

## TRUCK, LIGHTWEIGHT, MC2, LAND ROVER 110 4X4 – ALL TYPES TRUCK, LIGHT, MC2, LAND ROVER 110 6X6

### SUSPENSION AND STEERING INSPECTION PROCEDURE

## EQUIPMENT INSPECTION AND EXAMINATION DATA

This instruction is authorised for use by command of the Chief of the General Staff. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with GENERAL A 001.

### Introduction

1. This instruction details the criteria for the inspection of the suspension and the steering on the Land Rover 110 4x4 and 6x6 to assess wear in suspension and steering components.

### Associated Publications

2. Reference may be necessary to the latest issue of the following documents:
  - a. [EMEI Vehicle A 291-1](#) – Tyres and Tubes – Care and Maintenance of B Vehicles;
  - b. [EMEI Vehicle A 291-5](#) – Tyres and Tubes – General Service B Vehicle Tyre Guide;
  - c. [EMEI Vehicle A 298-2](#) – Tyres and Tubes – Inspection for Useability;
  - d. [EMEI Vehicle G 103](#) – Truck, Utility, Lightweight And Truck, Utility, Lightweight, Winch, Mc2 - Land Rover 110 4x4 – Light Grade Repair;
  - e. [EMEI Vehicle G 104-1](#) – Truck, Utility, Lightweight And Truck, Utility, Lightweight, Winch, Mc2 - Land Rover 110 4x4 – Medium Grade Repair;
  - f. [EMEI Vehicle G 109](#) – Truck, Utility, Lightweight And Truck, Utility, Lightweight, Winch, Mc2 - Land Rover 110 4x4 – Servicing Schedule;
  - g. [EMEI Vehicle G 189-11](#) – Reclamation of Panhard Rod, Rear Lower Link and Radius Arm Mounts;
  - h. [EMEI Vehicle G 197-13](#) – Fitting of Coil Spring Retainers;
  - i. [EMEI Vehicle G 197-14](#) – Repair of Manual Steering Box Sector Shaft End Float; and
  - j. [EMEI Vehicle G 203](#) – Truck, Cargo, Light And Truck, Cargo, Light, Winch, Mc2 - Land Rover 110 6x6 – Light Grade Repair;
  - k. [EMEI Vehicle G 204-1](#) – Truck, Cargo, Light And Truck, Cargo, Light, Winch, Mc2 - Land Rover 110 6x6 – Medium Grade Repair;
  - l. [EMEI Vehicle G 209](#) – Truck, Cargo, Light And Truck, Cargo, Light, Winch, Mc2 - Land Rover 110 6x6 – Servicing Schedule; and
  - m. [Technical Regulation of Army Materiel Manual](#) (TRAMM).

### Inspection Criteria

3. The stability of a vehicle is reduced when the steering and suspension components are worn beyond limits. As component wear accelerates, the overall stability of a vehicle will deteriorate rapidly. The wear rate of steering and suspension components is dependant on vehicle use. Vehicles predominantly used off-road will experience significantly increased wear rates requiring more frequent inspection. Inspection intervals based on 60% on-road and 40% off-road operation are listed in Table 1.

#### NOTE

The inspection intervals listed in Table 1 should be reduced when a vehicle is operated over harsh terrain.

4. Specifications are shown in Table 2.

Table 1 Inspection Intervals

Serial	Designation	Safety Critical Item Check	Inspection After Repair in Workshop	Inspection During Minor, Major or Alt Major Servicing
1	Panhard rod and mountings	I	I	I
2	Radius arm and mountings	I	I	I
3	Swivel pin housing bushes, pins and bearings	I	I	I
4	Rear axle lower link and mountings	I	I	I,A
5	Rear axle top link and mountings	I	I	I
6	Top link ball joint	I	I	I
7	Front and rear coil springs/seats	I	I	I
8	Leaf springs, U-bolts and mountings	I	I	I
9	Leaf spring rocker beam	I	I	I
10	Front and rear shock absorbers and mountings	I	I	I
11	Front and rear bump rubbers	I	I	I
12	Steering box end float and backlash	I	I	I,A
13	Steering box mounts	I	I	I,Y
14	Drop arm ball joint	I	I	I
15	Drag link and ball joints	I	I	I
16	Track rod and ball joints	I	I	I
17	Steering damper and mountings	I	I	I
18	Tyre Inflation, wear and type	I	I	I
19	Steering Stop Adjustment	I	I	I
<b>Key: A – Adjust, I – Inspect, Y – Tighten</b>				

Table 2 Specifications

Serial	Designation	Specification
1	Panhard rod mounting bolts	176 N.m (130 lbf.ft)
2	Radius arm mountings	176 N.m (130 lbf.ft)
3	Swivel pin housing bush wear limit Swivel pin housing bush preload	0.4 mm (0.016 in ) 4.5–9 kg (10–20 lb)
4	Rear axle lower link to axle Rear axle lower link to chassis	168–186 N.m (124–137 lbf.ft) 176 N.m (130 lbf.ft)
5	Rear axle top link to body	115 N.m (85 lbf.ft)
6	Top link ball joint to axle	176 N.m (130 lbf.ft)
7	Top link ball joint free play	1.0 mm (0.040 in)
8	Leaf springs shackle bolts Leaf spring U-bolts	80–95 N.m (60–70 lbf.ft) 128–142 N.m (95–105 lbf.ft)
9	Leaf spring rocker beam pivot bolt	366 N.m (270 lbf.ft)
10	Steering box mounting bolts	80 N.m (60 lbf.ft)
11	Drop arm ball joint, drag link ball joint and track rod ball joint	40 N.m (30 lbf.ft)
12	Steering stop adjustment (tyre wall to radius arm minimum clearance)	20 mm (0.78 in)
13	Steering shaft universal joint pinch bolts	20–25 N.m (15–18 lbf.ft)
14	Toe out	1.2–2.4 mm (0.047–0.094 in)
15	Steering box sector shaft end float maximum allowable wear (to be set at zero during adjustment)	0.5 mm (0.02 in)

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## Inspection Guidelines

### NOTE

Two persons are required to complete some of the inspection procedures.

- The inspection procedures for steering and suspension are detailed in the paragraphs that follow. The lever, referred to throughout the inspection procedures, is to be 600 mm long and 12–20 mm wide. The lever can be manufactured at unit level (Figure 1). Alternatively, a tyre lever can be modified. When testing for bush movement, allow for elasticity of the bushes.

### NOTE

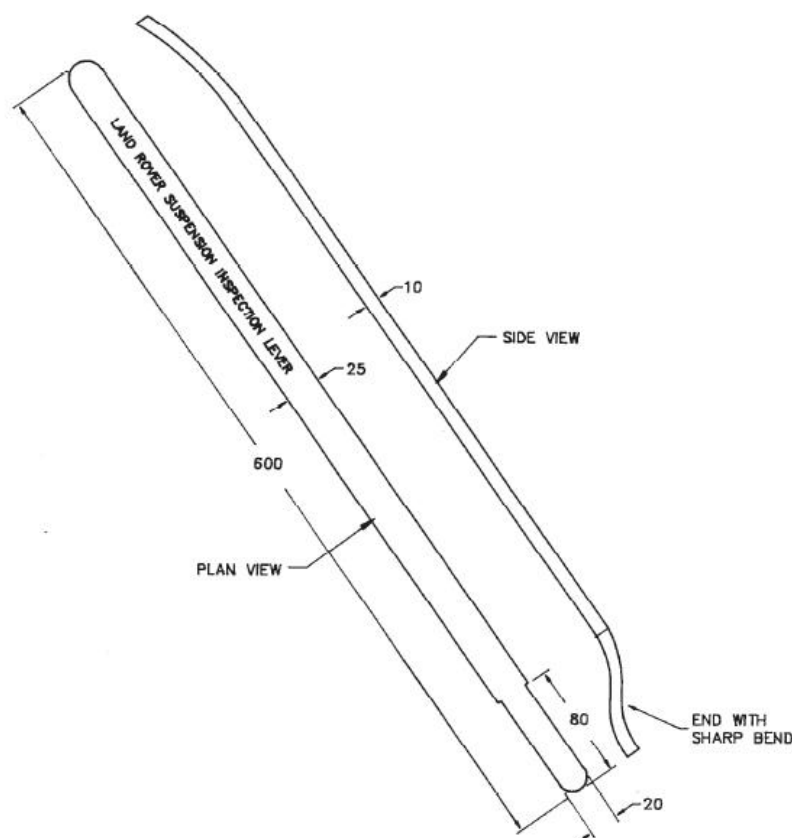
Elasticity, by definition, means that a bush or mounting will resume its normal bulk or shape after contraction, dilation or distortion. Do not confuse worn mounting bolts and mounting brackets with worn bushes.

Funding is a unit responsibility.

This figure shows a representation of a Heyco 1500 brand tyre lever. To manufacture the inspection lever, modify the tyre lever by grinding the end with the sharp bend to a width of 20 mm. This will allow the lever to be used for checking swivel pin wear.

The words 'LAND ROVER SUSPENSION INSPECTION LEVER' are to be engraved or stamped on the tool.

Modified levers are not to be used for tyre changing.



**Figure 1 Manufacture of Land Rover Suspension Inspection Tool**

- Before commencing the inspection, ensure that the vehicle is on level ground with the park brake applied.
- The inspector should consider when the next scheduled inspection is due and classify the bushes accordingly. The vehicle should be road tested after the inspection to identify or confirm any handling problems or noises. Wear in

suspension components may cause rear axle steer, wander, vibration or noises during power on and power off situations.

8. Bushes, rubber mounts, mounting bolts and shock absorbers are to be replaced as sets. EMEI Vehicle G 189-11 details the procedure to reclaim the axle mounts for the panhard rod, radius arm and rear lower link.

### Inspection Procedure

9. **Panhard Rod Assembly and Mountings.** The panhard rod functionality is assessed as follows (Figure 2):

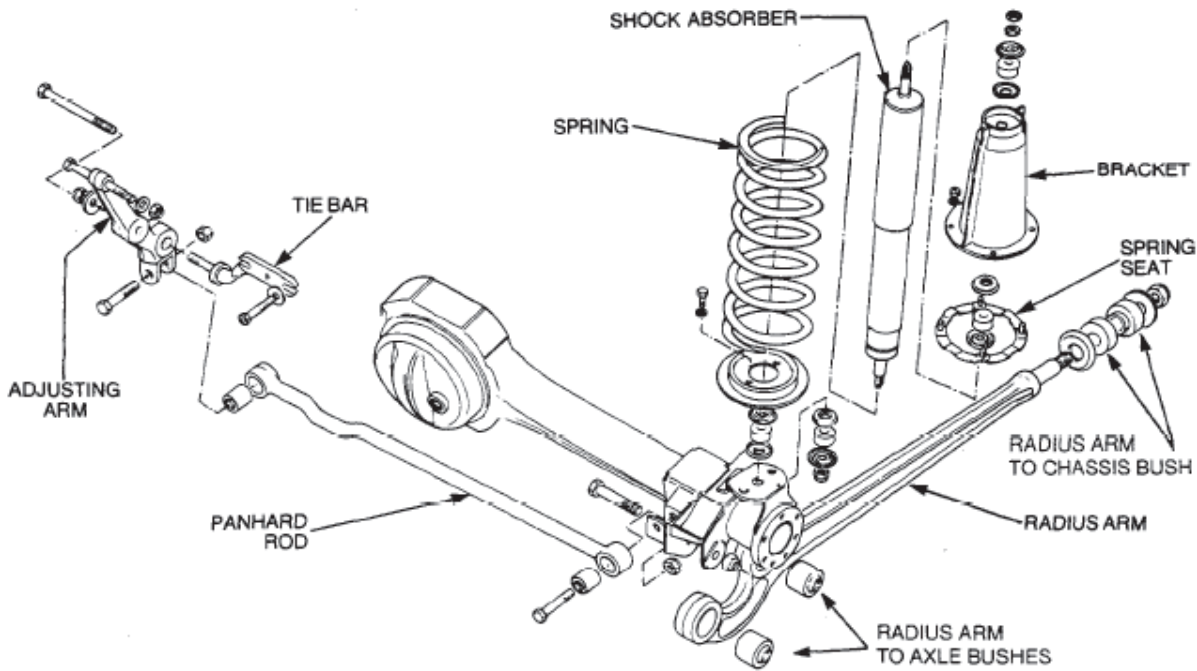


Figure 2 Front Suspension

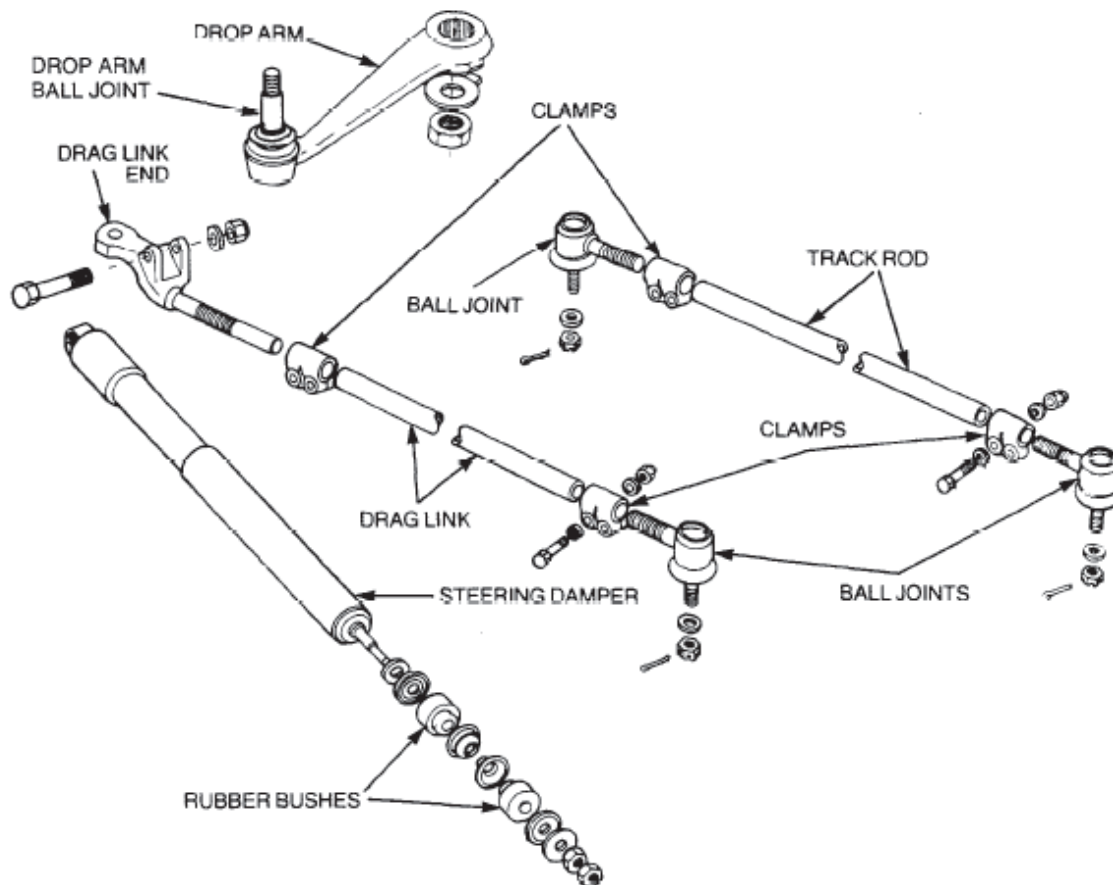
- a. Check the panhard rod for damage and ensure that the mounting bolts and nuts are tensioned to 176 N.m (130 lbf.ft).
- b. Check the bushes for separated, extruding or perished rubber.
- c. With the steering centralised and the wheels on the ground, rock the steering wheel from side to side. No appreciable play should be evident in the bushes.
- d. If any doubt exists, place a lever between the panhard rod mounting brackets and the rod and check for free play or separation of the rubber bonding on the metal sleeves.

10. **Radius Arm Assembly and Mountings.** The radius arm's functionality is assessed as follows (Figure 2):

- a. Check the radius arm for damage and ensure that the mounting bolts and nuts are tensioned to 176 N.m (130 lbf.ft).
- b. Check the bushes for separated, extruding or perished rubber.
- c. Check for movement in the axle bushes by placing a lever between the axle mounting brackets and the radius arm and checking for excessive movement and separation of the rubber bonding on the metal sleeves.
- d. Check the chassis end bushes for wear and free play.

11. **Drop Arm Ball Joint.** The drop arm ball joint (Figure 3) functionality is assessed by having an assistant rocking the steering wheel from side to side while checking for free play in the ball joint.

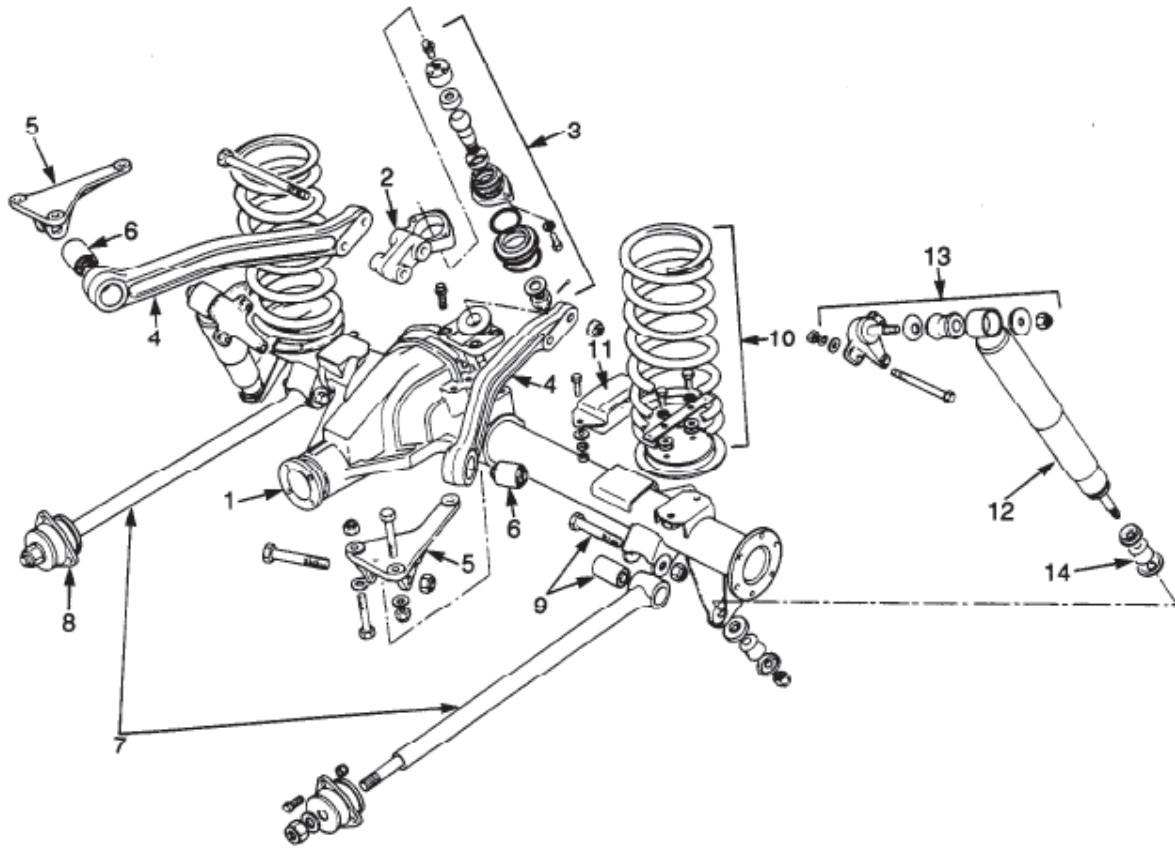
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**Figure 3 Steering Linkages**

- 12. Drag Link and Ball Joints.** The drag link functionality is assessed as follows (Figure 3):
- Check the drag link for damage.
  - With an assistant rocking the steering wheel from side to side, check for free movement in the ball joints.
- 13. Track Rod and Ball Joints.** The track rod functionality is assessed as follows (Figure 3):
- Check the track rod for damage.
  - With an assistant rocking the steering wheel from side to side, check for free movement in the ball joints.
- 14. Steering Damper and Mountings.** The steering damper functionality is assessed as follows (Figure 3):
- Check that the mounting rubbers are not perished or worn and mounting nuts are tight.
  - Inspect the damper for leaks, dents or other damage.
- 15. Steering Box and Column.** The steering box and column functionality is assessed as follows:
- Check that the steering box mounting bolts are tight.
  - Check the steering shaft universal joints for wear and that the pinch bolts are tensioned to 20–25 N.m (15–18 lbf.ft).
- 16. Manual Steering Box End float and Backlash.** Adjust the Land Rover 4x4 manual steering box end float and backlash in accordance with EMEI Vehicle G 103.
- Sector Shaft End float.** The maximum sector shaft end float is 0.5 mm. The sector shaft end float is evident as vertical movement of the sector shaft, and is caused by play between the sector shaft adjuster screw and the adjuster screw plug. The rectification of end float requires the partial disassembly of the steering box. End float should not be confused with steering wheel free play.

- b. **Steering Wheel Free Play.** Free play is normally caused by worn steering linkage components or by backlash between the worm and sector shafts. Free play can be rectified by replacing worn components or by turning the sector shaft adjusting screw to reduce backlash.
17. **Steering Lock Stops.** The steering lock stops must be adjusted to provide a minimum clearance of 20 mm between the tyre wall and the radius arm with the wheel at full lock.
18. **Rear Lower Link.** The rear lower link functionality is assessed as follows (Figure 4):

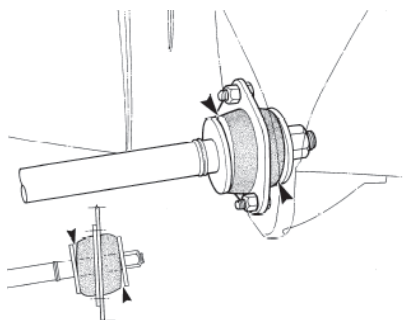


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- |                                 |                                      |  |
|---------------------------------|--------------------------------------|--|
| 1. Salisbury Axle Casing        | 6. Top Link Bushes                   | 11. Bump-stop                          |
| 2. Fulcrum Bracket              | 7. Lower Links                       | 12. Shock Absorber                     |
| 3. Top Link Ball Joint Assembly | 8. Lower Link Front Flexible Mount   | 13. Shock Absorber Top Bush Assembly   |
| 4. Suspension Top Links         | 9. Lower Link Bush and Bolt Assembly | 14. Shock Absorber Lower Bush Assembly |
| 5. Top Link Mounting Brackets   | 10. Coil Spring Assembly             |  |

**Figure 4 Rear Coil Spring Suspension**

- a. Check the lower link for damage.
- b. Inspect the front flexible mount (link to chassis) as follows:
  - (1) Check that the mounting nuts are correctly tensioned to 176 N.m (130 lbf.ft).
  - (2) Check the flexible mounts for separated, extruding or perished rubber and damage to the end plates.
  - (3) Check that the rubber bushing is in compression with the metal end plates; a gap will be apparent due to the angle of the link (Figure 5).



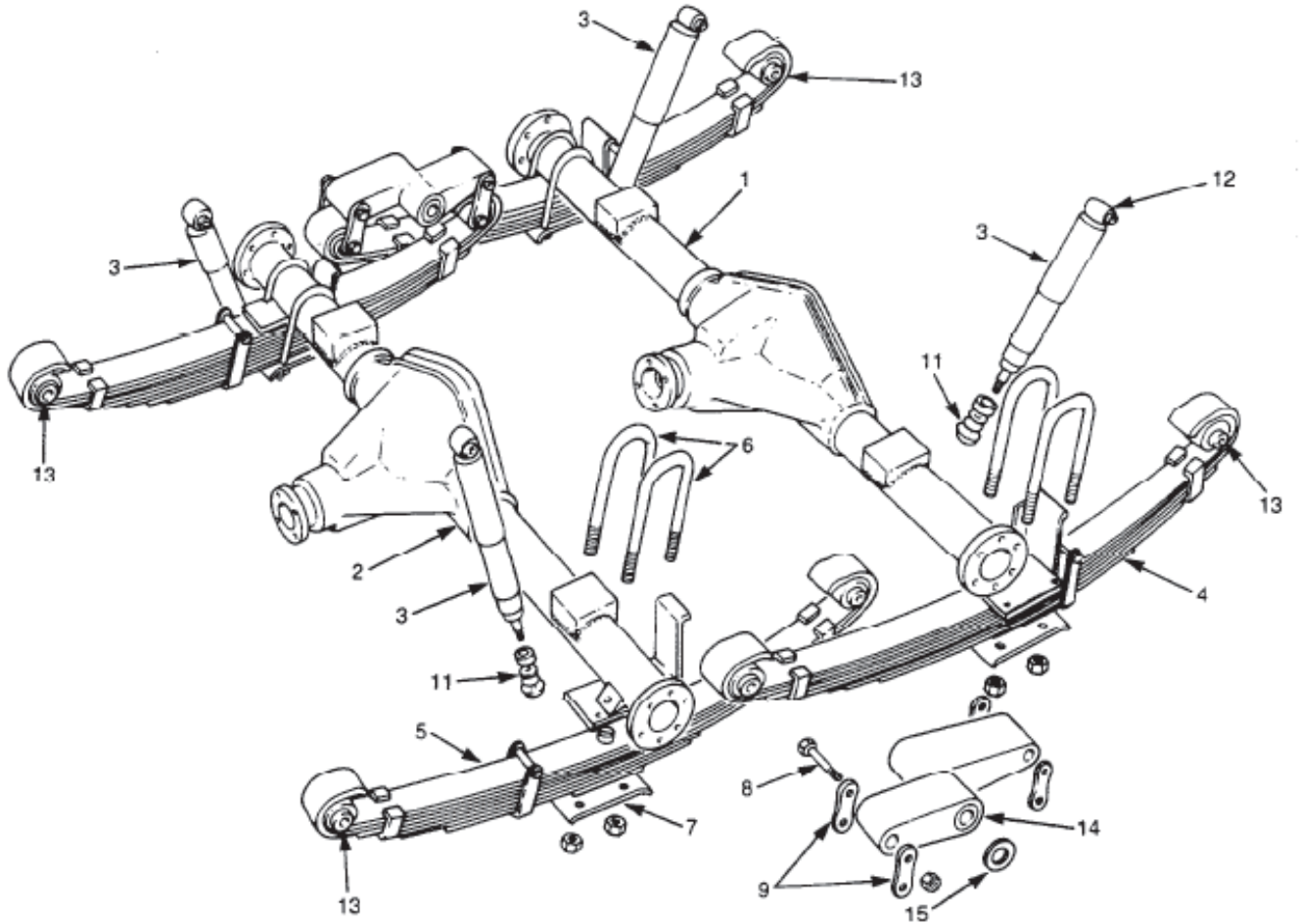
**Figure 5 Rear Lower Link Front Flexible Mount Detail**

- (4) If in doubt, lateral movement in the mount can be checked by rocking the vehicle back and forth with the park brake applied. The rubber bushing must remain in partial contact with both the metal end plates.
- c. Inspect the rear link-to-axle bushes as follows:
- (1) Check that the mounting nuts are correctly tensioned to 168–186 N.m (12–137 lbf.ft).
  - (2) Check the mounts for separated, extruding or perished rubber and damage.
  - (3) Place a lever between the axle bracket and link and check for free play in the bushes.
19. **Rear Top Link and Top Link Ball Joint.** The top link functionality is assessed as follows (Figure 4):
- a. Check the links for damage and ensure that the body mounting bolts and nuts are correctly tensioned to 115 N.m (85 lbf.ft).
  - b. Check that the top link ball joint is correctly tensioned to 176 N.m (130 lbf.ft).
  - c. Check the bushes for separated, extruding or perished rubber.
  - d. Check for movement in the body to link bushes and separation of the rubber bonding by placing a lever between the mounting brackets and link.
  - e. Place a lever between the top link ball joint and the axle and check for free play. The maximum free play is 1 mm (0.040 in).

**NOTE**

If the top link ball joint is worn out it will normally exhibit a loud ‘clunking’ noise when the clutch is engaged at the point of the vehicle moving off or on acceleration or deceleration.

20. **Rear Leaf Springs and Rocker Beam.** The rear leaf springs and rocker beam functionality is assessed as follows (Figure 6):
- a. Check the spring leaves for damage and ensure that the shackle bolt locking nuts are correctly tensioned to 80–95 N.m (60–70 lbf.ft).
  - b. Check the springs for sag.
  - c. Check that the U-bolts are correctly tensioned to 128–142 N.m (95–105 lbf.ft).
  - d. Check the shackle bushes for separated, extruding or perished rubber.
  - e. Place a lever between the shackle brackets and spring and check for excessive movement in the shackle bushes and separation of rubber bonding on the metal sleeves.
  - f. Check the axle rebound strap and retainers for damage.
  - g. Check the wear plates on the rocker beams.
  - h. Check that the chassis pivot bolt is tensioned to 366 N.m (270 lbf.ft).



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|---------------------------------|-----------------------|--|
| 1. Rear Axle Assembly           | 6. U-bolts            | 11. Shock Absorber Lower Bush Assembly |
| 2. Intermediate Axle Assembly   | 7. U-bolt Lower Plate | 12. Shock Absorber Upper Bush          |
| 3. Shock Absorber               | 8. Shackle Bolt       | 13. Shackle Bush                       |
| 4. Rear Spring Assembly         | 9. Shackle Bolt       | 14. Rocker Beam                        |
| 5. Intermediate Spring Assembly | 10. Centre Bolt       | 15. Wear Washes                        |

**Figure 6 Rear Leaf Spring Suspension**

- 21. Front and Rear Shock Absorbers.** The functionality of the shock absorbers is assessed as follows (Figure 6):
- a. Check that the mounting rubbers are not perished or worn and that the mounting nuts are tightened securely.
  - b. Inspect the shock absorbers for leaks, dents or other damage.
  - c. Bounce the vehicle through two suspension oscillations and check that the vehicle settles within one oscillation.
- 22. Front and Rear Bump Rubbers.** The functionality of the bump rubbers is assessed as follows:
- a. Ensure that the mounting bolts are tight.
  - b. Ensure that the bump rubbers are not damaged.
- 23. Coil Springs and Seats.** The functionality of the springs and seats is assessed as follows:
- a. Check that the coil springs are not broken or sagged.
  - b. Check that the spring seat retainers have been fitted to 4x4 variants in accordance with EMEI Vehicle G 197-13 and are functional.
  - c. Check that the spring seats are not damaged.



**24. Swivel Pin Bushes Initial Inspection.** Carry out an initial inspection of the swivel pin bushes as follows:

**NOTE**

If swivel pin bush wear is suspected, carry out the following abbreviated procedure to give an indicative measurement and prevent unnecessary work before going through the full procedure.

- a. With the front wheels on the ground, place a lever between the lower spring seat and the swivel housing and check for play.
- b. If play is evident at the upper swivel pin, place a Dial Test Indicator (DTI) with the base attached to the axle housing and the stylus against the swivel housing adjacent to the upper swivel pin. Then, with an assistant depressing the brake pedal (to eliminate wheel bearing play), measure the play which is not to exceed 0.3 mm.

**25. Swivel Pin Bushes Full Inspection.** If the play measured at Para 24 exceeds 0.3 mm at the swivel pin (DTI method) during the initial inspection, or if the inspector is unsure, the procedure detailed in the following paragraphs shall to be carried out.

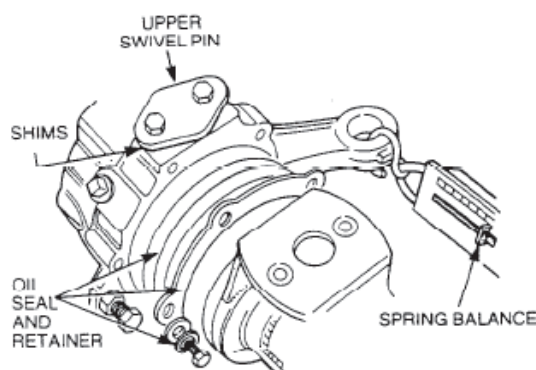
- a. Apply the hand-brake and chock the rear wheels.
- b. Loosen the front wheel nuts.

**WARNING**

**Personnel are to stay clear of the area between the wheels and the chassis whilst the vehicle is in the raised position and unsupported by safety stands.**

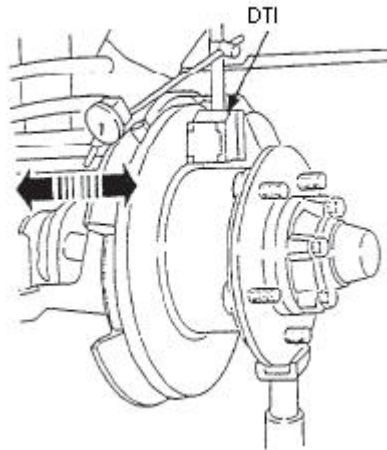
**Do not work underneath a raised vehicle without it being supported on axle stands.**

- c. Raise the front of the vehicle and support it on axle stands.
- d. Remove the road wheels.
- e. Disconnect the track rod and drag link from the swivel pin housing.
- f. Remove the swivel housing seal and rotate the swivel pin housing from lock to lock four to five times.
- g. Check the upper swivel pin preload by attaching a spring balance to the track rod ball joint arm and pulling to determine the effort required to turn the swivel (after the initial inertia is overcome, the resistance should be 4.5–9 kg (10–20 lb) (Figure 7).



**Figure 7 Measuring Swivel Pin Rotating Resistance**

- h. Adjust the preload to 4.5–9 kg (10 lb–20 lb) by adding or deleting shims from the upper swivel pin.
- i. Place a DTI on the outer face of the brake disc (Figure 8).



**Figure 8 DTI Position**

- j. Place the DTI stylus on the lower spring seat in line with the top of the axle as near to horizontal as possible and zero the pointer.

**WARNING**

**Do not place any body parts underneath the vehicle while the axle is clear of the axle stand.**

**Do not release the brake pedal while the axle is clear of the axle stand. If the brake pedal is released, the vehicle may roll off the jack.**

- k. With an assistant depressing the brake pedal by hand, place a jack under the outer end of the hub and raise the axle until it is **JUST** clear of the axle stands.
- l. Note the DTI reading and then lower the axle back onto the stand.
- m. Apply a downward force to the outer end of the hub, and ensure that the DTI returns to zero.
- n. Repeat para k. to m. six times and average the readings.
- o. An average of 0.4 mm (0.016 in) or less indicates that the clearance is within specification.

**NOTE**

If the clearance exceeds 0.4 mm then overhaul the swivel pin housing and set the preload.

- p. Refit the swivel housing seal and reconnect the drag link and track rod.
- q. Refit the road wheels and lower the vehicle to the ground.

**26. Tyre Inflation and Wear.** Inspect the tyres in accordance with EMEI Vehicle A 291-1, A 291-5, and A 298-2

**27. Post Inspection Road Test.** Road test the vehicle and check the following areas:

- a. prior to driving off, centralise the steering box and ensure the Land Rover decal on the steering wheel is horizontal;
- b. excessive bind in the steering;
- c. excessive play in the steering;
- d. steering wander;
- e. steering shimmy;

- f. rear axle steer;
- g. noises on cornering, acceleration and deceleration;
- h. steering vibration; and
- i. unusual characteristics in the suspension or steering likely to cause an unsafe situation.

**28. Recording Action.** As stated in Para 3, wear in steering and suspension components will affect vehicle stability. Unless the immediate replacement of components that have failed the inspection is to occur, an Inspection Report (GI 041) is to be raised detailing the components that have failed the inspection. The vehicle is to be classified ‘**DO NOT USE – XX**’ and the inspection details recorded in the GM-120 (Record Book for Service Equipment) – Part 2 (Record of Inspection).

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**END**

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