

Special precautions (including system contamination test procedure)



WARNING

Use only hydraulic system mineral oil (LHM) to replenish the braking and levelling systems.

Do not use brake fluids (Castrol RR363, Universal, or any other type). The use of any type of brake fluid, even in very small amounts, will cause component failure necessitating extensive rectification to the braking and levelling systems of the car.

Always ensure before fitting any seals, hoses, pipes, etc., that they are suitable for a mineral oil system. For details of correct component identification reference should be made to Section G3 of this Workshop Manual.

Always ensure that two sealed containers of hydraulic system mineral oil (LHM) are fitted in the luggage compartment.

Always ensure that no foreign matter enters the systems when work is being carried out.

Before attempting any work on the hydraulic systems of the car, service personnel must note carefully the contents of this Section and be fully conversant with the precautions required to ensure adequate safety and correct system operation. Also, before fitting any seals, hoses, pipes, etc., always ensure that they are suitable for use with a mineral oil hydraulic system.

The hydraulic systems operate at high pressure.

Pipes and components must never be removed when the hydraulic systems are in a charged state.

Before any work, except a specified test, is carried out on the hydraulic systems, they must be depressurized.

All items of hydraulic system equipment should carry identification to show that it is to be used only with hydraulic system mineral oil (colour reference green).

To assist in the identification marking of mineral oil components and equipment, self adhesive labels bearing the logo shown in figure G3-1 are available from the Parts Distribution Centre at Crewe.

If any work is carried out on either reservoir, ensure that the reservoir tops are retamperproofed. Refer to Section G7 for details.

Hydraulic system mineral oil (LHM)

Hydraulic system mineral oil is **Green** in colour. It is essential that only approved hydraulic system mineral oil is used (see Chapter D - Lubricants). Contamination

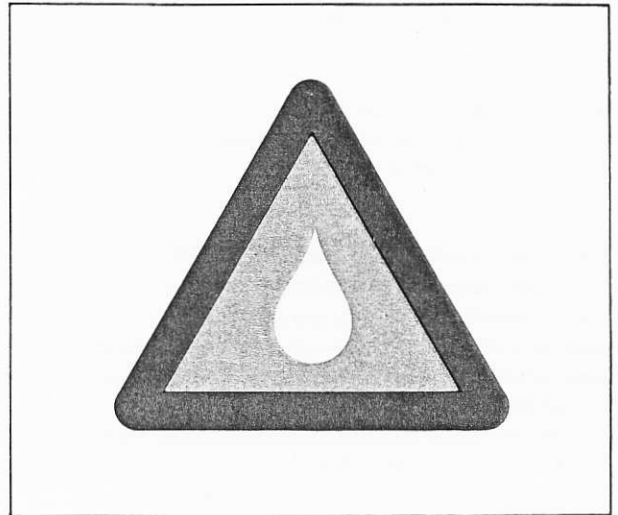


Fig. G3-1 Hydraulic system mineral oil logo

of mineral oil hydraulic systems or components with any conventional vegetable or synthetic type of brake fluid will cause seals and hoses to deteriorate which could result in eventual brake faults.

To avoid contamination all mineral oil containers and components should be stored in a clearly defined area away from that used for conventional brake fluid.

Hydraulic system mineral oil can cause damage to tyres. In the event of mineral oil coming into contact with a tyre, damage can be prevented if the mineral oil is removed immediately using a soap solution. Finally, wash the tyre with clean water.

Components identification

All components which are susceptible to damage from brake fluids are colour coded **Green** and have GMF prefix part numbers e.g. GMF 1062.

Other components in the system which are not susceptible to brake fluid damage (i.e. metal pipes and connectors) are neither colour coded nor do they have a GMF prefix part number. It must be stressed however that these parts must not become contaminated with brake fluid as this could circulate to other components in the hydraulic systems.

For details of individual component identification reference should be made to the relevant component Section within this Chapter.

Cleanliness

For the correct functioning of the hydraulic system, meticulous care should be taken to ensure complete cleanliness at all times.

Since both the braking system and levelling system have components with very fine



manufacturing tolerances, the ingress of even very small particles of foreign matter could have very serious effects on the operation of the systems.

Care must be taken to ensure that at all times, only clean hydraulic system mineral oil is used in the system and that any overhauled units or components are not exposed to contamination during assembly or fitting.

Contact with conventional brake fluids must be avoided at all times as these fluids have a detrimental effect on the rubber seals and hoses used in hydraulic mineral oil systems.

Hydraulic system mineral oil (LHM) contamination test kit and procedure

The hydraulic reservoirs are considered to be contamination proof. However, if contamination is suspected the following procedure should be adopted.

Rolls-Royce Motors have developed a simple test kit and procedure which will allow Franchise Holders to quickly check the mineral oil (LHM) hydraulic system for contamination with conventional types of brake fluid i.e. Universal brake fluid, Castrol RR363.

Two test procedures have been established.

These simple methods of testing the hydraulic system mineral oil (LHM) for contamination have been developed to assist Franchise Holders in the following circumstances.

1. To determine the presence of a conventional type of brake fluid i.e. RR363, in hydraulic system mineral oil (LHM) prior to cars passing into the workshops. This is to help protect the Franchise Holder against claims of liability for contamination of the systems.
2. To determine the presence of contamination in cars that have been out in service, prior to the Franchise Holder accepting cars for part exchange or retailing.

The following tests do not guarantee that the system has not been contaminated with brake fluid (i.e. RR363, Universal, or any other type), it is only an indication that brake fluid does/does not appear within the system(s).

If brake fluid has been introduced into the system(s) no matter how briefly, **no** amount of corrective action (draining, flushing out, etc.) except for a complete hydraulic system(s) overhaul (i.e. replacement of seals, hoses), will ensure that damage has not occurred or will not occur at some future date.

Note Once the hydraulic system mineral oil has been tested and proved to be free from contamination, the reservoirs should be tamperproofed and the warning panel fitted. Cleanliness throughout the sampling and testing procedures is of vital importance.

Test kit

Hydraulic system mineral oil (LHM) test kit RH2841, can be obtained from the Parts Distribution Centre at Crewe. The kit consists of the following.

- 1 off Dropping bottle with dye solution.
- 1 off Test tube rack.
- 10 off Glass test tubes with corks.
- 1 off Photograph depicting the colour for varying degrees of contamination.
- 1 off Sampling tube.
- 1 off Set of instructions.

First procedure

1. Switch on the ignition and depressurize the hydraulic systems by pumping the brake pedal until both low pressure warning panels illuminate. Continue to pump the pedal for at least a further 20 applications to ensure that all the accumulator mineral oil is returned to the reservoir.
2. Clean the area around each hydraulic reservoir top and remove the warning panel. Remove the securing clips attaching the pipes from the reservoirs to the inner longeron.
3. Lift the pipes from the reservoir tops, noting their positions. Remove the setscrew from the circular cover in the top of each reservoir and lift out the covers.
4. Ensure that the components in the test kit are clean and dry. The sampling tubes should be thoroughly cleaned out with petroleum ether (120/160°C). Paraffin or petrol should **not** be used.
5. Using a small syringe, extract 50 ml of mineral oil from the top and bottom of each reservoir, through one of the small holes exposed.
6. Place the samples into individual clean dry containers.
7. Shake each sample taken to ensure it is well mixed.

Pour 10 ml of each sample into clean test tubes (do not mix the samples together).

8. Using the dispenser, add two drops of the red dye solution contained in the kit into each 10 ml sample.
9. Cork the test tubes and shake them thoroughly.
9. Leave the samples to settle for at least 30 minutes and then examine each sample (refer to Examination of results, in this Section).

Workshop procedure (to be carried out when contamination is suspected)

1. Depressurize both System 1 and System 2 accumulators by releasing the internal bleed screw (see Section G9). This procedure returns all high pressure fluid to the reservoirs.
2. Clean the area around each hydraulic reservoir top and remove the warning panel. Remove the securing clips attaching the pipes from the reservoirs to the inner longeron.
3. Lift the pipes from the reservoir tops, noting their positions. Remove the setscrew from the circular cover in the top of each reservoir and lift out the covers.
4. Ensure that the components in the test kit are clean and dry. The sampling tubes should be thoroughly cleaned out with petroleum ether (120/160°C). Paraffin or petrol should **not** be used.

5. Using a small syringe, extract 50 ml of mineral oil from the top and bottom of each reservoir, through one of the small holes exposed.
6. Place the samples into individual clean dry containers.
7. The procedure described in Operation 1 has depressurized all components forward of the minimum pressure valve. Therefore, the gas springs, struts, etc. are still pressurized.

To obtain a sample rearward of the minimum pressure valve carry out the following procedure.

8. Bleed off approximately 50 ml at the bleed point situated on the inner right-hand sill, forward of the rear road spring.
9. Ensure that each sample taken is tested.

Test procedure for determining hydraulic system mineral oil (LHM) contamination

Any cloudiness within a sample taken is an indication of mixed fluids. This is because hydraulic system mineral oil (LHM) and conventional types of brake fluid (Castrol RR363, Universal, etc.) **do not** mix to give a clear fluid.

The following procedure explains the sequence for testing a sample. It should be noted that a test must be carried out on each sample taken.

1. Shake the sample to ensure that it is well mixed.
2. Ensure that the test tube is clean and dry. Then, extract 10 ml from the sample and pour it into the test tube.
3. Using the dispenser, add two drops of the red dye solution.
4. Cork the test tube and shake well.

Examination of results

On adding the red dye solution and the subsequent mixing, it is possible that the green colour of the mineral oil will change to a reddish brown. **This does not indicate contamination of the hydraulic system mineral oil.**

Contamination can only be confirmed by the formation of a cloudy red mass which will begin to settle towards the bottom of the tube if left to stand for at least 30 minutes.

If the sample in the test tube on addition of the dye turns red but remains clear, it indicates that the sample is not contaminated.

The volume of red mass which will eventually settle to the bottom of the test tube indicates the amount of contamination within the hydraulic system mineral oil.

Complete separation of the two liquids may take a considerable amount of time, for example a very small percentage of contamination may take more than seven days to completely separate.

If contamination is suspected, but difficult to diagnose, due to the small amount of contamination that may be present, or any doubts exists, confirmation should be obtained by sending a sample to Rolls-Royce Motors (if in the United Kingdom) or to a chemical analysis laboratory.

Very small percentages (less than 0.5%) of a

conventional type of brake fluid contaminating the hydraulic system mineral oil is sufficient to cause seal and component failure.

Depressurizing the system

Method 1

Switch on the ignition and pump the brake pedal 50 to 60 times until resistance felt at the pedal reduces indicating that the systems are depressurized. The facia warning panels should be illuminated (see Section G2). Switch off the ignition.

To depressurize the rear suspension struts, attach a bleed tube to the struts bleed screw. Open the bleed screw and allow the hydraulic system mineral oil to bleed into a clean container until the flow ceases.

Method 2

Open the bleed screw on both accumulators and allow sufficient time for the mineral oil pressure to discharge back to the reservoir. These bleed screws are an integral part of the accumulator, the mineral oil being allowed to flow from the accumulator sphere back to the reservoir when the bleed screw is opened (see Section G9). Switch on the ignition and check that the facia warning panels are illuminated (see Section G2).

Depressurize the rear suspension struts as described in Method 1.

Accumulator and Gas spring spheres

The accumulator and gas spring spheres are charged on one side of their diaphragms with nitrogen gas to a pressure of 60 bar to 64 bar (870 lbf/in² to 928 lbf/in²) and 10,35 bar to 18,63 bar (150 lbf/in² to 270 lbf/in²) respectively, prior to despatch from the factory.

Each sphere is marked with a band of white paint or with a stick-on yellow label when charged. The charge pressure in bar is stamped on the non-return valve cap at the end of the sphere.

A date of manufacture is also marked on each sphere. It is recommended that spheres are stored and issued from stock in date sequence.

Bleeding the hydraulic systems

Remove fuse A6 from fuse panel F2 on the main fuseboard, to isolate the electric gearchange whilst the systems are bled.

Only use hydraulic system mineral oil bleed equipment when bleeding the hydraulic systems. **Never connect equipment that has been used for conventional brake fluids to the system.**

The bleed screws for the accumulators are an integral part of the accumulator valve housing and a bleed hose connection is not required.

Reference should be made to Section G5 for details of the complete bleeding procedure.

When bleeding the hydraulic system, any hydraulic system mineral oil that has been spilt onto the tyres must be removed. The use of a soap solution and a final rinse with clean water is recommended for this purpose.



Under no circumstances should hydraulic system mineral oil be allowed to remain on the tyres for prolonged periods as this will cause tyre damage.

General information

Removing components

Prior to disconnecting any pipes or removing hydraulic components from the car, the area around the pipes and components should be thoroughly cleaned. Particular attention should be given to the localized areas around the pipe unions and their corresponding ports.

Whenever units, pipes, or components are disconnected from the hydraulic systems all open ports and pipe ends must be blanked off immediately, to avoid contamination of the system.

It is stressed that the clean condition of any blanks used is equally as important as the clean condition of the components they seal.

Blanks which have been used on cars with conventional brake fluid systems should not be used, unless they have been thoroughly cleaned and all traces of brake fluid removed.

Note Masking tape or cork bungs do not constitute blanks.

Quantities of blanks may be obtained, on request from the Parts Distribution Centre at Crewe.

In addition, special pressure blanks are available, capable of withstanding full hydraulic system pressure. These blanks should be used during testing and fault diagnosis procedures where it may be necessary to blank off a pipe or component and then charge the systems. When fitted these blanks must be torque tightened to the figures quoted for the pipe unions which they replace.

Cleaning components

The recommended cleaner is petroleum ether (120/160°C).

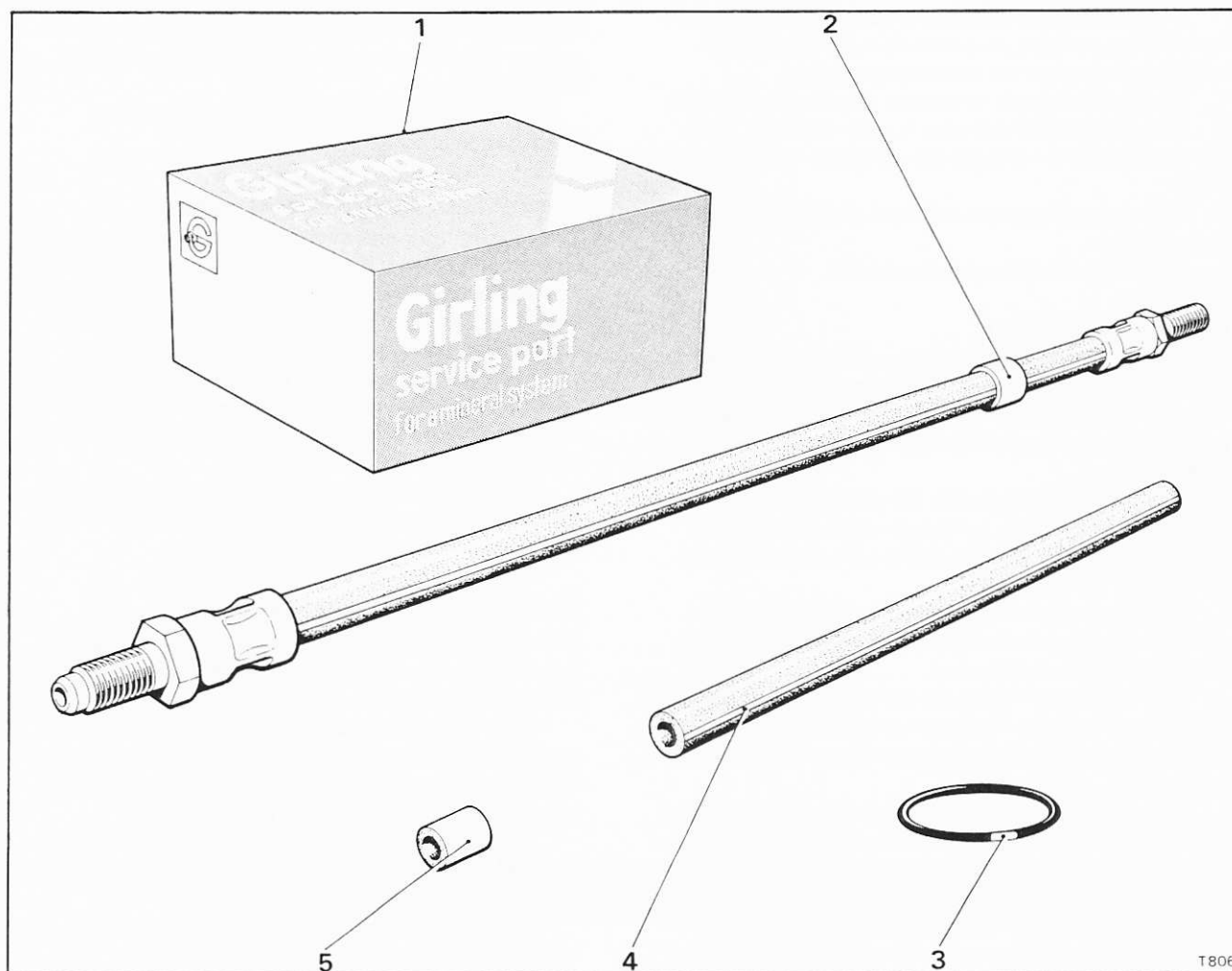


Fig. G3-2 Hydraulic system mineral oil component identification

- | | |
|---|-----------------------------------|
| 1 Brake seal kit container | 3 Sealing ring (green paint mark) |
| 2 Flexible brake hose (green collar and stripe) | 4 Brake hose (green stripe) |
| | 5 Pipe seal (green outer surface) |

Components which have been removed should be thoroughly cleaned before replacement.

Rubber pipes, sealing rings, and other components should be washed in petroleum ether (120/160°C) and then dried with dry compressed air.

Metal pipes requiring the removal of underseal and road dirt from their outer surfaces, may be cleaned with trichlorethylene or paraffin. In such cases, a final cleaning procedure and flushing of the pipe internal bore using petroleum ether (120/160°C) should be carried out. Blow dry with clean compressed air.

Cloths, even the lint free types, should never be used to clean hydraulic components.

Servicing equipment

All servicing equipment should be clearly marked to indicate the type of hydraulic system for which it is suitable.

Under no circumstances should equipment used for conventional brake fluids be used on a mineral oil hydraulic system or component.

Only pressure gauges, test, and bleed equipment bearing hydraulic system mineral oil identifications should be connected to a mineral oil system.

Hydraulic systems - Filling or topping-up

When the hydraulic reservoirs require topping-up or the systems are completely drained, always fill/top-up with fresh clean hydraulic system mineral oil of the specified type. Refer to Chapter D for the correct specification.

After filling the systems, bleed as described in Section G5.

Servicing rubber components

In the interest of safety, the rubber components used in the hydraulic systems have been allotted specific 'life' mileages at the completion of which or at the nearest service prior to completion it is recommended that the components are renewed. Reference should be made to the Service Schedule Manual publication number TSD 4702 for this information.

Only rubber components bearing mineral oil identification marks should be fitted to a mineral oil hydraulic system.

Under no circumstances must a rubber component for a conventional brake fluid system be substituted for the correct component.

Fitting replacement units

Replacement hydraulic units are tested and blanked off before being despatched from the factory.

It is advisable, when fitting a replacement unit, that when the unit has been placed in position and the blanks removed, the mineral oil in the unit is allowed to drain before the pipes are connected.

When drained, the pipes should be connected and the appropriate bleeding operations carried out.

Note The mineral oil should not be blown out, allowing it to drain is sufficient.

Storage and transportation

The care taken to prevent contamination of components during storage or transportation is extremely important.

All mineral oil components should be stored in a separate and clearly defined area from that used for conventional brake fluid components.

Replacement parts, pipes, and units must be clearly identified and securely sealed with the correct blanks. Blanks should not be removed until immediately prior to fitting; the replacement parts must also be protected from dust and damage.

Sealing rings and rubber pipes in storage should be protected from dust, light, and heat in order to reduce deterioration of the rubber.

Where mineral oil components are transported or returned to the manufacturer they should be clearly marked as being for use on mineral oil hydraulic systems.

Hydraulic system pipework

Bundy tubing is used to carry mineral oil around the hydraulic systems, except where flexible hoses are used to accommodate movement between two units. Flexible hoses are also used on several connections to the reservoirs, plus the levelling valve seepage return hose.

The bundy tubing pipework is almost entirely 4,76 mm (0.186 in) diameter, the exceptions being 6,35 mm (0.250 in) diameter and 9,52 mm (0.375 in) diameter.

To enable pipe identification, neoprene sleeves are fitted to each end of the metal pipes, except for the feeds from the reservoirs to the hydraulic pumps and the engine hydraulic pipes (pump to accumulator). A chart quoting the pipe colours and functions is given on page G4-2. This chart should be consulted to determine the function of each pipe i.e. high pressure, low pressure, and system.

Generally, pipework connections are effected by flared pipe ends and unions, either male or female as necessary. Conical seats are machined in the components or junctions to seat the flares and provide effective joints.

On the accumulators a different type of connection is used requiring the fitting of a small rubber sleeve (see fig. G4-1). Sealing is achieved by deformation of the rubber when the sleeve nut is tightened.

To fit this type of connection the procedure given at the end of this Section should be carried out.

In certain flexible pipe joints, face seals (aluminium) and copper washers are employed. A new copper washer and face seal must be fitted whenever the pipe is removed.

If hydraulic pipes are disturbed the following points should be noted.

The area around the pipe union and pipe end should be thoroughly cleaned before the union is unscrewed.

Pipe ends should always be blanked off immediately after removal. The blanks should not be removed until immediately prior to fitting.

Whenever pipes are removed, the flares should be inspected for serviceability. Pipes showing signs of damage, cracking, or collapse must be renewed.

Before fitting pipes and unions they should be cleaned thoroughly using petroleum ether (120/160°C), then blown through with clean dry compressed air. Particular attention should be made to the union and the exterior of the pipe immediately behind the flares.

Whenever any work is carried out which disturbs the anti-lock braking system components, the complete system must be checked with the ABS test box **before** the car is driven (see Section G6).

Special care must be exercised when removing or fitting any reservoir pipe connections. The pipes are a push-in fit into the reservoir manifold therefore, ensure the swaged end of the pipes engage with the nitrite seal.

Also, the levelling valve red and yellow coded pipes forming the double coiled pipe assembly, must be connected the correct way round. This is; red in the union nearest to the front of the car and yellow nearest to the levelling valve operating pivot. These red and yellow coded pipes are secured together using heatshrink ties to form the double coil assembly.

When fitting pipes, do not overtighten unions as this could cause damage to pipe flares.

If when a pipe is removed the coloured sleeves are in poor condition, they should be renewed. This is best achieved by expanding a new correctly coloured rubber sleeve sufficiently to clear the union, using a small three pronged expanding hand tool (i.e. Penguin pliers).

Identification sleeves are not fitted to the flexible hoses but the sleeves on the connecting pipes at either end may be used to identify the flexible pipe and its function.

The flexible and metal pipes can be readily identified by means of the colour coding and component location layouts (see Section G2).

Also refer to the function chart shown on page G4-2.

Note The two high pressure pipes from the hydraulic pumps to the hydraulic accumulators and the feeds from the reservoirs to the hydraulic pumps are not marked and do not connect to any other marked pipes. Since these pipes are the only ones without means of identification confusion should not arise.

Extreme caution should be taken when fitting or renewing flexible pipes to ensure that the correct type of pipe is fitted, in the correct location, and in accordance with the colour coding.

In the interest of safety, the flexible pipes fitted to the hydraulic systems have been allotted specific 'life' mileages at the completion of which or at the nearest service prior to completion, it is recommended that the flexible pipes are renewed.

For recommended 'life' mileages reference should be made to the Service Schedule Manual, publication number TSD 4702.

When renewing flexible pipes and hoses, only those conforming with hydraulic system mineral oil requirements and bearing mineral oil identification marks should be fitted (see fig. G3-2). Under no circumstances must any other type of flexible pipe or hose be fitted.



When removing rigid or flexible pipes, the positions of all clipping points and pipe routing should be noted to ensure that, when fitted, no chafing or vibration of the pipes can occur. Always ensure that the flexible hoses and rigid pipes are routed to clear other components and that clearance is maintained during the full range of steering and suspension movement.

In the event of replacement pipes being required, it is recommended that they are produced using 'Armco' 25 microns zinc plated, fully chromate passivated and/or green polymer coated bundy tubing. Care should be taken to avoid sharp bends when producing replacement pipes as this could cause the plating/coating to fracture. A hydraulic pipe manufacturing kit RH 12043 is available (see Section G23).

Note The pipe connection tappings on the front road wheel brake calipers, accumulators, modulator (if fitted), and levelling valve, have a metric thread form. Therefore, care should be taken when producing replacement pipes to ensure that the correct type and standard of pipe nut is fitted.

All pipes must be thoroughly cleaned using petroleum ether (120/160°C) and dried using clean compressed air. The ends should then be blanked until immediately prior to fitting.

Torque tighten all pipe unions and fittings, referring to either Section G22 or Chapter P.

After fitting of replacement pipes they should be leak checked and then coated with underseal if they are in an exposed area.

Rubber sleeve pipe connection – To fit (see fig. G4-1)

A. Slide the rubber sleeve onto the pipe until it abuts the collar.

B. Insert the small end of the pipe into the close fitting bore at the bottom of the threaded connection port.

C. Carefully centralize the pipe in the bore and screw in the sleeve nut until it abuts the pipe collar.

D. Torque tighten the nut to the figures quoted in Section G22.

Note The rubber sleeve must be renewed each time the pipe is disconnected.

It is important that the torque figures quoted in Section G22 are not exceeded as damage to the pipe end could result. This will cause pipe restriction and difficulty in withdrawing the pipe end from the connection bore.

Pipework colour coding

(Refer to Section G2)

Colour	Function	Location
Red	High pressure No. 1 system	Rear brakes and levelling; pipes from the front hydraulic pump, to the front (vertically mounted) accumulator and from the front accumulator to the upper distribution valve. Also from the front accumulator to the rear levelling struts, passing through the priority valve, levelling valve, minimum pressure valve, and restrictors. Left-hand drive turbocharged cars have a pipe from the front accumulator to the pressure switch.
Blue	High pressure (with foot-brake applied) No. 1 system	Anti-lock braking systems Brake line; pipe from the upper distribution valve to the modulator. Pipe from the modulator to the upper cylinders on the rear wheel brake calipers, passing through the 'G' valve. Non anti-lock braking systems Brake line; pipes from the upper distribution valve to the front brake calipers on the front wheels and the upper cylinders on the rear wheel brake calipers.
Yellow	Low pressure No. 1 system	Levelling return; pipe from the levelling valve to the inboard reservoir.

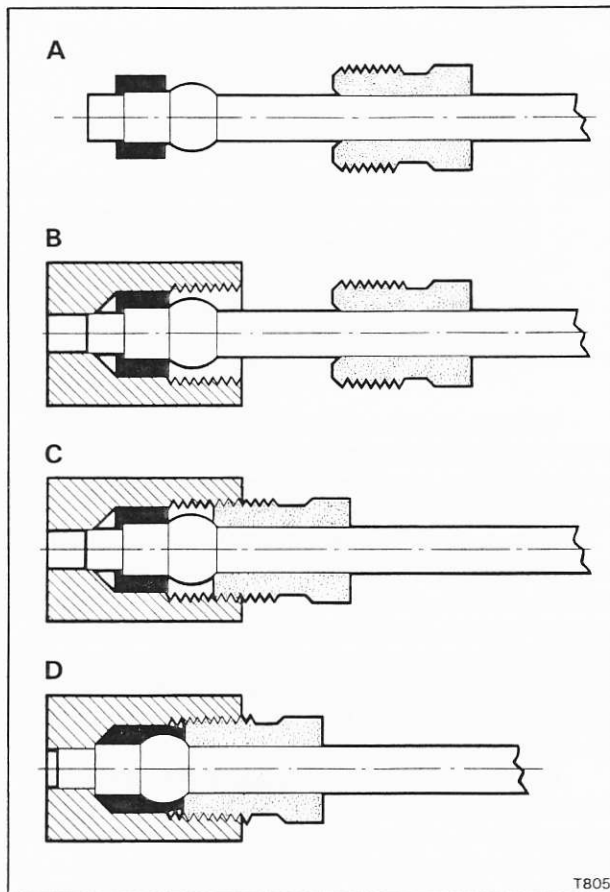


Fig. G4-1 Fitting a sleeved pipe connection

Black	Low pressure return No. 1 system	<p>Rear brakes and levelling; pipes from the upper distribution valve to the inboard reservoir and from the levelling struts through the minimum pressure valve and priority valve to the inboard reservoir. Also the return pipe from the front accumulator to the inboard reservoir.</p> <p>Anti-lock braking systems also have a return pipe from the modulator to the inboard reservoir.</p>
Orange	High pressure No. 2 system	<p>Brake line; pipes from the rear hydraulic pump, to the rear (horizontally mounted) accumulator and from the rear accumulator to the lower distribution valve.</p> <p>Left-hand drive turbocharged cars have a pipe from the rear accumulator to the pressure switch.</p>
Mauve	High pressure (with foot-brake applied) No. 2 system	<p>Anti-lock braking systems Brake line; pipe from the lower distribution valve to the modulator. Pipes from the modulator to the front brakes, including the caliper bridge pipes. (Pipe from 3-way connector forward of the 'G' valve to the lower cylinders on the rear wheel brake calipers, including the rear caliper bridge pipe, No. 1 system.)</p> <p>Non anti-lock braking systems Brake line; pipes from the lower distribution valve to the rear brake calipers on the front wheels and the lower cylinders on the rear wheel brake calipers, including the rear caliper bridge pipe.</p>
White	Low pressure return No. 2 system	<p>Brake line; pipe from the lower distribution valve to the outboard reservoir. Also the return pipe from the rear (horizontally mounted) accumulator to the outboard reservoir.</p> <p>Anti-lock braking systems also have a return pipe from the modulator to the outboard reservoir.</p>

