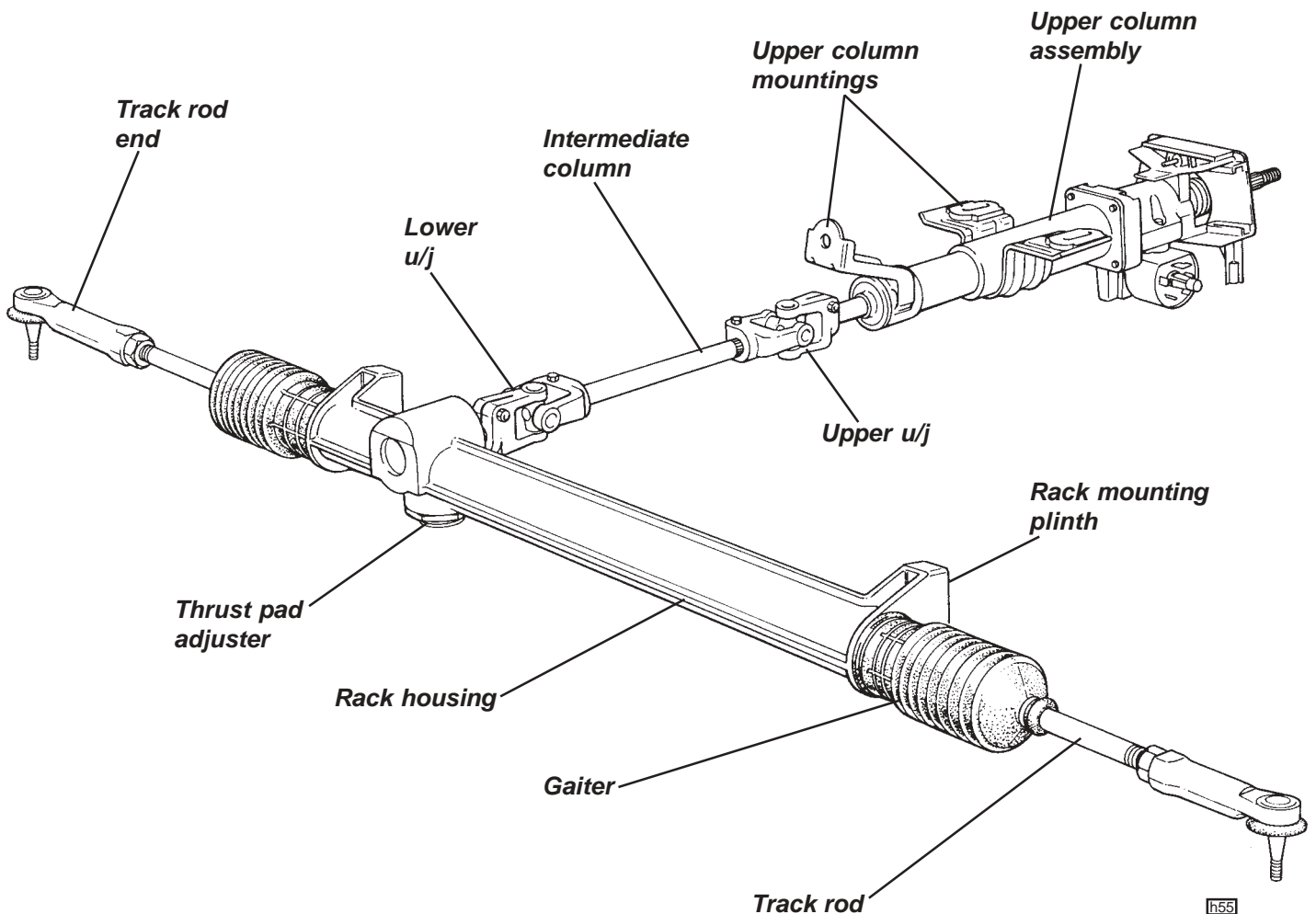




STEERING

SECTION HG

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HG.1 - GENERAL DESCRIPTION

The steering system of the Elise comprises a telescopically collapsible upper column assembly, connecting to a rigidly mounted rack and pinion assembly via a universally jointed intermediate shaft. The steering rack tie rods connect to rearward facing steering arms bolted to the forged steel front hub carriers, with geometry providing 30% Ackermann effect, and a toe-out on bump characteristic. No power assistance is provided. Prior to June '04, the steering rack assembly used a one-piece, alloy, pinion/rack housing, superseded after that time by a cast alloy pinion housing mated to a tubular steel rack housing.

The upper column is fixed to the scuttle beam, with the column upper bearing carrier also providing mountings for the steering lock and column switches. 'Break out' inserts fitted in the column upper mounting flanges, allow for telescoping of the column in a frontal collision. The steering rack assembly, which provides 2.4 turns from lock to lock at a 15.8:1 ratio, is rigidly mounted inside a chassis transverse extrusion behind the top wishbone rear pivots.

HG.2 - STEERING WHEEL

Non Airbag Type: The alloy three spoke steering wheel, has a leather trimmed rim and moulded rubber covered spokes, and is secured to the column via a 36 spline boss. The horn button is mounted in the steering wheel centre pad which is supported by a collapsible steel spider bolted to the hub of the wheel. The positive feed to the horn button is supplied via a spring loaded contact housed in the column switch carrier, and a slip ring mounted on the forward side of the wheel. The earth contact of the button is connected to a terminal on the spider.

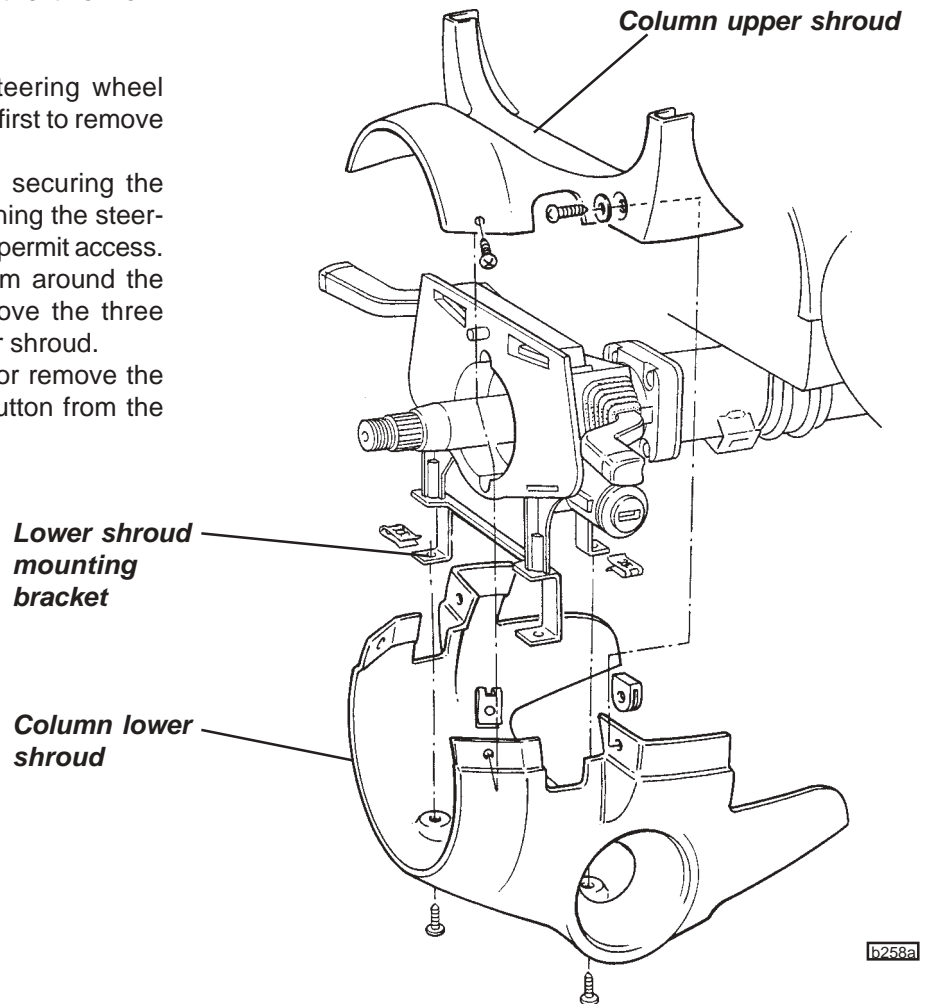
Airbag Type: The alloy three spoke steering wheel has a leather trimmed rim and moulded rubber covered spokes which incorporate horn buttons in the outer ends of each of the nominally horizontal spokes. An airbag



module is incorporated in the centre of the wheel, and uses a rotary coil unit to maintain cable continuity to the airbag and horn buttons.

To Remove Steering Wheel (non airbag type)

1. Pull off the centre trim pad with horn button, and disconnect the two horn leads.
2. To allow access for a steering wheel puller tool, it is necessary first to remove the column shroud:
 - Release the four screws securing the shroud upper section, turning the steering wheel as necessary to permit access.
 - Pull out the grommet from around the ignition switch, and remove the three screws securing the lower shroud.
 - If necessary, disconnect or remove the trip/panel lights control button from the lower shroud.



3. Remove the nut securing the steering wheel boss to the column. Match mark the boss and column to enable alignment to be maintained on re-assembly.
4. Use a suitable steering wheel puller tool to locate behind the steering wheel boss and bear against the end of the column.
CAUTION: If excessive force is applied to either the wheel or column without an appropriate puller, the telescoping mechanism of the outer column may be overridden, necessitating column replacement.
5. If necessary, unclip the slip ring from the steering wheel boss and withdraw with the horn lead. Withdraw the column bearing preload spring.
6. To refit the steering wheel, reverse the above procedure with the following notes:
 - Clip the horn slip ring to the steering wheel boss with the turn indicator cancelling vane on the left hand side.
 - Ensure that the column bearing preload spring is fitted over the inner column before fitting the wheel with the match marks aligned. If re-alignment is necessary, see later.
 - Torque tighten the steering wheel to column nut to 25 Nm.



To Remove Steering Wheel (airbag type)

WARNING: The driver's airbag is housed in the hub of the steering wheel. Precautions need to be taken for personal safety when working with airbags and associated componentry. Do not attempt to remove the airbag or steering wheel without first referring to section WD.

On the back of the airbag type steering wheel hub, is mounted a 'rotary connector', being a device which allows the steering wheel to turn whilst maintaining electrical continuity to the airbag module and horn buttons. This device needs to be centralised before fitting, or breakage will result. Follow instructions below carefully.

1. Column shrouds: Remove the two screws retaining the top part of the shroud, and the four screws retaining the lower part, and withdraw both parts from the column, if necessary disconnecting the trip/panel lights control button from the lower shroud.
2. Refer to section WD to remove the airbag module from the wheel.
3. Disconnect the horn harness plug.
4. The steering wheel may be released from the hub by removing the four attaching screws.
5. To remove the hub, or wheel and hub assembly from the column, first ensure the front wheels are pointing straight ahead. Bend back the locking tabs and release the nut securing the hub to the column. Before attempting to remove the hub, match mark the position of the hub against the column to aid re-assembly.
6. Using a suitable steering wheel puller tool, position the legs to reach through the holes in the wheel hub and bear directly against the hub, without interfering with the rotary connector on the back of the hub. The centre screw should bear against the end of the column. Withdraw the wheel/hub/rotary connector assembly from the column splines.
Alternatively, for better puller access, the steering wheel can first be removed from the hub by releasing the four retaining screws.

CAUTION: If excessive force is applied to either the wheel/hub or column without an appropriate puller, the telescoping mechanism of the outer column may be overridden, necessitating column replacement.

Refitment

7. If the hub is already fitted to the column, refit the steering wheel to the hub and tighten the four fixing screws. Mate the horn buttons harness connector plug.
8. If fitting the wheel/hub/rotary connector assembly to the column, the rotary connector must first be centralised: Turn the connector centre element fully counterclockwise until tight, then turn clockwise approximately 2.5 turns until the arrow marks on the two parts of the rotary connector are aligned. Make sure the front wheels are pointing straight ahead, and fit the assembly onto the column with the hub to column match marks (made on disassembly) aligned, and engage the spring loaded pin on the column switch housing with the slot in the rotary connector.
9. Fit a new locking tab washer, followed by the steering wheel nut, and torque tighten to 25 Nm (18.5 lbf.ft). Bend up the locking tabs to secure.
10. Refer to section WD to refit the airbag module, and verify the system.

Steering Wheel Alignment

Ideally, the steering wheel should align in the straight running position, with the steering rack centralised and with equal track rod lengths. In practice, a minor compromise to track rod lengths may have to be made. To arrive at the optimum setting, proceed as follows:

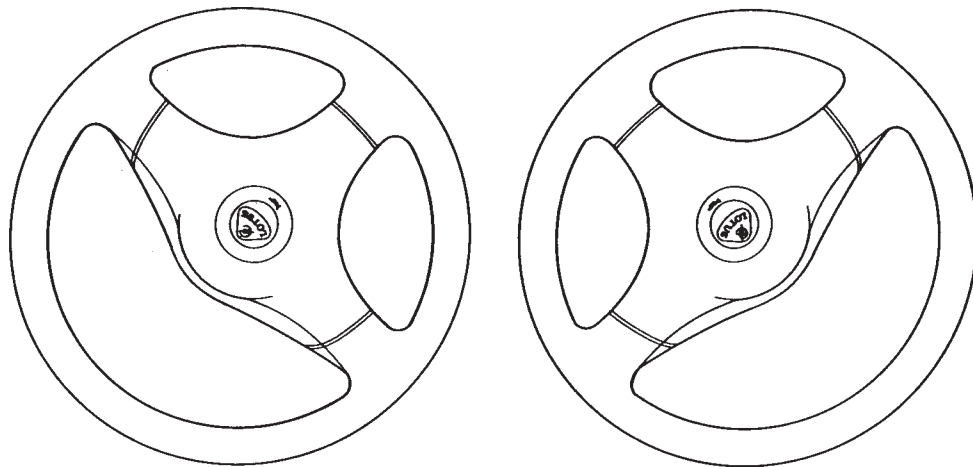
Note that only one splined joint in the steering system allows a choice of position, this being the lower joint to rack pinion shaft.

1. Set the front wheel alignment to specification with equal track rod lengths (see sub-section C1.2).



- Turn the steering to each full lock in turn and set the steering wheel on the column splines such that its orientation in one full lock position is the nearest possible mirror image of its position at the opposite full lock.

Mirror image wheel positions

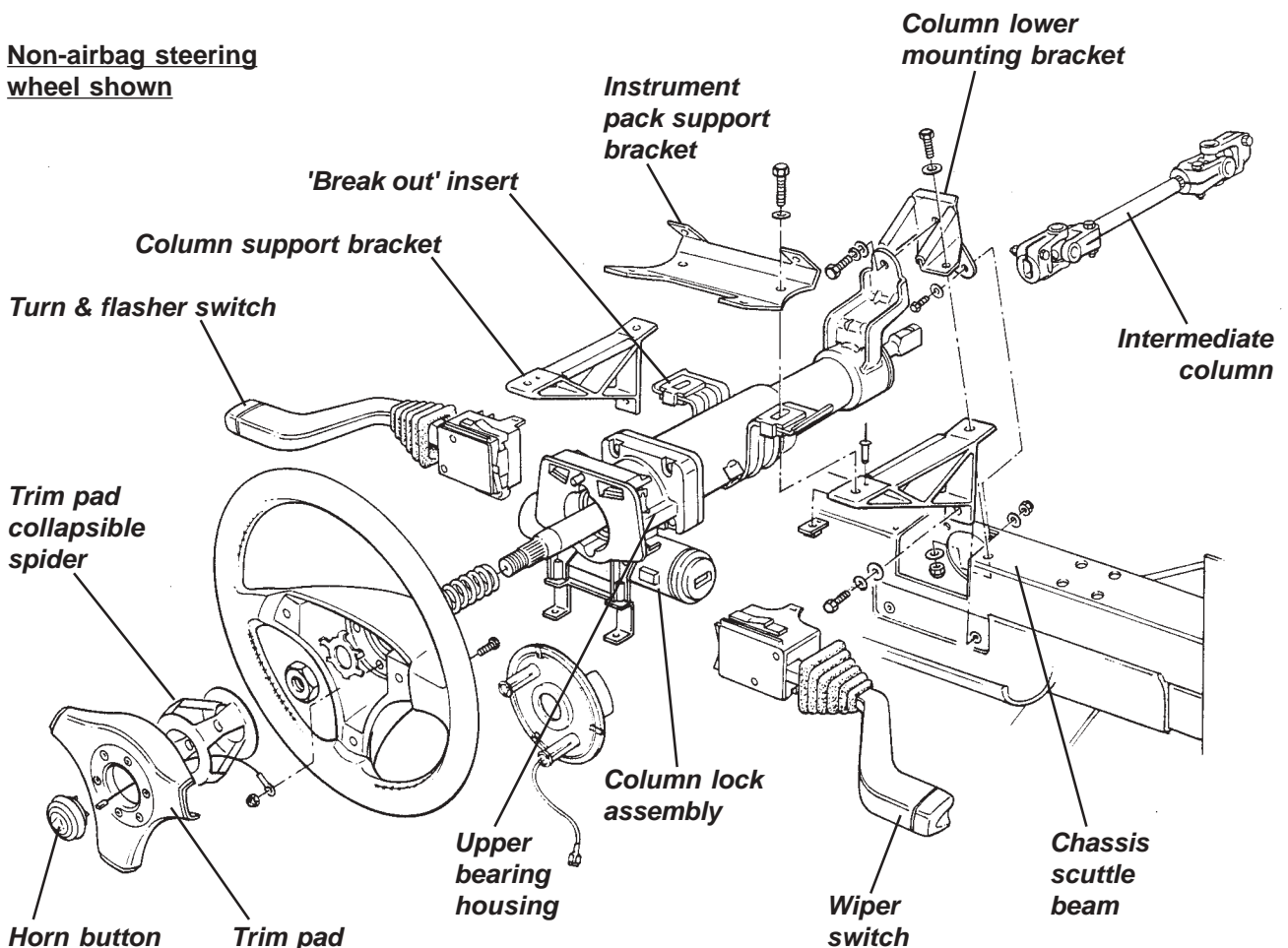


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- Secure the steering wheel before road testing the car and marking the actual 'straight ahead' position of the steering wheel which should deviate from the ideal position by less than 5°. Final alignment is achieved by asymmetric adjustment of the track rods, retaining the overall toe-out setting.

HG.3 - UPPER COLUMN ASSEMBLY

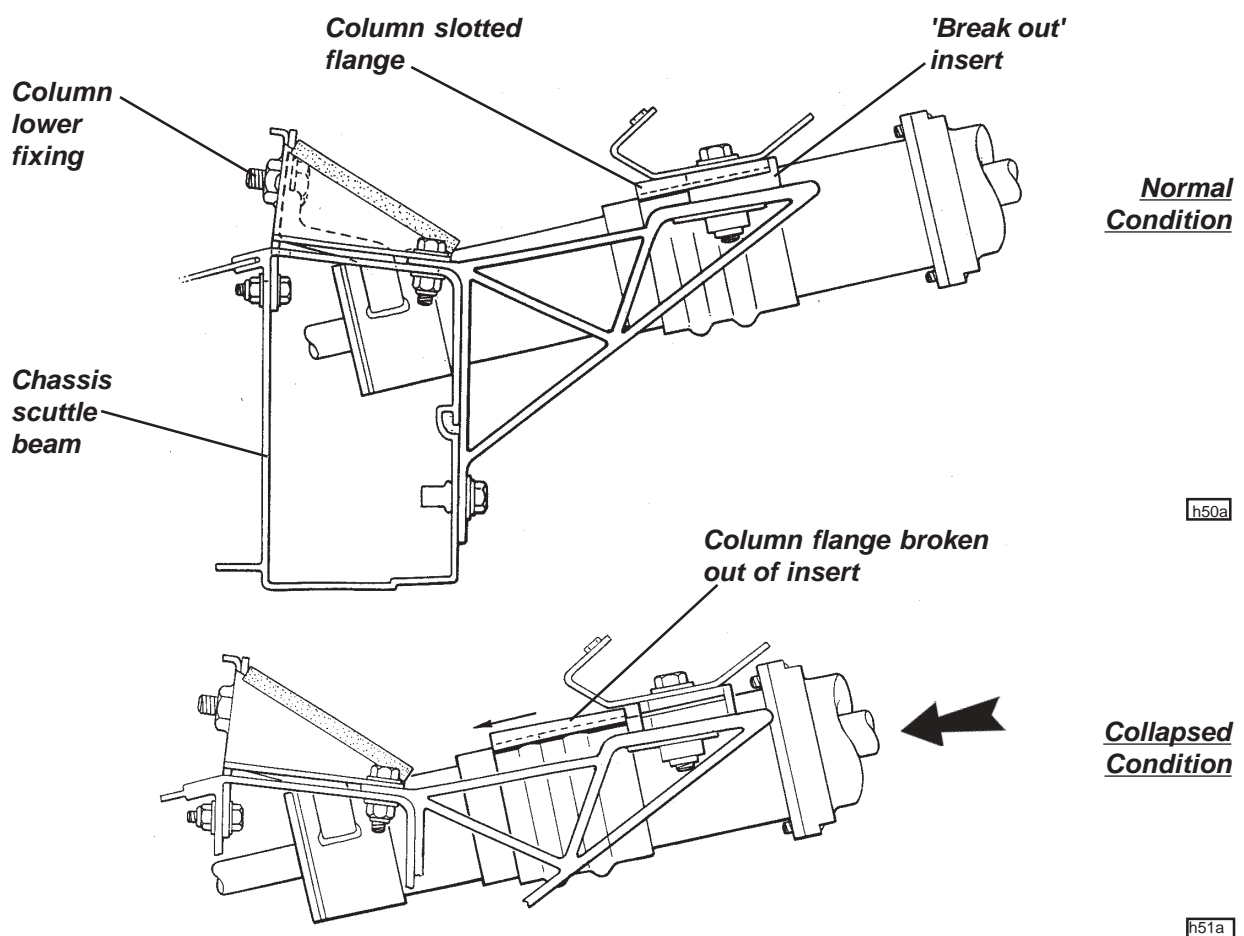
Non-airbag steering wheel shown



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The upper steering column assembly comprises an inner column which connects the steering wheel to the intermediate shaft, and a tubular steel outer column which, with its alloy upper bearing housing, supports the inner column and carries the column lever switches for lighting and wiper control, and also the ignition switch/steering lock.

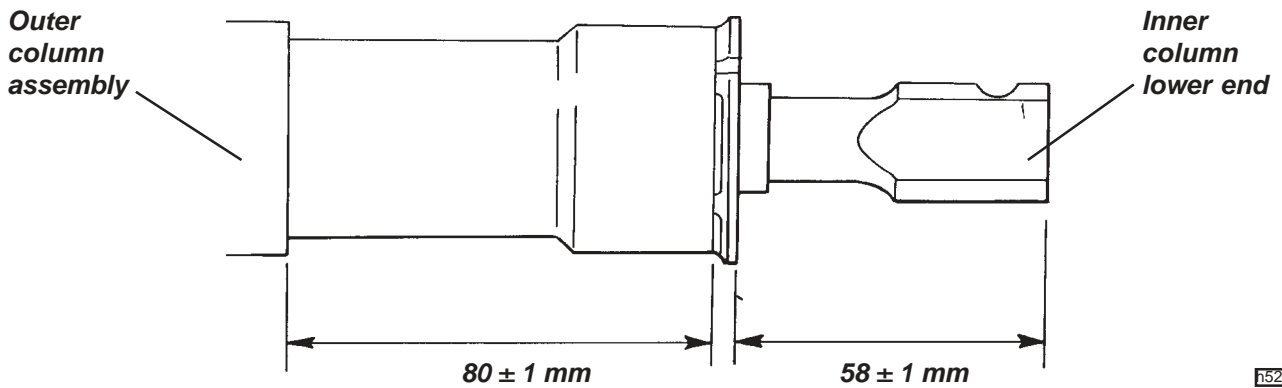
Both inner and outer columns are of fixed length, but are telescopically collapsible when subjected to crash forces. The two parts of the inner column are fixed together by plastic pins designed to shear and allow telescoping to occur beyond a specified axial load. The two part outer column tube uses gripper rings to retain the column length, with the lower part mounted by a single fixing to the chassis scuttle beam via a three point fixing steel bracket. The upper part of the outer column has two open slotted mounting flanges each of which is fitted with a 'break out' alloy insert, bolted through to an extruded alloy plinth fixed to the scuttle beam. In the event of an extreme axial load being applied to the column via the steering wheel, as may occur during a vehicle frontal collision, the plastic retaining pins in the column flange inserts will shear and allow the upper part of the column to break free of the upper fixings and telescope forwards, reducing the potential for column induced injury.



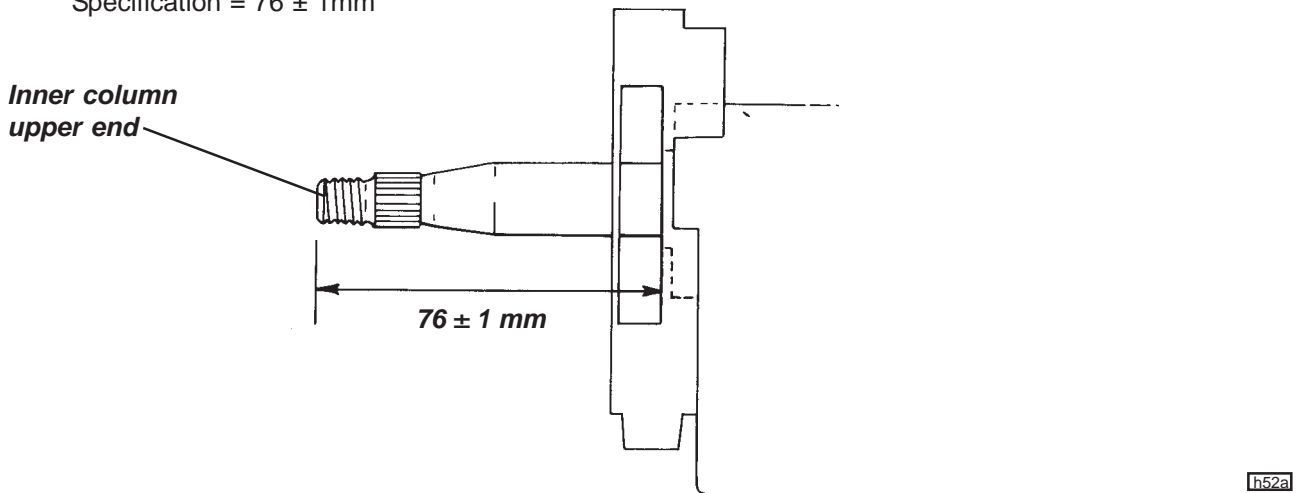
Dimensional Check

If the vehicle is involved in an accident, or any part of the column is subjected to an abnormal load including airbag deployment, the column should be carefully examined to establish if any telescoping has occurred. Perform the following checks, and replace the complete upper column assembly if any of the dimensions are outside specification:

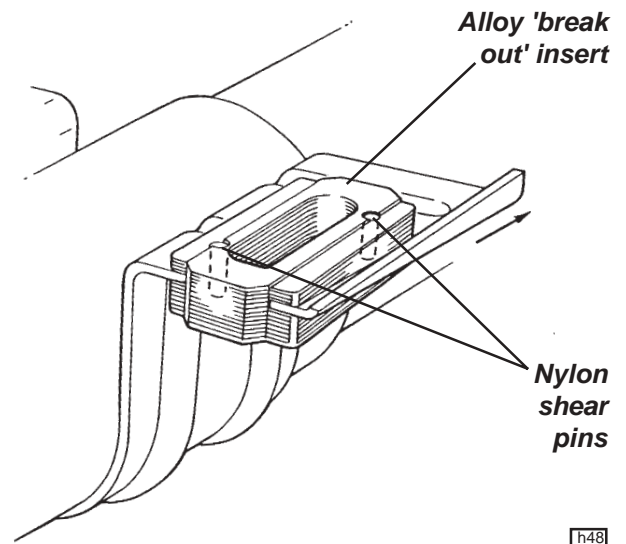
1. Outer Column:
Measure the length of the lower part of the outer column as shown:
Specification = 80 ± 1 mm
2. Inner Column Lower:
Measure the length of the exposed part of the inner column as shown:
Specification = 58 ± 1 mm



3. Inner Column Upper
With the steering wheel removed, measure the length of the exposed part of the upper column as shown:
Specification = $76 \pm 1 \text{ mm}$



4. 'Break out' Inserts
Remove the column shrouds and the column flange fixing bolts, and check that each of the alloy 'break out' inserts is securely attached to the column flange. If the plastic pins are sheared, the column assembly must be replaced.





To Remove Upper Steering Column Assembly

WARNING: On cars so equipped, the driver's airbag is housed in the hub of the steering wheel. Precautions need to be taken for personal safety when working with airbags and associated componentry. Do not attempt to remove the airbag, steering wheel or column without first referring to section WD.

1. Disconnect the battery, and remove the column shrouds (see sub-section HG.2).
2. Disconnect the column lever switches, or release the retaining pawls and slide the switches out of the carrier. Disconnect the horn contact pin. On airbag equipped cars, refer to section WD and unplug the yellow airbag harness connector.
3. To disconnect the ignition switch: prise open the terminal cover, and use a small screwdriver to release the retaining barb located between the white and yellow cables. Withdraw the connector.
4. If necessary, remove the steering lock/ignition key barrel: Turn the key to position 'I', depress the spring pin accessible via a hole in the column switch carrier, and withdraw the lock barrel.
5. If necessary, remove the ignition switch: First remove the steering lock/ignition key barrel (see above). Remove the retaining grub screw and withdraw the switch.
6. If necessary, remove the steering lock assembly: Remove the spline head screw securing the column switch carrier, and drill or chisel out the two shear head bolts fixing the lock assembly to the column.

Non-airbag type shown

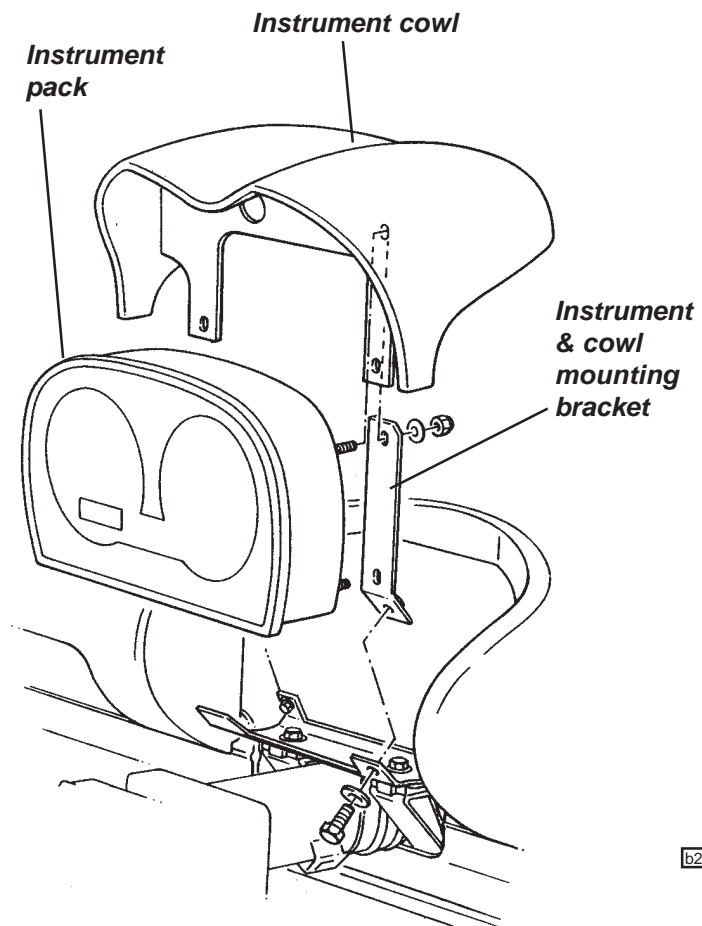
7. Remove the pinch bolt securing the upper universal joint to the intermediate column.

8. On non-airbag cars, remove the two fixings for the instrument pack mounting brackets, and remove the instrument pack and cowl assembly after unplugging the single harness connector.

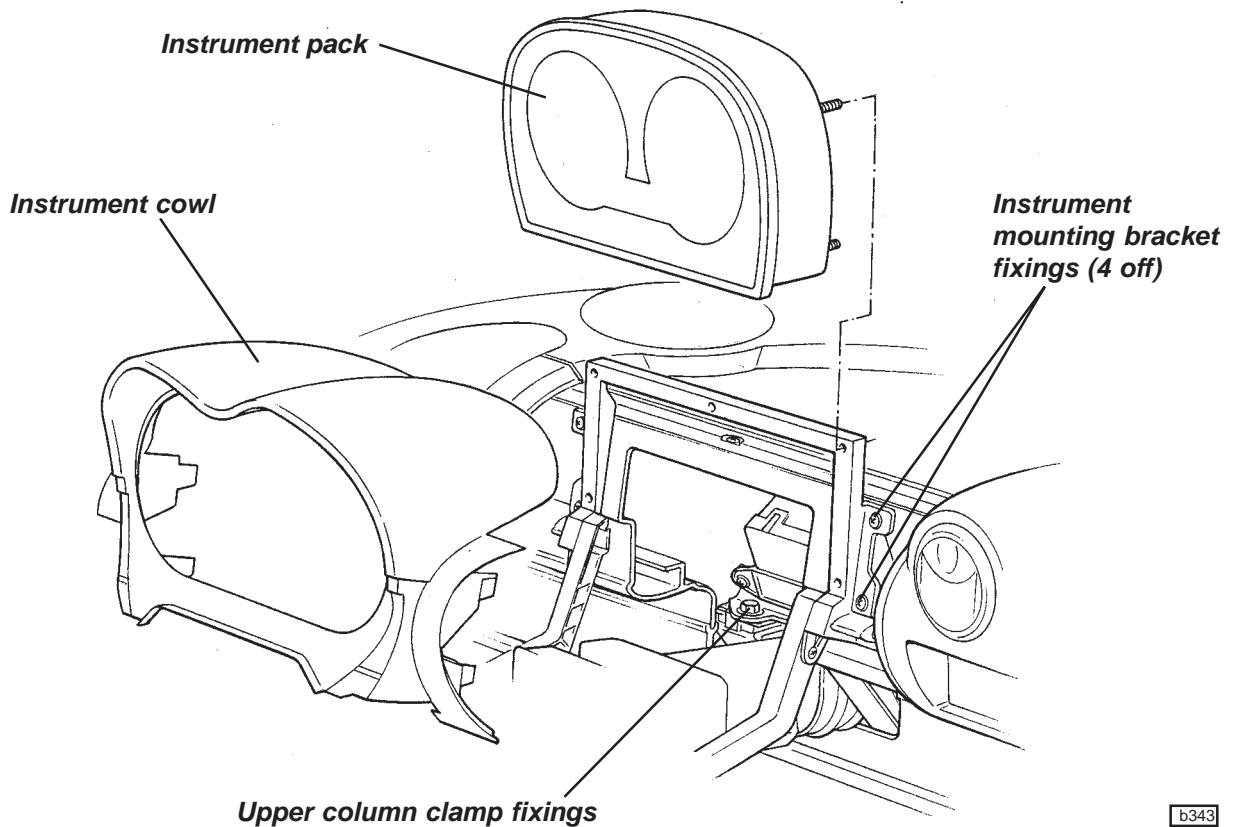
On airbag equipped cars, withdraw the instrument surround and cowl straight rearwards from the dash panel to release the spring clips. Remove four screws to release the instrument pack mounting bracket from the dash and unplug the two harness connectors

9. Release the two bolts securing the upper column clamp to the dash brackets, and remove the switch pack.

10. From the access provided by the removal of the switch pack, release the upper column single lower fixing and withdraw the column assembly from the scuttle and off the intermediate steering column.



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11. Refit the column in reverse order to removal with the following notes:
 - The groove for the pinch bolt allows assembly of the universal joint to the intermediate column in only one orientation. Torque tighten the pinch bolt to 35 Nm.
 - Torque tighten the column lower fixing bolt to 45 Nm
 - Torque tighten the two column upper fixing bolts to 22.5 Nm.
 - If applicable, use new shear bolts to secure the steering lock assembly, and tighten until sheared.

HG.4 - INTERMEDIATE COLUMN

The intermediate steering column consists of a symmetrical splined shaft and two different Hookes type universal joints. The lower joint uses an un-indexed 36 spline connection to the steering rack pinion shaft, and the upper joint accommodates a double flatted boss on the end of the upper column, with a pinch bolt groove allowing assembly in only one orientation. The intermediate shaft itself, uses a splined joint at each end and an indexed pinch bolt groove.

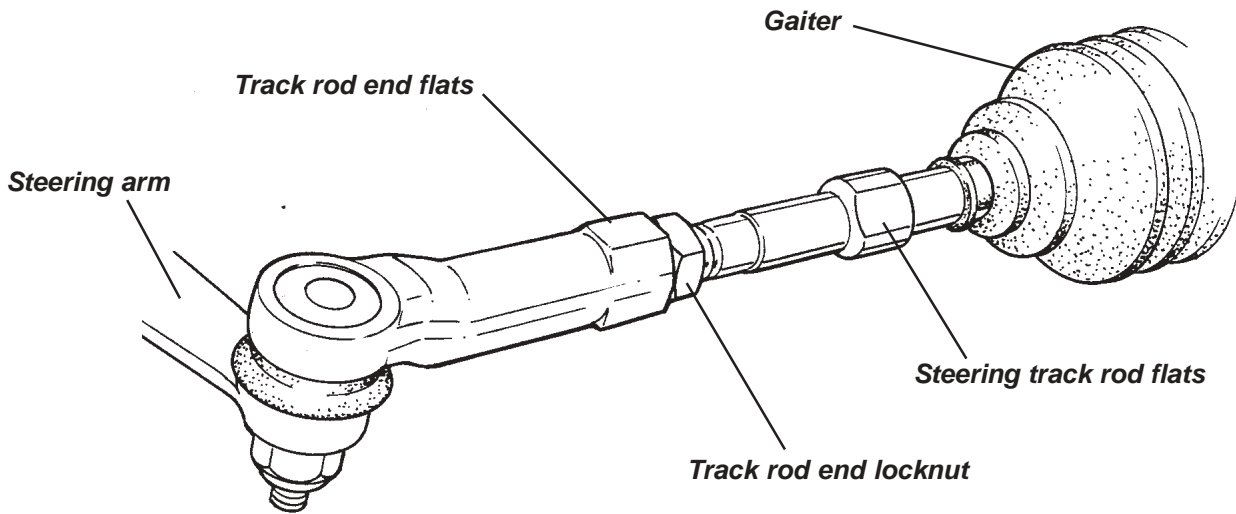
To remove the intermediate column assembly, the upper column must first be removed (see sub-section HG.3), after which the rack pinion shaft pinch bolt may be removed and the column assembly withdrawn. Match marking the lower u/j to the pinion shaft will aid steering wheel alignment on re-assembly. Torque tighten the pinch bolts to 35 Nm.

HG.5 - TRACK ROD ENDS & RACK GAITERS

Front Wheel Alignment

Alignment is measured either by the angle a wheel makes with the vehicle centre line, or the difference in dimension between the wheel rim to wheel rim measurement at the front and rear of the wheel at hub centre height. The wheels are said to 'toe-in' when the wheel paths converge ahead of the vehicle, and 'toe-out' when they diverge. Wheel alignment is designed to vary with both steering angle (Ackermann) and suspension travel (bump steer) and should be measured only 'straight ahead' at the specified ride height.

Provision is made for the adjustment of front wheel alignment at the joint between the steering rack track (tie) rods, and the outer ball joints ('track rod ends'). The required ride height and alignment specification is detailed in sub-section CI.2.



Note that in order to preserve the required bump steer characteristic and steering symmetry, the effective length of each track rod must remain equal - adjust each track rod by a similar amount:

- Hold the track rod end using the flats provided, and slacken the locknut. Repeat for the opposite side.
- Turn each track rod a similar amount. As a guide, turning both track rods by one quarter of a turn will alter overall toe-out by approx. 2.0 mm.
- When adjustment is correct, hold each track rod end and tighten the locknuts to 80 - 82 Nm (58 - 60 lbf.ft).

When slackening or tightening the track rod end locknuts, it is important that the torque reaction is resisted using the track rod end flats, and that the ball joint itself is not allowed to be stressed.

Track Rod Ends

The track rod ends are sealed for life and maintenance free, but if replacement is required; remove the ball pin nut and use a ball joint splitter tool to separate the joint from the steering arm. Unscrew the joint from the track rod. On re-assembly, tighten the ball joint to steering arm nut to 30 Nm, and set the front wheel alignment as detailed in sub-section CI.2.

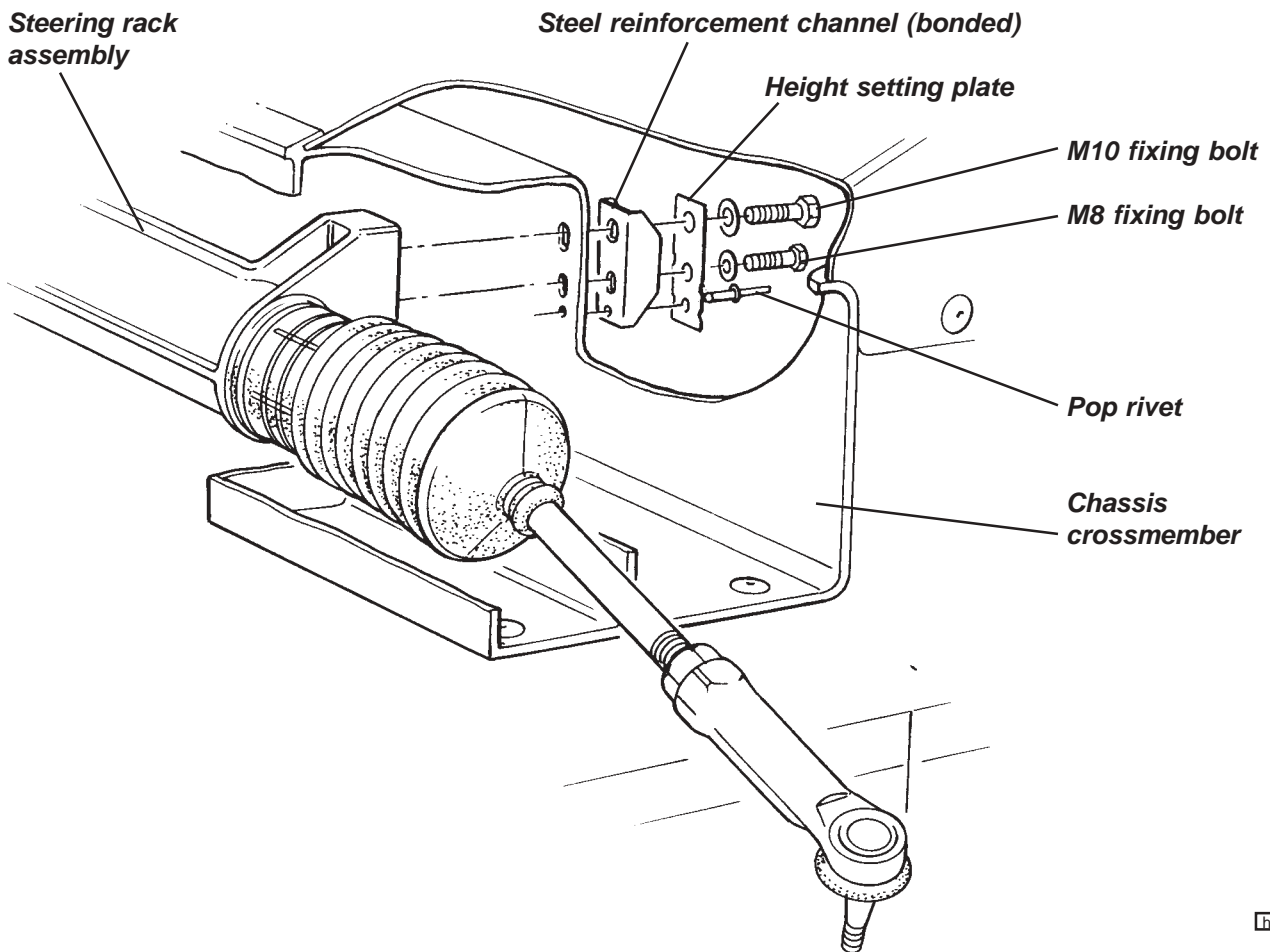
Steering Rack Gaiters

The convoluted gaiters sealing each end of the steering rack housing to the track rods, should be inspected at service intervals and replaced immediately if found to be torn, cracked or otherwise damaged. The ingress of dirt or water into the rack housing will cause rapid deterioration of the track rod inner ball joints and rack and pinion mechanism.

To replace a gaiter, remove the track rod end (see above), release the gaiter clips, and slide the gaiter off the housing and track rod. Check for consequent damage or wear and replace the steering gear assembly if necessary. Fit the new gaiter into position, and secure with new retaining clips.

HG.6 - RACK & PINION ASSEMBLY REMOVAL/REPLACEMENT

The rack and pinion assembly is mounted inside an extruded chassis box section crossmember at the top front of the footwell. Each of the two rack housing mounting plinths uses an M10 (upper) and M8 (lower) fixing bolt to secure the housing to the vertical rear face of the crossmember. A steel reinforcement channel is bonded to the outside of the crossmember, with a riveted height setting plate to define the vertical position of the housing. Note that the only approved repairs or adjustments to the steering rack assembly are the replacement of the track rod ends and rack housing gaiters, and the adjustment of the rack pressure pad.



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To Remove/Replace Steering Assembly

1. Remove the nut securing each track rod end to the steering arm, and use a ball joint splitter to separate the joint.
2. From inside the footwell, match mark the pinion shaft against the u/j yoke to aid steering wheel alignment on re-assembly, and remove the pinch bolt.
3. From inside the footwell, remove the two M8 and M10 bolts securing the rack housing.
4. Draw the housing forwards to disengage the intermediate shaft u/j, and manoeuvre the assembly out of the chassis crossmember.
5. On re-assembly, check that the correct rack height setting plate is fitted. For the standard ride height of 130/130 or 135/135, the '6 notch' plate A111H0017 should be fitted. Fitment of the wrong plate (identified by the number of notches in the vertical edges) will result in an incorrect bump steer characteristic and degraded handling. The plate is secured to the chassis by a single pop rivet.
6. Feed the rack assembly into the chassis crossmember and engage the pinion shaft into the lower u/j with the match marks aligned. If a new assembly is being fitted, follow the 'Steering Wheel Alignment' procedure in sub-section HG.2.
7. New fixing bolts for the steering rack housing are pre-coated with thread locking compound. If existing bolts are to be re-used, wire brush the threads before re-applying a suitable thread locking compound and torque tightening the M8 bolts to 22.5 Nm, and the M10 bolts to 45 Nm.

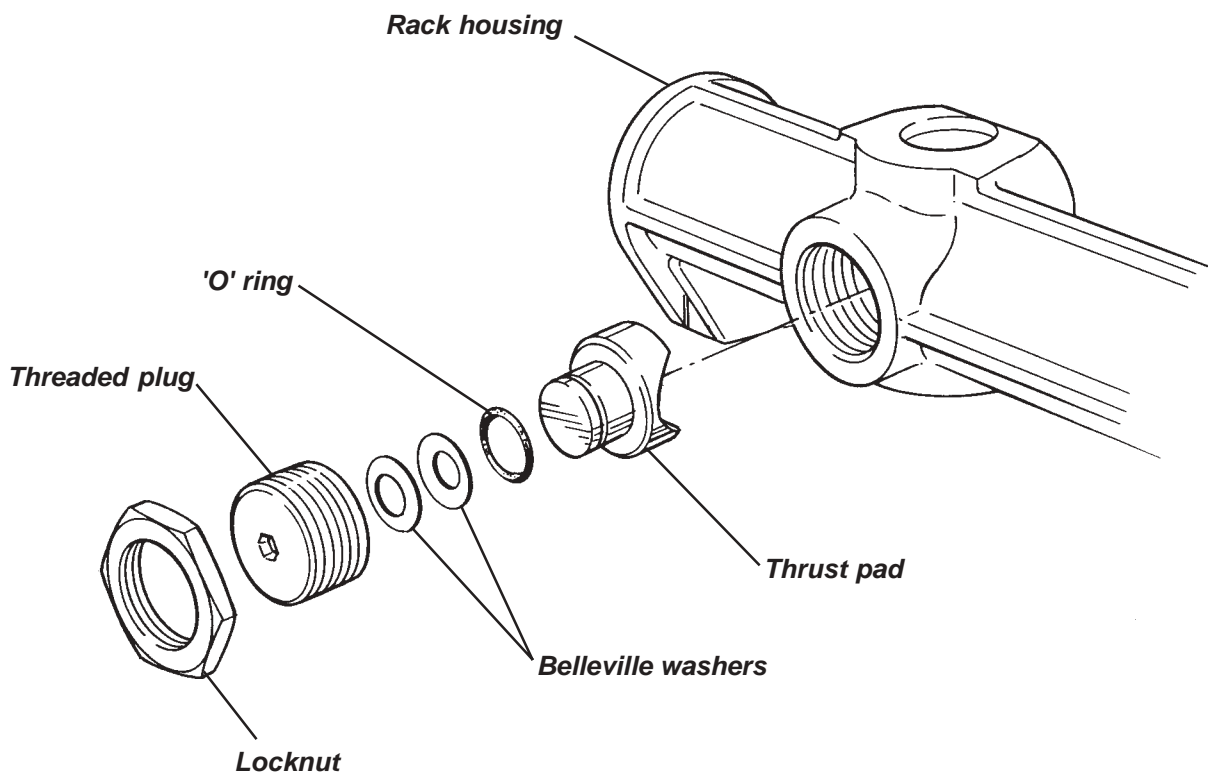
8. Fit the lower u/j pinch bolt, and tighten to 35 Nm.
9. Fit the track rod ends into the steering arms, and tighten the nuts to 30 Nm.
10. Check and adjust the front wheel alignment as detailed in sub-section CI.2.

HG.7 - ADJUSTMENT OF RACK BAR THRUST PAD

The following information applies to one-piece alloy bodied steering rack units:

A thrust pad backed by a pair of belleville washers, is used to control the preload between the rack bar teeth and the pinion gear, and is adjustable via a threaded backstop plug. The correct preload allows the horizontally mounted rack bar (column disconnected) to be pulled through its full travel by a steady force of 50 - 70 N (12 - 16 lbf). The rack and pinion assembly must be removed from the chassis before any adjustment may be carried out.

To adjust the thrust pad, release the locknut (36mm socket) and use a 5.5mm hexagonal bit to adjust the backstop as required before tightening the locknut. For an approximate initial setting, screw in the backstop plug until solid, then back off $\frac{1}{2}$ turn.



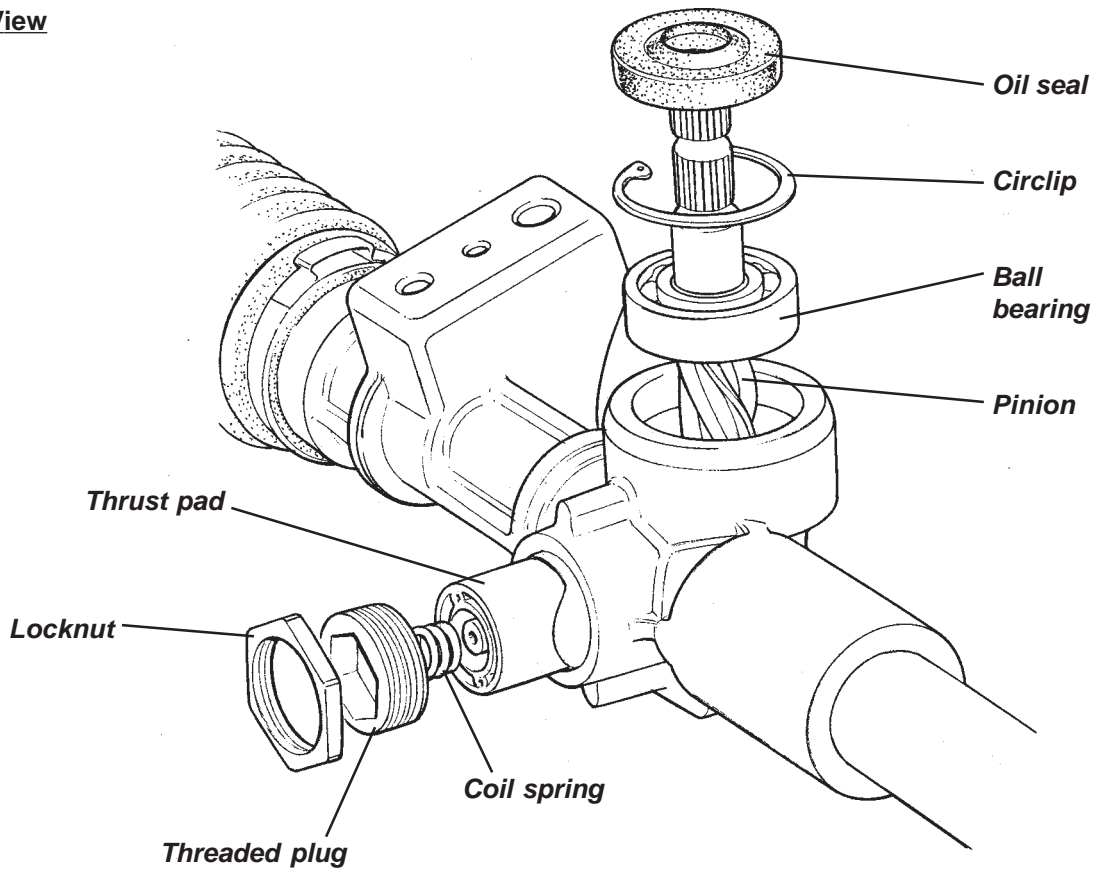
The following information applies to alloy/steel tube type steering rack units:

A thrust pad backed by a coil spring, is used to control the preload between the rack bar teeth and the pinion gear, and is adjustable via a threaded backstop plug. The correct preload allows the horizontally mounted rack bar (column disconnected) to be pulled through its full travel by a steady force of 50 - 100 N (12 - 20 lbf). The rack and pinion assembly must be removed from the chassis before any adjustment may be carried out.

To adjust the thrust pad, release the locknut (36mm socket) and use a 19mm hexagonal bit to adjust the backstop as required before tightening the locknut. For an approximate initial setting, screw in the backstop plug until solid, then back off $\frac{1}{4}$ turn.

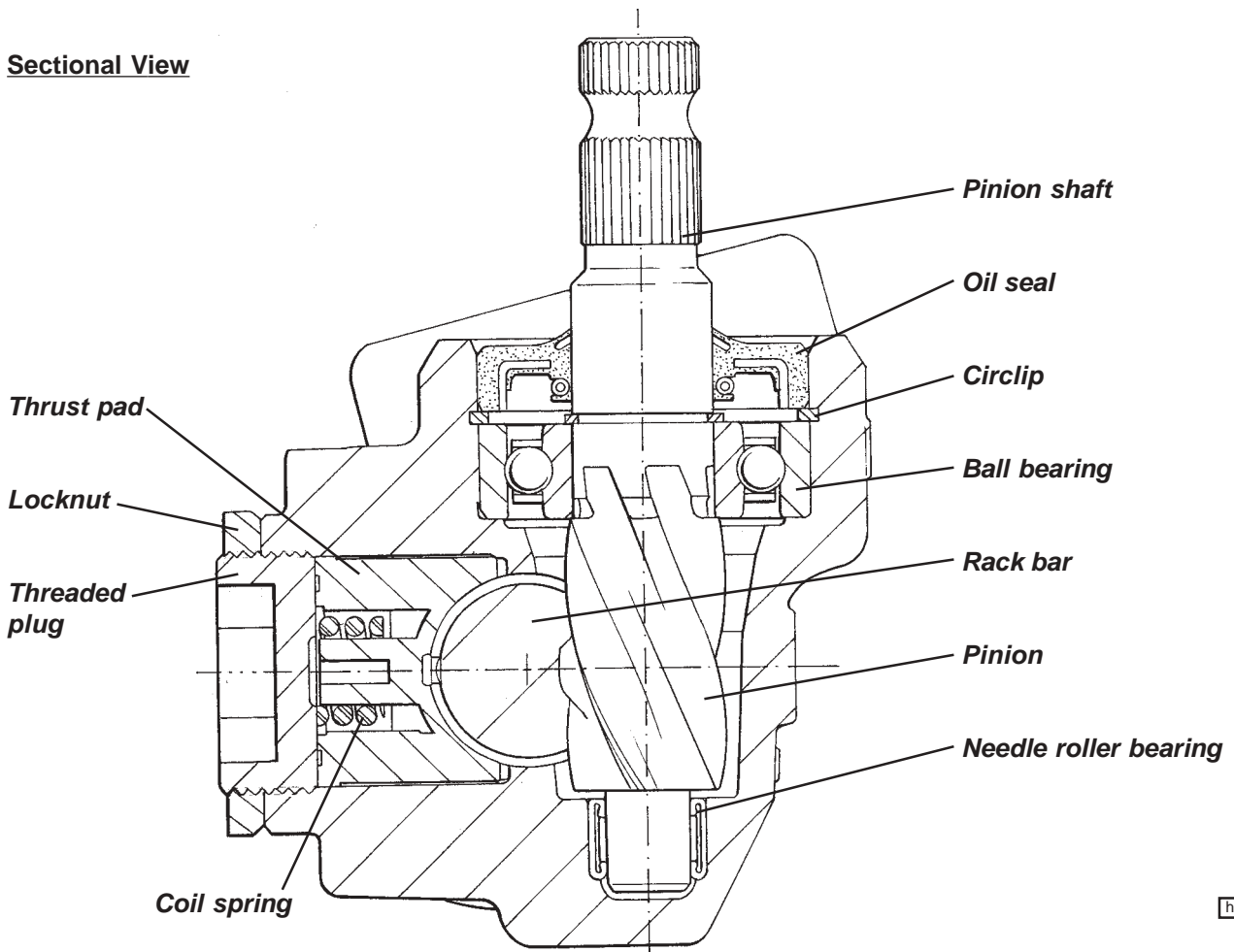


Exploded View



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Sectional View



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