

# Drum / cylinder handling

This Technical Measures Document covers the storage and handling of toxic and flammable substances in drums and cylinders and refers to relevant codes of practice and standards.

Related Technical Measures Documents are:

- [Operating procedures](#)<sup>[1]</sup>
- [Maintenance procedures](#)<sup>[2]</sup>
- [Training](#)<sup>[3]</sup>
- [Plant layout](#)<sup>[4]</sup>
- [Leak / gas detection](#)<sup>[5]</sup>
- [Secondary containment](#)<sup>[6]</sup>
- [Emergency response / spill control](#)<sup>[7]</sup>

The relevant Level 2 Criteria are [5.2.1.3\(29\)c, g, i](#)<sup>[8]</sup> and [5.2.4.3\(97\)](#)<sup>[9]</sup>.

## Introduction

A variety of toxic and flammable chemicals are frequently stored and transported in drums and cylinders. Although individual containers hold relatively small inventories, a single cylinder of a compressed or liquefied toxic gas can present a significant hazard to personnel. Additionally large quantities of drums and cylinders are often stored together giving rise to potentially large inventories of hazardous materials. The movement and connection / disconnection of drums and cylinders to process plant requires the direct involvement of operating personnel giving rise to the potential for human error to cause incidents.

## General principles

### Storage location

Both the hazards of the material and the size of the inventory need to be considered in determining where a store should be located. Considerations should include the distance from other stored materials, process plant, traffic routes and occupied buildings. Guidance on separation distances is provided in various HSE Codes of Practice such as [HS\(G\)51 Storage of flammable liquids in containers](#)<sup>[10]</sup> and [HS\(G\)40 Safe handling of chlorine from drums and cylinders](#)<sup>[11]</sup>. Where separation distances are inadequate measures such as firewalls can be employed to reduce the impact of incidents (see Technical Measures Document [Active / Passive Fire Protection](#)<sup>[12]</sup>). The operator should demonstrate that the storage location and design has taken into account site-specific security requirements and the potential for vandalism.

## Ventilation

The preferred location for the storage of drummed flammable liquids and compressed / liquefied gases is in the open air, to allow vapours to be dispersed effectively. When located in buildings, the operator should demonstrate that there is an adequate level of ventilation achieved by either the presence of a sufficient size and number of permanent openings such as louvres or mechanical ventilation. If stored indoors, flammable gases such as LPG may only be stored in purpose built compartments or buildings constructed with fire resistant walls and explosion relief.

## Compatibility with other stored materials

Toxic, flammable or self reactive materials should not in general be stored in the same location (see Technical Measures Document [Segregation of Hazardous Materials](#)<sup>[13]</sup>). The operator's risk assessment should demonstrate the compatibility of the substances stored and the suitability of the arrangements. [HS\(G\)71 Chemical warehousing: the storage of packaged dangerous substances](#)<sup>[14]</sup> gives guidance on storage arrangements for warehouses and storage compounds.

## Layout

Drums and cylinders should be stored in a safe manner. Both the height and method of stacking should take into account the hazard of the material stored and the construction of the container. Racking or freestanding multi layer stacks can be used for drummed materials storing low hazard liquids. Consideration should be given to the detection of leaks from containers and the method for collection and disposal of such spills to reduce the possibility of cross-contamination and domino effects. Training should be provided to operators on dealing with spills and emergency procedures. Adequate access for forklift

trucks should be provided. Pressurised cylinders and drums should be stored with their valves uppermost in a secure manner. The size of any particular stack should be limited and separation distances should be provided between stacks. Drums should not be filled or emptied within the storage area.

### **On-site transportation**


Whilst drums containing flammable liquids can be transported securely on a simple pallet, cylinders and drums containing compressed or liquefied gases require special care and appropriate means of transport such as cylinder trolleys or purpose designed attachments for fork lift trucks should be used at all times. The operator should maintain records demonstrating that personnel involved in the movement of drums and cylinders have received training in the hazards involved in handling them and in the operation of any machinery involved such as cranes and fork lift trucks.

### **Connection and discharge to process**

Drums containing flammable substances should be adequately earthed prior to discharge (see Technical Measures Document on [Earthing](#)<sup>[15]</sup>). All containers should be secured in position before connection to process plant. A procedure should be in place for making the connection and all employees should have received adequate training in the use of the procedure. The materials used in making the joint, such as gaskets and lubricants, should be strictly controlled and an appropriate leak test should be carried out when the joint has been made. The pipework that the container is connected to should be designed to an appropriate standard. Where installations contain fluids at greater than 0.5 bar gauge pressure, they will usually be subject to the [Pressure Systems Safety Regulations 2000](#)<sup>[16]</sup> and such systems will usually be required to be subject to periodic examination at regular intervals.

### **Design and maintenance of container**

Drums and cylinders should be designed and constructed to an appropriate standard. The operator should be able to demonstrate that an appropriate inspection and maintenance programme is in place in accordance with the relevant Regulations.

The Regulatory framework is complex with [Transportable Pressure Vessels Regulations 2001](#) <sup>[17]</sup>(TVPR) and schedule 8 of [Carriage of Dangerous Goods \(Classification, Packaging and Labelling\) and Use of Transportable Pressure Receptacles Regulations 1996](#)<sup>[18]</sup> (CDGCPL2) currently applying in parallel. Essentially, CDGCPL2 applies to all

types of transportable pressure receptacle, but there is currently a choice between complying with CDGCPL2 or TPVR in respect of cylinders, tubes and cryogenic receptacles (but not pressure drums).

As such, periodic inspection should be done at appropriate intervals as required under CDGCPL2 or, where inspection is in accordance with TVPR, at the intervals specified in RID and ADR (European Directives covering transport of dangerous goods by rail and road).

## Containment of spills

Suitable precautions should be in place for the containment of leaked materials. Where liquids are handled suitable spillage containment such as bunding and drainage sumps should be in place. Arrangements should be in place for the routine drainage of rainwater from sumps. Where materials that react with water are stored outdoors, the operator's risk assessment should demonstrate the suitability of the arrangements (see Case Study [Staveley Chemicals Ltd - Derbyshire \(27/6/1982\)](#)<sup>[19]</sup>). For the storage of toxic gases, location of the containers in a purpose designed indoor store will reduce the rate at which gas is released to the environment.

## Control of ignition sources

Where flammable liquids or gases are stored, the area should be subject to hazardous area classification for the control of ignition sources. This requirement should be reflected both in the equipment installed and in the control of operational and maintenance activities in the location. The movement of drums and cylinders often involves the use of forklift trucks, which can provide a source of ignition for flammable vapours. Any vehicle operating in a zoned area should be protected to an appropriate standard.

## Industry applications

### Flammable liquids

Containers should be stored in the open air where practical, but if stored inside five air changes per hour is considered a sufficient ventilation rate. Standard 205 litre metal drums should be stacked no more than three high and preferably on pallets or racking. The maximum stack size should be 300,000 litres with at least 4 metres between stacks. Storage should be on an impervious surface such as concrete and be bunded with drainage towards a sump or other suitable handling system.

## LPG cylinders

Cylinders should be stored preferably in the open air on a concrete or load-bearing surface. Flammable liquids, combustible, corrosive, oxidising materials, toxic materials or compressed gas cylinders should be kept separate from LPG containers in general. Containers should be stored with their valves uppermost. The maximum size of any stack should not exceed 30,000 kg. For storage indoors, no more than 5000 kg may be stored in each purpose designed building compartment and a maximum of five compartments may exist in a single building.

## Chlorine cylinders

The vast majority of chlorine cylinder and drum stores are located indoors and should be solely used for storing chlorine. Access doors should fit closely to help contain any leak. These stores should be protected from any nearby radiant heat hazards. The store should be at least 5 m from any roadway. A cylinder store should be at least 20 m from the site boundary and a drum store 60 m. Chlorine gas detectors / alarms should normally be provided.

Risk assessments should be carried out to consider hazards arising from mishandling (dropping of containers in transport/handling), incorrect operation of valves and failure to connect correctly, maintenance errors and damage by external sources (domino, vehicle impacts, etc.)

## Codes of Practice relating to drum and cylinder handling

[HS\(G\)51 Storage of flammable liquids in containers](#)<sup>[20]</sup>, HSE, 1998.

Comprehensive guidance on the design construction, operation and maintenance of facilities used for the storage of flammable liquids in containers is provided.

[HS\(G\)140 Safe use and handling of flammable liquids](#)<sup>[21]</sup>, HSE, 1996.

This code of practice provides useful information on the connection and discharge of flammable liquid containers to process.

LPGA CoP 7 Storage of full and empty LPG cylinders and cartridges, LP Gas Association, 1998.

Guidance on the design and construction of facilities for the storage of LPG in cylinders including fire protection.

[HS\(G\)40 Safe handling of chlorine from drums and cylinders](#)<sup>[22]</sup>, HSE, 1999.

Comprehensive guidance on the design construction, operation and maintenance of chlorine drum and cylinder storage facilities. Information on the safe connection and discharge of chlorine containers to process is included.

[HS\(G\)71 Chemical warehousing: the storage of packaged dangerous substances](#)<sup>[23]</sup>, HSE, 1998.

This document gives guidance on compatibility of various substances in shared storage facilities.

[HS\(G\)131 Energetic and spontaneously combustible substances : identification and safe handling](#)<sup>[24]</sup>, HSE, 1995.

This guidance note covers self-reactive materials and the circumstances in which these materials can be hazardous.

[CS21 Storage and handling of organic peroxides](#)<sup>[25]</sup>, HSE, 1998.

This document deals specifically with the handling and storage of organic peroxides and the hazards that can arise. It gives guidance on the safety measures required for the safe storage of organic peroxides.

[L122: Safety Of Pressure Systems](#)<sup>[26]</sup>, HSE, 2000

This document contains the approved code of practice (ACOP) and guidance on the Pressure Systems Safety Regulations 2000

## **Case studies illustrating the importance of drum / cylinder handling**

[Staveley Chemicals Ltd - Derbyshire \(27/6/1982\)](#)<sup>[27]</sup>

## Link URLs in this page

1. Operating procedures  
<http://www.hse.gov.uk/comah/sragtech/techmeasoperatio.htm>
2. Maintenance procedures  
<http://www.hse.gov.uk/comah/sragtech/techmeasmaintena.htm>
3. Training  
<http://www.hse.gov.uk/comah/sragtech/techmeastraining.htm>

4. Plant layout  
<http://www.hse.gov.uk/comah/sragtech/techmeasplantlay.htm>
5. Leak / gas detection  
<http://www.hse.gov.uk/comah/sragtech/techmeasleakgas.htm>
6. Secondary containment  
<http://www.hse.gov.uk/comah/sragtech/techmeascontain.htm>
7. Emergency response / spill control  
<http://www.hse.gov.uk/comah/sragtech/techmeasspill.htm>
8. 5.2.1.3(29)c, g, i  
<http://www.hse.gov.uk/comah/sram/index.htm>
9. 5.2.4.3(97)  
<http://www.hse.gov.uk/comah/sram/index.htm>
10. HS(G)51 Storage of flammable liquids in containers  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
11. HS(G)40 Safe handling of chlorine from drums and cylinders  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
12. Active / Passive Fire Protection  
<http://www.hse.gov.uk/comah/sragtech/techmeasfire.htm>
13. Segregation of Hazardous Materials  
<http://www.hse.gov.uk/comah/sragtech/techmeassegregat.htm>
14. HS(G)71 Chemical warehousing: the storage of packaged dangerous substances  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
15. Earthing  
<http://www.hse.gov.uk/comah/sragtech/techmeasearthing.htm>
16. Pressure Systems Safety Regulations 2000  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
17. Transportable Pressure Vessels Regulations 2001  
<http://www.legislation.gov.uk/uksi/2001/1426/contents/made>
18. Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996  
<http://www.hse.gov.uk/comah/sragtech/docs.htm>
19. Staveley Chemicals Ltd - Derbyshire (27/6/1982)  
<http://www.hse.gov.uk/comah/sragtech/casestaveley82.htm>

20. HS(G)51 Storage of flammable liquids in containers  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
21. HS(G)140 Safe use and handling of flammable liquids  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
22. HS(G)40 Safe handling of chlorine from drums and cylinders  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
23. HS(G)71 Chemical warehousing: the storage of packaged dangerous substances  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
24. HS(G)131 Energetic and spontaneously combustible substances : identification and safe handling  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
25. CS21 Storage and handling of organic peroxides  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
26. L122: Safety Of Pressure Systems  
<http://www.hse.gov.uk/comah/sragtech/docspubguid.htm>
27. Staveley Chemicals Ltd - Derbyshire (27/6/1982)  
<http://www.hse.gov.uk/comah/sragtech/casestaveley82.htm>