Chapter 10 Steering

Contents

Degrees of difficulty

Easy, suitable for novice with little experience

Fairly easy, suitable for beginner with some experience

Fairly difficult, suitable for competent DIY mechanic

Difficult, suitable for experienced DIY mechanic

Very difficult, suitable for expert DIY or professional

Specifications

Type	Rack and pinion with safety column
Steering wheel diameter	381.0 mm (15.0 in)
Number of turns, lock-to-lock	4
Turning circle	9.4 m (3084 ft)
Steering angles of roadwheels	
Inner wheel	32º 58’
Outer wheel	39º 8’
Front suspension steering angles	
Camber	0º 5’ negative to 0º 55’ positive
Castor	1º 40’ to 2º 20’ positive
Toe-in	0 to 2.0 mm (0 to 0 08 in)
Rear suspension	
Camber	0º (non-adjustable)
Rack lubricant	
Type	Lithium based molybdenum disulphide grease
Capacity	140 cc

Torque wrench settings	**Nm**	**lbf ft**
Steering wheel nut	50	37
Steering shaft coupling pinch-bolt	27	20
Steering gear mounting bolts	24	18
Tie rod balljoint locknut	35	26
Tie-rod balljoint taper pin nut	35	26
Steering column upper mounting bolts	5	3

1 Description and maintenance

1 The steering gear is of rack and pinion type with a universally-jointed column which incorporates a steering lock and ignition switch.
2 The steering wheel is of two spoke type on all models except the SX which has four spokes.
3 The system is maintenance-free except to check occasionally the pinch-bolts.
4 At the intervals specified in *“Routine Maintenance”* carefully inspect the rack gaiters for splits, particularly at the bottom of the vees, as a split here can often go unnoticed.
5 Check the tie-rod balljoints for wear. To do this, have an assistant turn the steering wheel repeatedly in both directions through an arc of about 10 or 15 degrees. Observe the balljoints for lost motion or slackness. If evident, renew the balljoint as described in Section 2

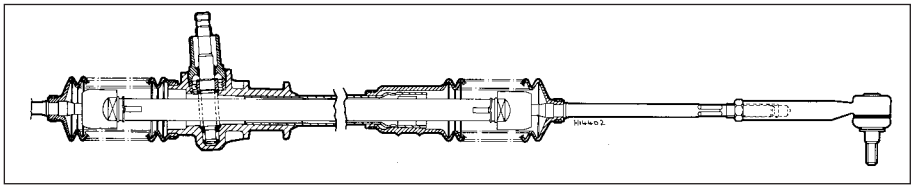


Fig. 10.1 Sectional view of steering gear (Sec 1)

2.2 Disconnecting a tie-rod end balljoint

4.2 Removing steering wheel hub plate

2 Tie-rod end balljoint - renewal

1 Jack up the front of the car and remove the roadwheel from the side on which the balljoint is to be renewed.
2 Unscrew the tie-rod balljoint taper pin nut and, using a suitable extractor, separate the tie-rod balljoint from the eye of the steering arm (photo).
3 Release the locknut on the tie-rod, unscrewing it only just enough to be able to unscrew the tie-rod end from the tie-rod.
4 With the tie-rod end removed, wire brush the threads on the tie-rod without disturbing the position of the locknut; apply grease to the threads and screw on the new tie-rod end until the locknut can be tightened by turning it through the same amount of rotation it was given when unscrewed.
5 Reconnect the balljoint taper pin to the eye of the steering arm and tighten the retaining nut to the specified torque. *Never grease the taper pin or eye;* the pin will otherwise turn when the nut is tightened. If a taper pin is inclined to rotate when a nut is being tightened, apply pressure to the socket of the joint to force the taper pin into closer contact with the tapered hole in the eye. If a taper pin is pointing downward, a strong lever can be used to apply the extra pressure. Where the taper pin of a balljoint points upward, a jack placed under the joint socket will produce the desired result.
6 Although the careful fitting of the new tie-rod end will have approximately maintained the original front wheel alignment of the car, manufacturing differences alone of the new component make it essential to check the setting, as described in Section 8 and to adjust if necessary.

3 Steering rack gaiter - renewal

1 If lubricant is found to be leaking from the gaiters (at the ends of the housing), first check that the gaiter clips are secure.
2 If the lubricant is leaking from the gaiter through a split, the gaiter can be removed in the following way, without the necessity of withdrawing the gear from the car.
3 Remove the tie-rod end from the side concerned, as described in the preceding Section.
4 Release the gaiter clips; draw the gaiter from the rack housing and off the tie-rod.
5 If the gaiter has only just split, road dirt is unlikely to have entered and lubricant can be wiped away. If it is severely grit contaminated, the steering gear should be completely removed, the original lubricant flushed out and new lubricant pumped in.
6 If the gear does not have to be removed from the car, slide the new gaiter into position and secure it with the inboard clip.
7 The rack lubricant is molybdenum disulphide type grease.
8 When recharging the gaiter with this type of lubricant, give full steering lock to the side being replenished so that the extended section of the rack will take the grease into the housing as it returns.
9 Reconnect the tie-rod end to the tie-rod and the eye of the steering arm. Provided the locknut is tightened by only rotating it through the same distance by which it was loosened, the front wheel alignment (tracking) should not have been unduly disturbed. Even so, check the alignment as described in Section 8.

4 Steering wheel - removal and refitting

1 Disconnect the battery negative lead.
2 Set the steering wheel and the front roadwheels in the straight-ahead attitude. Prise out the hub plate (photo).
3 Unscrew and remove the steering wheel securing nut, then pull the wheel from the column shaft. If it is tight on its splines, tap it upward at the wheel rim, using the palms of the hands.
4 Refitting is a reversal of the removal process; make sure that the spokes of the wheel are in the lower part of the wheel.
5 Tighten the securing nut to the specified torque.

5 Steering column - removal, overhaul and refitting

1 Remove the steering wheel as previously described.
2 Extract the screws from the underside of the steering column upper shroud and then lift off the upper and lower shroud sections (photo). Where applicable, detach and remove the trim panel from the underside of the facia on the driver's side.
3 Disconnect the battery negative lead.
4 Disconnect the wiring plug for the steering column combination switch.
5 Unscrew the clamp nuts and pull the combination switch off the end of the steering shaft.
6 Unscrew the column upper mounting bracket bolts and lower the shaft/column tube to rest on the seat (photo).
7 Remove the pinch-bolt from the lower universal joint coupling and remove the shaft/column tube from the car.

Overhaul

8 Remove the pinch-bolt from the upper universal joint and disconnect the lower shaft.
9 Grip the tube mounting flange in the jaws of a vice and relieve the staking at the base of the tube.
10 Using a plastic or copper-faced hammer, tap the shaft down out of the tube.
11 The lower bush will be ejected while the upper one should be prised out of the tube.
12 Reassemble the upper shaft into the tube by tapping new bushes into position.

5.2 Removing steering column shrouds

5.6 Steering column upper mounting

Fig. 10.2 Removing steering column shroud screws (Sec 5)

Fig. 10.3 Unscrewing combination switch clamp nuts (Sec 5)

Fig. 10.4 Renewing steering shaft bushes (Sec 5)

13 Stake the lower end of the tube to retain the bush.
14 Reassembly is a reversal of removal, noting that the universal joint coupling pinch-bolts should pass smoothly through the grooves in the steering shaft.
15 Fit the steering wheel when the roadwheels are in the straight-ahead position.
16 Tighten all nuts and bolts to the specified torque. Reconnect the battery.

6 Steering rack - removal and refitting

1 Set the steering in the straight-ahead mode.
2 Working inside the car, disconnect the steering shaft lower coupling by unscrewing and removing the pinch-bolt (photo).
3 Disconnect the tie-rod end balljoints from the steering arms as described earlier in this Chapter.
4 Unscrew and remove the rack clamp mounting bolts and withdraw the steering gear from the car crossmember (photo).
5 Refitting is a reversal of removal, but on completion check the front wheel alignment as described in Section 8.

6.2 Steering shaft coupling

7 Steering gear - overhaul

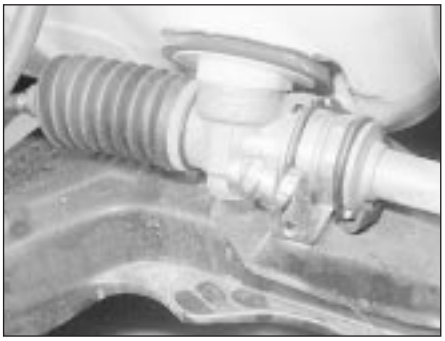
1 A worn steering gear should not be overhauled, but a new or factory reconditioned unit fitted.
2 After a high mileage, the following adjustment may be needed however.

Rack damper - adjustment

3 The slipper in the rack housing presses the rack into mesh with the pinion. This cuts out any backlash between the gears. Also, due to its pressure, it introduces some stiffness into the rack, which cuts out excessive reaction from the road to the steering wheel.
4 In due course, wear reduces the pressures exerted by the slipper. The pressure is controlled by the cover plate and a spring.
5 The need for resetting of the slipper is not easy to detect. On bumpy roads, the shock induced through the steering will give a feeling of play, and sometimes faint clonking can be heard. In extreme cases, free play in the steering may be felt, though this is rare. If the steering is compared with that of a new rack on another car, the lack of friction damping is quite apparent in the ease of movement of the steering wheel of the worn one.
6 Centralise the steering rack. Do this by counting the number of turns lock-to-lock and then turning the steering wheel from one lock through half the number of turns counted.
7 Take the cover plate off the damping slipper, remove the spring and shims, and refit the cover plate.
8 Screw in the cover plate bolts just enough to hold the slipper against the rack.
9 Measure the gap between the cover plate and the rack housing using feeler blades.
10 Select shims from the thicknesses available (0.10, 0.125 and 0.30 mm) to provide a shim pack thicker than the gap by between 0.05 and 0.13 mm.
11 Remove the cover plate, fit the spring and bolt on the cover plate with the selected shims.

8 Steering angles and front wheel alignment

1 Accurate front wheel alignment is essential to provide good steering and roadholding characteristics and to ensure slow and even tyre



6.4 Steering rack housing at pinion end

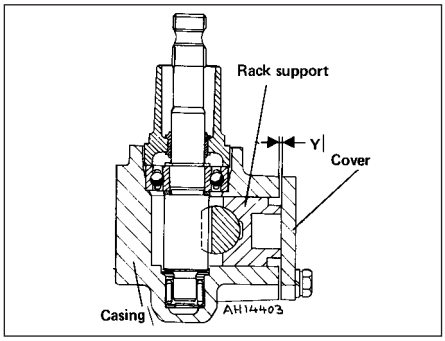


Fig. 10.5 Sectional view of rack damper (Sec 7)

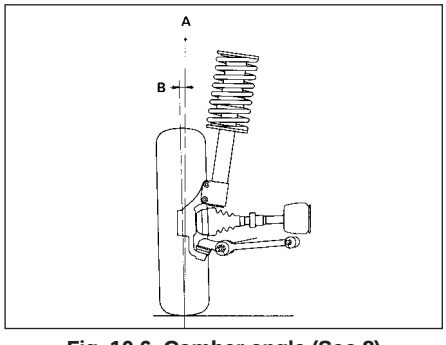


Fig. 10.6 Camber angle (Sec 8)
A Vertical line B Camber angle (positive)

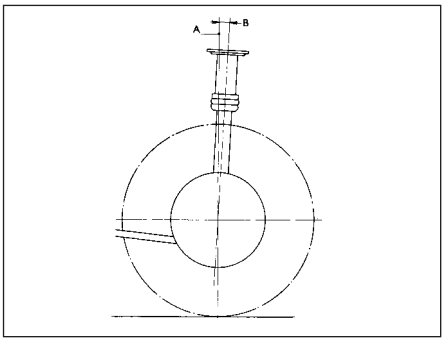


Fig. 10.7 Castor angle (Sec 8)

A Vertical line B Castor angle (positive)

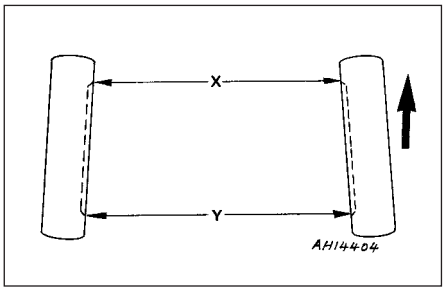


Fig. 10.8 Front wheel alignment diagram (Sec 8)

X Front dimension Y - X = Toe-in
Y Rear dimension

Fig. 10.9 Steering column lock shear bolts (arrowed) (Sec 9)

wear. Before considering the steering angles, check that the tyres are correctly inflated, that the front wheels are not buckled, the hub bearings are not worn or incorrectly adjusted and that the steering linkage is in good order, without slackness or wear at the joints.

2 Wheel alignment consists of four factors:

Camber, is the angle at which the road wheels are set from the vertical when viewed from the front or rear of the vehicle. Positive camber is the angle (in degrees) that the wheels are tilted outwards at the top from the vertical.

Castor, is the angle between the steering axis and a vertical line when viewed from each side of the vehicle. Positive castor is indicated when the steering axis is inclined towards the rear of the vehicle at its upper end.

Steering axis inclination, is the angle when viewed from the front or rear of the vehicle between vertical and an imaginary line drawn between the upper and lower suspension strut mountings.

Toe, is the amount by which the distance between the front inside edges of the roadwheel rims differs from that between the rear inside edges.

3 If the distance between the front edges is less than that at the rear, the wheels are said to toe-in. If the distance between the front inside edges is greater than that at the rear, the wheels toe-out.

4 Camber and castor are set during production of the car and are not adjustable. Any deviation from specification will be due to collision damage or to gross wear in the components concerned.

5 To check the front wheel alignment, first make sure that the lengths of both tie-rods are equal when the steering is in the straight-ahead position. Measure between the locknut at the balljoint and the ball cup at the end of the rack housing by passing a thin rod under the rack of the gaiter. If adjustment is required, release the locknut and turn the tie-rod.

6 Obtain a tracking gauge. These are available in various forms from accessory stores or one can be fabricated from a length of steel tubing suitably cranked to clear the sump and bellhousing and having a setscrew and locknut at one end.

7 With the gauge, measure the distance between the two wheel inner rims (at hub height) at the rear of the wheel. Push the vehicle forward to rotate the wheel through 180º (half a turn) and measure the distance between the wheel inner rims, again at hub height, at the front of the wheel. This last measurement should differ from (be less than) the first by the appropriate toe-in according to the Specification (see Specifications Section).

8 Where the toe-in is found to be incorrect, release the tie-rod balljoint locknuts and turn the tie-rods equally. Only turn them a quarter of a turn at a time before re-checking the alignment. Viewed from the centre line of the car, turning the tie-rod clockwise will decrease the toe-in.

9 Make sure that the gaiter outboard clip is released otherwise the gaiter will twist as the tie-rod is rotated.

10 Always turn both rods in the same direction when viewed from the centre line of the vehicle otherwise the rods will become unequal in length. This would cause the steering wheel spoke position to alter and cause problems on turns with tyre scrubbing.

11 On completion, tighten the tie-rod balljoint locknuts without altering their setting. Check that the balljoint is at the centre of its arc of travel and then retighten the gaiter clip.

9 Steering column lock - removal and refitting

1 Remove the steering wheel and column shrouds as described in Section 5, also the steering column combination switch.

2 Unscrew and remove the steering column mounting bolts and lower the column to expose the lock shear bolts.

3 Drill out the bolts or extract them using an extractor.

4 Refer to Chapter 4 for details of separation of the ignition switch from the lock section.

5 When fitting the new lock, tighten the shear bolts until their heads break off.

6 Bolt up the column, fit the combination switch, shrouds and steering wheel and tighten all nuts and bolts to the specified torque.

Fault finding - steering

Note: *Before diagnosing steering faults, be sure that trouble is not due to incorrect or uneven tyre pressures, inappropriate tyre combinations, or braking system or suspension defects.*

Car pulls to one side

- ☐ Incorrect steering geometry
- ☐ Collision damage

Vibration at steering wheel

- ☐ Roadwheels out of balance or loose
- ☐ Tyre damage
- ☐ Loose driveshaft-to-hub nuts

Car wanders

- ☐ Play in steering gear
- ☐ Wear in steering balljoints

Heavy or stiff steering

- ☐ Lack of lubricant in steering gear or balljoints
- ☐ Incorrect steering geometry
- ☐ Collision damage

Play at steering wheel

- ☐ Wear in steering rack or balljoints
- ☐ Loose steering shaft coupling pinch-bolt or worn splines
- ☐ Worn steering column/shaft universal joints

Rattles from steering

- ☐ Steering damper defective or in need of adjustment
- ☐ Loose steering column mounting bolts
- ☐ Loose steering column/shaft coupling pinch-bolts
- ☐ Loose steering rack housing mounting bolts
- ☐ Worn steering shaft bushes

Excessive or uneven tyre wear

- ☐ Incorrect steering geometry
- ☐ Worn steering components
- ☐ Collision damage