Health and Safety Executive

Safe recovery (and repair) of buses and coaches fitted with air suspension

Guidance Note **PM85**

This document contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

Guidance Notes are published under five subject headings:

Medical
Environmental Hygiene
Chemical Safety
Plant and Machinery
General

Introduction

1 This guidance note is primarily aimed at people involved in the roadside recovery and repair of public service vehicles (PSV's) (buses and coaches) fitted with air suspension. This includes recovery firms and tyre fitters, but the advice is equally applicable to work within repair workshops and bus depots. It provides supplementary guidance for people who have already received relevant training (as described in paragraph 11), and may also be of use to those involved in risk assessment for recovery and repair operations.

2 This guidance note has been jointly prepared by the Health and Safety Executive (HSE) and the Institute of Vehicle Repair (IVR), and reflects good working practice. It describes methods and equipment that can be used for the safe recovery and repair of vehicles fitted with air suspension. It applies to the majority of makes and models of single and double-deck PSV's. However, it is recognised that each type of vehicle presents its own unique hazards, and technicians will require specific knowledge to ensure that they can work safely.

3 This guidance does not cover:

- recovery of vehicles that have sustained heavy accident damage requiring specialist lifting and righting techniques;
- general hazards associated with recovery and repair (these are covered in other HSE publications – see www.hse.gov.uk/mvr).

4 When repairing or recovering buses and coaches fitted with air suspension, technicians must take care to ensure that the vehicle cannot suddenly and unexpectedly fall and trap them. The risk of this happening is significantly reduced if two basic principles are adopted:

- **Never crawl beneath a vehicle fitted with air suspension unless it is properly supported.**
- **Never tamper with the ride height for the purposes of recovery or repair.**

5 It should be possible to follow these principles if the task is adequately planned and sufficient time is allowed. Recovery technicians should not feel that the police, other officials or their employer are rushing them. Sufficient planning means that:

- the risks associated with each task are adequately assessed;
- each task is explained so that it is fully understood by the technician. Their roles and responsibilities must be clearly understood as well as those of their colleagues;
- all technicians have specific knowledge of the casualty vehicle and carry the necessary equipment to undertake the job safely;

- the technician arrives with a suitable recovery vehicle (if recovery is necessary);
- working procedures are planned and well rehearsed;
- equipment is in a safe condition by virtue of adequate inspection, maintenance and examination and has been subject to statutory examination;
- technicians understand the procedures about what to do if their training and instructions do not cover the situation encountered; and
- documentation should be in place to ensure that all of the above measures, controls and plans are correctly implemented.

Background

6 For many years, PSV's have been manufactured having rubber bellows (also known as airbags) supplied with air from the vehicle's air compressor. These are used instead of conventional springs and have the advantage that the system both cushions the ride and ensures a consistent ride height, regardless of the load being carried. It allows the height to be varied to suit certain needs, for example, lowering the step for disabled passengers. Some coaches are fitted with a 'ferry lift' facilitating safe negotiation of ramps onto ferries. A typical setup is shown in Figure 1.

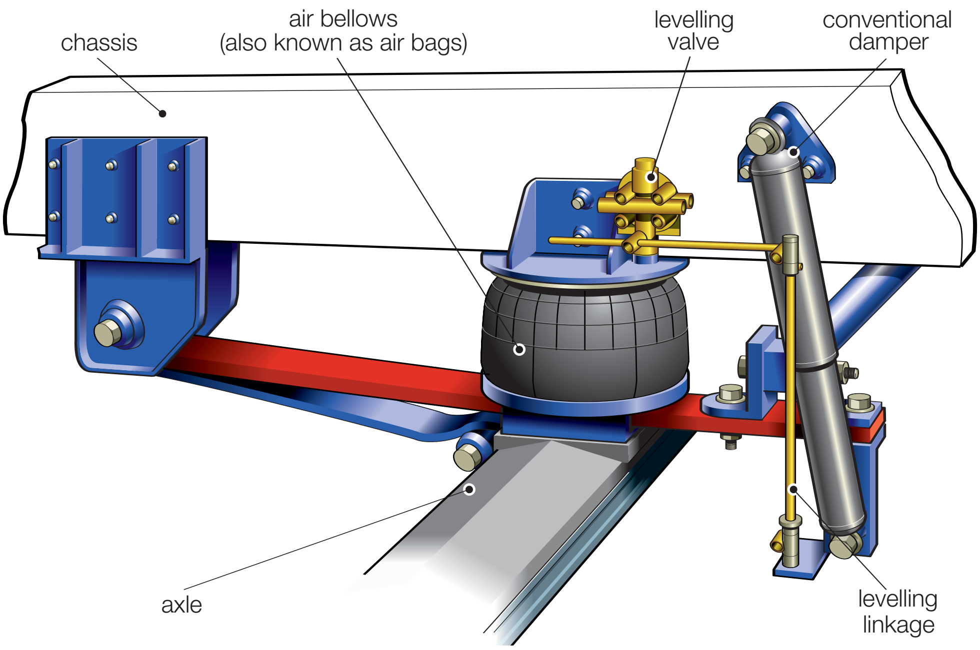

Figure 1 Schematic layout of air suspension components

7 A characteristic of air suspension is that vehicle ground clearance can suddenly and unexpectedly change due to a drop in air pressure. This presents crushing and trapping hazards to technicians recovering or repairing vehicles, especially if working beneath the vehicle. Figure 2 illustrates just how limited ground clearance is, even on conventional height buses. For modern low-floor buses, or when suspension deflates, clearance can be much less.

8 Air bellows can suddenly and unexpectedly rupture or deflate, leaving a small clearance between the vehicle structure and the ground. This has occurred on a number of occasions with the technician beneath the vehicle, resulting in serious injury or death.

9 In addition to crush injuries, a bellows has the potential to cause hearing damage from the bang as it ruptures. There is also a risk of fragments being ejected from the bellows at high speed.

10 In recent years the risks have increased because some modern vehicles have extremely low ground clearance (low-floor buses). In addition, sophisticated electronics are used to control several interlinked systems that are capable of affecting ground clearance without warning, and when the technician is least expecting it to do so. For example, opening the doors, applying the parking brake and even taking the bus out of drive can cause the control system to reduce ground clearance in expectation that the bus has arrived at a bus stop. Even on less complex systems, suspension can alter unexpectedly because of air leaks, tampering or component failure.

Training

11 Technicians should receive relevant training before recovering or repairing buses and coaches fitted with air-ride suspension. 'Relevant training' means training that is task-related, practical and realistic. Technicians

Figure 2 Clearance on a conventional bus with inflated suspension

should be able to demonstrate their competence and working knowledge before they are allowed to undertake work activities alone and unsupervised. Technicians should understand their duties and responsibilities relating to the recovery of vehicles. They should attend regular refresher and updating courses to ensure they are aware of current legislation, new techniques and advances in equipment. Further details on the minimum content of recovery training is provided in BS 7121 Part 12.[1]

Safe recovery methods

Main categories of recovery

12 In many cases, the engine on the casualty vehicle will still operate, but this does not necessarily mean that the vehicle is driveable. For example, it may have transmission problems, brake seizure, air supply failure/leaks or accident damage. Each casualty vehicle must be considered on a case-by-case basis to decide if it needs recovering or can be repaired at the roadside. The training and experience of the person doing the work will have an important role in the final decision.

13 There are three main recovery methods available, the benefits of which are described in Table 1:

- winching onto a transporter, for example a low-loader trailer;
- 'lift and tow', whereby either the front or rear end of the casualty is raised off the ground by the recovery vehicle, the weight being partly supported by the casualty's own axle, still on the ground, and partly by the rear of the recovery vehicle;
- flat towing, whereby the casualty vehicle supports its own weight on the road and is towed by means of a bar or towing frame.

Precautions during recovery

14 A factor common to all three recovery methods in Table 1 is the potential for the bottom of the vehicle to catch the road, especially if its air suspension is not fully inflated. This can be a particular problem on buses that have a large front or rear overhang with low ground clearance.

15 The use of low loaders solves this problem in terms of transporting the vehicle, but during recovery, the ground clearance of the vehicle is likely to be too low. Clearance can be increased by placing wooden blocks or ramps in front of the wheels, as shown in Figures 3 and 4, then winching the vehicle onto them. The vehicle can then be pulled along these blocks onto the trailer. For rectangular blocks, wedges may be needed in front of the main blocks to act as a ramp to ease the wheels onto the blocks.

Table 1 Main recovery methods

	Advantages	Disadvantages
Transporter	■ Fully inflated suspension not necessary. ■ Only requires one man to operate. ■ Transmission does not need to be uncoupled. ■ Easier to drive and control after recovery.	■ Not normally suitable for double-deckers due to height restrictions. ■ Air supply generally needed for brakes. ■ Blocks may be required to increase vehicle ground clearance during loading and unloading.
Lift and tow	■ Fully inflated suspension not always required depending on the route. ■ Only requires one man to operate. ■ If the brakes cannot be released on one axle, it can be lifted using the other axle to tow the vehicle.	■ Suspension needs to have some height. ■ Crush injuries can occur beneath the lifting arm. ■ The length of the load and the front overhang cause problems when cornering. ■ Emergency braking can lead to the casualty vehicle going out of control. ■ Air supply needed for brakes. ■ Transmission needs to be uncoupled.
Flat tow	■ Can be towed with deflated suspension on some roads, depending on condition, speed humps etc. ■ Does not require access to underside of vehicle unless brakes cannot be released by air pressure.	■ Air supply needed for brakes. ■ Requires two drivers, one in casualty vehicle and one in recovery vehicle. ■ Good communication and co-ordination between drivers is essential. ■ Transmission needs to be uncoupled. ■ Towing eyes can fail or can be missing, leading to makeshift connections. ■ Some functions of the vehicle being towed can be lost if the engine will not run, eg power-assisted steering, lighting. ■ Cornering can be difficult and emergency braking can lead to casualty vehicle going out of control (pendulum effect).

Figure 3 A low bus being successfully winched onto a low loader using ramps

Figure 4 A low bus being successfully winched onto a low loader using wooden blocks to increase vehicle height

16 When winching a casualty vehicle onto a low-loader trailer, it is essential to create and maintain a safe working area, with special attention to pedestrians and other road users. Nobody should be allowed to stand behind the casualty vehicle during winching. Remote-controlled winches make this process safer because the technician can control the winch from a safe position where they are not at risk of being struck, but are able to move around to gain a clear view of the operation. They should avoid the need to climb onto the trailer/bus but if absolutely necessary, precautions should be in place to avoid falling from height.

17 Exercise caution when using towing hitches because manufacturers rate hitches to empty curbside weight only. When using screw-in tow eyes, particular attention should be paid to threads for damage. Recovery technicians should carry a thread tap so that the threads of the towing eye socket can be cleaned before inserting the towing eye. To avoid the threads on towing eyes becoming stripped out under tension, it is essential that they screw in to an adequate thread length. To avoid them bending, it may be necessary to fit washers under the head to ensure that the eye seats solidly.

Safe working on vehicles

Gaining access beneath a vehicle

18 A vehicle can nearly always be recovered without the need to go underneath. Where it is deemed to be essential to go beneath a vehicle, a higher level of planning and assessment will be necessary, but in any case:

- **Never go beneath a vehicle unless it is adequately supported by suitably rated props or stands and wheels are chocked.**

19 After raising the height using a jack, props and stands should be placed under the vehicle or its wheels.

20 Despite a large number of components being located beneath vehicles, it is often possible to access many from above via access panels in the vehicle floor or through panels in the side of the vehicle. For example, the spring brake chambers often have access panels above them, as shown in Figure 5. Wherever possible, these access features should be used in preference to crawling beneath the vehicle.

Figure 5 Large access panel to give full access to spring brake chambers

Figure 6 Small access panel between seats giving limited access to spring brake chambers

Figure 7 Typical bellows that has been over inflated

However, these features can deteriorate with age as panels become seized or covered over. Furthermore, some access panels are large while others only provide limited access, as shown in Figure 6.

21 There may be circumstances where it is unavoidable to gain access to the underside of the vehicle or to reach under, for example, to manually release the brakes via the spring brake chambers, to remove prop shafts and to connect auxiliary supplies. In these situations, it is essential that technicians have the appropriate training, experience and equipment to undertake the work safely (see paragraph 11, *Training*).

Air bellows

22 **Under no circumstances should air suspension be tampered with in an attempt to raise the height of the casualty vehicle**. (The exception being where a proprietary ferry-lift device is fitted which is designed to raise the vehicle safely.)

23 Tampering with the suspension to adjust the ride height can result in sudden and unexpected deflation of the air bellows, resulting in collapse of the suspension. This causes the vehicle to fall, often instantaneously, with the potential to crush anybody working beneath it.

24 Tampering with ride height can result in the maximum system air pressure (or higher if a recovery vehicle air supply is used) being supplied to the bellows. The bellows may not be capable of withstanding this increase, especially if it has weakened due to ageing; this can cause it to burst, as shown in Figure 7. Even a brand-new bellows can unseat from its mounts causing instant deflation.

25 Even without tampering with the ride height, a bellows can deflate suddenly and unexpectedly due to a failed pipe or a fall in system air pressure.

26 On modern vehicles, many functions are interlocked with the ride height. For example, simply opening the doors or applying the park brake can cause the ground clearance to reduce suddenly, with the potential to crush people working beneath the vehicle.

Raising the vehicle safely

27 On the rare occasions where it is considered necessary to crawl beneath a vehicle or where a wheel needs changing, proprietary jacks should be used to raise the vehicle before placing stands under the vehicle or its wheels.

28 The design of some modern buses has deviated from the traditional rigid chassis and separate body attached to it. Instead, the body often incorporates structural members or is supported by a light space frame, and in some cases even the glazing is used to increase structural strength. Normally these vehicles have jacking points, as shown in Figure 8, designated by the manufacturer. It is essential that recovery technicians know where these are, otherwise they could be injured and/or the vehicle could be permanently damaged if it is jacked at the wrong point.

29 For the majority of vehicles, irrespective of design, solid structural members such as axles or other suspension components can be used to jack up and support a vehicle safely. **As a rule of thumb, a support point will be adequate if the vehicle's weight is normally supported at this point when running on its wheels.**

Air supplies

30 It is common for the system air pressure to be low on casualty vehicles and for it to be incapable of regenerating its own pressure. Hence, most vehicles are equipped with an auxiliary air connection point

Figure 8 Jacking point on a space frame vehicle

Figure 9 Test points which can be used to charge individual air circuits

(normally an 'n'-type coupling or 'ISO'-type fitting) behind the front panel that can be coupled to the recovery vehicle. Often brake circuits have dual systems and therefore two air supplies may be required to remove the brakes. The air supplies on recovery trucks may be colour coded, for example the 'yellow' service line and the 'red' emergency line may both be required to release the brakes.

31 On some modern vehicles each individual air circuit can be tapped into. These systems enable specific functions to be selected as required, for example, park brakes, transmission, doors, etc. Access to these circuits is normally from a convenient panel at the side of the vehicle, as shown in Figure 9, thereby providing a safe method of supplying auxiliary air. However, this system requires the technician to carry the correct fittings on his recovery vehicle.

32 If air cannot be supplied via an auxiliary coupling, it is tempting to unscrew a drain valve from an air tank and screw in a suitable fitting so that air can be supplied to the system. This practice should be avoided because of the need to crawl under the vehicle but there is also a danger of unscrewing a drain from a tank that is under pressure. This can result in fittings being ejected at high speed, and non-return valves can sometimes cause unexpected results.

33 The air system may take some time (this will vary depending on recovery vehicle and bus type) to charge fully and the technician must expect this delay before being tempted to crawl under the vehicle to try an alternative approach.

34 Auxiliary air supplies from a recovery vehicle should only be coupled to the casualty vehicle in series with an air pressure regulator set to match the casualty's own air supply. (Normally the operating pressure can be obtained by looking at the maximum pressure marked on the dashboard instrument gauge or it may be marked on the air receiver or elsewhere on the vehicle.)

35 This configuration should prevent the air bellows being over inflated by the recovery vehicle, which often provides air at higher pressures.

Transmission

36 For towing, other than short distances, many vehicles require the transmission to be disengaged to avoid transmission damage from lack of oil circulation. In addition, it may be necessary to deactivate a microprocessor on computerised gearboxes. Disengaging the transmission by removing drive shafts (known as half shafts) or prop shafts should only be undertaken when traffic conditions allow it to be done safely. Recovering vehicles onto low-loader trailers eliminates these hazards because it is unnecessary to disengage the transmission.

37 Drive axles often have a double reduction hub and wheel bearings that are fed with oil from the axle. On these types of axle, technicians often prefer to crawl beneath the vehicle and remove prop shafts so that they do not cause oil spillage. A safer method is to remove half shafts and then fit plugs into the resulting holes to minimise oil loss. In theory the recovery technician will need to have plugs available to suit the entire range of casualty vehicles, but in practice it is likely that they will only recover a limited range.

Brakes

38 In some cases, brakes can be released by applying air pressure to the brake chamber, either directly or indirectly via other parts of the air circuit. Where air cannot be applied, winding off the brake springs manually will be the only option.

39 Before attempting to release brakes, ensure that the wheels have been chocked.

40 Even if a brake pipe is broken, a temporary repair can sometimes be made, eg using an air hose and hose clips to form a continuous pipe again, so that system can be temporarily charged to move the vehicle.

41 A brake mechanism can seize, locking the brake shoe onto the brake drum. In these scenarios, the brake cannot be wound off manually and this may require access beneath the vehicle to dismantle components to free the brake. However:

- **under no circumstances should technicians attempt to release the spring entirely from its chamber, as springs can eject at very high speed.**

Equipment

42 Recovery vehicles should always be equipped with a sufficient amount of good-quality timber to support and prop casualty vehicles, along with wedges that can be used as wheel ramps. Timber must be of adequate strength, preferably hardwood, which is not prone to splitting and splintering. Some typical blocks are shown in Figure 10. Alternatively, lightweight steel props and stands are commercially available which can be used as adequate supports as shown in Figures 11 and 12.

43 Vehicles with extremely low ground clearance may need to be raised first using proprietary jacks. There are two basic types of jack, either air cushion or hydraulic/pneumatic.

44 Air cushion jacks, as shown in Figures 13 and 14, deflate to a very low profile, so they can easily be positioned under a rigid member beneath the vehicle. An air supply from the recovery vehicle is then used to inflate the cushion.

Figure 10 Typical hardwood blocks for general-purpose use

Figure 11 Proprietary steel stands for propping vehicles

Figure 12 Proprietary wheel stands used to support a vehicle once it has been jacked up

Figure 13 Air cushion jack deflated

Figure 14 Air cushion jack inflated

45 Hydraulic jacks come in many different forms but it is common for low buses to use sets of jacks, where a low-profile jack initially raises the vehicle enough to place a larger jack underneath. This procedure is repeated using larger and larger jacks until sufficient height is gained to place stands or props beneath the vehicle. Typical jacks are shown in Figures 15 and 16.

Figure 15 Typical hydraulic jacks in a range of sizes

Figure 16 Long-handled air jack

46 Jacks with long handles, as shown in Figure 16, are particularly useful as the jack can be pushed under the vehicle without crawling under to locate it. Similarly, wooden poles such as brush handles can be used to position stands and props to avoid crawling under the casualty vehicle, but care is needed to ensure the jack aligns with the jacking point.

47 The lift on a recovery vehicle offers an alternative to jacking but the vehicle and the lifting beam must be adequately propped so that it cannot fall. This option should only be used as a last resort where jacking is not possible, because its safety relies on a carefully controlled system of work to ensure that the recovery vehicle and its controls are not moved.

Maintenance and inspection of equipment

All equipment

48 All tools, machinery, plant and equipment used at work are covered by the requirements of the Provision and Use of Work Equipment Regulations 1998 (PUWER). Examples of equipment under PUWER include axle stands, props, towing bars, etc.

49 PUWER requires that work equipment exposed to conditions causing deterioration liable to result in dangerous situations be inspected at suitable intervals, to ensure that its integrity is maintained and any deterioration detected and remedied in good time. In addition to formal inspection regimes, technicians who use the equipment should visually examine it on a daily basis, or at least before use, for obvious signs of deterioration. Suspect equipment should be withdrawn from service immediately and either replaced or repaired as appropriate.

50 Written procedures for recovery operations should cover how technicians are to deal with equipment that they consider to be faulty. This must include instruction to ensure the equipment is not used, how to report the defect and how to get the equipment replaced.

51 Some items of equipment, eg jacks, will require regular maintenance in accordance with the manufacturer's instructions. Such maintenance should not be overlooked, as it is vital to ensure that equipment remains in a condition that is safe to use.

Lifting equipment

52 Work equipment that is also lifting equipment will be subject to the requirements of the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) as far as the lifting parts are concerned, and PUWER for the remainder. LOLER requires lifting equipment to be thoroughly examined by a competent person at periodic intervals to detect any defects. Thorough examination is likely to be required for jacks and other lifting accessories such as slings, chains, eyebolts, shackles, etc. Records from this thorough examination should be kept and made available at all times.

53 Both LOLER and PUWER have an Approved Code of Practice (ACOP)[2,3] accompanying them. See also HSE information document 803/69.[4]

References and further reading

References

1 BS 7121-12: 1999 *Code of practice for safe use of cranes. Recovery vehicles and equipment. Code of practice* British Standards Institution

2 *Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved Code of Practice and guidance* L113 HSE Books 1998 ISBN 978 0 7176 1628 2

3 *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance* L22 (Second edition) HSE Books 1998 ISBN 978 0 7176 1626 8

4 *Guidance on the application of Provision and Use of Work Equipment Regulations 1998 and the Lifting Operations and Lifting Equipment Regulations 1998 to motor vehicle repair* Information Document 803/69 HSE 2002 www.hse.gov.uk/fod/infodocs/803_69.pdf

Further reading

Further advice on safe systems of work for ensuring the health and safety of both roadside technicians and members of the public who may be affected by their activities may be obtained from the following publications:

PAS 43: 2006 *Safe working of vehicle breakdown, recovery and removal operations: Management system specification* British Standards Institution

BS 7901: 2002 *Specification for recovery vehicles and vehicle recovery equipment* British Standards Institution (Specifies the performance requirements for equipment to be used for vehicle recovery activities.)

See also the motor vehicle repair industry section of the HSE website: www.hse.gov.uk/mvr.

Further information

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