# Safety during tyre inflation in motor vehicle repair


This is a web-friendly version of leaflet INDG433

## Introduction

Removal, replacement and inflation of tyres is extremely common in motor vehicle repair (around 30 million tyres are replaced in the UK each year), so it may seem a simple task. But it can cause injury and even death resulting from:

- manual handling of the tyre and wheel;
- collapse of an elevated vehicle;
- being struck by vehicles at the roadside; and
- explosion of the tyre or disintegration of the wheel during inflation.

This leaflet deals specifically with the dangers during tyre inflation – advice on the other hazards can be found in *Health and safety in motor vehicle repair and associated industries* (HSG261). See 'Need to know more?' at the end of the leaflet for details.

## Explosive energy

Inflated tyres contain a large amount of stored energy. For example, the sidewall of a typical commercial vehicle (CV) tyre has over 34 tonnes of force acting on it. Tyres are designed to withstand this but if they are damaged or used while flat, or significantly underinflated, they may fail.

The force can then be released explosively at an angle of up to 45 degrees from the rupture (which is often, but not always, the face of the sidewall), resulting in a destructive air blast and the ejection of high-speed particles.

If the wheel is not restrained, it can fly metres through the air. Similarly, failure of multi-piece ('split rim') wheels can result in explosive ejection of component parts. These types of tyre explosion have led to numerous fatalities.

## Risk of failure

There will be an increased risk of failure:

- following tyre repair;
- where there has been sidewall damage (eg after a tyre has been run flat or significantly underinflated); or
- when fitting a tyre to a split-rim wheel.

Cuts and splits should be clearly visible by inspection and there are industry standards on whether a repair should be attempted. However, damage to the internal steel or textile cords may not be obvious. This can be caused by impact (eg hitting a kerb or pothole) or if the tyre is run significantly underinflated (normally taken as below 80% of its recommended pressure).

***Figure 1*** *Zipper failure like this can lead to fatalities*

When significantly underinflated, the tyre's sidewall flexes excessively and the cords become increasingly damaged the longer the wheel is run. Also, deflation may not be detected for some time, particularly on multi-wheel axles, where the exterior tyre is undamaged.

This internal damage may not become obvious until the tyre is reinflated and a bulge occurs. At this stage, the additional strain placed on the adjacent cords can cause them to break in rapid succession, spreading around the sidewall until the casing splits apart violently. This is commonly known as a 'zipper-failure'.

To reduce this risk:

- Before deflating a tyre, check the pressure and chalk the reading on the tyre wall. Remember, low tyre pressure may have caused tyre wall damage.
- Do not inflate any tyre that has been significantly underinflated until it has been adequately checked. Examine wheels and tyres (externally and internally) for signs of damage, eg cracks, 'marbling' (black lines), bulging, soft spots or exposed steel cord in the tyre carcass. If in doubt, do not reinflate the tyre.
- When reinflating, follow the precautions set out in this leaflet, taking particular care to stay outside the likely explosion trajectory. Watch and listen for signs that might indicate a zipper failure. If you suspect a problem, do not approach the tyre to deflate it – use the quick-release connection at the operator's end of the hose.

# How the types of wheels and tyres affect the risk

## Car tyres

Car tyres will generally contain less energy than truck tyres and their size and profile make them less likely to fail catastrophically.

Sensible precautions are still required, but inflation inside a safety cage is not normally necessary for new car tyres or where you are confident that the replacement tyre has no hidden damage.

***Figure 2*** *Quick-release couplings*

## Dos and don'ts for all tyre inflation

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| **Do** use a clip-on chuck to connect the airline with a quick-release coupling at the operator's end (this allows tyre deflation from a safe position if problems occur).<br>**Do** use airline hoses long enough to allow the operator to stay outside the likely explosion trajectory during inflation.<br>**Do** use enough bead lubricant when seating the tyre. Consider removing the valve core or using a 'bead-blaster' if seating is difficult.<br>**Do** remove the airline after use to prevent air seepage and possible overinflation. | **Don't** use valve connectors that require the operator to hold them in place.<br>**Don't** exceed the manufacturer's recommended tyre pressure for the size and rating of the tyre.<br>**Don't** use 'unrestricted' airlines (ie without a gauge or pressure control device).<br>**Don't** allow the control valve to be jammed open (which could allow the operator to leave the inflating tyre unattended). |

## Tyres on commercial vehicles (CVs)

Extra safety measures are needed for inflating larger, well-based (ie single-piece) CV tyres above 15 psi. This includes some light CV tyres which are inflated to around 70 psi and may cause serious injury in the event of failure.

The extra measures include using a restraining device such as:

- a strong, firmly-secured tyre inflation cage. Consider lining this with mesh to retain debris. For fixed installations, it is helpful to mark the safety exclusion zone on the workshop floor as a reminder to staff (see Figure 4);
- a secured horizontal stool and associated clamping mechanism (see Figure 4); or
- a portable restraint. Examples include a lightweight cover (see Figure 5) that encloses the tyre and wheel rim. This may be particularly useful for off-site repairs. In the event of an explosion the fabric contains projected debris. Fabric devices may need to be replaced after an explosion.

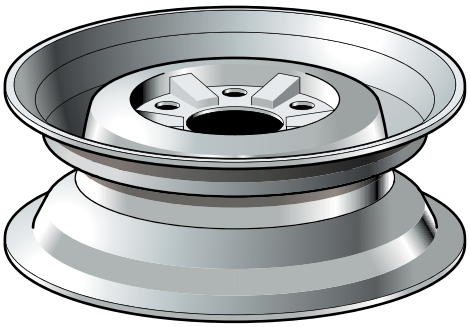

***Figure 3*** *Well-based wheel used on a light commercial vehicle*

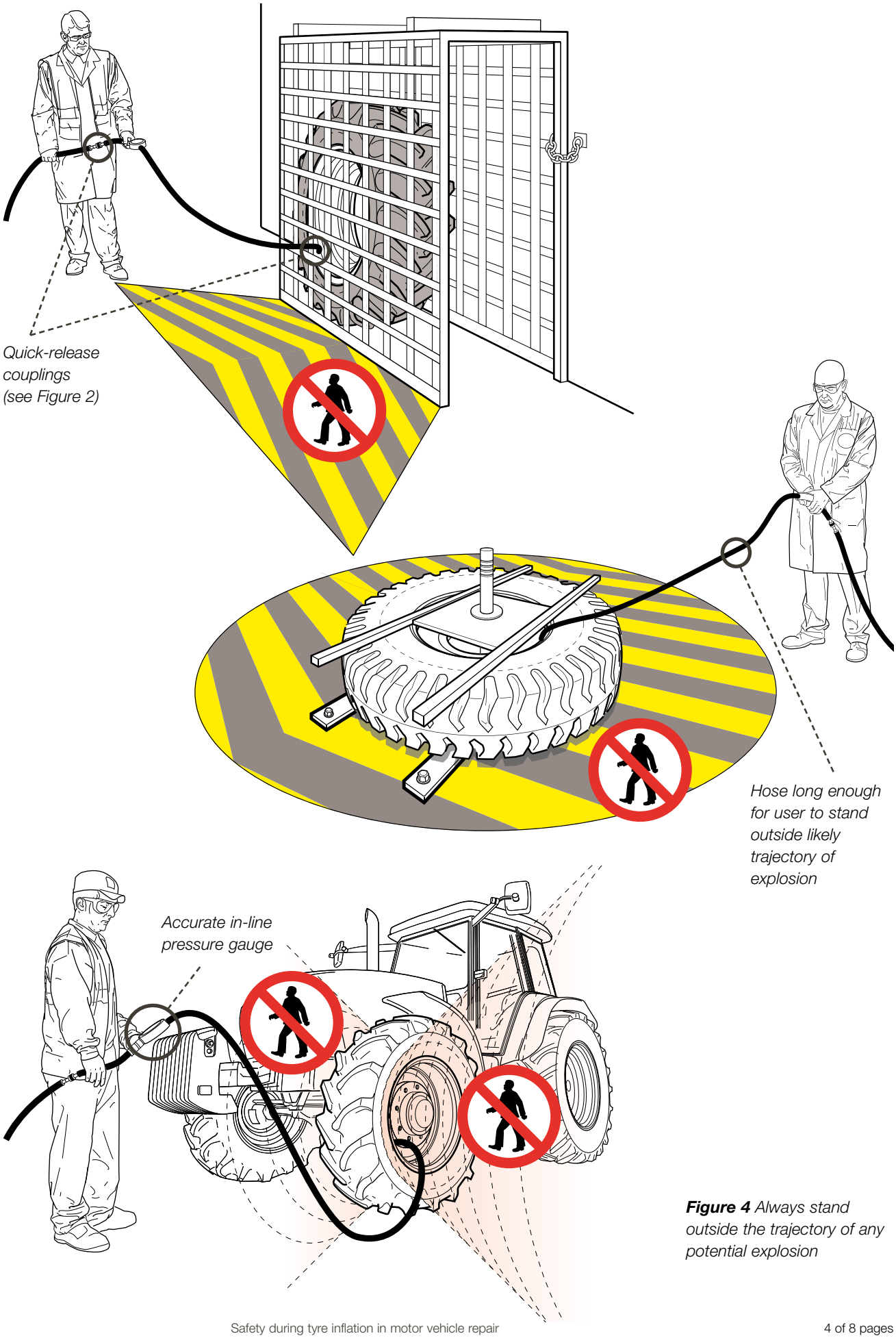


***Figure 4*** *Always stand outside the trajectory of any potential explosion*

***Figure 5*** *A bag-type restraint*

## Split-rim wheels

These are fairly uncommon, but are found on older vehicles as well as some military trucks, forklift trucks, cranes, scooters, caravans and wheelbarrows. They are also used for some off-road vehicles (because they allow the tyre to be removed without specialist equipment). There are two basic types of split-rim wheel assemblies:

- multi-piece wheels; and
- divided wheels.

### *Multi-piece wheels*

Multi-piece wheels have a split-spring flange that is levered into a groove in the side of the wheel rim (known as the gutter groove). Some have additional flanges held in place by the split locking ring.

If these parts are not seated correctly, there can be a violent separation of the wheel parts as the tyre is inflated.

A special type of multi-piece wheel has a three-piece, demountable rim in which the disc is created by short spokes forming part of the hub.

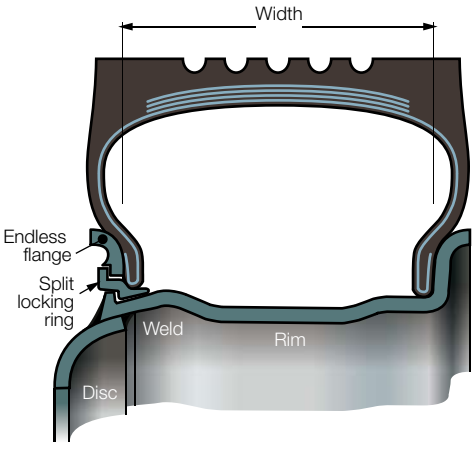


***Figure 6*** *Three-piece wheel*

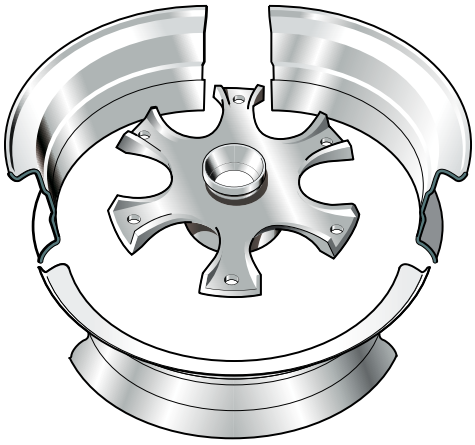

***Figure 7*** *Demountable rims*

### *Divided wheels*

These consist of two parts bolted together with an outer ring of rim fasteners, the whole assembly then being bolted to the vehicle hub by an inner ring of hub studs.

Loosening the rim fasteners with the tyre under pressure has resulted in violent separation of rim halves, causing fatal injuries. Loosening the hub studs can have the same result if there has been damage or unauthorised repair to the wheel.

***Figure 8*** *Divided wheel on a shovel loader*

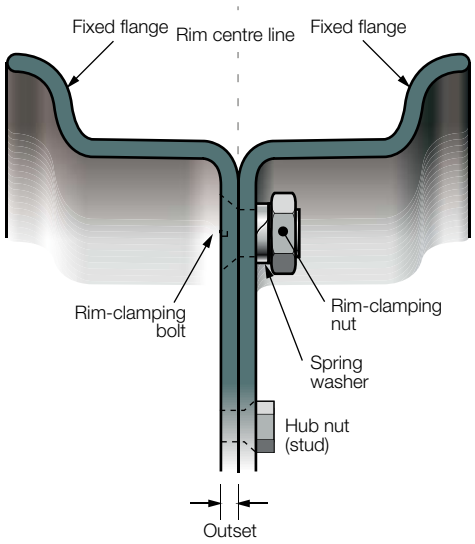


***Figure 9*** *Cross-section of a divided wheel*

Lack of knowledge can make working with split-rim wheels particularly dangerous, so it is important that it should only be carried out by competent staff with sufficient experience.

Always follow the manufacturer's guidance where available and take the precautions set out below, which are in addition to those for car and commercial tyres.

### *Reassembling split-rim wheels*

When reassembling split-rim wheels, you may need to partially inflate the tyre to check the parts are properly seated. Make sure this is to no more than 15 psi and that everyone is outside the likely explosion trajectory.

Before inflating further:

- a **multi-piece** wheel should be put inside a suitable cage or frame;
- a **divided wheel** should be fitted to the vehicle and the rim and hub fasteners should then be correctly tightened so the wheel halves are fully clamped. Where size permits, fit a suitable metal restraining device to contain the wheel components in the event of violent separation. Otherwise, position the assembly in front of a protective barrier, eg a wall, embankment or the side of a vehicle.

A bag-type restraint is not designed for split-rim wheels.

### Working on multi-piece wheels: dos and don'ts

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| **Do** check locking rings and flanges carefully before refitting and replace any that are damaged.<br>**Do** lubricate the components according to the manufacturer's instructions.<br>**Do** follow the manufacturer's instructions when taking demountable wheels apart and reassembling them. |
| **Don't** hammer components into position. |

### Working on divided wheels: dos and don'ts

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| **Do** make sure they are clearly identified. Sometimes, the rim-clamping nuts are painted in a contrasting colour to the rim to distinguish them.<br>**Do** remove the valve core and ensure any divided wheel is completely deflated, before undoing the fasteners. Check there is no obstruction in the valve stem preventing deflation (eg by inserting a wire or something similar). |
| **Don't** weld the rim-clamping bolts to one half of the wheel. This is likely to weaken the bolt, and if the tyre is still on the wheel, may cause an explosion. |

## Very large tyres

These are found on vehicles used in construction, quarries, agriculture etc and pose additional hazards during fitting and inflation due to their size and weight. It may not be reasonably practicable to provide purpose-built cages of adequate strength, particularly for work on site.

Restraint during tyre inflation is usually achieved by mounting on the wheel hub of the vehicle. Use a protective barrier, such as a wall, embankment or the side of another vehicle, to restrain flying objects ejected during a failure. It is essential that people can work in a safe position (see Figure 4).

## Need to know more?

*Health and safety in motor vehicle repair and associated industries* HSG261
HSE Books 2009 ISBN 978 0 7176 6308 8

You can find more advice on health and safety in the motor vehicle repair industries at: www.hse.gov.uk/mvr.

# Further information

HSE priced and free publications can be viewed online or ordered from www.hse.gov.uk or contact HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA Tel: 01787 881165 Fax: 01787 313995. HSE priced publications are also available from bookshops.

For information about health and safety ring HSE's Infoline Tel: 0845 345 0055 Fax: 0845 408 9566 Textphone: 0845 408 9577 e-mail: hse.infoline@natbrit.com or write to HSE Information Services, Caerphilly Business Park, Caerphilly CF83 3GG.

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

This leaflet is available in priced packs of 10 from HSE Books, ISBN 978 0 7176 6398 9. Single copies are free and a web version can be found at www.hse.gov.uk/pubns/indg433.pdf.