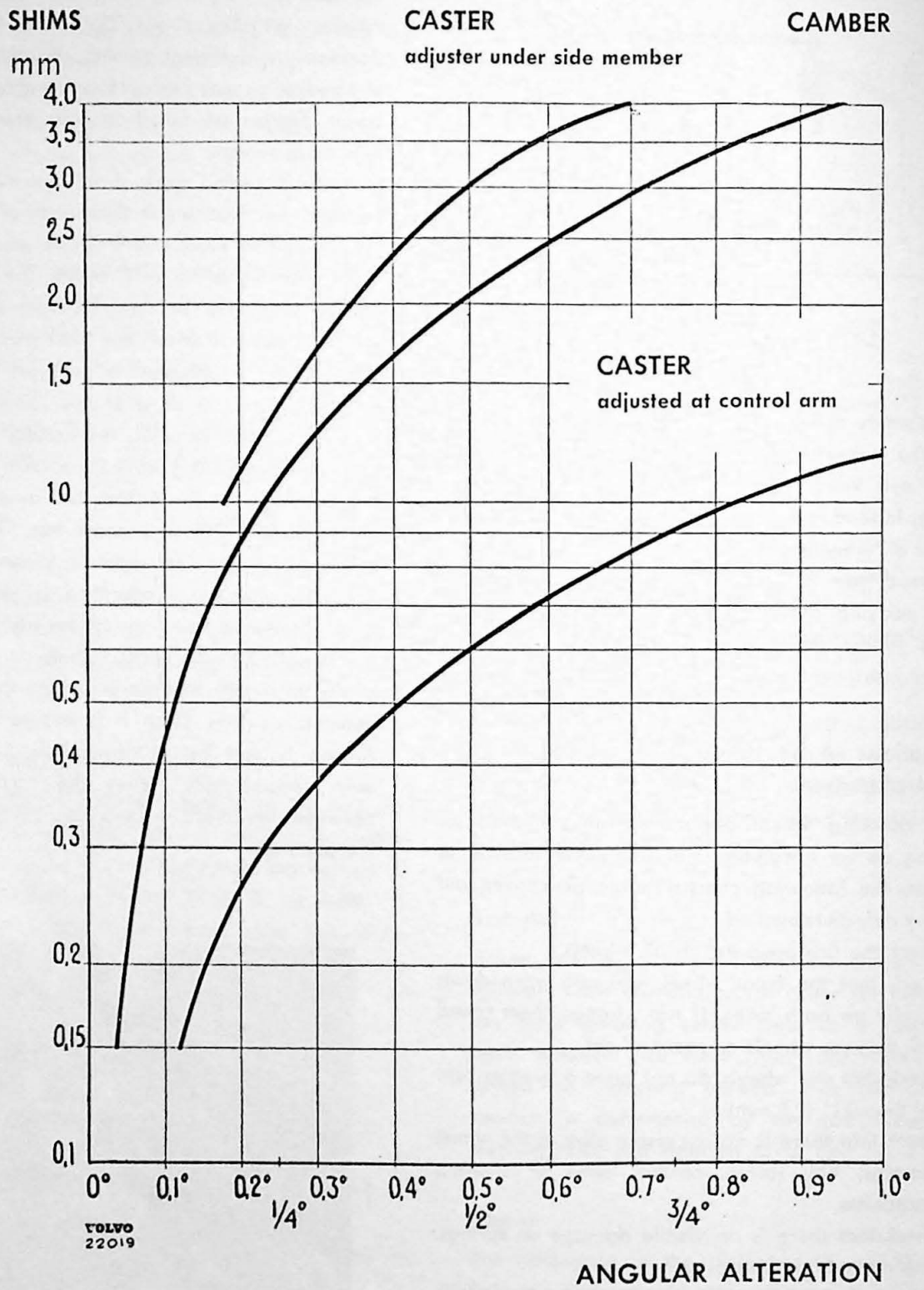


Fig. 6-37. Diagram for camber and caster adjustments

Adjusting camber

The camber angle should be 0° to $+1/2^{\circ}$. The camber is adjusted by means of shims at the upper control arm shaft (Fig. 6-36). Bend up the locking plate (3) and slacken the attaching bolts (2) so that the shims (1) can be lifted up. By increasing the number of shims a more negative camber is obtained and by decreasing the shims a more positive camber is obtained. Shims are available in thicknesses of 0.15, 0.5, 1, 3 and 6 mm. The amount by which the shims alter the camber is shown in Fig. 6-37.

NOTE. Shims of the same thickness must be added or removed at both attaching bolts, as otherwise the caster may be altered.

After adjusting, tighten the attaching bolts and recheck the camber. When the correct camber has been obtained, lock the bolts with the locking plate (3).

Checking king-pin inclination

The king-pin inclination, which on this car corresponds to the inclination of the center line through the ball joints, should be 8° at a camber of 0° .

Checking toe-out

1. Place the front wheels of the car on turntables and ensure that the wheels are in the straight-forward position. When the car is placed on the turntables they should be set to zero and locked.
2. Turn the wheels to the left until the right-hand wheel is turned 20° inwards. The left-hand turntable scale should then read $22.5 \pm 1^{\circ}$.
3. Turn the wheels in the other direction and read off the turning angle in a corresponding manner to that described above.
4. It is not possible to adjust toe-out and if it is faulty, the steering arms and steering rods should be checked and replaced if found to be damaged.

Adjusting steering lock

The amount by which the wheels can be turned outwards is limited by means of stop screws at the pitman arm and idler arm (Fig. 6-38). Adjustment is carried out as follows:

1. Turn the left-hand wheel inwards (as though for taking a right-hand curve) as far as possible. Check that the distance between the tire and stabilizer (measurement A, Fig. 6-39) is $0.59''$ (15 mm). If not, slacken the locknut (3, Fig. 6-38)

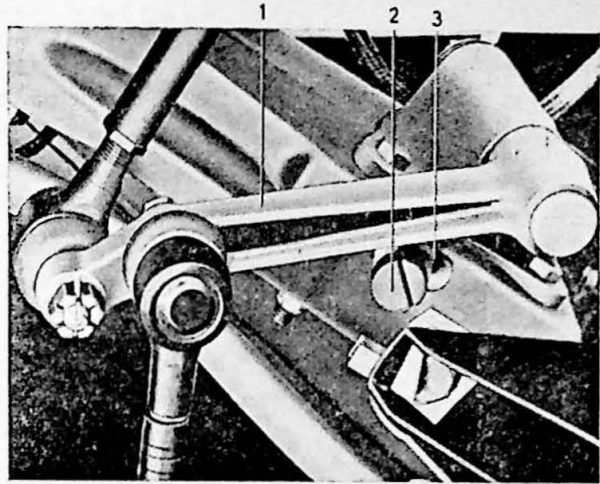


Fig. 6-38. Adjusting steering lock
1. Idler arm 2. Stop screw 3. Locknut

for the idler arm stop screw (2) and turn this until the correct value is obtained. Then lock the stop screw.

2. Repeat the procedure with the right-hand wheel and stop screw at the pitman arm.

Adjusting toe-in

Toe-in should be $0-0.16''$ ($0-4$ mm). This is adjusted by slackening the tie-rod locking nut (13, Fig 6-16) and turning the rod (12) in the desired direction. By turning the tie-rod the same way as the normal direction of rotation of the wheels, the distance between the tires at the front is decreased, that is to say, toe-in is increased. After having obtained correct toe-in, tighten the locknut.

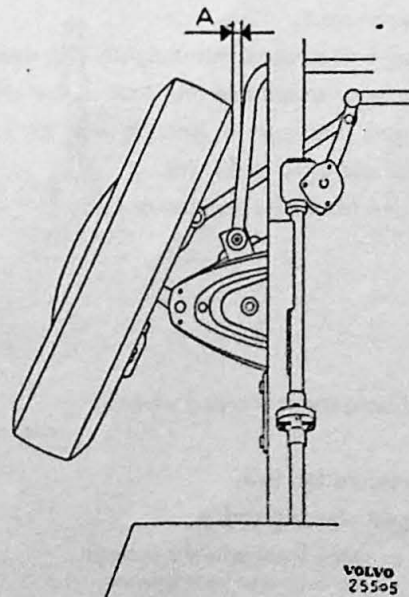


Fig. 6-39. Steering lock measurement
A = $0.59''$ (15 mm)

FAULT TRACING

FAULT

Cause _____ Remedy

The car wanders

Incorrect caster.	Check and adjust caster.
Excessive or insufficient play in the steering box mechanism.	Adjust the steering box mechanism.
Steering rod ball joints worn or too tight.	Check the ball joints and replace any which are worn.
Toe-in faulty.	Check and adjust toe-in.
Tires too soft.	Replace the tires.
Play in rear wheel suspension.	Replace the necessary parts (see Part 5).

The car pulls to one side

Low or uneven tire pressure.	Check and adjust tire pressure (see Part 8).
Front springs sag or are of different heights.	Remove and check the springs (see Part 9).
A roller bearing is excessively tight.	Check the bearings. Replace damaged bearings and adjust according to the instructions on page 4-6.
Faulty tracking.	Check-measure the body and straighten if necessary (see Part 11 and 9 respectively).
Brakes dragging.	Adjust the brakes (see Part 7).
Bent steering rod.	Replace damaged steering rod.
Incorrect camber.	Check and adjust camber.

Hard or stiff steering

Tire pressure too low.	Adjust tire pressure.
Front end in need of lubrication.	Lubricate the front end.
Excessive caster.	Adjust the caster.
Steering box mechanism too tightly adjusted.	Adjust the steering box mechanism.
Too little or unsuitable lubricant in the steering box.	Top up or change the oil as required.
Damaged bearings in steering box or jacket tube.	Replace damaged bearings.
Tight or damaged ball joints.	Replace the ball joints.
Damaged front axle member or body.	Straighten or replace damaged parts.

Front wheel shimmy

Out-of-balance or warped wheels.	Balance and if necessary true-up the wheels (see Part 8).
Tire pressure too low.	Adjust the tire pressure (see Part 8).
Damaged steering rod.	Replace the damaged rod.
Loose or worn front wheel bearings.	Remove wheel and hub. Examine bearing races. If any part is damaged, the whole bearing should be replaced.
Faulty wheel alignment.	Adjust wheel alignment.

Steering shock or kickback

Excessive play in the steering box mechanism.

Unsuitable or too little lubricant in the steering box.

Play in the front wheel bearings.

Play in steering rod ball joints.

Pitman arm wrongly fitted.

Out-of-balance or warped wheels.

Loose steering wheel or steering box mechanism.

Play in idler arm.

Bushings in shock absorber attachments worn or attachments loose.

Shock absorbers not functioning.

Adjust or if necessary recondition the steering box mechanism.

Check the oil. Concerning this, see specifications.

See under the heading "Front wheel bearings".

Replace loose ball joints.

Adjust position of pitman arm.

Balance the wheels and true them up if necessary.

Tighten the steering wheel or steering box mechanism.

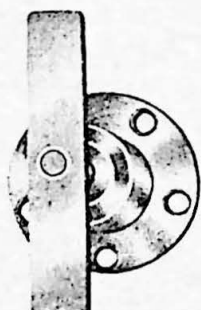
Tighten or if necessary replace bushings.

Replace necessary parts.

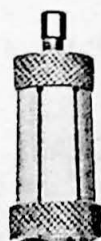
Replace shock absorbers.

TOOLS

The following special tools are required for repairs to the front axle and steering gear.



SVO 1791



SVO 1794



SVO 1797



SVO 1799



SVO 1798



SVO 1800



SVO 1801



SVO 2197



SVO 2281



SVO 2282

VOLVO
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Fig. 6-40. Special tools for front axle

FRONT AXLE

SVO 1791 Puller for wheel hub

SVO 1794 Puller for inner ring, inner wheel bearing

SVO 1797 Drift for fitting outer bearing ring

SVO 1798 Drift for fitting inner bearing ring and seal in hub

SVO 1799 Drift for removing inner bearing ring

SVO 1800 Drift for removing outer bearing ring

SVO 1801 Standard handle 18x200

SVO 2197 Drift for fitting and removing grease cap

SVO 2281 Tool for removing lower ball joint, control arm

SVO 2282 Puller for pitman arm

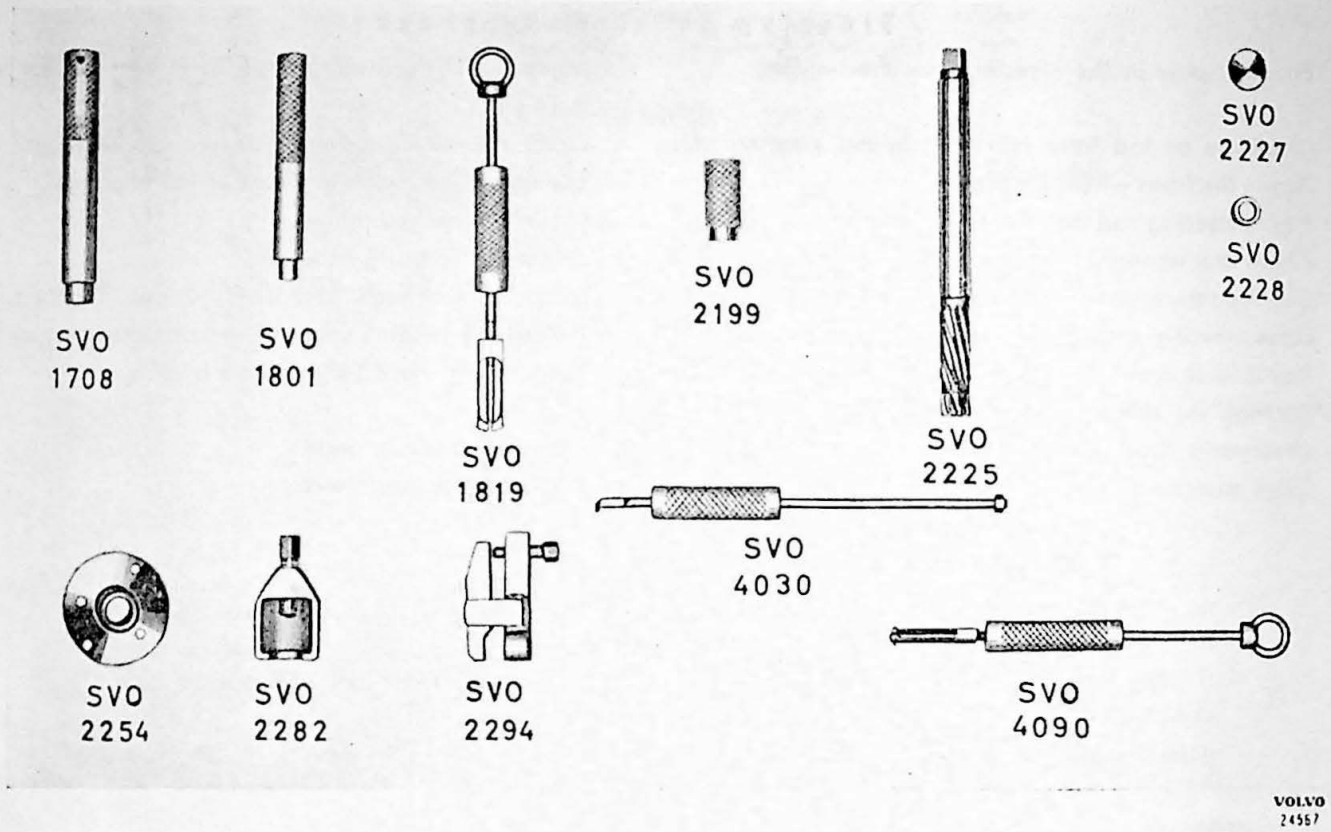


Fig. 6-41. Special tools for steering gear

STEERING GEAR

- | | | | |
|----------|--|----------|---|
| SVO 1708 | Drift for removing upper outer bearing race | SVO 2228 | Drift for fitting pitman arm shaft bushings |
| SVO 1801 | Standard handle | SVO 2254 | Guide for reamer SVO 2225 |
| SVO 1819 | Puller for pitman arm shaft bushings | SVO 2282 | Puller for pitman arm |
| SVO 2199 | Protective sleeve for seal when fitting pitman arm shaft | SVO 2294 | Puller for ball joint, tie-rod and steering rod |
| SVO 2225 | Reamer for pitman arm shaft bushings | SVO 4030 | Puller for stuffing boxes |
| SVO 2227 | Drift for fitting pitman arm shaft seals | SVO 4090 | Puller for needle bearings in idler arm bracket |

SPECIFICATIONS

FRONT AXLE

Shims for front axle member	Thickness = 2 mm
	Thickness = 3 mm
Shims for upper control arms	Thickness = 0.15 mm
	Thickness = 0.5 mm
	Thickness = 1 mm
	Thickness = 3 mm
	Thickness = 6 mm

STEERING GEAR

Steering wheel diameter	16" (406.4 mm)
Number of turns (from lock to lock)	3 1/4
Steering mechanism, type	Gemmer, "cam and roller"
ratio	15.5:1
Shims for steering worm bearings	Thickness = 0.10 mm
	Thickness = 0.12 mm
	Thickness = 0.15 mm
	Thickness = 0.30 mm
Washers between adjusting screw and pitman arm shaft (In stages of 0.05 mm)	Thickness = 2.20—2.45 mm
Lubricant for steering box	Hypoid oil SAE 80
Oil capacity	1/2 US pint = 3/8 Imp. pint (0.2 liter)

Idler arm:	
necessary turning torque	1.3—7.38 lb.in. (1.5—8.5 kg/cm)
shims	Thickness = 0.1 mm
	Thickness = 0.35 mm

WHEEL ALIGNMENT

Caster	0 to +1°
Camber	0 to +1/2°
"King pin" inclination at 0° camber	8°
Toe-in	0 to 5/32" (0 to 4 mm)
Toe-out:	
When the outer wheel is turned 20°, the inner wheel should be turned	21.5 to 23.5°

TIGHTENING TORQUES

Nyloc nut for idler arm (2, Fig. 6-18)	60 lb.ft. (8.5 kgm)
Steering wheel nut	25—35 lb.ft. (3.5—5 kgm)
Nut for pitman arm (14, Fig. 6-17)	100—120 lb.ft. (13.5—16.5 kgm)
Castle nut for steering rod and tie-rod	23—27 lb.ft. (3.2—3.7 kgm)
Nut for control arm clamp	15—17 lb.ft. (2.1—2.4 kgm)
Bolt for upper control arm shaft (2, Fig. 6-36)	35—40 lb.ft. (4.8—5.5 kgm)