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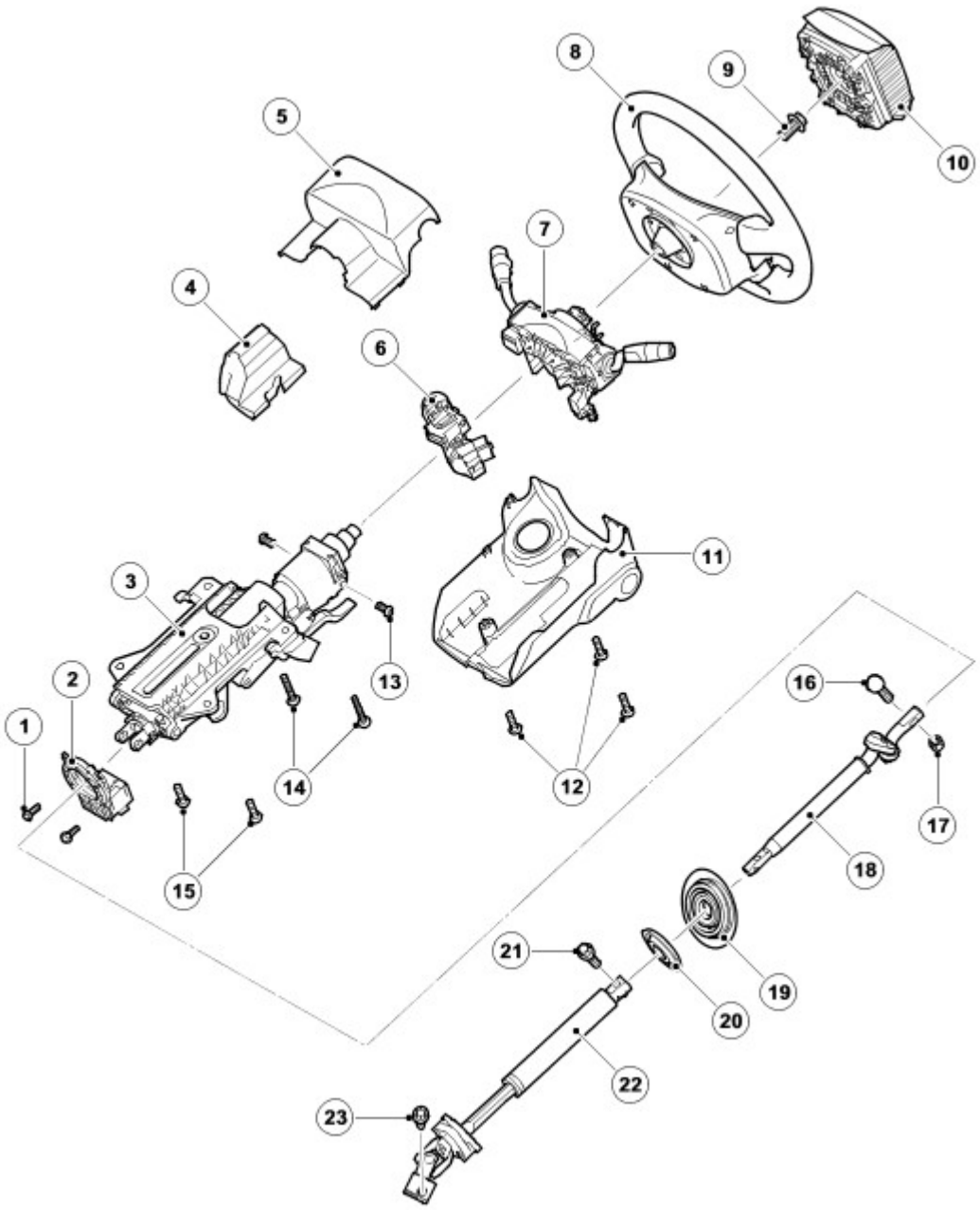
Steering Column

Steering Column Component Layout



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Item	Part Number	Description
1	-	Screw (3 off)
2	-	Steering angle sensor
3	-	Upper steering column assembly
4	-	Cowl insert

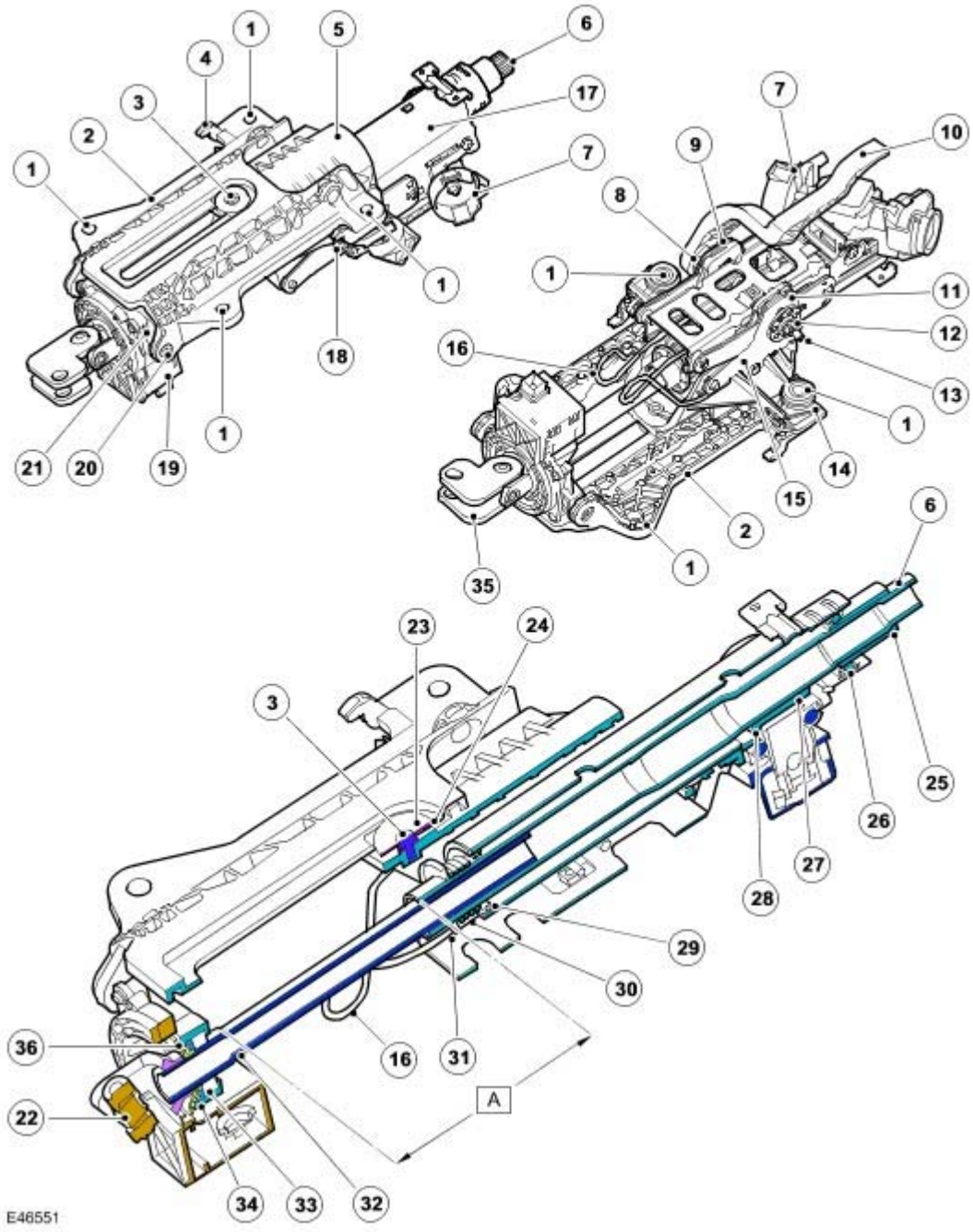
5	-	Upper cowl
6	-	Column lock assembly
7	-	Multifunction column switch
8	-	Steering wheel
9	-	Bolt
10	-	Driver airbag
11	-	Lower cowl
12	-	Screw, self-tapping (3 off)
13	-	Column lock shear bolt (2 off)
14	-	Bolt, thread forming (2 off)
15	-	Bolt, thread forming (2 off)
16	-	Cam bolt
17	-	Self-locking nut
18	-	Intermediate shaft
19	-	Column seal - bulkhead
20	-	Cover seal - secondary bulkhead
21	-	Screw
22	-	Lower collapsible shaft
23	-	Bolt - Torx - Lower collapsible shaft yoke

GENERAL

The steering column comprises the upper column assembly, the intermediate shaft and the lower collapsible shaft. The three components are positively connected together to pass driver rotary input from the steering wheel to a linear output of the steering rack.

The upper column assembly contains adjustment for steering wheel reach and rake and also provides the location for the ignition switch, the ignition lock barrel, the steering lock mechanism and the steering angle sensor.

UPPER COLUMN ASSEMBLY



Item	Part Number	Description
A	-	Crash Stroke 120.00 mm (4.72 in)
1	-	Attachment hole
2	-	Roof bracket
3	-	Screw
4	-	Locating hook
5	-	'U' bracket
6	-	Steering wheel splines

7	-	Lock assembly
8	-	Cam plate (part of adjustment lever)
9	-	Fixed cam
10	-	Adjustment lever
11	-	Brake pad
12	-	Lever nut
13	-	Lever bolt
14	-	Shearing capsule (2 off)
15	-	Clamp plate assembly (2 off)
16	-	Adjustment spring
17	-	Main body
18	-	Strap (2 off)
19	-	Steering angle sensor
20	-	Pivot pin
21	-	Pivot housing
22	-	Universal joint
23	-	Bush
24	-	Pressure washer (2 off)
25	-	Upper shaft
26	-	Upper bearing
27	-	Tolerance ring
28	-	Lock collar
29	-	Middle bearing
30	-	Spring
31	-	Retainer
32	-	Lower shaft
33	-	Retaining ring
34	-	Driving collar
35	-	Swing yoke
36	-	Lower bearing retaining ring

The steering column is attached to the in-vehicle crossbeam and secured with four, pan head, thread forming Torx screws. The two forward attachment screws are fixed through the column mounting bracket, the two rearward mounting screws also pass through the shearing capsules. In the event of a high energy frontal impact, the shearing capsules remain fixed to the crossbeam, but the 'U' bracket (with the main body) disengages from the capsules, allowing the column to shorten axially (collapse), absorbing energy to reduce occupant loading.

The column comprises a cast magnesium roof bracket which is attached to the in-vehicle crossbeam. Attached to the roof bracket is a pivot housing, a 'U' bracket, upper and lower shafts and a main body. The roof bracket has two hooks which locate in slots in the in-vehicle crossbeam. The hooks assist in supporting the weight of the column during removal or installation.

The pivot housing is attached to the forward end of the roof bracket with two pivot pins. The pivot housing allows for adjustment of the column rake and contains a bearing which supports the column lower shaft.

The 'U' bracket is attached to the roof bracket by a screw, bush and plastic washer assembly (third fixing) located in a slot in the top of the roof bracket. When the column is assembled into the vehicle, the shearing capsules, which are attached to the 'U' bracket, are clamped up against the roof bracket by the fixing screws, preventing movement of the 'U' bracket.

The main body is positioned in the 'U' bracket via the lever bolt. The bolt is captive within the vertical slots in the 'U' bracket and the horizontal slots in the main body. The bolt also passes through the clamp plate assemblies (one on either side of the 'U' bracket). The body houses the middle and upper bearings through which the upper shaft is located. Two offset holes in the main body provide for the attachment of the column lock assembly.

The upper and lower shafts are located through the length of the column assembly. The upper shaft is supported in two bearings in the main body and the lower shaft is located in the upper shaft and supported in a bearing in the pivot housing. The lower shaft has a tubular section with external splines. These splines mate with the internal splines in the upper shaft. The purpose of the splines is to transmit rotational movement of the upper shaft to the lower shaft, but allowing the two components to telescope into each other in the event of a collision. The length of the splined sections allow for 120 mm (4.72 in) of linear movement. The lower shaft is fitted with a universal joint spider to which a swivel yoke is attached. The swivel yoke attaches to the intermediate shaft of the steering column on the interior side of the bulkhead using a special cam bolt and self-locking nut.

A steering angle sensor is attached to the pivot housing of the column and its center gear is rotated by a drive collar which is attached to the lower shaft and rotates with movement of the steering wheel. The sensor transmits steering angle data on the high speed CAN bus which is used by various systems on the vehicle. The steering angle sensor is designed to become detached from the column in the event of a frontal impact. Care must be taken when handling the column assembly to prevent accidental damage to the sensor. For additional information, refer to Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control)

The upper shaft is fitted with a locking collar which engages with the lock bolt of the column lock assembly. The locking collar is retained by a tolerance ring on the shaft. The tolerance ring allows a specified amount of force to be applied to the shaft before it slips, preventing damage to the column lock due to excessive torque being applied to the steering wheel when the lock is engaged. The tolerance ring is designed to slip on the upper shaft when an applied torque exceeds its fitted slip load of 200Nm minimum. Repeated rotation of the lock collar will reduce its slipping torque to 100Nm minimum.

The steering column is adjustable for reach and rake. The column can be adjusted for 40 mm (1.57 in) of reach adjustment and 6º of rake adjustment. The adjustment mechanism comprises an adjustment lever, a cam plate, a lever bolt and nut, two brake pads and two clamp plate assemblies.

A plastic adjustment lever is located on the underside of the column assembly and is attached to a cam plate. When the lever is pulled downwards, the cam plate rotates and releases tension in the lever bolt. The lever bolt also passes through two sets of clamp plate assemblies. When the lever is moved upwards, the cam plate rotates applying tension to the lever bolt, which applies pressure to the brake pads which in turn apply pressure to the clamp plate assemblies (which lock the column in the desired position). The lever bolt is retained by a self-locking lever nut, which abuts a thrust bearing.

 **CAUTION : Under no circumstances should the lever nut torque be reduced, as this will reduce the clamping efficiency of the adjustment mechanism possibly effecting the stability of the column during a frontal impact.**

The pivot housing is attached to the roof bracket with two pivot pins. When the rake adjustment is operated, the pivot housing rotates around the pivot pins to allow for the up and down adjustment, but maintains a positive location to the roof bracket. An adjustment spring is fitted between the 'U' bracket and the main body, to counteract the weight of the main body, upper shaft, steering wheel and airbag, preventing the steering wheel from dropping rapidly when the adjustment lever is released.

In the event of a crash, the upper column assembly is designed to collapse reducing impact injury to the driver. A number of components interact together to ensure that the collapse of the column is in a controlled manner. The following components control the column collapse:

- Pressure washer and bush (third fixing)
- Shearing capsules
- Straps
- Upper and lower shaft (splined) connection.

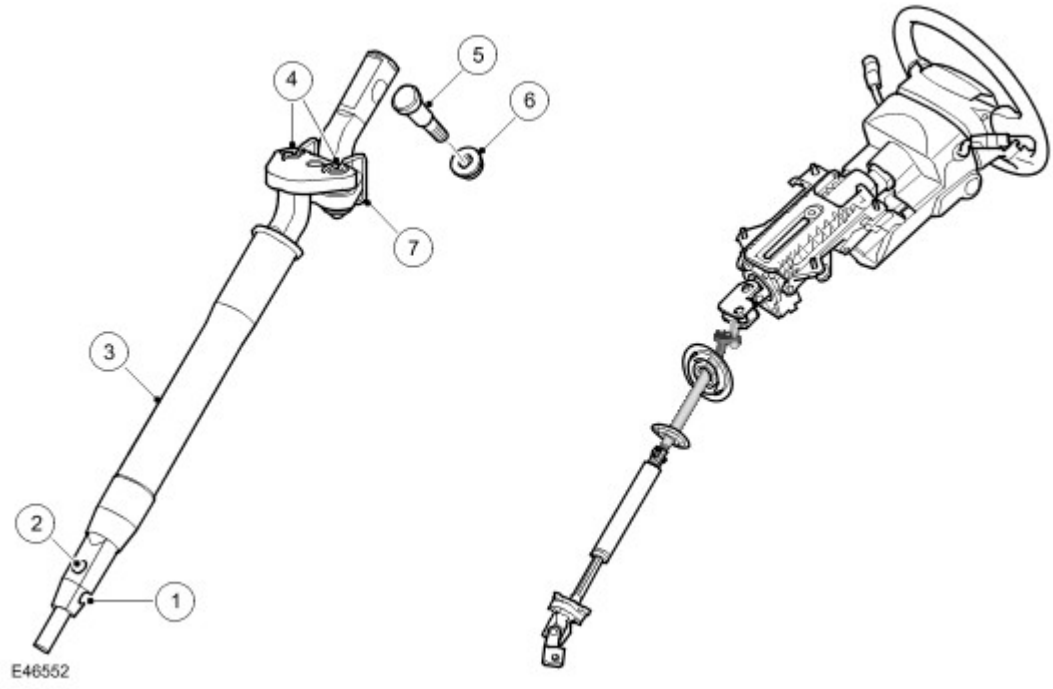
The shearing capsules have a central hole through which the rearward attachment bolts pass through into the roof bracket. The capsules are located in the 'U' bracket by tapered slots, which have small cut-outs in the inside faces. The shearing capsules have a number of small holes which align with the cut-outs in the 'U' bracket, and when the capsules are installed, plastic is injected into the holes and cut-outs. This plastic retention of the capsules provides the initial controlled break-out force for the column in the event of a collision. After 10 mm of displacement, the 'U' bracket is no longer located by the shearing capsules. When handling the column, care should be taken that the shearing capsules are not impacted or dislodged.

The tension in the 'Third Fixing' screw, applies a clamp load to the roof bracket (via the bush and compression washers). In the event of a collision, this clamp load (supplementary to the shearing capsules) must be overcome before the column can collapse. When this load has been exceeded (and the fixing has been displaced 20 mm (0.79 in)) it slides easily within the roof bracket slot, providing directional control to the column, as it collapses. Under no circumstances should the

screw torque be adjusted.

The straps are rectangular section steel, which at one end, have coils that locate around a plastic bush (positioned on the shearing capsule). The other end is formed into a hook which locates within a slot in the 'U' bracket. When a collision has occurred, and the 'U' bracket has been displaced from the shearing capsules by 8 mm (0.3 in), the straps begin to un-roll due to the displacement of the 'U' bracket. The straps provide the main element for energy absorption as the column collapses. The cross section of the straps change after approximately 40 mm (1.6 in) of extension, changing the amount of energy that they absorb.

INTERMEDIATE SHAFT



Item	Part Number	Description
1	-	Alignment slot
2	-	Attachment hole
3	-	Seal sleeve
4	-	Load limiter pins
5	-	Cam bolt
6	-	Self-locking nut
7		Retention spring

CAUTION : Care should be taken when handling the intermediate shaft, to ensure that it is not subject to impacts or that the retention spring is not displaced.

The non-handed, intermediate shaft is attached at its upper end to the swivel yoke on the lower shaft of the steering column assembly. The intermediate shaft comprises two main parts; the upper and lower axis which are joined together with a shear joint.

The upper axis has a cut-out in the shaft which allows for the fitment of the cam bolt. Only when the shaft is located correctly in the swivel yoke, can the cam bolt can be inserted. A self-locking nut is fitted to the cam bolt. The torque applied as the nut is tightened, rotates the bolt, forcing the cam against the shaft, positioning it correctly in the swivel yoke prior to the joint being clamped.

NOTE :

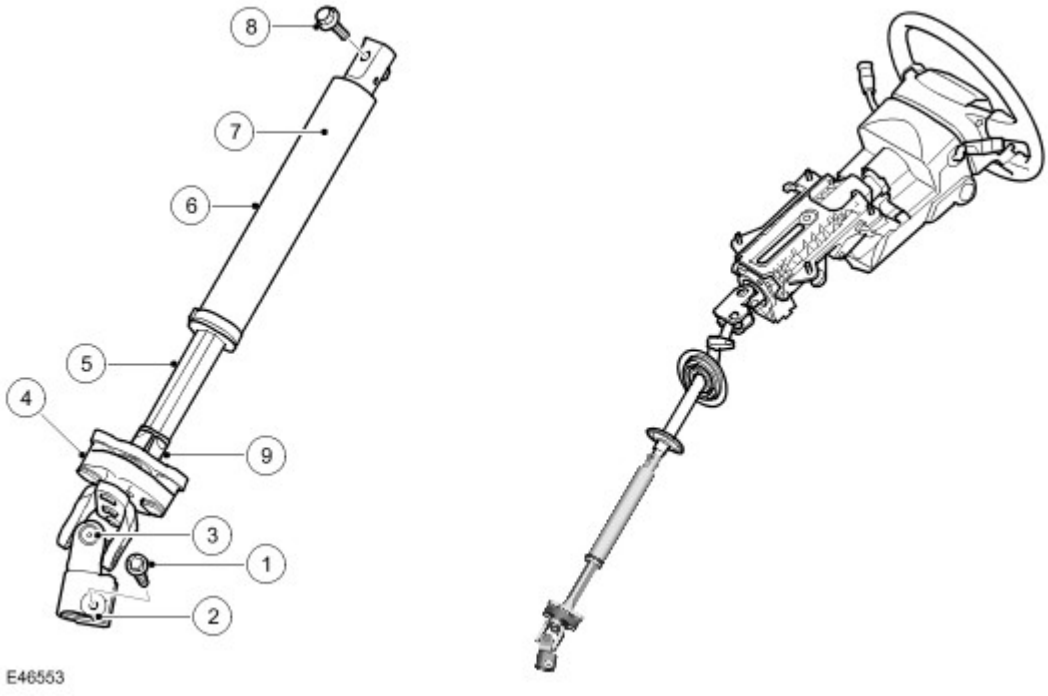
If the self-locking nut is removed for any reason, it is recommended that a new, correct nut is fitted to maintain the optimum torque on the cam bolt.

The lower axis is fitted with a plastic moulded seal sleeve which provides a suitable surface for the location of the plastic bearings within the two bulkhead seals. The bottom of the lower axis is machined to a double 'D' shape which tapers at the end. One side of the taper has a slot which is used to align the intermediate shaft and the lower collapsible shaft to ensure that the correct orientation of the steering wheel to steering gear is maintained. A hole is drilled through the double 'D' shape and provides for attachment of the intermediate shaft to the lower collapsible shaft.

The upper and lower axis are joined together via a load limiter. The load limiter is designed to disconnect the upper and lower axis in the event of a collision, preventing an excessive load being applied to the steering column (causing intrusion into the passenger compartment or an unstable airbag deployment).

The load limiter comprises two plates which are part of the upper and lower axis. The plates have a central 'guide' pin, and two retention pins, which pass through bushes in the plates and are staked into position. The size of the staking controls the load at which it shears, allowing the lower axis to separate from the upper axis. A wire 'retention' spring is also fitted to the load limiter.

LOWER COLLAPSABLE SHAFT



Item	Part Number	Description
1	-	Torx bolt
2	-	'U' yoke
3	-	Universal joint
4	-	Flexible coupling
5	-	Male shaft
6	-	Female shaft
7	-	Heat shield
8	-	Bolt
9		Plastic spacer

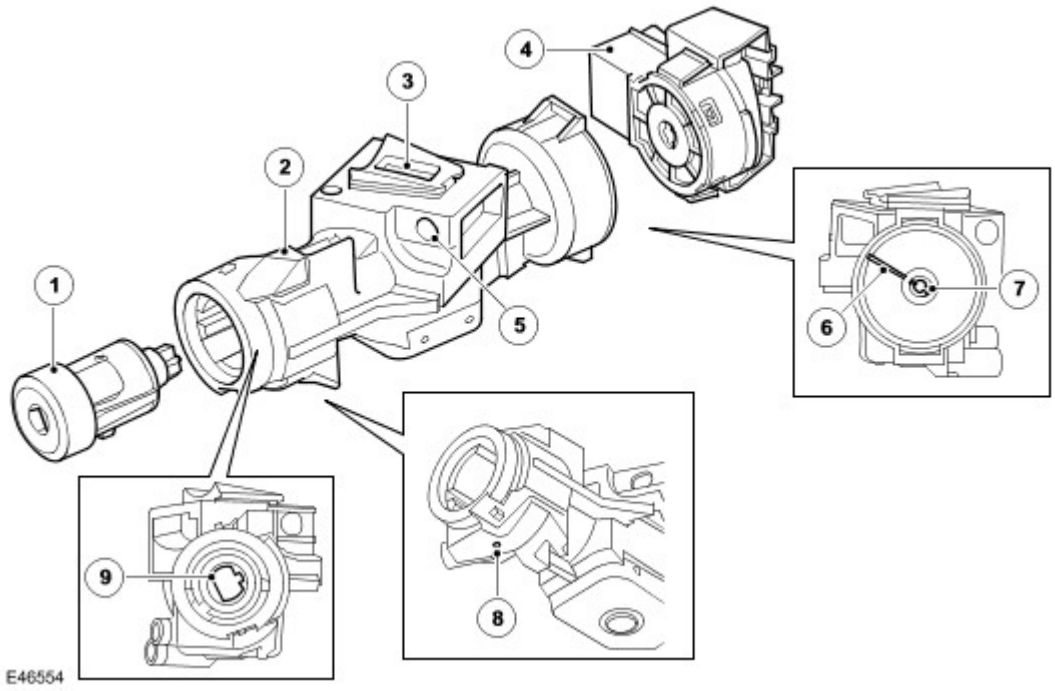
The lower collapsible shaft is an handed component and the correct component must be fitted to ensure that the steering phase angle is maintained. The shaft is attached at its upper end to the intermediate shaft and at its lower end to the valve unit pinion on the steering gear. These attachment joints can only be fitted in one orientation to ensure that the

correct alignment of the steering wheel to the steering gear. The shaft comprises two main parts; the female and male shafts which are a telescopic fit on each other. The male shaft can slide up to 77 mm (3.03 in) within the female shaft in the event of a collision, to minimize the effect of frontal intrusion. The sliding fit also allows for dynamic displacement between the chassis and the body during severe off-road driving. A plastic spacer is fitted to the male shaft which is only used as an assembly aid during vehicle production and serves no function once the shaft is assembled to the vehicle.

The female shaft is a triangular section tube which is formed to a double 'D' hole at its upper end which mates with the intermediate shaft. An indentation pressed in the wall of the tube ensures the correct alignment between the intermediate shaft and the lower collapsible shaft. A captive nut, clinched to one side of a through hole in the double 'D' section, allows for the fitment of a patchlock bolt to secure the intermediate shaft. Clamped around the end of the female shaft is a dust seal which prevents the ingress of dirt and moisture into the sliding joint, and a heat sleeve is also fitted to reflect radiant heat from the exhaust.

The male shaft is a triangular section tube which is staked at its lower end into a flange. A cage and curved 'spring plates' are fitted to its upper end, which slide in the female shaft. A pin is fitted into the side of the female tube, to secure the male tube in the bore. The lower end of the male shaft is fitted with a flexible coupling to absorb vibration and steering 'kick back', transmitted from the steering gear. A 'Stabilising pin' is fitted through the coupling to prevent coupling articulation (acting as a universal joint), while still allowing rotational flexing and plunge movement. The coupling is a rubber moulding within which are nylon fibres wound around the attachment holes to transmit torque applied to the steering. The coupling is attached to a drive flange (which is part of the male shaft), and to the 'U' yoke which in turn is connected to the pinion yoke, by the universal joint assembly.

STEERING COLUMN LOCK



Item	Part Number	Description
1	-	Ignition barrel
2	-	Column lock assembly
3	-	Lock bolt
4	-	Ignition switch
5	-	Attachment hole
6	-	Alignment mark
7	-	Switch drive
8	-	Barrel release hole
9	-	Barrel drive

The column lock comprises a cast housing which contains the locking components. The unit is assembled and sealed with a cover which is secured with roll pins into blind holes. The column lock is not a serviceable part and must be replaced as a complete component. The lock has a locking bolt which moves up and down on a cam. The cam is part of a shaft which runs through the lock and is operated by rotation of the ignition key in the ignition barrel.

The column lock is attached to the column with two shear bolts. When the column lock is fitted to the column, the bolts are tightened to a specified torque which shears off the heads of the bolts, preventing easy removal of the column lock.

 **CAUTION : Before removing the ignition switch and/or key barrel, ensure the lock is in key position I. Ensure that the shaft is not rotated from this position, when the ignition switch has been removed from the column lock. If the shaft is rotated, a plunger and spring can become unseated in the lock bolt mechanism causing incorrect operation of the column lock. It may be possible to detect this condition by shaking the lock, as the plunger and spring may be heard moving around in the lock. In this condition the lock is not serviceable and must discarded.**

The ignition barrel is fitted to the right hand end of the column lock. The lock is pushed into the bore and locks in position. Removal and fitment of the barrel is achieved by inserting the ignition key into the key barrel and turning to position I. To remove from the column lock, a suitable probe must be inserted through the release hole to depress the locking plunger on the key barrel. The key barrel can them be pulled from the lock using the key.

The ignition switch is fitted to the left hand end of the column lock. The ignition switch is pushed into the bore and two plastic clips locate in slots in the lock to retain the switch. Removal of the ignition switch is achieved by ensuring that the key is in the ignition barrel and turned to position I, depressing the two plastic clips and pulling the switch from the lock. Before replacing the ignition barrel, ensure that the switch is in position I (a new switch is supplied in position 0), and ensure that the drive tangs on the lock shaft are aligned with the alignment mark on the lock casting. Push the switch into the lock and ensure that it is fully engaged on the drive tangs and the plastic clips are fully located in the slots.