

Hazardous Substances

Storage of Hazardous Substances



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This code of practice can only reproduce essential items from the individual regulations and technical rules, cannot, however, demonstrate the measures required in a particular case. It is also possible that the state of technology and the legal basis have changed since this code of practice was issued.

The code of practice has been compiled with great care. This does not, however, absolve the employer from the duty and responsibility of checking the information for completeness, correctness and that it is up to date.

The numbers in the margin refer to the list of references (Annex 6: Bibliography).

1 Introduction

The compilers of this code of practice regard it as their duty to promote the knowledge and understanding of the safe handling of chemicals.

The purpose of this code of practice is to help warehouse operators store chemicals safely. It is based upon the Technical Rules for Hazardous Substances TRGS 510 "Storage of hazardous substances in non-stationary containers" (19), which make the requirements of the Hazardous Substances Ordinance (Gefahrstoffverordnung) (15) on the storage of hazardous substances in non-stationary containers more concrete.

The area of application of this code of practice corresponds to TRGS 510. It discusses the storage of chemical substances, mixtures and auxiliary and operating materials if these are being stored in packages. If packaging or technical materials are being stored together with chemical products, these stored products should also be taken into account.

The following were involved in the production of this code of practice:

Verband der Chemischen Industrie e. V. (VCI) (89)
Industriegaseverband e. V. (IGV) (90)
Industriegemeinschaft Aerosole e. V. (IGA) (91)
Industrieverband Agrar e. V. (IVA) (92)
Verband Chemiehandel e. V. (VCH) (93)
Berufsgenossenschaft Rohstoffe und chemische Industrie (BG RCI) (94)

2 Responsibilities in the warehouse

Overall responsibility for the warehouse is borne by the operator of the facility –, i.e. the business operator (owner) or the management in the case of legal entities.

In particular, the operator is responsible for:

- intended operation of the storage facility,
- due and proper labelling and safe handling of the products,
- due and proper storage,
- due and proper condition, in particular of the safety installations,
- assessment of risks and the stipulation of protective measures,

- work hygiene, work safety, and protection of the environment,
- selection of qualified employees,
- training and instruction of employees,
- coordination of activities and work processes,
- a code of practice for external personnel,
- planning of measures for emergencies.

Depending on the type and size of the company, the business operator can decide to appoint by delegation a suitable plant manager with the operator's obligations. In order to fulfil his/her tasks, the plant manager must have adequate knowledge of safe handling of hazardous substances. Training and further training are necessary in this respect.

Cooperation between various companies

An appraisal of the combined or reciprocal risks is necessary as soon as several companies carry out activities parallel to each other under own responsibility. Recurring situations are to be recorded in the documentation of the risk assessment; in individual cases or in the case of special activities, a co-ordinator should ensure that the necessary protective measures and scheduling are coordinated with each other.

3 Approvals

Operators of the warehouse are responsible for ensuring the proper operation thereof; in particular they may not store any products with properties and in quantities that are not covered by the approval. Consequently, the operating approval of the facility including the application documents, supplements, ancillary provisions, terms and conditions and the building and operating regulations referred to in the approval are to be taken into account for the appraisal of the intended operation of the storage facility. Approvals are binding regulations for the operators.

One or more approvals may exist for the operation of a warehouse, e.g.:

- water-law permits (e.g. suitability findings), [\(31\)](#)
- approval according to the building regulations of the Federal States (Bauordnungen der Länder – LBO) [\(32\)](#) or
- approval according to the Federal Immission Control Act (Bundes-Immissionsschutzgesetz – BImSchG); appropriate approval must also be obtained if subject to approval pursuant to the 4th Federal Immission Control Ordinance ([4. BImSchV](#)) (dependent on substance or substance group). [\(25\)](#) [\(26\)](#)

A permit according to the Ordinance on Industrial Safety and Health ([Betriebssicherheitsverordnung](#)) also has to be obtained if storing inflammable liquids [\(14\)](#)

If changes are made to operating procedures (e.g. other substances, greater quantities, other activities – e.g. filling or refilling, sample-taking – constructional changes), a check should be made to establish whether these are covered by the approvals.

Figure 1: Large storage facility



4 Risk assessment¹⁾

In order to operate a warehouse where hazardous substances are being stored in packages and containers, the business operator is required to carry out and document a risk assessment according to Section 5 Occupational Safety and Health Act (Arbeitsschutzgesetz) (9) and Section 6 Hazardous Substances Ordinance (Gefahrstoffverordnung) (15). This has to contain a list of all substances and activities representing a danger to the health and safety of employees and the environment, as well as an assessment of their potential danger. Furthermore, suitable protective measures - including personal protective equipment - and measures for monitoring effectiveness are to be determined. See TRGS 400 (18) and corresponding BG-Rules and information for details on the performance of a risk assessment for activities with hazardous substances. With regard to fire hazards, TRGS 800 (24) can be observed for measures for storage of combustible or oxidising hazardous substances.

The performance of a risk assessment is simplified for the operation of a warehouse where hazardous substances are being stored in packages and containers, as the necessary aspects for storage are outlined and necessary protective measures recommended with the activity-related TRGS 510. When the employer complies with the protective measures listed in TRGS 510, he can expect that the relevant requirements of the Hazardous Substances Ordinance are fulfilled. (19)

TRGS 510 requires detailed specification of the following topics as part of a risk assessment: (19)

- Absorption of hazardous substances through skin contact, oral intake or inhalation.
- Storage in small quantities.
- Joint storage of combustible liquids with flashpoints over 60 °C to 100 °C with flammable liquids.
- Storage of acutely toxic (marked with H330 or R26) or flammable gases in protected areas for pressurised gas cylinder or containers.
- Behaviour of combustible fluids in extinguishing water retention installations (explosion protection measures taking into account TRGS 720/TRBS 2152). (21)
- Storage of substances that require a shortening of escape/emergency route lengths.
- Behaviour in emergency situations (e.g. leaks, fires).
- Open handling (e.g. for refilling work and sampling).

1) *In this code of practice "risk assessment" is used according to "Directive 89/391/EEC on measures to improve safety and health at work" (German translation: "Gefährdungsbeurteilung") and not "Directive 2006/42/EC ... on machinery" (German translation: "Risikoanalyse") (4) (3)*

- Handling with warehouse facilities, vehicles and warehouse handling equipment (e.g. automatic stretch-wrapping machines, conveyors) as well as
- Frequency of emergency drills.

There may be a deviation from the rules and knowledge indicated in TRGS 510 if other measures are taken to ensure at least in a comparable way the safety and health protection of workers. The grounds for this are to be recorded in the risk assessment. Examples of this include: (19)

- Storage of flammable liquids with a flashpoint of over 55 °C to 60 °C. This applies in particular to diesel fuel and heating oil.
- Exceeding the permissible storage quantities for flammable liquids specified in Section 12.2 of TRGS 510 if appropriate fire-fighting measures are ensured for the size of the warehouse, e.g. through a certified plant fire brigade or automatic fire extinguisher systems .
- Adoption of the relief for containment areas for flammable liquids – transport containers with a volume of up to 1,000 litres that do not have any openings below the level of the liquid or if the transport container has a containment tub which must not be farther than 1 cm from the container walls at any point – for all liquid hazardous substances.

The existing approvals for the warehouse also stipulate safety and protective measures for the warehouse, the implementation of which is mandatory.

Safety data sheets (17)

Safety data sheets (SDS) are documents with information on the safe handling of hazardous substances or mixtures. Safety data sheets provide the professional user of chemicals with important information on the identity of the product, possible occurring risks, safe handling and storage, as well as appropriate measures for prevention and in the event of danger.

It is sensible to check the details in the supplied safety data sheet for consistency and plausibility upon initial receipt of goods. This check can be carried out in stages.

General details

The manufacturer's/supplier's identification, the trade name of the product and the revision date are to be shown on the first page of the safety data sheet. In addition, the respective page number and the total number of pages are to be stated on each page. Alternatively, reference can also be made to further following pages – in which case, the last page is to be marked clearly.

Section 1: Identification of the substance/mixture and of the company/undertaking

This section contains details of product identification, on its use and distribution, and an emergency phone number.

Section 2: Hazards identification

This section contains the classification and labelling elements of a substance or a mixture. (1a) (1b)

Section 3: Composition/information on ingredients

Using these details, it is possible to recognize the hazardous properties of the relevant components of a mixture. As it is not necessary to specify the complete composition (type of components and their respective concentrations), the total of specified ingredients can deviate from 100 %. The actual hazardous properties of the mixture are stated under section 2.

Section 4: First-aid measures

This section describes which steps are to be taken immediately in the event of accidents, whether medical assistance is necessary or advisable or whether immediate medical attendance is necessary, whether possible delayed effects have to be expected because of the exposure and what symptoms and effects can occur, but also when no first-aid should be carried out by untrained personnel.

Section 5: Fire-fighting measures

This section specifies the requirements for fighting a fire caused by the substance or mixture.

Section 6: Accidental release measures

This section contains details on personal protective measures, environmental protection measures and cleaning procedures.

Section 7: Handling and storage

The details in this section help the business operator to stipulate suitable work procedures and organisational measures.

Section 8: Exposure controls/personal protection

The details on limitation and monitoring of exposure help to keep employee exposure as low as possible whilst using the substance or mixture.

Section 9: Physical and chemical properties

This information provides details on how to take appropriate protective measures. For this reason, it is necessary to specify all known relevant physical-chemical properties of the substance or mixture.

Section 10: Stability and Reactivity

The stability of the substance or mixture, as well as possible dangerous reactions, are described in this section. Both the intended use as well as a foreseeable improper use of the product should be taken into account.

Section 11: Toxicological information

This section contains a brief but complete description of the various toxicological effects (on health) that may arise if coming into contact with the substance or the mixture.

Section 12: Ecological information

This section describes the possible effects and the behaviour and remaining traces of the substance in the environment (air, water and/or soil).

Section 13: Disposal considerations

This section contains appropriate disposal procedures for the substance or mixture and for soiled packaging materials (incineration, recycling, depot etc.).

Section 14: Transport information

Details are provided of the special precautions that need to be observed with regard to transport and transport containers. Where relevant, details of rating according to the respective regulations on the various types of transport are to be provided: IMDG (sea transport), ADR (road transport), RID (rail transport), ICAO/IATA (air transport). (34) (35)(36) (38) (37)

Section 15: Regulatory information

Information regarding relevant Community safety, health and environmental provisions for substances and mixtures which are not listed in the preceding sections of this safety data sheet, they are to be provided as far as possible in this section. Wherever possible, reference is also to be made to special national regulations and other relevant national features. Here, it can be seen whether the supplier has subjected the substance or mixture to a chemical safety assessment.

Section 16: Other information

Contains all other information that is of significance for understanding the safety data sheet. This also includes details concerning revisions of the safety data sheet (amendments can be specified and explained here), main abbreviations and important literature references and data sources.

Register of Hazardous Substances (15)

The Register of Hazardous Substances is a systematic compilation of hazardous substances stored and provides information for preparing risk assessments and necessary safety measures in the warehouse. The Register of Hazardous Substances must contain the following details:

- The names of the hazardous substances (e.g. product or trade name from the Safety Data Sheet).

- Classification of the hazardous substance or information on the hazardous properties.
- The tonnage levels used and
- Affected working areas (typical working areas can include warehouse, warehouse areas and warehouse sections).

There is no legal standard regarding the form of the Register of Hazardous Substances. A tried-and-tested form, however, is to summarize individual details in a table.

5 Labelling

All stored chemicals must be identifiable through their packaging/container with at least their substance name. Substances and mixtures classified as hazardous must also be labeled in accordance with the legislation on hazardous substances and/or dangerous goods (see [Annex 3](#)) that contains information on the main hazards and handling (examples of arrangements of the GHS labels may be found in Annex 7 of the CLP-Regulation ([1a](#)); see also [TRGS 201 \(16\)](#) with regard to labelling in compliance with respective legislation on hazardous substances). Decisive in this respect is the information contained in the safety data sheet. If a safety data sheet is not mandatory, information has to be provided by the manufacturer in another way.

Figure 2: Example of container labelling



6 Small quantities

TRGS 510 "Storage of hazardous substances in -non-Stationary containers" regulates the protective measures to be observed according to the hazard classification and the quantity per closed factory building or fire(-fighting) compartment or separate building unit. Qualifying quantities with regard to respective hazard classifications are shown in [Chapter 1, Scope of Application, Table 1, in TRGS 510 \(19\)](#)

Small quantities (quantities according to Table 1, column 4) may be stored outside of warehouses or hazardous substances cabinets. Fundamental and general safety measures for safety and protection of health are to be observed; a risk assessment is required.

If the respective amounts for small quantities are exceeded, the hazardous substances must be stored in warehouses or safety cabinets taking into account fundamental regulations, in particular the joint-storage rules. If the quantities of Table 1, column 5, are exceeded, additional special protective measures are necessary, which are pointed out there. Mostly, these are special fire prevention measures.

Supplementary requirements apply for hazardous substances with special hazard features, in particular with regard to building requirements on fire prevention.

7 Packaging and storage units

7.1 Packaging and containers

Packaging and containers (hereinafter referred to as “packaging”) are the primary protective measures when storing hazardous substances. Their design must be such that none of the contents can escape unintentionally. Wherever possible, hazardous substances should be stored in the original containers or in the original packaging.

Empty packaging that still contains residual material is subject to the same regulations as filled packaging unless appropriate steps have been taken to exclude any danger.

The requirements for the selection of packaging, packing and handling shall be deemed to have been met if the packaging meets the requirements for the transport of dangerous goods. In other cases, the following is to be observed:

Mechanical stability

Shocks, handling or stacking loads, vibrations, temperature changes, moisture or pressure changes under storage conditions – including placement into and removal from storage and internal transport – can lead to packaging failure. This is why it must be of adequate strength and made of suitable materials.

Figure 3: Containers in a high-bay warehouse



Chemical stability

Only packaging (including closures and seals) may be chosen which is made of materials which are not affected or significantly weakened when coming into contact with the product.

Appropriate dimensioning

The dimensions (height, width and length) of the packaging must fit the intended storage system. Protruding parts such as immersion pipes are to be avoided or protected against ripping off.

The size of the packaging must be such that in the case of liquids sufficient ullage shall be left to ensure that no leakage of the liquid substance and no permanent distortion of the packaging can occur as a result of expansion of the liquid substance due to temperatures which may occur during storage. Conversely, in the case of solids the ullage shall be kept small enough to avoid any buckling of the packaging during stacking.

Shape and labelling

Hazardous substances must not be kept or stored in containers whose shape or marking could lead to the contents to be mistaken for foodstuffs.

Proper closure

Packaging must be closed in accordance with the information provided by the manufacturer (e.g. torque, suitable closure for cardboard boxes).

Protection against breakage

Internal packaging such as glass bottles or ampules and plastic containers must be protected in such a way that they cannot break or be punctured under normal storage and transport conditions and their contents cannot leak into the outer packaging. Adequate protection can be achieved through packing, if applicable, with substances with absorbing properties and/or padding in outer packaging.

Restrictions on packing together

Inner packaging of different products may not be packed together in the same outer packaging if they could react together dangerously and cause a fire, evolution of flammable, asphyxiant, oxidising or toxic gases, or form unstable substances. Only those substances may be packed together which may be stored together.

7.2 Sustaining the protective function of packaging

Further protective measures include all organisational and technical measures that are suitable for sustaining the protective function and stability of the packaging. These include:

Avoiding contamination

No hazardous residue or product shall adhere to the outside of packagings during storage so that there is no danger to warehouse personnel or reduction in the mechanical stability (e.g. through corrosion).



Package orientation

Packages with orientation arrows must be stored according to these markings in order to prevent any package leaking as a result of permanent pressure from fluids on the closure, vents or sealing materials.

Restriction of storage period

The protective properties of the packing materials, in particular plastics, cardboard and paper, can suffer considerably as a result of physical or chemically induced ageing. A maximum storage period is to be stipulated in order to avoid leakages.

The permitted period of use for drums and jerricans made of plastic, rigid plastic IBC and combination IBC with plastic inner receptacles is a maximum of five years according to the requirements for the transport of dangerous goods, unless a shorter period of use is prescribed because of the type of substance being transported (e.g. hydrofluoric acid). The year of manufacture of design-certified packaging can be established by means of the packaging's UN labelling.

Light, UV protection and temperature

Products being stored are to be protected against direct sunlight and UV radiation by protective roofs, sunblinds or tinted window glass if the effects of intensive sunlight and UV and heat radiation could not only reduce the usage period of plastic, cardboard and paper packaging through embrittlement but also change the properties of the product. For example by drying out of phlegmatizers, peroxide formation with ethers or triggering of decomposition of thermally unstable products.

Temperature fluctuations can have effects on the packing material and lead, for example, to embrittlement, softening, pressure increases, freezing.

Protection against moisture

Moisture can cause corrosion and mould formation which reduces the mechanical stability of the packaging. Appropriate measures are to be taken to prevent any penetration by condensation or the formation of high humidity.

Avoiding mechanical damage

During transportation, entry into and removal from storage, as well as manual handling, attention must be paid at all times that the packaging is not damaged, for example by falling down, crushing or crashing into.

7.3 Securing palletized load units

The correct condition of the load is an important requirement for safe working whilst transporting, entering into and removing from storage, stacking and unstacking. The load must be packed in such a way that it does not fall apart, becomes dislodged or has parts fall off when picked up, transported and set down.

Choice of load carrier

The secure structure of a palletized load unit commences with the load carrier (e.g. flat pallets, wire-mesh box pallets). The "Chemical Pallet System" (CP-System) has established itself in this respect in the chemical industry. The europallet has also proven to be successful for this.

Pallet design	Area of use
CP 1 (1000 x 1200 mm)	Mostly used pallet for chemical products (e.g. bagged goods/sacks)
CP 2 (800 x 1200 mm)	In consumer-related areas, chainstores, alternative to reusable Europool pallets
CP 3 und 9 (1140 x 1140 mm)	Container pallet, suitable for FIBC, corrugated cardboard octagon containers, drums with rolling hoops Ø 585 mm
CP 4 und 7 (1100 x 1300 mm)	Dispatch of bulk goods in sacks, primarily plastic granulate and fertilizers
CP 5 (1140 x 760 mm)	Container-suitable pallet, suitable for small piece goods, e.g. corrugated cardboard boxes
CP 6 (1200 x 1000 mm)	Dispatch of bulk goods in sacks
CP 8 (1140 x 1140 mm)	Container-suitable special pallet for large containers with base outlet (FIBC/ corrugated cardboard octagon containers)

Nine standard pallets have been included in this CP system and a pallet life-cycle developed. There is therefore the possibility of reusing the pallets or recycling through a CP-registered pallet manufacturer/reconditioner.

Damaged or faulty pallets, e.g. mouldy or chemically contaminated, are to be replaced. The damage is not rectified by placing a second flat pallet underneath.

Figure 4: Flat pallet unsuitable for use



Flat pallets are not suitable for use (see fig. 4) for example if

1. a board is missing or broken at an angle or broken crossways,
2. more than two bottom edge or top edge boards or a cross-board have broken away to such an extent that more than one nail or screw shaft is visible per board,
3. a block is missing, broken or broken away to such an extent that more than one nail or screw shaft is visible,
4. main marking is missing or non-legible,
5. apparently non-permitted components have been used for repair (boards or blocks which are too thin, too narrow or too short),
6. the general condition is so bad that the load bearing capacity can no longer be guaranteed (rotten, mouldy, or several broken-away boards or blocks).

Fig. 5: Wire-mesh box pallet unsuitable for use



Wire-mesh box pallets are not suitable for use (see figure 5) for example if

1. the positioning bracket attachment or corner columns are deformed,
2. the front hinged panels do not move or are deformed in such a way that they can no longer be closed or if the clasp fastenings no longer function,
3. the base frame or the feet are bent to such an extent that the wire-mesh box pallet can no longer stand evenly on all four feet or can no longer be stacked without danger,
4. the round steel mesh is torn so that wire ends protrude inwards or outwards (one mesh can be missing per side),
5. a board is missing or broken or
6. main marking is missing or non-legible.

Permitted payloads

Experience has shown that not only the type of pallet but also the way a pallet is loaded has a large influence on the permitted payload of the pallet. It is relevant in this respect for example if the load is more punctiform or lies across the surface, whether the packaging is interlocking or not and whether the packaging is flexible (e.g. sacks) or rigid (e.g. barrels). In addition, the methods of securing and wrapping can also have an influence. Specific details in this respect can be found in the VCI manual for packaging. (89)

Pallet securing

The weight of the packaging is often insufficient to prevent slipping, tipping over or falling down. In most cases, auxiliary appliances for pallet securing are necessary for putting together load units. The following points must be observed, irrespective of the type of pallet securing:

- The stacking load of the packaging must not be exceeded.
- The packaging should be standing upright and plumb on the pallet.
- The packaging mustn't protrude beyond the outer dimensions of the pallet.
- The height of the load unit must be such that there is still sufficient free space for entry into and removal from storage.
- The pallets should not be loaded punctiform with heavy packaging.

Interlinked stacking

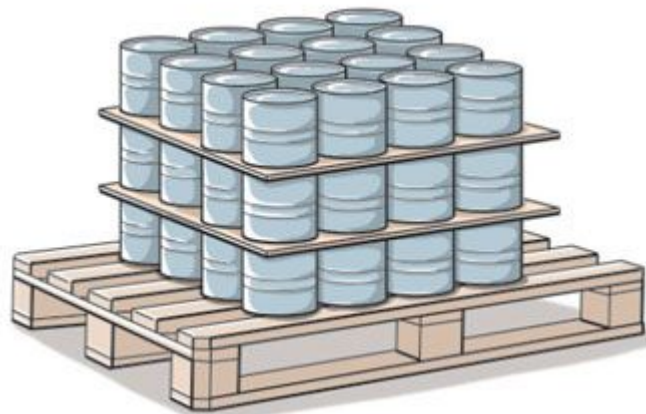
The stability of the packaging stack on the pallet can be increased significantly by the stacking scheme. Intermediate layers, e.g. made of laminated paper or corrugated cardboard, represent a layer bond with columns.

With interlinked stacking of boxes, the unburdened upper layer often has to be held together additionally. If, however, the individual pieces (e.g. boxes) are very light, the individual layers should also be secured additionally.

Figure 6: Interlinked stacking



Figure 7: Securing of columns and sacks by intermediate layers



Strapping

Packaging on a pallet can be made more stable with the aid of vertical and/or horizontal strapping using textile, plastic or steel straps or lashing straps. With boxes made of corrugated cardboard, conical packaging or soft packaging, attention must be paid that the strapping is not too tight as this can restrict stability and/or damage the packaging. Edge protectors must be used in order to protect the packaging so that the clamping force of the straps can spread more evenly. In addition, the pressure on the edges is spread over a larger area.

Figure 8: Strapping with additional edge protectors: Long edge protectors underneath the straps hold the stacked cartons on the pallet together better

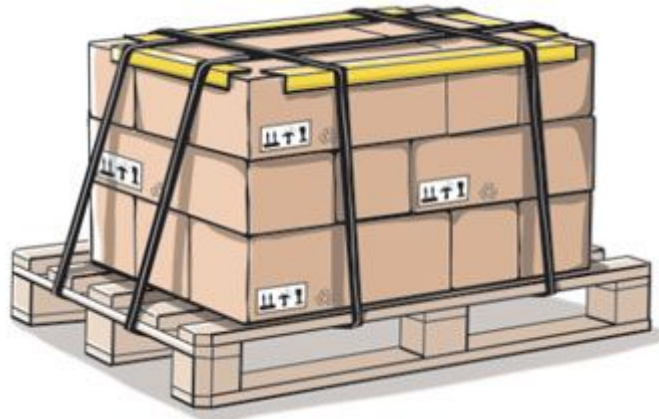
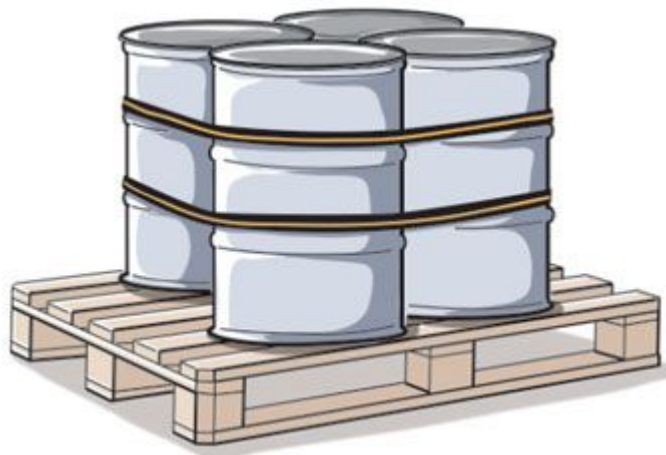


Figure 9: Strapped barrels



Stretch wrapping

Stretch foil can be used for securing evenly stacked packages on pallets. The number of wraps has to be observed (at least 5) according to the weight of the shipping items and the quality of the foil being used. An increased number of wraps should be observed in the lower areas in order to ensure that the load is securely bound to the pallet. Stretch foil can have the disadvantage that condensation can form inside the packed stack depending on temperature and humidity.

Other securing forms

Along with straps and stretch foil, there is a wide range of aids for securing loads such as wire-mesh box pallets for holding packages, stretch hoods, push-on frames for fastening non-load bearing or deformable packaging and drum pallets.

Figure 10: Wire-mesh box pallet with gas cylinders



8 Organisational measures for safety and health protection

The employees in the warehouse make a considerable contribution to safe storage. Appropriate steps should also be taken to protect them against risks to health and safety when storing products.

Only appropriate and instructed employees who carry out work in accordance with operating instructions and regulations may be employed in the warehouse (39). The employees are under obligation to notify the warehouse management immediately about any occurrences such as damaged packaging, leakages, fires and accidents.

8.1 Operating instructions and employee information (20) (56)

Operating instructions must be on hand when carrying out storing and related activities. The results of the risk assessment are the basis for the operating instructions. The following points should be clarified in the instructions:

- Each employee is responsible for the cleanliness and tidiness of his own workplace; each workplace should always be tidied up at the end of work.
- Gangways, aisles and means of access must be kept free of obstructions.
- Tools and auxiliary appliances which are no longer required, e.g. ladders, steps and empty pallets, must be cleared away immediately and returned to the intended storage points.
- Floor soilage, in particular caused by oil and grease, must be removed immediately.
- Waste must be collected at the intended collection points and removed from the warehouse at the end of work.

Good housekeeping is very important. Attention must be paid in this respect to not only cleaning floors but also removing dust deposits and cleaning conveyor systems. Brushing with a broom should be avoided as this throws up clouds of dust particles. Dust deposits should preferably be cleared away with industrial vacuum cleaners or industrial suction sweepers. The type of vacuum cleaner and filter quality should be chosen according to the type of substance involved.

Figure 11: The actual workplace is the focal point for instruction



An examination of orderliness and cleanliness is part of the regular inspection routine. Corroded, deformed or damaged containers are to be removed. Damaged or illegible labels are to be replaced. Slow moving items should be identified at the latest during a stock inventory (e.g. on an annual basis). Warehouse items that are no longer required should be disposed of in a correct manner. The behaviour of employees should also be noted during inspection tours.

Rules of conduct include in particular:

- compliance with the ban on smoking,
- wearing suitable work clothing,
- no consuming of food and beverages in the storage area,
- washing hands before breaks,
- follow access and behaviour rules for visitors,
- not damaging safety installations; reporting any damaged safety installations,
- not restricting the function of or access to safety installations.

8.2 Operating instructions for hazardous substances

Operating instructions pursuant to TRGS 555 can relate to individual substances (e.g. special substances or substance groups such as cyanide, hydrofluoric acid, organic peroxide, potentially explosive substances) or groups of hazardous substances with similar properties (group instructions). In particular, the following points are to be observed: (20)

- Specification of respective hazard labelling and classification.
- Hazards that are linked to the storage of these dangerous substances.
- Technical, organisation and personal protective measures, as well as code of behaviour.
- References to joint storage bans.
- Behaviour in the event of emergencies, e.g. instructions for occurrences of leaks or fires.

- Pay attention to any danger of fire and explosion.
- Avoid ignition sources that could lead to fires or explosions. Ignition sources can include auxiliary substances or waste (e.g. oil-soaked cleaning rags).
- First-aid measures.
- Disposal of waste products.

Operating instructions are to be brought into line with latest findings and must be updated accordingly to the current level of risk assessment.

If further measures for the protection of employees have been identified that fall not under the regulation range of TRGS 555, they are to be described in separate work instructions.

8.3 Instruction

Employees are to be instructed on the basis of the operating instructions prior to commencement of activities and subsequently at least once a year in the event of significant changes. Attendance to the course of instruction must be confirmed by means of signature. It is important for the course of instruction – as well as for the preparation of the operating instructions – that the choice of language is such that everyone involved is able to understand the contents. Photos are also very suitable for illustrating general operating instructions. (15) (20)

The contents of the course of instruction should also include behaviour in the event of emergencies, e.g. in the event of product leakage or fire. In addition, drills should be carried out to rehearse how employees in the warehouse should get to safety or be rescued. The frequency of these regular emergency drills is to be determined in the risk assessment.

Substance-related information (e.g. safety data sheets) concerning the substances stored in the warehouse must be kept on hand in order to inform the indoor and outdoor workforce about possible dangers and the corresponding steps to be taken, in particular in the event of any product leakage. This information must show:

- The name of the stored hazardous substances.
- Name and address of the manufacturer, importer or distributor.
- Information about particular dangers.
- Protective measures in order to counteract such danger.
- Steps to be taken in the event of any breakage or other damage to the packaging.
- Steps to be taken and appropriate assistance if anyone comes into contact with the stored substance.
- Steps to be taken in the event of fire, in particular the resources or groups of resources that may or may not be used for fire-fighting.
- Steps to be taken in order to avoid environmental damage.

8.4 Hygiene

The employer is responsible for providing employees with the necessary resources for their personal hygiene. These include: (10)

- Sanitary systems.
- Washing and showering facilities.

- Social rooms.
- Separate storage possibilities for everyday and work clothing if there is a danger of contamination by dangerous chemicals.

In order to avoid hazardous substances being carried along inadvertently into clean areas such as offices, conference rooms or canteens, it is important to ensure that work clothing contaminated with hazardous substances is removed before leaving the work area (e.g. do not hold stairway banisters with contaminated gloves).

8.5 Personal protective equipment

Personal protective equipments as body protection must always be used if the dangers of injury and health hazards cannot be eliminated or not adequately eliminated through technical or organisational safety measures (5). This applies, for example, in the case of contaminated containers, when working above head-height and in the event of leakages and their rectification.

Risks and dangers at the respective workplace are to be taken into account when choosing appropriate personal protective equipment because there is no universally suitable form of protective equipment. Additional protection against electrostatic charging is to be provided in explosive atmospheres, e.g. antistatic safety shoes and work clothing.

The protective equipments (depending on requirements according to the results of the risk assessment: safety gloves, safety shoes, safety helmet, safety goggles, face protection mask, protective clothing, respiratory protective devices etc.) must be suitable for leaking chemicals and work to be carried out and must be placed at the disposal of the respective employees. Employees must wear provided protective equipment as instructed; compliance is to be monitored by supervisors. Regular maintenance (and cleaning where applicable) is required to ensure correct function. The employer must ensure the appropriate cleaning of any work clothing contaminated by hazardous substances. The employer shall dispose of and replace damaged personal protective equipment. (53) (50) (47) (49) (48)

Portable respiratory-protection equipment is also to be kept available or carried depending on the type of substances being stored and the local conditions. Personnel must be carrying respiratory protective devices when entering storage rooms if hazardous substances marked with H330 or R26 are being stored in pressurised gas containers in those rooms. Respiratory protective devices must be kept outside of the hazard areas in a manner such that the employees can access it quickly.

8.6 Storage plan

For storing hazardous substances, a storage plan must always be drawn up to provide employees in the warehouse with a clear indication which substances and amounts of them can be stored where so that an easy orientation is possible in the event of a fault (e.g. leakage) or a fire.

The storage plan should also contain information on storage points that may only be used under certain restrictions. These include storage points

- with height restriction, e.g. because of ventilation ducts, sprinkler pipes or nozzles,
- with reduced load capacity,

- in the immediate vicinity of effective sources of ignition; in this case, storage of flammable hazardous substances is not permitted,
- in the immediate vicinity of lighting elements; products may not be stored here that could react dangerously as a result of warming up.

Controlling joint storage is achieved appropriately through the details in the storage classes for each warehouse area or warehouse sector. The storage class is determined through the classification of a product. The rules for the separate and joint storage with products of different storage classes are based on this. Classification can take place according to [Annex 4](#) if the supplier does not provide any details of storage class.

The following basic rules must be observed when drawing up the storage plan:

- Hazardous substances may only be stored jointly if this does not increase the risk.
- Separate storage within one warehouse sector may be necessary in order to reduce hazards related to specific stored substances of the same storage class or substances of different storage classes. This can be achieved by sufficient distances or by barriers (e.g. walls, cabinets made of non-combustible materials, products made of non-combustible substances of storage class 12 or 13) or by storing them separately in separate containment areas. Indications for the need to store substances separately may result from, for example:
 - hazard statements, supplemental hazard information and precautionary statement (R- and S-phrases and/or H-, EUH- and P-sentences) of the marking (this applies in particular to R29, R31, R32, S14, S17, S50, EUH014, EUH029, EUH031, EUH032, P220, P223 and P420) and
 - product-related safety information, such as:
 - safety data sheets (Section 5 "Fire-fighting measures" and Section 7 "Handling and Storage"; experience has shown that information contained in Section 10 "Stability and Reactivity" is less detailed), or
 - information leaflets issued by the accident insurance funds(e.g.: cyanides shall not be stored jointly with substances – e.g. acids – with which they may produce hydrogen cyanide).

Derogations from the joint storage rules are allowed if

- not more than 400 kg hazardous substances are stored, of which a max. 200 kg may belong to one storage class,
- hazardous substances of up to 200 kg are additionally be stored in a warehouse for storage classes 6.1 C, 6.1 D, 8 A, 8 B and 10 to 13 and
- there is no need to fear an increase in the risks encountered.

Stored substances of the same storage class or stored goods of different storage classes for which no separate storage is prescribed may not be stored jointly if this can cause a substantial increase in risk. This is the case if they, for example:

- require different extinguishing agents,
- require different temperature conditions,
- react with each other while producing flammable or toxic gases or
- react with each other while causing a fire.

Hazardous substances must be neither kept or stored in the immediate proximity of pharmaceuticals, food or forage, including their additives, or cosmetics, drink and tobacco. Suitable steps must be taken in order to avoid cross-contamination. This can be achieved with horizontal spacing of more than two metres.

In individual cases, it is possible to deviate from the rules in the joint storage table on account of suitable fire protection concepts and risk assessment results.

Storage class		10-13	13	12	11	10	8 B	8 A	7	6.2	6.1 D	6.1 C	6.1 B	6.1 A	5.2	5.1 C	5.1 B	5.1 A	4.3	4.2	4.1 B	4.1 A	3	2 B	2 A	1
Explosive substances	1																									
Gases	2 A	2			2			2								1									2	3
Aerosol packages	2 B															1										
Flammable liquids	3	5			5						6						4									
Other explosive substances	4.1 A	1	1	1	1	1	1	1							1							1	1			
Flammable solid or desensitizing explosive substances	4.1 B										6			4	1		4		6	6						
Pyrophoric or self-igniting substances	4.2	6			6	6	6	6			6	6							6							
Substances producing oxidizing gases with water	4.3	6		6	6	6	6	6			6	6														
Highly oxidizing substances	5.1 A																									
Oxidizing substances	5.1 B	7			7	7		7			6	6	4	4		1										
Ammonium nitrate and mixtures containing ammonium nitrate	5.1 C	1	1	1	1	1	1	1								1										
Organic peroxides and self-reactive substances	5.2	1			1	1																				
Combustible acutely toxic substances	6.1 A	5			5																					
Non-combustible acutely toxic substances	6.1 B	5			5																					
Combustible acutely toxic or chronic substances	6.1 C																									
Non-combustible acutely toxic substances or substances with chronic effects	6.1 D																									
Infectious substances	6.2																									
Radioactive substances	7								1																	
Combustible corrosive substances	8 A																									
Non-combustible corrosive substances	8 B																									
Combustible liquids	10																									
Combustible solids	11																									
Non-combustible liquids	12																									
Non-combustible solids	13																									
Other combustible and non-combustible substances	10-13																									

Separate storage is required
 Joint storage permitted

Number

 Joint storage is only permitted with restrictions (see Number)

(19)

Explanations with regard to the joint storage table

1. Specific statutory storage rules must be observed:
 - Storage classes 1 and 4.1 A: 2. Explosion Ordinance (SprengV); (28)
 - Storage class 5.1 C: Dangerous Substances Ordinance (GefStoffV) Annex I No. 5 Ammonium nitrate; (15)
 - Storage class 5.2: Regulations of the German Statutory Accident Insurance BGV B4 "Organische Peroxide" (Organic peroxides) (42); attention: the joint storage rules quoted here shall also be applied by analogy to the storage of self-reactive hazardous substances;
 - Storage class 7: Radiation Protection Ordinance (StrlSchV) and DIN 25422. (29) (83)
2. Joint storage in rooms is only allowed if
 - max. 50 filled pressurised gas containers are stored, of which no more than 25 contain gases that are flammable, oxidising, acutely toxic, marked with H331 or toxic, and if these
 - are separated by a wall that is at least 2 m high and made of non-combustible materials and if
 - a distance of at least 5 m is observed between the wall and the combustible substances.
3. Pressurised gas cylinders filled with different gases may only be jointly stored in the same warehouse room under the following conditions:
 - Pressurised gas containers containing gases that are flammable, oxidising, acutely toxic, marked with H331 or toxic, provided the total number of 150 pressurised gas containers or 15 pressure barrels is not exceeded. In addition, pressurised gas containers filled with inert gases may be stored in any quantity.
 - Pressurised gas containers with flammable and pressurised gas containers with inert gases may be stored in any quantity.
 - Pressurised gas containers with oxidising gases and pressurised gas containers with inert gases may be stored in any quantity.
 - Pressurised gas containers with acutely toxic hazardous substances of categories 1, 2 or 3/very toxic, toxic and pressurised gas containers with inert gases may be stored in any quantity.
 - In the cases 1 to 3, an additional 15 pressurised gas containers or a pressure barrel containing gases that are acutely toxic, marked with H330, and/or very toxic, may be stored. Larger quantities of pressurised gas containers with acutely toxic gases must be stored in a special storage room.
 - There must be a distance of at least 2 m between pressurised gas containers containing flammable gases and pressurised gas containers containing oxidising gases.
 - There are no restrictions as to outdoor storage.
4. Joint storage shall be permitted if the restrictions of:
 - Table 1 are observed for storage classes 3, 5.1B, 6.1A and 6.1B,
 - Table 2 are observed for storage class 4.1B with storage class 6.1A

Table 1: Preconditions for joint storage of storage classes 3, 5.1 B, 6.1 A and 6.1 B

Total quantity	Restrictions
up to 1 t	without restriction
up to 20 t	in buildings if an automatic fire extinguishing installation exists or an automatic fire detection system exists in combination with a <ul style="list-style-type: none"> • non-automatic fire extinguishing system and • a certified plant fire brigade

Table 2: Preconditions for joint storage of storage class 4.1 B with 6.1. A

Total quantity	Restrictions
up to 10 t	without restriction
up to 20 t	if <ul style="list-style-type: none"> • in buildings: an automatic fire detection system exists • outdoors: fire detection and fire alarm are guaranteed by <ul style="list-style-type: none"> - hourly controls with alert possibilities (e.g. via telephone, fire alarm, radio equipment etc.) or - there is evidence that an appropriate automatic fire alarm/detection system exists.
up to 50 t	if <ul style="list-style-type: none"> • an automatic fire detection system exists and • the fire brigade can reach the scene of the fire within 10 minutes of the alarm being raised.
up to 100 t	if <ul style="list-style-type: none"> • an automatic fire extinguishing installation exists or • an automatic fire detection system exists in combination with a non-automatic fire extinguishing installation and a certified plant fire brigade

5. Materials that may contribute to the outbreak or rapid expansion of a fire due to their nature and quantity as e.g. paper, textiles, wood, wood wool, hay, straw, packagings, combustible packaging filling materials must not be stored in the warehouse sector unless they form a unit with the non-stationary containers for storage or transport.
6. Different stored substances may only be stored together or jointly with other materials provided that this will not lead to a substantial increase in risk. A substantial increase in risk can be prevented through separate storage.
7. Oxidising hazardous materials may be stored jointly with combustible materials:
 - in quantities of up to a total of 1 tonne without restrictions
 - in quantities of more than 1 tonne according to the restrictions of section 4 no. 1.

The requirements under explanation 5 must also be observed.

Quantity limits resulting from the approval situation or the safety concept are also to be stated in the storage plan. These include

- Maximum permitted total storage quantity – maximum quantity of the substances and categories according to the 4th Federal Emissions Control Act, Appendix I Ordinance on Industrial Accidents (4. BImSchV, Anh. I StörfallV, see also Council Directive 96/82/EC) [\(26\)](#) [\(27\)](#)

- Maximum quantity of flammable liquids (Ordinance on Industrial Safety and Health (Betriebssicherheitsverordnung) or repealed Regulation on Flammable Liquids (Verordnung brennbare Flüssigkeiten – VbF) (2b) (14))
- Restriction of the volume of water-endangering substances (Water Hazard Class 1, 2, 3). (31b)

It is also advisable to list in the storage plan substances and substance groups that are not going to be placed in stores but which could be according to their storage class (e.g. storage class 3 without H224; storage class 4.2 without H260 or 261; storage class 6.1 B without cyanide).

8.7 Work clearance

A work clearance system including special written instructions by the employer shall be applied in the event of activities that could cause hazards through interaction (e.g. welding). Work clearance shall be provided by the responsible person before the beginning of the activities. (55)

8.8 Access to the warehouse

The purpose of access restriction is to achieve two protection objectives. On the one hand, the group of people present in the warehouse is to be limited to employees and on the other hand actions by unauthorized persons (e.g. theft or manipulation) are to be avoided. (15) (19)

Authorized persons shall be appointed and instructed by the employer at regular intervals. Prohibition of access shall be clearly and permanently indicated by means of a prohibiting sign ("Zutritt für Unbefugte verboten" (No access for unauthorized persons)) (11). Organisational measures are to be taken to ensure that only authorised persons have access to the warehouse (e.g. non-employees are to be addressed by personnel; gates and doors are to be locked at end of work).

Zutritt für Unbefugte verboten
(No access for unauthorized persons)



Substances and mixtures that are classified as toxic, highly toxic, carcinogenic of category 1 or 2, mutagenic of category 1 or 2 or toxic to reproduction of category 1 or 2 pursuant to Annex VI of Directive 67/548/EEC (1b) shall be kept under seal or must be stored in such a manner that only experts and reliable persons have access to them. Eventually access and distribution restrictions from other legal areas may also have to be observed for other substances.

Further technical measures are required in warehouses requiring certification pursuant to no. 9.34 or 9.35 of the 4th Federal Immission Control Ordinance (4. BImSchV). These include, for example, building the storage facility

in a solid manner, windowless outer walls or barred windows and surveillance of doors and windows by burglar alarm systems. (26)

8.9 Special qualifications for operating materials handling industrial trucks

Accidents in warehouses are often linked to the operation of industrial trucks (running into people, warehouse installations or other vehicles; damage to packaging; packaging falling over as a result of cornering too fast; collapsing loading ramps). The accident prevention regulations BGV D27 "Flurförderzeuge" ("Industrial Trucks") contain details for activities of works transportation and the use of industrial trucks. In particular, it also regulates in which cases special training is required for the operation of the equipment (vehicle licence). The driving instruction must be issued in writing by the employer or the latter's appointed agent. (43)

8.10 Monitoring work stages

The organisational measures for the safety and protection of health also include the implementation of an effective monitoring system. The monitoring system consists of implementation and effectiveness checks. The employer or site manager appointed with the corresponding duties must ensure that the employees adhere to the respective instructions and behave in a duly safe manner and that they are appropriately suitable and qualified.

The frequency and intensity of the checks depend on the circumstances in each individual case. In particular, with regard to

- the probability of the occurrence of a hazardous condition,
- the severity of possible consequences, including those for third parties,
- the reliability of the employee with regard to adherence to work safety regulations,
- the experience of the employee with regard to risks at own workplace and
- the type of protective measures that have been taken.

The frequency and intensity of the checks must be in line with the influence that an employee can have on the use or efficiency of a protective measure. For example, this applies in particular if wearing personal protective equipments.

Records are to be kept about the place and time of the inspections, in particular if deviations were found.

8.11 Inspections

The employer must check the functioning and effectiveness of the technical protective measures upon initial installation and thereafter regularly, however at least every three years (15). The results of these checks shall be recorded and preferably kept together with the documentation of the risk assessment. Necessary maintenance and repair work to constructional and technical installations must be carried out without delay.

Insofar as the type and extent of and deadlines for inspections have been stipulated by the Ordinance on Industrial Safety and Health (Betriebssicherheitsverordnung) (14), permit regulations, manufacturer's operating instructions or professional association rules, the individual inspections are to be determined as part of risk assessment and recorded in a maintenance plan taking into account the respective conditions. Installations to be inspected include

- shelving
- collection facilities

- ventilation facilities
- fire detection systems
- fire extinguishing systems
- industrial trucks
- electrical appliances
- fire barriers (e.g. doors and doorways)
- hold-open devices
- smoke and heat extractor systems
- lightning protection systems

Supplementary organisational measures are regular function checks as part of regular warehouse inspection tours, among others in the form of

- visual controls, e.g. of the undamaged openings for venting and ventilation,
- audio controls, e.g. for dripping or trickling of products.

Checklists can be used (for example) for checking protective measures (see [Annex 5](#)).

9 Design of warehouse and warehouse equipment

The warehouse concept forms the basis for the planning, approval and construction of the warehouse. Among other things, this includes the stipulation of the warehouse sectors, type of storage and the technical protective measures, as well as the size and purpose. The operation of the warehouse is bound by these circumstances. Significant changes to the warehouse concept (e.g. automation, change from small to large packages or changes to stock) are only possible with considerable expenditure.

9.1 Types of warehousing

Rack storage

In small warehouses, racks are used in which the transport or individual containers are placed in storage or removed by hand. Racks and walk-through racks are also used for order picking of smaller packaging units. Handling of chemicals above head-height is banned for safety reasons. Steps and ladders or storage retrieval machines are therefore to be used in the case of higher racks. Fragile packages are to be protected against falling down. This can be achieved with upturned shelf edges, small trays, special shelf inserts and spacing away from the shelf edge.

Figure 12: High-bay stores



The storage facilities of larger warehouses are divided into pallet, mobile-rack, walk-through, drive-through and high-bay stores. Individual shelving units are formed into shelving aisles. These aisles can consist of single or double shelves. Push-through protectors are to be provided in the case of safety spaces of less than 0.1 m between the pallets on double shelves. There is a wide range of versions depending on the flow of material and space requirements.

Pallet storage is carried out by industrial trucks (fork-lift trucks) or storage retrieval machines. When placing pallets into storage, attention is to be paid that

- the contours of the pallet units are retained (no overhang by packaging slipping out of place),
- the pallet weight does not exceed specifications for field loads,
- specific features for individual shelving points or levels such as restricted height or width because of hindrances (e.g. sprinkler pipes or ventilation shafts) are observed.

The pallets are to be placed straight and central on the shelving beams or shelving areas. Opened pallets (commissioning pallets) should preferably be stored on the lowest shelving level and not on upper shelving levels. If shelves are being serviced by industrial trucks (except track-bound), the corner areas must be protected by collision guards. The collision guard, at least 0.3 m high, must not be connected to the shelf and must have black-yellow marking.

The maximum permitted shelf loads are to be clearly marked on the storage shelves.

Any damage to shelf supports or beams during storage or removal must be reported to warehouse management immediately so that the extent of the damage can be assessed without delay. If necessary, loads must be removed from the shelf immediately and the damage parts replaced.

Block storage and line storage

Unlike shelf storage, pallets in block warehouses are placed straight on the floor. Block storage is only suitable for large quantities of identical products as access is only available to the pallets at the front. This consists of rows of blocks standing next to each other with aisles in between. Permitted carrying loads, vertical loads and stacking heights may not be exceeded when stacking pallets and stack-nest containers. Packaging for the transportation of hazardous goods (with the exception of sacks, non-stackable combination and large packaging) is tested for a stacking height of 3 m.

Figure 13: Line storage outdoors with ground marking



If remaining below the maximum permitted gross mass (e.g. shown on the packaging labelling), the stacking height may amount to a maximum of 6:1 in ratio of height to narrow side of the ground area. The angle of the warehouse floor – and the wind load if storing outdoors – is to be taken into account when stacking.

In addition, the load capacity of floor elements and stacking aids must be observed. Flat pallets are only stackable if the load is stable and has a horizontal resting surface. If the stack has an angle of more than 2 % or if the product spills from the containers, the stack is to be taken down in a non-hazardous manner.

Two rows each of inspection aisles are to be provided for block storage. These aisles must have a width of at least 0.5 m.

Storage in cabinets

Chemical cabinets are suitable for the storage of small quantities. A chemical cabinet (up to approximately 200 kg or 200 l) without additional fire protection qualities is suitable for the storage of non-flammable hazardous substances that do not fall under no. 5 of TRGS 510. Hazardous substances that fall under no. 5 of TRGS 510 can also be stored in these cabinets insofar as their suitability is proven in the risk assessment. Attention must be paid that acute toxic fluids and solids (formerly very toxic and toxic substances) must be stored in lockable cabinets. As in the case of shelving, steps must be taken here to prevent containers from falling down. (19)

Cabinets compliant with Federal Water Act (Wasserhaushaltsgesetz) (31), toxic or environment cabinets are to be provided with a design-certified collecting basin and must be suitable for the storage of non-flammable hazardous substances that do not fall under no. 5 of TRGS 510. In this case as well, attention must be paid that toxic substances have to be stored in lockable cabinets.

A lockable safety cabinet pursuant to the requirements of DIN EN 14470-1 with design-certified collecting basin (as of 100 litres storage volume) in F30 to less than F90 design with ventilation, self-closing doors is suitable for the storage of flammable hazardous substances. (85)

Annex 3 of TRGS 510 (19) is to be observed for the storage of flammable fluids.

Only safety cabinets compliant with the requirements of DIN EN 14470-1 in F90 design may be used for the unrestricted storage of flammable fluids. The F90 design is also necessary for fulfilling the requirement of separate storage. (85)

Safety cabinets should be operated with technical ventilation, though they can also be operated without technical ventilation. See the collection of examples 2.2.8 of the explosion protection regulations (BGR 104) for corresponding classification zones. (44)

Figure 14: Safety cabinet



9.2 Operating equipment (51)

The warehouse concept also provides the basis for the use of operating equipment. The following operating equipment is primarily used in the warehouse.

Figure 15: Transport in the warehouse



Industrial trucks

There is a wide variety of industrial trucks. The local conditions of the warehouse and the intended purpose are decisive for the selection of suitable industrial trucks. In particular, the following points are to be taken into account for procurement and stipulation of work areas of fork-lift trucks:

- Fork-lift type
 - Type of drive with regard to emissions, carrying load and ignition sources,
 - Type (front-loaders, side-loaders, high-reach forklifts, four-way stackers).
- Dimensions
 - Height and width (depending on transit heights, aisle widths and turning circle),
 - Mast height (depending on shelf heights),
 - Floor clearance (driving over sills),
 - Load suspension means (depending on pallets).
- Permitted loads
 - Pallet weights,
 - Stacking heights.
- Necessary attachments e.g.
 - Drum grips,
 - Hydraulic fork extension.
- Ergonomic design, e.g.
 - Operator's seat,
 - Weather protection.

In the case of exclusively passive storage of combustible fluids in transport containers complying with dangerous goods regulations in storage rooms that are classified under zone 2, industrial trucks of standard design may be used insofar as the industrial trucks do not have any effective ignition sources and it can be shut down immediately in the event of danger.

Loading equipment/loading stations for industrial trucks are to be installed in well-ventilated rooms or outside and under no circumstances in potentially explosive atmospheres. Loading equipment/Loading stations are to be separated from the -warehouse area by distance or walls.

The manufacturer's operating instructions must contain recommendations and safety instructions for the fork-lift operator.

Equipment for securing pallets

Danger can ensue from equipment for securing pallets (ignition sources, product release). The choice of equipment depends on the type of packaging, the number of pallets to be secured and the available working area.

Stretch wrapping equipment is fundamentally suitable. Stationary shrinking systems with encapsulated flame, electric heating or steam may only be used with limiter for temperature and retention time. These systems are to be located outside the warehouse area, preferably in the finishing area.

Manual shrinking equipment with open flames may not be used.

Non-stationary electrical equipment

Only explosion-protected electrical equipment or electrical equipment that complies with the Industrial Safety Ordinance (Betriebssicherheitsverordnung) of Equipment Group II, Category 3 with marking "G" may be used in potentially explosive atmospheres of Zone 2.

Mobile electrical equipment such as sweeping machines and vacuum cleaners, as well as lamps, scanners, hand-held-equipment and tools, must be suitable for the respective warehouse sector (conformity declaration, manufacturer's operating manual). Electrical equipment must be checked for apparent faults, as well as according to BGV A3, each time before being used. (41)

The use of private electrical equipment by employees, such as mobile phones, radios or MP3 players, is not permitted insofar as their safety status cannot be ensured.

9.3 Containment facilities (19)

In order for chemicals to be recognized, retained and removed in the event of emission or spillage, a containment tub or appropriate containment area is to be provided in particular for fluids; this must be made of chemical resistant material and may not be connected to the public sewers. Capacities are to be brought into line with stored volumes; if necessary, other statutory regulations are to be applied. In the case of solids, a sound, fortified area which is easy to clean is sufficient. The containment facility must be electrostatically conductive in the case of flammable liquids.

The following also applies if storing more than 200 kg of flammable liquids:

The storage containers must be installed in containment spaces that can sufficiently resist the stored liquids and which are also impermeable to liquids in the event of fire. These requirements are deemed to have been fulfilled if the building materials and components used comply with the respective building inspectorate suitability certification, whereby use in the event of fire has also been taken into account. The fire impact duration taken as a basis must comply at least with the requirements placed on the room surround components.

Figure 16: Containment facility for liquid hazardous substances



Draining surfaces must be designed so that any emerging liquids are drained into the respective containment space. They must be appropriately resistant to any short-term contact with the stored product, however, they do not have to be resistant for hours or days.

Containment spaces and draining surfaces not made of fire-retarding or fire-resistant components must be located below the lowest storage level.

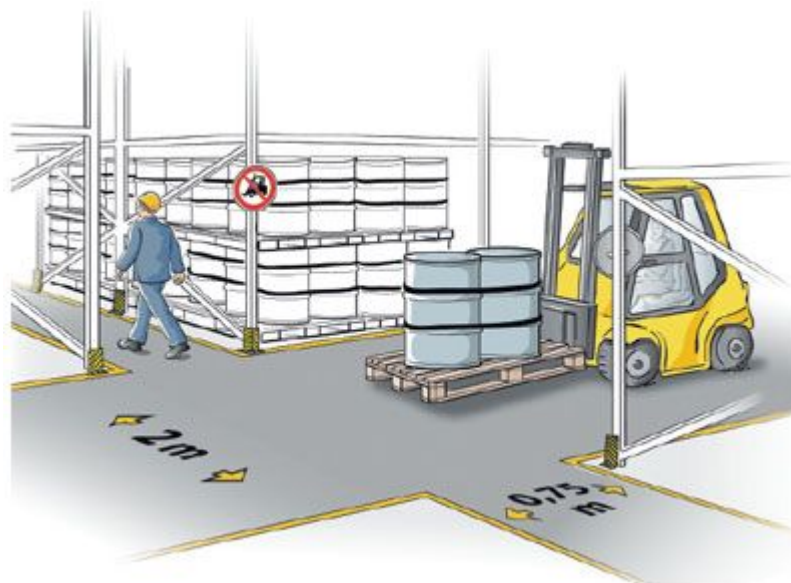
Containment areas in warehouses must fundamentally be open at the top (no insulation, sufficient ventilation) and must not have any drainage.

Outdoor containment areas must have installations that can be locked or switched off in order to remove water and must be used for this purpose only. Drainages are generally not permissible. Polluted water shall be treated according to relevant water law provisions. (31)

10 Traffic routes

Traffic routes in warehouses for hazardous substances must have a specific width. In the case of traffic routes for persons, these must be at least 0.75 m wide, and for fork-lift traffic the routes must have the width of the fork-lift plus at least 0.5 m on each side of the fork-lift truck.

Figure 17: Traffic routes in a warehouse for hazardous substances



Example: Width of the forklift truck 1 m; in this case, the traffic route should have a minimum width of $1\text{ m} + 2 \times 0.5\text{ m} = 2\text{ m}$.

The aisle for inserting and removing pallets must be dimensioned so that safe manoeuvring of the forklift truck is possible. If the shelving is designed accordingly, a part of the storage area for the pallet may be used by the forklift truck forks during insertion or removal. Transit pathways and routes must be provided with a cover (chipboard, grating). The clear transit height must be at least 2 m.

Transit traffic by persons and the unauthorized entry of the shelving aisles and relay areas is to be prevented. The latter is achieved in the shelving areas by constructional measures, in particular barriers. If, for operational reasons, it is not possible to prevent persons from entering shelving aisles or if persons have to spend time there in order to store or remove warehouse goods, the specific provisions of [BGV D27 \(43\)](#) "Flurförderzeuge" ("Industrial trucks") for the operation of industrial trucks in narrow aisles are to be observed if using guideline-controlled shelving industrial trucks (fork-lifts). Pedestrians are to be instructed to the effect that they are to catch the fork-lift truck operator's visual attention before they cross a fork-lift's traffic route or working area.

für Fußgänger verboten
(Pedestrians prohibited)



Escape and emergency routes and alarm (19)

The following is to be stipulated according to the type of chemicals being stored and the size of the warehouse

- The number of the emergency exits (generally at least two, if possible opposite each other; correspondingly, in storage rooms above ground level generally at least two escape and emergency routes per floor, of which one can be designed as an emergency exit via outside stairs, escape balconies or terraces etc. as long as this will not be endangered by fire or smoke in the event of a fire).
- Maximum length of the escape route (generally an exit must be reachable at a maximum distance of 35 metres which leads either outdoors, to a necessary staircase or another fire section).
- Type of alarm

In order to ensure a rapid evacuation of persons in the event of an emergency, all emergency exits and escape routes must be clearly identified and kept free at all times. Identification must comply with [ASR A1.3](#) "Sicherheits- und Gesundheitsschutzkennzeichnung" ("Safety and Health Protection Signs") (11). Emergency exits must be easy to open from inside without key (e.g. by anti-panic bars) and to open in the escape direction. The requirements of [ASR A2.3](#) "Fluchtwege und Notausgänge, Flucht- und Rettungsplan" ("Escape Routes and Emergency Exits, Escape and Rescue Plan") are to be observed. (13)

Notausgang/Fluchtweg
(Emergency exit/Escape route)



A summarized description of the following should be provided in an alarm plan:

- Details of alarm signals, fire protection devices, escape and emergency routes, collection points as well as information about personnel attendance checks to be carried out,
- List of measures in the order to be carried out,
- List with telephone numbers of rescue services, fire service and police, hospitals, doctors and poison control centres,
- Telephone number of the plant manager and other persons of responsibility.

Alarm plans may also be required according to other legal provisions (e.g. Ordinance on Industrial Accidents (Störfallverordnung/4. BImSchV). (27)

11 Goods Receipt

Goods Receipt has an important control function in the management of a warehouse so that only the correct (i.e. also only actually required and ordered) and permitted goods are received and placed in storage.

Assurance has to be provided that storage is authorized and that all necessary measures have been observed:

- Review of risk assessment and all technical, organisational and personal protective measures,
- Adherence to corresponding technical and legal requirements and restrictions (cf. warehouse approval) such as quantity restrictions,
- Restrictions to the storage of specific groups of substances (e.g. flammable liquids, explosive substances),
- Load-bearing capacity of shelving,
- Adherence to joint storage prohibitions.

Figure 18: Goods delivery to a chemicals warehouse



Goods Receipt is divided into several sub-sections:

Goods receipt control and acceptance

- Check of delivery papers and comparison with order (Was correct material delivered? Are the delivery papers complete?).
- Identity control (e.g. analysis),
- Check of labels (product identification, labelling),
- Check of quantities,
- Check of containers (cleanliness, intact, suitability of storage unit),
- Comparison of analyses certificates with specification,

- If necessary, attachment of Goods Receipt labels,
- If necessary, inclusion in own materials management system.

Each individual packaging and mixed pallet is to be checked in the case of composite packaging with differing products, as well as mixed pallets.

Physical storage

- Stacking suitability of containers,
- Assignment and transport to place of storage.

Documentation of storage

- Warehouse management through suitable system,
- When storing opened containers, the nominal volume is to be taken into account for the calculation of the warehouse volume for hazardous substances. In the case of storing emptied containers, 0.5 % of the capacity of the containers is taken into account for the calculation of the storage volume.

12 Emergency response organisation

12.1 First-aid

First-aid measures to be taken by the employer can be divided into

- Medical care, occupational doctors and company first-aid providers,
- Instruction of workers,
- First-aid facilities, rescue equipment and installations and other aids.

Figure 19: First-aid box



This code of practice only covers the aspects of “first-aid facilities, rescue equipment and installations and other aids”. Legal and German Statutory Accident Insurance (“Berufsgenossenschaft”) regulations (such as the Occupational Safety and Health Act, Occupational Safety Act, Works Constitution Act, Social Security Code VII, Hazardous Incident Ordinance, Radiation Protection Ordinance, BGV A1, DGUV Regulations 2)²⁾ are to be applied

directly with regard to “medical care, works doctors and first-aid providers“ and “staff instruction“. (9) (7) (8) (6) (27) (29) (39) (40)

The installations include designated telephones, emergency alarm buttons or similar with which the persons (respective doctor, rescue service etc., names and telephone numbers) or appropriate offices named in the alarm plan can be reached. The employees are to be notified of the alarm procedure; the effectiveness of stipulated emergency measures should be checked on a regular basis.

BGI 509 provides information about the quantity and quality of bandaging materials (first-aid box). Stipulations may also be contained in the operating approval, e.g. in the report by the respective fire service. (52)

Further installations, facilities and appliances for first-aid and emergency rescue in the warehouse can include:

- Eye showers, body showers (emergency safety showers),
- Respiratory protective devices (escape masks),
- Fire blankets, rescue belts,
- Medical equipment, first-aid rooms, antidotes.

The type and extent thereof should be determined in the risk assessment under inclusion of the company doctors. This should also include a review of the necessity of eye showers and emergency safety showers (and in what number and at which locations) e.g. depending on the type of activity, properties of the stored substances and the effectiveness of other technical and organisational safety measures.

The existing safety devices should be shown in the plans for averting danger. Steps are to be taken to ensure the entirety and usability of the equipment deemed to be necessary. For example, first-aid boxes are to be re-filled after use, and the contents of first-aid boxes, respiratory protective devices and antidotes are to be replaced if they have reached their use-by dates. Rescue belts are to be tested by appropriately qualified personnel. In the case of eye showers and emergency safety showers, tests are to be carried out to ensure that the appropriate flow quantity and water quality is ensured (danger of frost, water contamination). The supply lines are to be rinsed out regularly; the water condition must also be checked. Regular heating of pipelines and showers is required in the case of outdoor systems.

12.2 Fire extinguishers

Structural fire protection is to be stipulated according to the type and extent of local operating conditions and the goods being stored in each case. In addition, extinguishers for fighting incipient fires are to be made available and kept in a functional condition in the warehouse (12). The necessary type and number of fire extinguishers depends on the type of fire risk and the size of the room. The functionality of the fire extinguishers must not be restricted by weather influences, vibrations or other external effects. Fire extinguishers to be operated by hand must be easy to reach rapidly at all times. They must be suitable for their respective intended purpose in accordance with the following table.

2) Arbeitsschutzgesetz, Arbeitssicherheitsgesetz, Betriebsverfassungsgesetz, Sozialgesetzbuch VII, Störfall-Verordnung, Strahlenschutzverordnung, BGV A1, DGUV Vorschrift 2

Table 1: Suitability for the respective purpose (84)

	Fire Classes DIN EN 2			
	A	B	C	D
	Substances to be extinguished			
Types of fire extinguishers	Solid, glow-forming substances	Liquid substances or substances becoming liquid	Gaseous substances, also under pressure	Combustible metals (use only with powder spray)
Powder extinguisher with ABC extinguishing powder	+	+	+	–
Powder extinguisher with BC extinguishing powder	–	+	+	–
Powder extinguisher with metal fire powder	–	–	–	+
Carbon dioxide extinguisher	–	+	–	–
Water extinguisher (also with additives, e.g. wetting agent, antifreeze or corrosion inhibitor)	+	–	–	–
Water extinguishers with additives which, in combination with water, also extinguish fires of the fire class B	+	+	–	–
Foam extinguishers	+	+	–	–

+ = suitable – = not suitable

Note: Other suitable extinguishing agents can be found on the safety data sheet. Information about the respective extinguishing agent units can be taken from the details on the fire extinguisher.

If necessary, it is possible to also use either larger mobile extinguishing appliances of the respective fire class, e.g. mobile powder extinguishing appliances, mobile carbon dioxide extinguishers, foam extinguishers for the generation of heavy, medium and light foam and wall hydrants, or stationary fire extinguishing systems.

12.3 Procedure in the event of product leakage

Mechanical loads, chemical effects (e.g. in the event of damage to the inner coating or paint layer in the case of metal containers), ageing and moisture can lead to packaging failure and, consequently, product leakage (see also section 7.1 “Packaging and Containers”). A further cause for leakages is incorrect closure of packaging, in particular after removal of a part-quantity of the product. Rodents can also cause damage to packaging made of paper or cardboard.

Hazardous substances must be stored in such a way that any leakages can be detected and intercepted. Leakages must be rectified immediately in order to restrict the duration and extent of exposure. Regular inspection patrols are to be carried out in order to detect leaking substances. Employees must leave the danger zone immediately in the event of any danger.

Personal protective equipments are to be worn and stipulated protective measures are to be taken according to the properties of the respective substance and the volume of the leakage (observe safety data sheet).

Equipment to be kept available in the warehouse for clearing up leaked hazardous substances shall include:

- Empty drums or solvage drums for leaked products
- Suitable absorption material (absorbents or binding agents)
- Neutralization agents and detergents
- Brooms and shovels
- If necessary, industrial vacuum cleaners (see [figure 21](#)) and fluid pumps (attention must be paid to explosion protection where applicable).

Example for procedure upon product leakage:

- Leave danger area, shut down machinery and electrical equipment in the danger area.
- Alert employees, superiors and, if necessary, the fire brigade and seal off the danger area.
- Select appropriate measures.
- Prevent damage from spreading; prevent liquid products from flowing or spreading by turning the damage point upwards or creating liquid barriers.
- Seal damaged container or pump off contents and transfer to another container.

Figure 21: Cleaning away spilled storage product using explosion-protected vacuum cleaner



- Pick up spilled liquids with absorption material. Attention must be paid that oxidising substances are not picked up together with flammable materials. A hazard-free removal of these substances is generally possible by dissolving in plenty of water or collecting with suitable bonding material, such as diatomite ("Kieselgur"), sand or cement. Powders and granulates are to be collected dust-free, e.g. with an industrial vacuum cleaner.

- Clean any contaminated surroundings; fill cleaning material and contaminated packaging into sealable containers.
- Remove immediately any clothing contaminated by the product; store separately and clean or dispose of accordingly.
- Leaked product, used absorption material, cleaning material and contaminated package are to be disposed of correctly. Contaminated water must be disposed of in a correct manner.

Attention must be paid to good ventilation at all times when carrying out measures to clear away leakages. Leaked products may only be cleared away by appropriately instructed personnel wearing suitable personal protective equipment.

Annex 1: Storage of gas under pressure

Terminology and limits

Pressurised gas containers are refillable, non-stationary containers that can be filled with gas under pressure and after filling can be taken to another place for the removal of the pressurised gas. Pressurised gas containers include the accessoires that can influence their safety. Differentiation is made between the following types of pressurised gas containers:

- Bottles/cylinders
- Cylinder racks
- Pressurised gas barrels
- Cryogenic -receptacles
- Gas containers

Figure 22: Different pressurised gas containers



Holding available also applies if filled pressurised gas containers are kept in readiness as reserve containers connected to release devices at points intended for the emptying thereof, insofar as this is necessary for the continuation of operations. Examples of this include gas cylinders which are used for supplying a laboratory with process and operating gases. In this case, the same number (and type) of gas cylinders are “kept ready” at the infeed point as are necessary for connecting as replacement upon emptying the pressurised gas containers currently in operation.

Pressurised gas cylinders in operation as well as pressurised gas cylinders in readiness are often connected to the plant. The switch-over takes place automatically as soon as pressurised gas cylinders in operation are empty.

Conditions for storage

The design and structure of the packaging and containers must be such that none of the contents can escape or leak out unintentionally.

This condition is deemed to have been fulfilled, among other things, if the packaging/container fulfils the requirements for transporting hazardous goods. The packaging instructions P200 (ADR/RID) [\(35\)](#) [\(36\)](#) are to be

observed completely. Gas cylinders that have been tested and are in perfect technical condition are deemed to be permanently and technically leak-proof.

The measures and regulations described below are to be observed for the following gases:

- Inert gases (H280) – e.g. nitrogen, compressed; argon, compressed
- Flammable gases (H220, H221) – e.g. hydrogen, methane, propane
- Oxidising gases (H270) – e.g. oxygen
- Cryogenic liquefied gases (H281) – e.g. cryogenic liquefied nitrogen, cryogenic liquefied oxygen

Pressurised gas containers must be secured against falling over or down.

This is generally achieved in the case of industrial gases with the so-called gas pallet in which the individual gas cylinders can be secured against falling over by means of lashing straps or bars.

Figure 23: Gas pallets



The valves are to be protected by the safety devices provided by the gas suppliers, e.g. with a protective cap or a protective hood or collar. These protective devices must not be removed under any circumstances during storage.

Figure 24: Valve protection



Extra protection against falling over or down is not necessary, for example, if sufficient protection is achieved through the design of the pressurised gas containers, placement in large groups or the type of storage.

For the purpose of avoiding a hazardous accumulation or spread of gases no pits, channels or drains to channels, or cellar entrances or other open connections to cellar rooms, may be present within the possible hazard area of the warehouse. This applies for gases that are heavier than air, e.g. argon and liquefied gases (such as propane, carbon dioxide or deep-frozen liquefied nitrogen).

Furthermore, no cleaning holes or other holes in flues may be present at this location.

Storage of toxic gases

The following additional regulations have to be observed for the storage of toxic gases (marked with H330 or H331, alternatively R23 or R26) such as chlorine, ammoniac or sulphur dioxide:

- The pressurised gas cylinders shall be under seal or kept in such a manner that only knowledgeable and reliable persons have access to them.
- Gases marked with H330 or R26 must only be stored in rooms that have a gas detection system that triggers an acoustic and optical alarm when permissible workplace limit values are exceeded.
- Necessary safety measures (e.g. carrying of respiratory protective devices) must be defined in the operating instructions.
- Respiratory protective devices must be kept outside of the hazard areas in a manner such that the employees can access it quickly.

Storage in rooms

A maximum of 50 filled pressurised gas containers may be stored in rooms below ground level if one of the following conditions has been fulfilled:

- Assurance of a ventilation system with an air-change rate of two per hour. This must either be constantly active or switched on automatically by a gas detection system when a defined limit value is exceeded. An alarm must be triggered in the event of a failure in the ventilation system. Steps to be taken under such circumstances are to be included in a risk assessment and alarm plan.
- Natural ventilation of the storage room. In this case, the ventilation openings must have a total cross sectional area of at least ten percent of the floor area of the storage room and achieve proper ventilation. The floor of the storage room may not be more than 1.5 metres below the ground level as otherwise adequate horizontal ventilation is not possible and it is no longer possible to guarantee that there will be no accumulation of heavy gases on the floor of the storage room.
- Storage of pressurised gas containers in safety cabinets that meet the requirements of EN 14470-2. (86)

Empty, uncleaned, non-stationary pressurised gas containers may be present in twice this number.

Rooms in which more than five pressurised gas containers are stored must be sufficiently ventilated and vented. Natural ventilation shall be deemed to be sufficient if there are ventilation openings leading directly to the outdoors with a total cross-sectional area of at least 1/100th of the floor area of the storage room. The arrangement of the ventilation openings must take account of the density of the gases.

The size of the ventilation opening required can be based on the floor area provided for the storage of non-stationary pressurised gas containers, provided that the ventilation opening is located directly at the storage area.

Storage rooms used to store more than 25 filled pressurised gas cylinders or two filled pressurised gas barrels containing flammable gases or more than five filled pressurised gas cylinders or even just one pressurised gas barrel containing acutely toxic gases of category 1 or 2/highly toxic gases must not be below or above rooms that are used for permanent occupation by persons. Connections to adjoining rooms shall only be permitted if those rooms have their own emergency routes.

Storage rooms for non-stationary pressurised gas containers containing flammable gases (marked with H220 or H221 or R12) or acutely toxic gases of category 1 or 2 that are marked with H330 or R26 and that are adjacent to a public right of way must be designed with a wall with no doors and with no openable windows or other openings up to a height of 2 m on the side that is directly adjacent to the public right of way. This shall not apply to doors that are self-closing and that are at least fire-retardant (fire resistance rating: at least 90 minutes).

A quick exit from storage rooms must be possible.

Fire protection

If storing bottles/cylinders, cylinder racks, pressurised barrels or cryogenic -receptacles in storage rooms

- the storage rooms must be separated from adjoining rooms by fire-retardant components (fire resistance rating: at least 30 minutes),

- components must be fire-resistant (fire resistance rating: at least 90 minutes) if there is a risk of fire or explosion in adjoining rooms not used for the storage of gases,
- the outer walls of warehouses must be at least fire-retardant (fire resistance rating: at least 30 minutes); where the distance to adjoining installations and facilities that could represent a hazard is at least 5 m the outer wall may consist of non-combustible materials,
- the roof covering must be sufficiently resistant to spreading fire and radiated heat,
- floor coverings in storage rooms for non-stationary pressurised gas containers must be at least flame-resistant.

Pressurised gas containers may only be stored in working areas in suitable safety cabinets with a fire resistance rating of at least 30 minutes. In particular safety cabinets that meet the requirements of EN 14470-2 shall be deemed to be suitable. (86)

Here, acutely toxic gases of categories 1 to 3 or highly toxic or toxic gases (marked with H330 or H331 or R23 or R26) may only be stored in safety cabinets with ventilation systems achieving an air-change rate of 120 times per hour.

Oxidising gases (marked with H270 or R8) or flammable gases (marked with H220 or H221 or R12) may only be stored in safety cabinets with ventilation systems achieving an air-exchange rate of 10 times per hour.

In general, however, Section 8 paragraph 6 of the Hazardous Substances Ordinance (Gefahrstoffverordnung) "Restriction of hazardous substances (e.g. gases) present at a workplace to the amount necessary for the continuation work" shall also apply. (15)

Outdoor storage areas must observe a distance of at least 5 m from the pressurised gas containers to adjoining installations and facilities that can present a fire hazard. The safety distance may be replaced by a protection wall of at least 2 m in height and sufficient width and made of non-combustible building materials.

When more than five pressurised gas containers containing oxidising gases such as oxygen (marked with H270 or R8) or flammable gases such as propane and hydrogen (marked with H220 or H221 or R12) are stored, the floor must be made of non-combustible materials.

When calculating extinguishing water volumes, it is necessary to take into account that pressurised gas containers can burst under extreme heat conditions because of the expansion of the gas in the container. For this reason, calculations in this respect also have to take into account the volume of water that will be necessary to cool the pressurised gas containers in the event of fires in surrounding areas.

Special protective measures that have to be taken if pressurised gas containers are being connected to systems within the warehouse

In the case of acutely toxic gases (marked with H330 or R26) or flammable gases (marked with H220, H221 or R12), safety areas must be set up around pressurised gas containers, the size of which shall depend on the density of the gas(es). Particular account must be taken of these areas in the risk assessment; e.g. explosion-protection measures might be necessary.

The safety area is a three-dimensional space around pressurised gas containers containing combustible or acutely toxic gases in which the occurrence of gas or gas-air mixtures cannot be ruled out due to leaks in connections and valves or the connection or removal of pipe connections during the course of operation or as a result of mishandling.

Explosion protection measures (see TRGS 720 ff.) (21) (22) (23) must be taken for flammable gases in these safety areas; in the case of acutely toxic gases, these safety areas must not extend into emergency/escape routes.

In addition to valve protection, the valves must be fitted with a lock nut for acutely toxic gases of category 1 or 2 and pyrophoric gases, e.g. silane or arsine.

Note: This requirement is automatically fulfilled in the case of pressurised gas containers for pyrophoric gases/gas mixtures that have been equipped according to ADR/RID (P 200 “q”) (35) (36). It is important, however, that the lock nut is tightened again after removal.

Information: The distances pursuant to paragraph 1 are necessary because leaks cannot be excluded. Leaks can occur in fittings and valves or operationally during connection or disconnection of pipeline connections or as a result of human errors in handling. In pure warehouse operation (see section “Scope of Application” in TRGS 510 (19)), work of this kind does not occur .

The dimension of the safety areas for non-stationary pressurised gas containers shall be 2 m in each direction in the event of storage in storage rooms. For gases that are heavier than air, the safety area can be reduced to 1 m in the upward direction. Outdoors, the dimensions for safety areas can be halved. In the event of storage rooms with a floor area $\leq 20 \text{ m}^2$, the entire room must be designated as a safety area.

In the case of the aforementioned points, attention must be paid that pressurised gas cylinders, cylinder racks and pressurised barrels that have been checked for leaks following filling in the filling plant and which are stored in an original state (inspected and technically perfect gas cylinders) are deemed to be permanently technically leak-proof. For this reason, the implementation of the aforementioned measures is not necessary under such circumstances.

Annex 2: Storage of aerosol dispensers and pressurised gas cartridges

The following rules shall apply to the storage of aerosols in aerosol dispensers, (marked with H222 or H223) and of gases in pressurised gas cartridges (marked with H220 or H221) in a net mass of more than 20 kg. These rules shall apply equally to aerosol dispensers and pressurised gas cartridges that are not marked as dangerous and that have a mass of 200 kg or more, unless these are stored in closed wire-mesh boxes that prevent release in the event of rupturing.

An **aerosol dispenser** as defined by directive 75/324/EEC is understood to be a metal, glass or plastic container that cannot be refilled, that contains a gas that is condensed, liquefied or dissolved under pressure with or without a liquid, pasty or powdery substance (5). It is fitted with a retrieval device which allows an ejection of the contents as a suspension of solid or liquid particles in a gas, as a foam, a paste or a powder or in the liquid or in the gaseous state.

The most popular form is the so-called "spray can". This enables substances to be applied selectively at the point of usage. Aerosol dispensers can be stored with extraction valve (i. e. ready for use - e.g. with spray head). In addition, it is also possible that the aerosol dispensers are only fitted with a locking mechanism (e.g. spring-loaded valve in the can lid), with the appropriate extraction device being fitted by the end user.

Pressurised gas cartridges as defined by TRGS 510 are non-refillable containers without their own extraction valve (19). Every cartridge consists of a container and a locking device for the filling opening. Cartridges are emptied through a special retrieval device after piercing.

These types of gas cartridges are often used for supplying propane, butane or propane-butane mixtures for blowtorches, camping cookers or gas lamps. When the pressurised gas cartridges are inserted into the device, the cartridge is pierced and in this way the gas contained in the cartridge is fed to the consumer.

Properties of flammable propellants

Propane, butane and dimethyl ether (DME) are colourless, low-odour and flammable and can form a potentially explosive atmosphere when in contact with air. In contrast to propane-butane, DME have the property of dissolving in water, whereby a gas emission is possible. The volume ratio for a standard propane-butane mixture to the same mixture in gas form is about 1:220. Even slight leakages can therefore lead to large-scale explosive areas.

Safety aspects for building and storage systems

Filled aerosol dispensers and pressurised gas cartridges must not be heated by more than 50 °C by sunlight or other heat sources.

Where aerosol dispensers or pressurised gas cartridges are stored in storage rooms for non-stationary containers, the stored quantity of combustible liquids and the net volume of the content indicated on the aerosol dispensers or pressurised gas cartridges must, together, not exceed the maximum permissible storage quantity of 100 tonnes per storage room.

Storage rooms must

- not be in residential buildings,
- be separated from other rooms by fire-resistant components (fire resistance rating: at least 90 minutes),

- have floors made of non-combustible materials and
- have sufficient ventilation and satisfy the explosion protection requirements set out in [Annex 5 of TRGS 510](#).

Warehouses with a total ground area of more than 500 m² must be located in a building or building section that is used solely for storage purposes. A fire protection concept agreed with the competent authority must be in place in the case of storage rooms with a total area of > 500 m². Additional fire walls are prescribed in the case of storage rooms > 1600 m². Further requirements regarding extinguishing water retention, electrical installations, ventilation systems, gas and fire detection systems, fire-fighting and organization, are described in [TRGS 510](#). (19)

Requirements on the storage of aerosol dispensers

The storage of aerosol dispensers with flammable gases and a content of up to 1000 ml requires approval as of a storage volume totalling 30 tonnes.

Fundamentally, the 4th and 12th Federal Immission Control Act (4. und 12. Bundes-Immissionsschutzverordnung) are to be observed for the storage of flammable aerosols [\(26\)](#) [\(27\)](#). Quantity observations made in the ordinances, acts and directives, relate only to the liquid gas content in accordance with the legal situation valid up to now.

Note: The replacement of the directive 96/82/EC with the directive 2012/18/EU on the control of major-accident hazards involving dangerous substances will result in changes in the storage of aerosol dispensers: [\(2b\)](#) [\(2a\)](#)

- Flammable aerosols are listed separately under Annex I Part 1 “Categories of dangerous substances” – and no longer under Storage of Liquid Gas; in this case the qualifying quantities refer to the net weight of the total content of the stored aerosol dispensers (without considering the weight of the cans and the transport packaging)
- New qualifying quantities apply for flammable aerosols with regard to basic requirements (150 tonnes net content) and extended requirements (500 tonnes net content)
- Special qualifying quantities apply for flammable aerosols containing neither flammable gases of hazard classes 1 or 2 nor flammable liquids of hazard class 1: for basic requirements (5,000 tonnes net content) and extended requirements (50,000 tonnes net content)

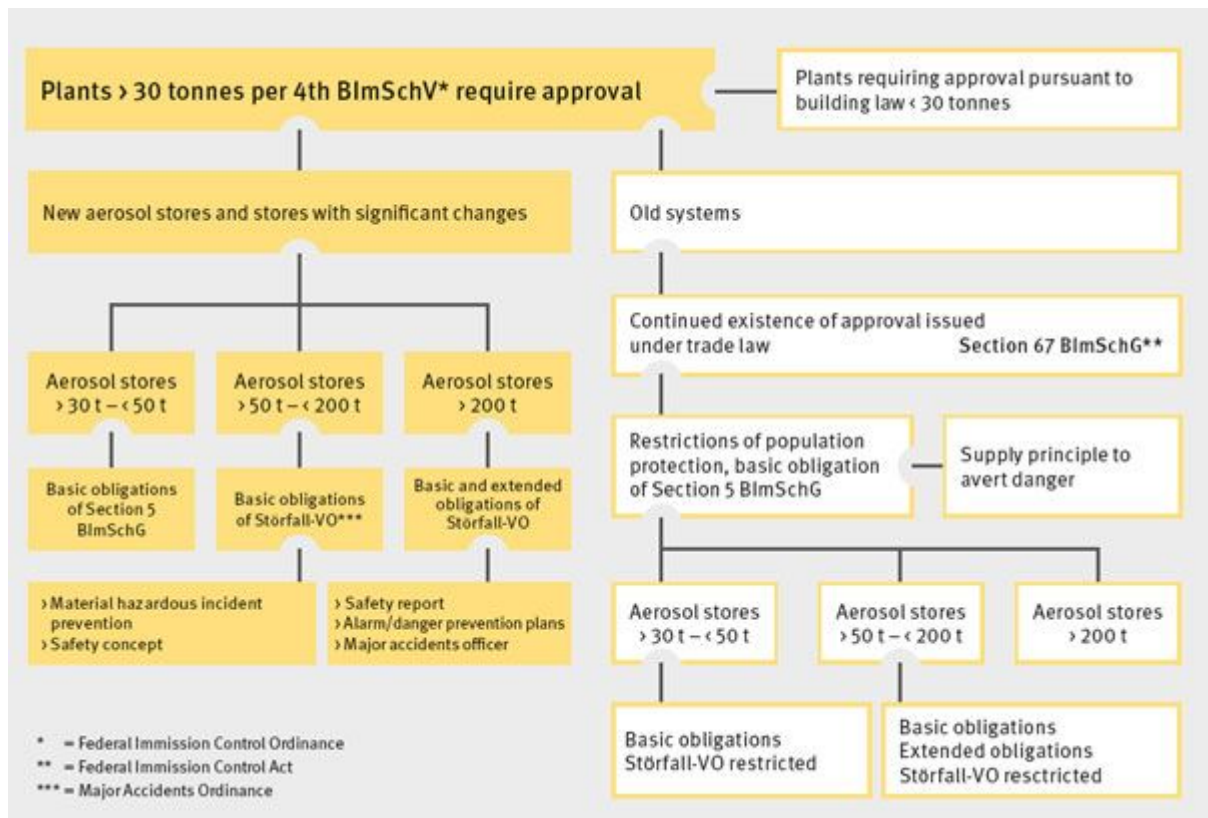
The directive must be implemented in German law by 31.05.2015.

Obligations and requirements of the [Bundes-Immissionsschutzgesetz](#) (Federal Immission Control Act)




The storage of less than 30 tonnes of aerosol finished products with a flammable liquid gas content is subject to commercial law. The aerosol store requires authorization according to the 4th Federal Immission Control Ordinance (4. BImSchV) if the qualifying quantity of 30 tonnes liquid gas is exceeded. The basic requirements apply for storage quantities from 50 to 200 tonnes; the extended requirements (12th Federal Immission Control Ordinance) come into force for amounts of more than 200 tonnes. If the store falls under the extended requirements, a safety report has to be drawn up in compliance with the Major Accidents Ordinance (12th Federal Immission Control Ordinance (Störfall-Verordnung)). Inspection and consultation with the respective authorities is recommended. Furthermore, an environmental impact assessment is required in this respect. [\(26\)](#) [\(27\)](#)




Figure 25 provides a general outline of the legal requirements of the Federal Immission Control Act ([BImSchG](#)). [\(25\)](#) [\(26\)](#) [\(27\)](#)




Figure 25: Summary of obligations and requirements of the Federal Immission Control Act (BImSchG) on aerosol warehouses (91)










Annex 3: Labelling of hazardous substances


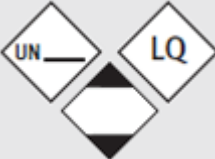
Labelling	Description
	<p>Explosive substances Substances that can be caused to explode through heat, impact or initial ignition, are termed explosive substances. These include substances which according to</p> <ol style="list-style-type: none"> 1. CLP-Regulation (CLP) (1a) are classified in the hazard class “explosive substances” and classified as unstable, explosive or in the sub-classifications 1.1 to 1.5 are marked with the H-sentences H200, H201, H202, H203, H204 or H205, 2. Hazardous Goods Law are classified in class 1, sub-classifications 1.1 to 1.6. <p>e.g. nitro-glycerine, dibenzoylperoxide, gunpowder</p>
	<p>Gases Gases are substances that</p> <ol style="list-style-type: none"> a. at 50 °C have a vapour pressure of more than 300 kPa (3 bar) or b. at 20 °C and a standard pressure of 101.3 kPa are completely gaseous. <p>This includes substances that</p> <ol style="list-style-type: none"> 1. are marked according to CLP (1a) <ol style="list-style-type: none"> a. with H280 or H281 as compressed, liquefied, dissolved (under pressure), b. with H220 or H221 as flammable gases, c. with H270 as oxidising gases, 2. are assigned to class 2 per Hazardous Goods Law (30). 3. These gases also include hydrogen fluoride (UN 1051) and hydrogen cyanide (UN 1052). <p>e.g. acetylene, ammoniac, chlorine, oxygen</p>
	<p>Aerosols Aerosol dispensers which are classified as follows:</p> <ol style="list-style-type: none"> 1. marked according to CLP with the H-sentences H222 or H223; 2. which are assigned to the UN number 1950 according to Hazardous Goods Law.

Labelling	Description
	<p>Flammable liquids With these substances, dangerous gas/air mixtures can form and cause fires and explosions. The risk increases as the flashpoint/boiling point decreases.</p> <p>This includes substances which according to</p> <ol style="list-style-type: none"> 1. the Hazardous Substances Ordinance (Gefahrstoffverordnung) (15) are marked with the R-sentences R10, R11 o R12, 2. CLP (1a) are marked with the H-sentences H224, H225 or H226, 3. the Hazardous Goods Law are assigned to class 3. <p>e.g. diethyl ether, petrol, acetylene, butyl acetate</p>
	<p>Other explosive substances These consist of substances which may explode under the effect of flame or which are sensitive to shock or friction.</p> <p>In Germany, these substances are classified on the basis of the Second Ordinance to the Explosives Act (2. SprengV) (28) by the BAM (Bundesanstalt für Materialforschung und -prüfung/Federal Institute for Materials Research and Testing).</p> <p>This includes</p> <ol style="list-style-type: none"> 1. substances of the storage groups I to III according to the Second Ordinance to the Explosives Act (2. SprengV), 2. self-reactive substances type A and type B (marked with H240 and H241 respectively), 3. substances which are marked with R2 or R3 pursuant to the Hazardous Substances Ordinance (GefStoffV). <p>e.g. 2,4-dinitrophenylhydrazine (with 0.5 ml H₂O/g), hydroxylammonium chloride</p>
	<p>Flammable solids These are readily combustible substances or items that according to</p> <ol style="list-style-type: none"> 1. CLP are marked with the H-sentence H228, 2. the Hazardous Substances Ordinance (GefStoffV) are marked with R11, 3. the Hazardous Goods Law are assigned to flammable substances of class 4.1. <p>e.g. sulphur, phosphorus pentasulphide</p>

Labelling	Description
	<p>Pyrophoric or self-heating substances Liquids and solids that react so violently with atmospheric oxygen that they are self-heating and in some cases even ignite, which could cause a fire in a warehouse.</p> <p>This includes substances that according to</p> <ol style="list-style-type: none"> 1. CLP (1a) are marked with the H-sentence H250, H251 or H252, 2. the Hazardous Substances Ordinance (<u>GefStoffV</u>) (15) are marked with R17, 3. the Hazardous Goods Law (30) are assigned to spontaneously combustible substances of class 4.2. <p>e.g. white phosphorous or aluminium alkyls</p>
	<p>Substances which emit flammable gases in contact with water. Some substances react vigorously in contact with water or humidity, and emit flammable gases which can then ignite spontaneously.</p> <p>This includes substances that according to</p> <ol style="list-style-type: none"> 1. CLP are marked with the H-sentence H260 or H261, 2. the Hazardous Substances Ordinance (<u>GefStoffV</u>) are marked with R15, 3. the Hazardous Goods Law are assigned to class 4.3. <p>e.g. trichlorsilane, sodium, calcium carbide</p>
	<p>Oxidising substances In the event of a fire, these substances increase the severity of the reaction and therefore cause a very rapid spread of a fire. They can react very violently with other stored hazardous substances as well as with packaging materials and cause spontaneous fires.</p> <p>This includes substances that according to</p> <ol style="list-style-type: none"> 1. CLP are marked with the H-sentences H271 or H272, 2. the Hazardous Goods Law are assigned to class 5.1. <p>e.g. potassium nitrate, sodium nitrite, sodium peroxide, hydrogen peroxide, perchloric acid</p>

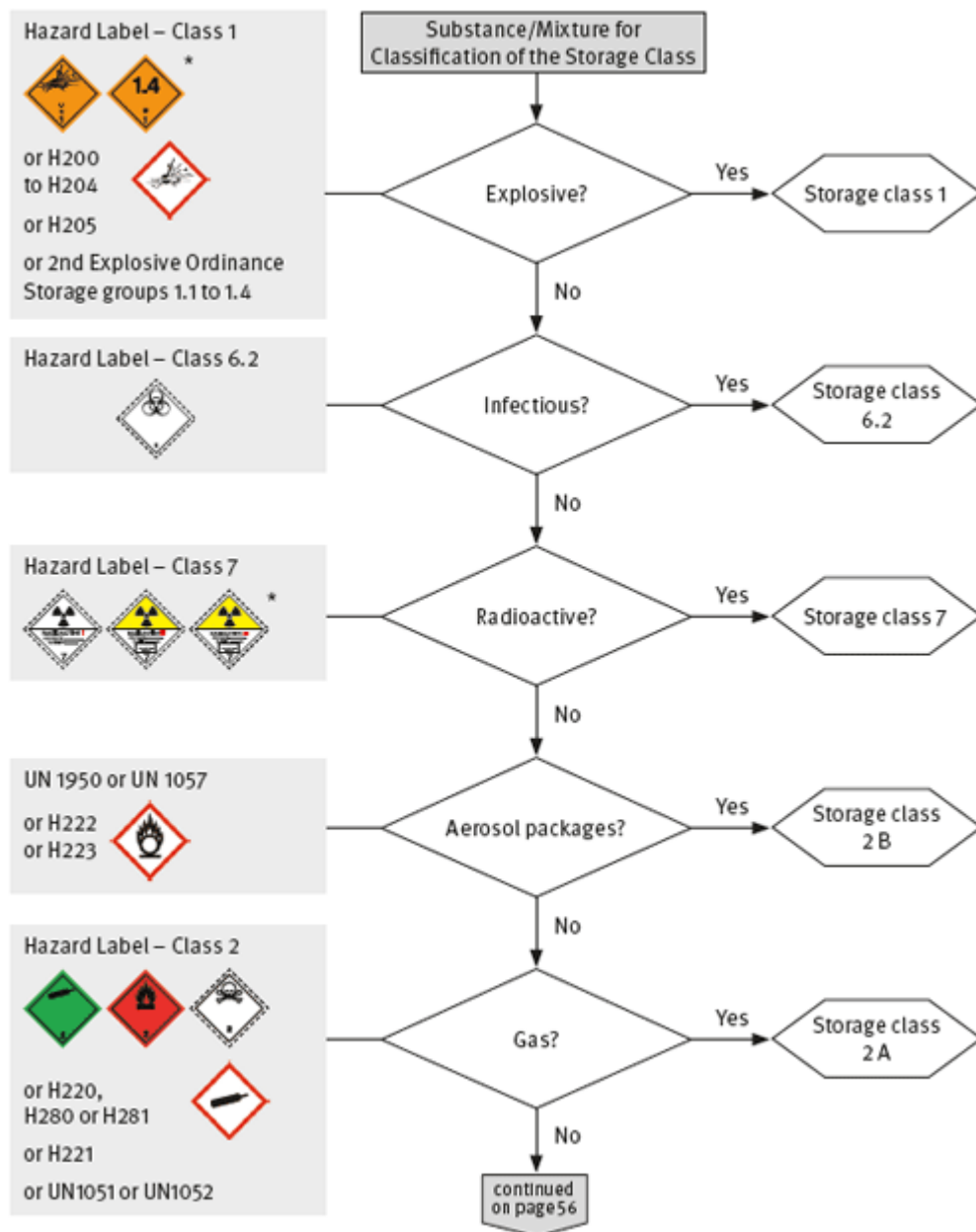
Labelling	Description
	<p>Organic peroxides Organic peroxides are organic substances which contain the bivalent -O-O- structure and may be considered as derivatives of hydrogen peroxide where one hydrogen or both of the hydrogen atoms have been replaced by organic radicals.</p> <p>These include</p> <ol style="list-style-type: none"> 1. Organic peroxides type C, D, E or F which are marked with the H-sentence H242, (42) (35) 2. Organic peroxides which are classified in class 5.2 according to Hazardous Goods Law. <p>e.g. benzoyl peroxide, 4.4-dichlorobenzoyl peroxide, peroxy acetic acid</p>
	<p>Toxic and very toxic substances These are substances which even in a relatively small quantity are able by a single action or by action of short duration to cause damage to human health or death as a result of inhalation, cutaneous absorption or ingestion.</p> <p>This includes substances that are</p> <ol style="list-style-type: none"> 1. marked according to CLP (1a) with H300, H310 or H330, 2. marked with R26, R27 or R28 according to the Hazardous Substances Ordinance (GefStoffV) (15), 3. assigned to class 6.1 according to the Hazardous Goods Law. (30) <p>e.g. arsenic(III) oxide, sodium cyanide, mercury(II) chloride</p>
	<p>Substances with chronic effects are marked according to CLP with the H-sentences</p> <ol style="list-style-type: none"> a. H301 or H311 or H331 (acute toxicity), b. H340 (germ-cell mutagenicity), c. H350 (carcinogenicity), d. H360 (reproductive toxicity), e. H370 (specific target organ toxicity (STOT)), f. H372 (specific target organ toxicity (STOT)).
	<p>Infectious substances These are assigned to class 6.2 according to the Hazardous Goods Law.</p> <p>These are not covered by this code of practice.</p>

Labelling	Description
	<p>Radioactive substances</p> <ol style="list-style-type: none"> where handling requires notification and authorization pursuant to Section 4 Radiological Protection Ordinance (Strahlenschutzverordnung), (29) which are classified in class 7 according to the Hazardous Goods Law, are not covered by this code of practice.
	<p>Corrosive substances</p> <p>Substances with corrosive properties can damage the skin, mucous membranes or tissue. They can also cause damage, for example, to wood, metal or plastics. These also include substances that first form corrosive liquid substances with water or corrosive vapours or mist with natural humidity.</p> <p>This includes substances that according to</p> <ol style="list-style-type: none"> CLP are marked with the H-sentence H314, (1a) the Hazardous Substances Ordinance (GefStoffV) (15) are marked with the R-sentences R34 or R35 or the Hazardous Goods Law are classified in class 8. (30) <p>e.g. hydrochloric acid, sulphuric acid, potassium hydroxide, sodium hydroxide, phosphorous trichloride</p>
	<p>Substances hazardous to the environment</p> <p>Substances hazardous to the environment include, among others, liquid or solid water-contaminating substances, as well as solutions and mixtures with such substances (such as preparations and waste).</p> <p>This includes substances that according to</p> <ol style="list-style-type: none"> CLP are marked with the H-sentences H400, H410 or H411, the Hazardous Substances Ordinance are marked with the R-sentences R50, R51, R52 or R53 or the Hazardous Goods Law are marked "dangerous to the environment".

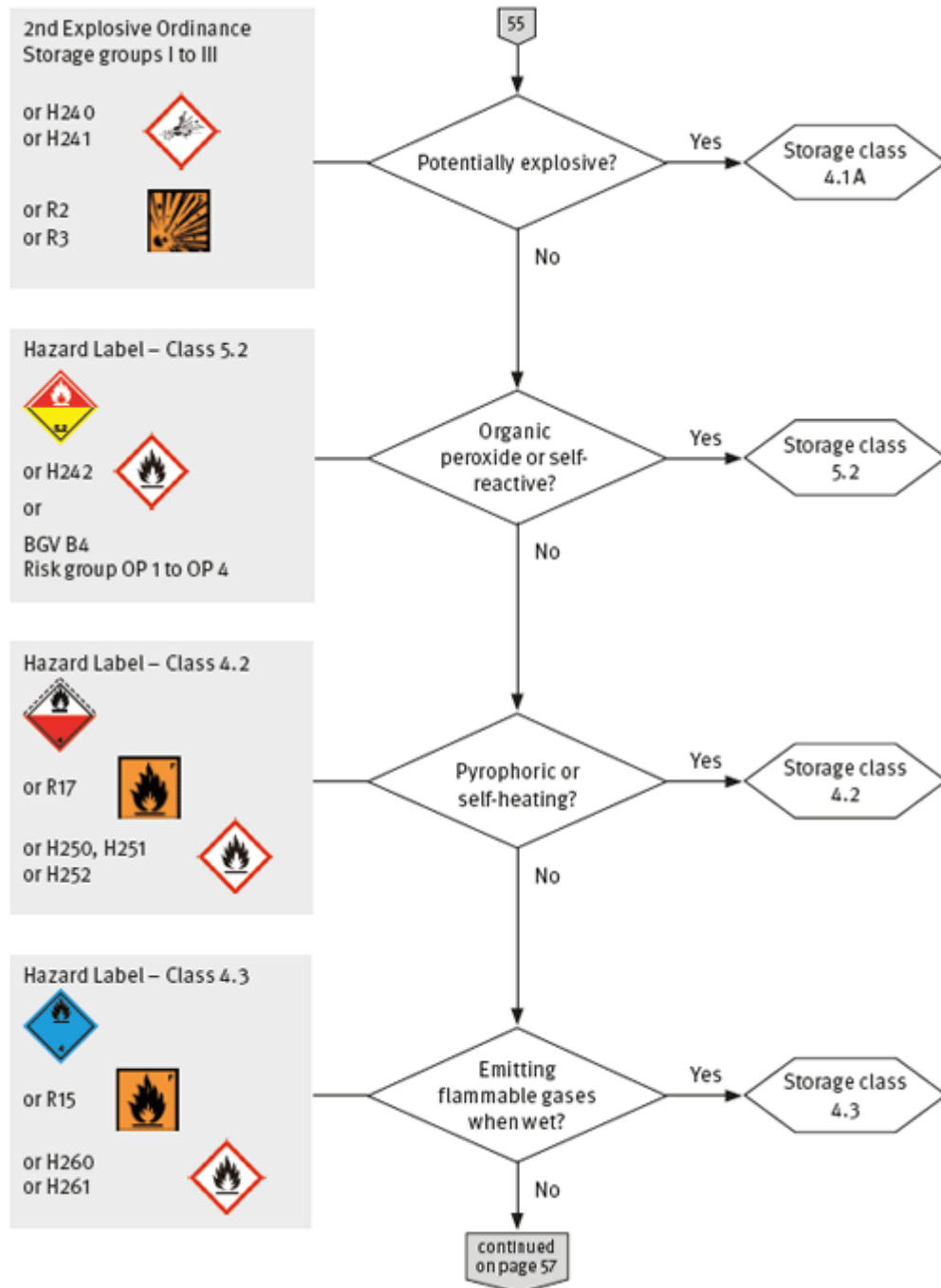
Labelling	Description
	<p>Irritants and harmful substances These include among others</p> <ul style="list-style-type: none"> substances which if inhaled, coming into contact with the skin or swallowed can cause harmful effects to health (R-sentences R20, R21, R22) and corresponding CLP (1a) substances with acute toxicity category 4 (H-sentences H302, H312, H332) as well as substances that can irritate the eyes, respiratory organs or skin or cause a sensitization through skin contact (R-sentences R36, R37, R38, R43) and corresponding to CLP must be marked with the H-sentences H315, H319, H335 or H317 and since the introduction of the CLP also substances that cause drowsiness and dizziness (H336) [Note: These previously bore the R-sentence R67, but no symbol]. <p>Irritant and harmful substances are not subject to Hazardous Goods Law labelling obligations.</p>
	<p>Limited quantities (LQ) According to hazardous goods regulations, specific exemptions may be applied in the case of certain packed hazardous goods. The labelling, however, only states that a hazardous substance is involved; there is no indication of the dangers it may cause. (35) (57)</p>

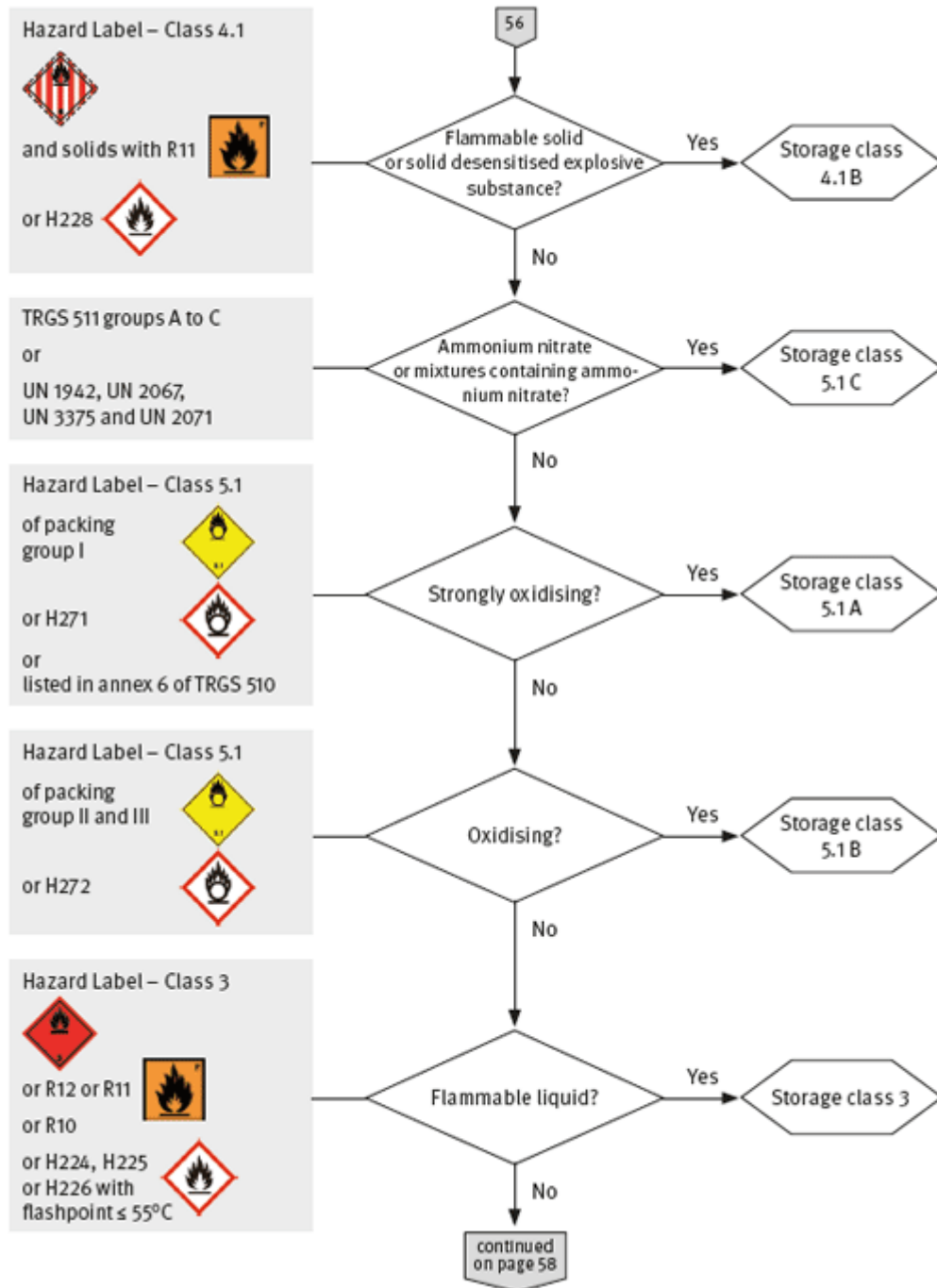
Annex 4: Flowchart for assigning storage classes (assignment guidelines) (19)

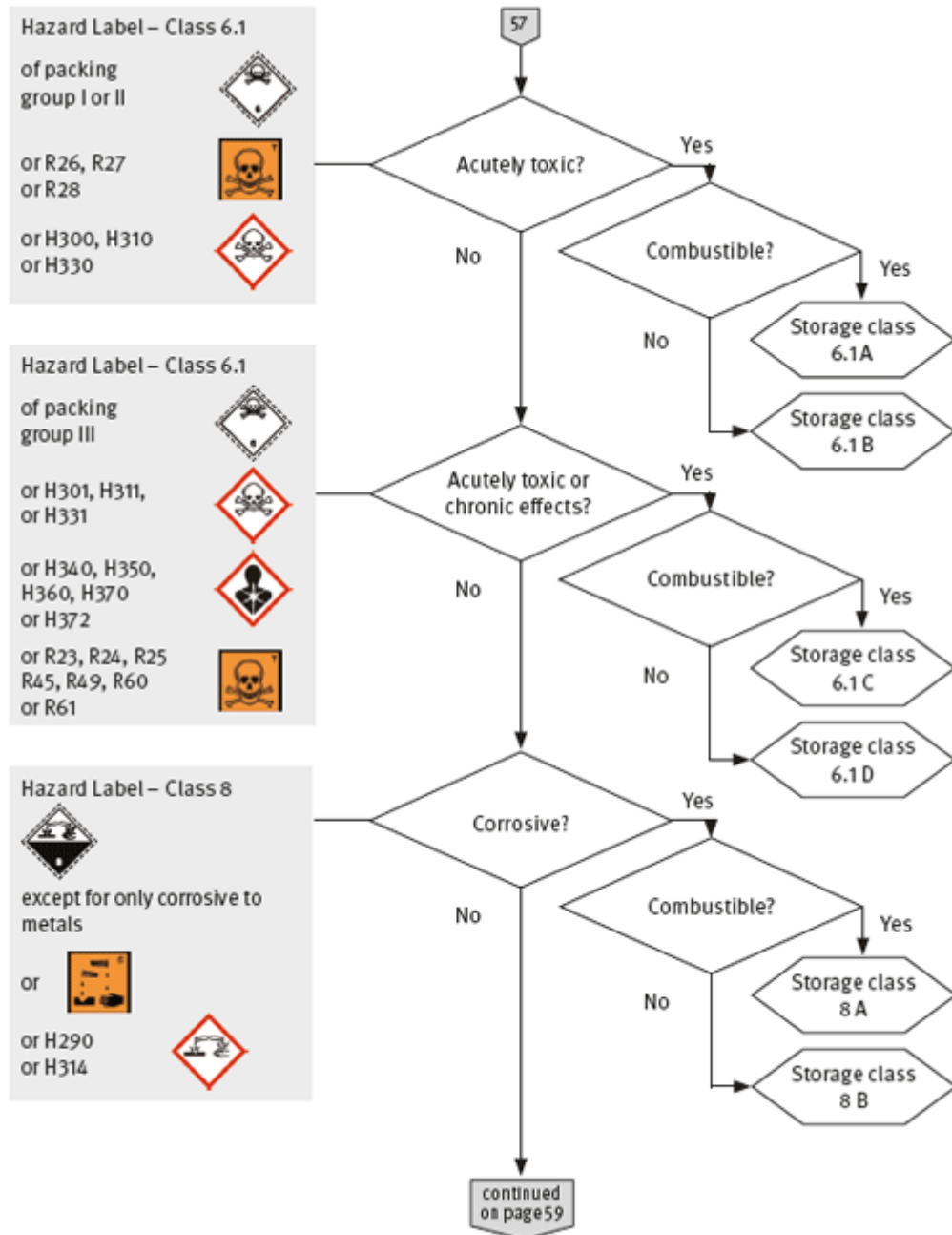
Procedure for assigning storage classes:

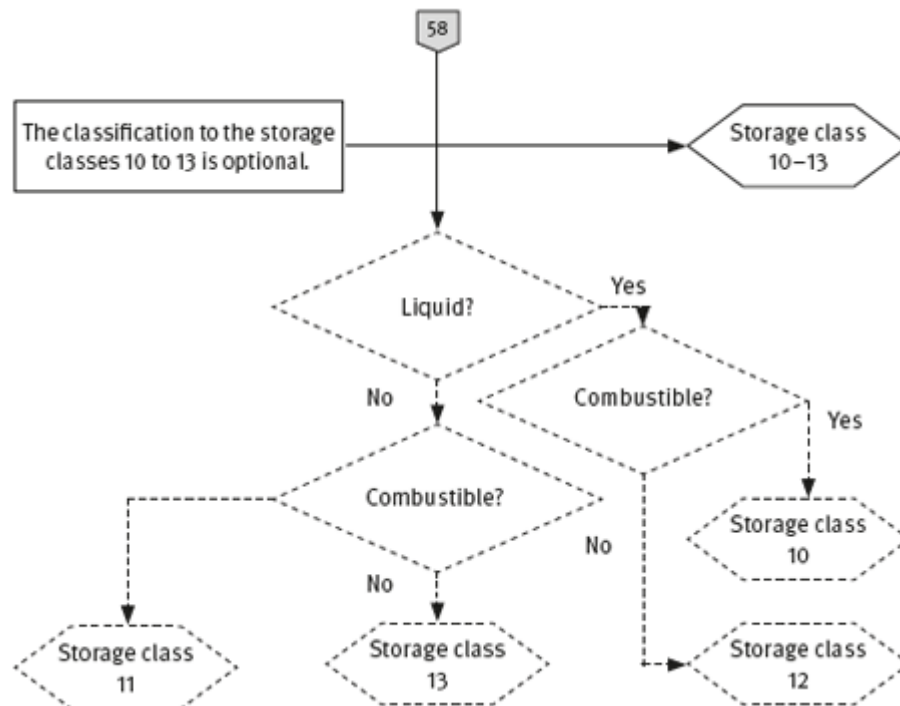


* Example, classes 1 and 7 also have other danger labels









Annex 5: Points that should be observed during a warehouse inspection tour

The following list is an open compilation of checkpoints that the warehouse operator or correspondingly designated employee should check when carrying out an inspection tour of the warehouse.

Although some points can already be checked during the careful execution of daily work ("going through the plant with eyes open"), it is recommended to draw up an individual checklist on the basis of the points below. This can be used for inspection tours at regular intervals, and to record the results. Those can also take place for key issues.

Inspections as part of daily work or during an inspection tour generally take place on a random sampling basis; some checks can only be made visually during an inspection tour.

General points

Order and cleanliness

- ☐ Does the warehouse create an overall clean and tidy impression?
- ☐ Are items/tools/appliances lying around?
- ☐ Are the workplaces tidy?
- ☐ Are storage items stored in correct places?
- ☐ Are passageways, warehouse aisles and access routes free of obstructions?
- ☐ Is there risk of stumbling points and are those places marked?
- ☐ Is there any waste lying around? Is waste collected in an orderly fashion at prescribed points?
- ☐ Are cleaning rags lying around (outgassing hazardous substances)?
- ☐ Is the floor unclean? In particular, oil and grease must be cleaned up immediately.
- ☐ Are operating instructions provided, easily accessible and up-to-date?

General work hygiene

- ☐ Are the sanitary, changing and social rooms in a clean and orderly condition?
- ☐ Do employees wear suitable work clothes and are those in an appropriate condition?
- ☐ Is the ban on smoking observed?
- ☐ Do employees eat/drink etc. in the warehouse?

First-aid

- ☐ Have an adequate number of employees been trained as first-aiders?
- ☐ Are the means for first-aid available in adequate numbers?
- ☐ Are the means for first-aid easily accessible?

Access to the warehouse, warehouse sections and traffic routes

Signposting

- ☐ Are signs in place and legible?
- ☐ Are the warehouse sections clearly identifiable?

Access restrictions

- ☐ Are the respective areas (e.g. for the storage of toxic and very toxic substances) locked?
- ☐ Do unauthorized persons have access to this area?

Traffic routes, loading ramps and storage spaces

- ☐ Are traffic routes and storage spaces signposted?
- ☐ Are the traffic routes freely accessible or are they obstructed?
- ☐ Is there any damage?
- ☐ Are the railings in order?

Warehouse installations, equipments and tools

Condition of the shelving

- ☐ Are shelves damaged?
- ☐ Are collision guards in place and undamaged?

Equipments/Tools

- ☐ Are equipments/tools functioning, in good condition and have they been inspected?
- ☐ Ladders?
- ☐ Industrial trucks?
- ☐ Hoists/Loading equipment?
- ☐ Packing machines?

Ventilation systems/Extractors/Heating/Air-conditioning

- ☐ Are the ventilation systems operating?
- ☐ Is the heating/air-conditioning operating correctly?

Maintenance plans

- ☐ Do maintenance plans exist? Are they up-to-date and are they followed?

Stored goods

Storage plan

- ☐ Are only approved substances placed in storage?
- ☐ Are the substances in the correct warehouse sector?
- ☐ Is the joint storage prohibition observed?
- ☐ Are the permitted quantities observed?
- ☐ Are there critical substances that have to be placed under special control?

Condition of containers

- ☐ Are the containers correctly labelled?
- ☐ Are the containers in an appropriately proper condition (original container, damage, cleanliness)?
- ☐ Are there any leakages?
- ☐ Are the packing materials such as pallets or wire-mesh box pallets undamaged?
- ☐ Are the pallets correctly secured?

Storage

- ☐ Are the permitted storage heights, stacking heights, storage weights, floor loads etc. observed?
- ☐ Are the stored goods secured against falling over, falling down, tipping over etc.

Safety equipments/installations

Escape and emergency routes, emergency exits

- ☐ Do escape and rescue plans/alarm plans exist? Are they legible, accessible and up-to-date?
- ☐ Are the escape and emergency routes, as well as emergency exits, freely accessible, not blocked, obstructed by parking and not locked?

Fire protection doors

- ☐ Are the fire protection doors closed or do they close automatically?
- ☐ Do chemical cabinet doors close automatically?

Fire extinguishers, emergency showers, eye-baths/showers

- ☐ Are the location points marked?
- ☐ Is the equipment in place and freely accessible?
- ☐ Have they surpassed their inspection dates/use-by dates?

Simple function tests

- ☐ Emergency showers, eye-baths/showers (depending on design)?
- ☐ Fire protection doors; safety cabinet doors?

Collecting and/or shut-off systems

- ☐ Are the collecting and shut-off systems functioning?
- ☐ Do the collecting systems leak (visual inspection)? Are they empty (no outgasing residual material) and clean (e.g. leaves in the autumn)?
- ☐ Are drain covers in place and undamaged?
- ☐ Are adsorbing materials and suitable disposal containers in place?

Personal protective equipments

- ☐ Are the personal protective equipments clean and in appropriate condition?
- ☐ Are they checked regularly?
- ☐ Are they stored at the correct point outside of a potentially contaminated area?
- ☐ Are they accessible?
- ☐ Have they surpassed their use-by dates (e.g. for respiratory protection filters)?

Emergency drills

- ☐ Are emergency drills carried out?
- ☐ Can the alarms be heard?

Miscellaneous

Check employee training and level of knowledge

- ☐ Are employees included in the inspection tour? Are processes questioned?
- ☐ Do the employees adhere to regulations/operating instructions?
- ☐ Do the employees demonstrate safety-awareness in their behaviour?

Damage to equipment/installations and anomalies of any kind

- ☐ Have you noticed anything unusual during the inspection tour?
- ☐ Ask employees (Have they noticed anything?)

Disposal

☐ Is disposal carried out cleanly and correctly?

Contractors

☐ Do contractors behave correctly?

☐ Are they integrated correctly by own employees (e.g. training, permits)?

Permits

☐ Are permits filled out correctly?

☐ Are they signed by the appointed persons?

You can also find this checklist at downloadcenter.bgrci.de.

Annex 6: Bibliography

Laws, ordinances, and legal text of the Accident Prevention Regulations are **binding legal norms**. Deviations require permission of the competent authority and the competent Statutory Accident Insurance Institution (e. g. Berufsgenossenschaft). It is required for issuing a special dispensation that compensation measures must provide at least the same safety level.

Technical rules affiliated to ordinances, execution instructions of Accident Prevention Regulations, BG-Rules, BG-Informationen, Codes of Practice, DIN-/VDE standards are **not binding legal norms**. These are regarded as important standards of evaluation and rules of technology that do not need to be adhered to if the same safety level can be obtained otherwise.

Sources of information on the internet

Publications of the German Social Accident Insurance Institution for the raw materials and chemical industry (BG Rohstoffe und chemische Industrie – BG RCI) as well as a broad part of the German occupational health and safety regulations issued by the State Germany and the German Statutory Accident Insurance Institutions (approximately 1750 files (nearly all in German)) can be found in the compendium for occupational health and safety, "Kompendium Arbeitsschutz". The use is not free of charge. A free limited trial is available. For further information see www.kompendium-as.de.

The homepage www.bgrci.de/praevention offers numerous further informations.

See medienshop.bgrci.de for detailed information about publications and media of the BG RCI and for mail order.

The Prevention ("Praevention") download centre of the BG RCI offers selected attachments and forms from codes of practice and BG-Rules, as well as additional work tools, downloadcenter.bgrci.de.

Current Accident Prevention Regulations (Unfallverhütungsvorschriften), BG-Rules (BG-Regeln), BG-Principles (BG-Grundsätze) and a wide range of BG-Informationen can be found on the homepage of the German Social Accident Insurance (Deutschen Gesetzlichen Unfallversicherung – DGUV) under publikationen.dguv.de.

The following is a compilation of relevant regulations, rules and other literature that deserve special attention in connection with this code of practice.

1. Publications of the European Community in the Official Journal of the European Community

Obtainable from: Bundesanzeiger-Verlag, Postfach 10 05 34, 50445 Köln;
Full text from eur-lex.europa.eu/de/index.htm

- (1a) Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No. 1907/2006, last amended by Ordinance (EU) No. 487/2013
- (1b) Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, last amended by Directive 2009/2/EC

- (2a) Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC
- (2b) Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances, last amended by Ordinance (EC) No. 137/2008
- (3) Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC, last amended by Regulation (EU) No 167/2013
- (4) Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work, last amended by Regulation (EC) No 1137/2008
- (5) Council Directive 75/324/EEG of 20 May 1975 on the approximation of the laws of the Member States relating to aerosol dispensers, last amended by Directive 2013/10/EU

2. Laws, directives, technical regulations

Obtainable from: Bookstores

Free download from www.gesetze-im-internet.de (laws and directives) or www.baua.de (technical rules)

- (6) Siebtes Buch Sozialgesetzbuch – Gesetzliche Unfallversicherung (SGB VII)
- (7) Gesetz über Betriebsärzte, Sicherheitsingenieure und andere Fachkräfte für Arbeitssicherheit (ASiG)
- (8) Betriebsverfassungsgesetz (BetrVG)
- (9) Gesetz über die Durchführung von Maßnahmen des Arbeitsschutzes zur Verbesserung der Sicherheit und des Gesundheitsschutzes der Beschäftigten bei der Arbeit (Arbeitsschutzgesetz – ArbSchG)
- (10) Verordnung über Arbeitsstätten (Arbeitsstättenverordnung – ArbStättV) with Technischen Regeln für Arbeitsstätten (ASR), in particular
- (11) ASR A1.3: Sicherheits- und Gesundheitsschutzkennzeichnung
- (12) ASR A2.2: Maßnahmen gegen Brände
- (13) ASR A2.3: Fluchtwege und Notausgänge, Flucht- und Rettungsplan
- (14) Verordnung über Sicherheit und Gesundheitsschutz bei der Bereitstellung von Arbeitsmitteln und deren Benutzung bei der Arbeit, über Sicherheit beim Betrieb überwachungsbedürftiger Anlagen und über die Organisation des betrieblichen Arbeitsschutzes (Betriebssicherheitsverordnung – BetrSichV) with Technischen Regeln für Betriebssicherheit (TRBS)
- (15) Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung – GefStoffV) with Technischen Regeln für Gefahrstoffe (TRGS), in particular

- (16) TRGS 201: Einstufung und Kennzeichnung bei Tätigkeiten mit Gefahrstoffen
- (17) Announcement 220: Safety data sheet
- (18) TRGS 400: Risk assessment for activities involving hazardous substances
- (19) TRGS 510: Storage of hazardous substances in non-stationary containers
- (20) TRGS 555: Betriebsanweisung und Information der Beschäftigten
- (21) TRBS 2152/TRGS 720: Gefährliche explosionsfähige Atmosphäre – Allgemeines
- (22) TRBS 2152 Teil 1/TRGS 721: Gefährliche explosionsfähige Atmosphäre – Beurteilung der Explosionsgefährdung
- (23) TRBS 2152 Teil 2/TRGS 722: Vermeidung oder Einschränkung gefährlicher explosionsfähiger Atmosphäre
- (24) TRGS 800: Fire protection measures
- (25) Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz – BImSchG)
- (26) Vierte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über genehmigungsbedürftige Anlagen – 4. BImSchV)
- (27) Zwölfte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Störfall-Verordnung – 12. BImSchV)
- (28) Zweite Verordnung zum Sprengstoffgesetz (2. SprengV)
- (29) Verordnung über den Schutz vor Schäden durch ionisierende Strahlen (Strahlenschutzverordnung – StrlSchV)
- (30) Gesetz über die Beförderung gefährlicher Güter (Gefahrgutbeförderungsgesetz – GGBefG)
- (31) Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz – WHG) mit zugehörigen Verordnungen
- (31a) Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen und über Fachbetriebe (VAwS)
- (31b) Allgemeine Verwaltungsvorschrift zum Wasserhaushaltsgesetz über die Einstufung wassergefährdender Stoffe in Wassergefährdungsklassen (Verwaltungsvorschrift wassergefährdender Stoffe (VwVwS)), www.umweltbundesamt.de/wgs

2a. Other binding regulations

Obtainable from: bookstores

- (32) Landesbauordnung (LBO)
- (33) Richtlinie zur Bemessung von Löschwasser-Rückhalteanlagen beim Lagern wassergefährdender Stoffe (Löschwasser-Rückhalte-Richtlinie – LÖRüRI)
- (34) International Maritime Dangerous Goods Code (IMDG-Code)
- (35) Accord européen relatif au transport international des marchandises Dangereuses par Route (ADR); English title: The European Agreement concerning the International Carriage of Dangerous Goods by Road, concluded at Geneva on 30 September 1957. (Link: europa.eu/legislation_summaries/transport/road_transport/tr0006_en.htm)
- (36) Règlement International concernant le transport des marchandises Dangereuses chemins de fer (RID); English title: Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations (Link: www.roadsafeeurope.com/Rail)
RID: Regulations concerning the International Carriage of Dangerous Goods by Rail, appearing as Appendix C to the Convention concerning International Carriage by Rail (COTIF) concluded at Vilnius on 3 June 1999
- (37) International Air Transport Association – Dangerous Goods Regulations (IATA-DGR)
- (38) International Civil Aviation Organisation (Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO-TI), www.icao.int → publications → Doc 9284

3. German Social Accident Insurance Institution accident prevention regulations, rules, principles, information and codes of practice

Obtainable from: Jedermann-Verlag GmbH, Postfach 10 31 40, 69021 Heidelberg und Berufsgenossenschaft Rohstoffe und chemische Industrie, Postfach 10 14 80, 69004 Heidelberg, medienshop.bgrci.de
Members of the BG RCI (German Social Accident Insurance Institution for the Raw Materials and Chemical Industry) can obtain the following publications (until next list of sources) free-of-charge from the BG RCI in quantities appropriate for the size of the company.

- (39) Accident prevention regulation: Grundsätze der Prävention (BGV A1, probably as of 2014: DGUV Vorschrift 1)
- (40) Accident prevention regulation: Betriebsärzte und Fachkräfte für Arbeitssicherheit (DGUV Vorschrift 2)
- (41) Accident prevention regulation: Elektrische Anlagen und Betriebsmittel (BGV A3)
- (42) Accident prevention regulation: Organische Peroxide (BGV B4)
- (43) Accident prevention regulation: Flurförderzeuge (BGV D27)

Obtainable from: E&B engelhardt und bauer Druck und Verlag GmbH, Niederlassung Rhein-Neckar, Roßlauer Weg 5, 68309 Mannheim und Max Dorn Presse GmbH & Co. KG, Georg-Kerschensteiner-Straße 6, 63179 Obertshausen.

Free download under publikationen.dguv.de

(44) BG-Rule: Explosionsschutz-Regeln (EX-RL) (BGR 104)

Obtainable from: Max Dorn Presse GmbH & Co. KG, Georg-Kerschensteiner-Straße 6, 63179 Obertshausen
Free download under publikationen.dguv.de

(45) BG-Rule: Arbeitsplatzlüftung – Lufttechnische Maßnahmen (BGR 121)

(46) BG-Rule: Einsatz von Feuerlöschanlagen mit sauerstoffverdrängenden Gasen (BGR 134)

(47) BG-Rule: Benutzung von Schutzkleidung (BGR 189)

(48) BG-Rule: Benutzung von Atemschutzgeräten (BGR/GUV-R 190)

(49) BG-Rule: Benutzung von Augen- und Gesichtsschutz (BGR 192)

(50) BG-Rule: Benutzung von Schutzhandschuhen (BGR 195)

(51) BG-Rule: Lagereinrichtungen und -geräte (BGR 234)

(52) BG-Information: Erste Hilfe im Betrieb (BGI/GUV-I 509)

Obtainable from: Jedermann-Verlag GmbH, Postfach 10 31 40, 69021 Heidelberg und Berufsgenossenschaft Rohstoffe und chemische Industrie, Postfach 10 14 80, 69004 Heidelberg, medienshop.bgrci.de
Members of the BG RCI (German Social Accident Insurance Institution for the Raw Materials and Chemical Industry) can obtain the following publications (until next sources) free-of-charge from the BG RCI in quantities appropriate for the size of the company.

(53) Code of Practice A 008: Persönliche Schutzausrüstungen

(54) Leaflet A 008-1: Chemikalien-Schutzhandschuhe

(55) Code of Practice A 009: Zusammenarbeit im Betrieb – Sicherheitstechnisches Koordinieren

(56) Code of Practice A 010: Betriebsanweisungen für Tätigkeiten mit Gefahrstoffen (BGI 566)

(57) Code of Practice A 013: Beförderung gefährlicher Güter (BGI 671)

(58) Leaflet A 013-1: Gefahren richtig kennzeichnen beim Transport und im Betrieb (BGI 671-1)

(59) Code of Practice A 016: Gefährdungsbeurteilung – Sieben Schritte zum Ziel (BGI 570)

- (60) Code of Practice A 017: Gefährdungsbeurteilung – Gefährdungskatalog (BGI 571)
- (61) Code of Practice A 023: Hand- und Hautschutz (BGI 540)
- (62) Code of Practice M 001: Organische Peroxide (BGI 752)
- (63) Code of Practice M 002: Cyanwasserstoffe – Blausäure, Cyanide (BGI 569)
- (64) Code of Practice M 005: Fluorwasserstoff, Flusssäure und anorganische Fluoride (BGI 576)
- (65) Code of Practice M 058: Organische Peroxide – Antworten auf häufig gestellte Fragen (BGI/GUV-I 8619)
- (66) Code of Practice M 060: Gefahrstoffe mit GHS-Kennzeichnung – Was ist zu tun? (BGI 5150)
- (67) Code of Practice M 063: Lagerung von Gefahrstoffen – Antworten auf häufig gestellte Fragen
- (68) Code of Practice R 004: Thermische Sicherheit chemischer Prozesse (BGI 828)
- (69) Code of Practice T 012: Betriebliches Transportieren und Lagern (BGI 869)
- (70) Code of Practice T 013: Arbeitsbühne für Gabelstapler
- (71) Code of Practice T 016: Umgang mit Gabelstaplern
- (72) Code of Practice T 018: Kranführer – Krane fachkundig und sicher bedienen
- (73) Code of Practice T 028: Transport von Hand – Heben, Tragen, Schieben, Ziehen (BGI 641)
- (74) Code of Practice T 030: Geh-Flurförderzeuge – Gabelhubwagen
- (75) Code of Practice T 037: Warmlagerung von Bitumen (BGI 5041)
- (77) Code of Practice T 047: Regalstaplerfahrer und Kommissioniergeräteführer
- (78) Code of Practice T 048: Vorbeugender Brandschutz
- (79) Code of Practice T 049: Explosionsschutz – Antworten auf häufig gestellte Fragen (BGI 5027)
- (80) Code of Practice T 053: Brennbare Flüssigkeiten – Antworten auf häufig gestellte Fragen (BGI 8615)
- (81) Code of Practice T 057: Ladungssicherung beim Transport (BGI/GUV-I 5134)
- (82) Safety briefings: Lagerung von Gefahrstoffen (SKG 003)

4. Standards

Obtainable from: Beuth-Verlag GmbH, Burggrafenstraße 6, 10787 Berlin, www.beuth.de www.beuth.de

- (83) DIN 25422: Aufbewahrung und Lagerung radioaktiver Stoffe – Anforderungen an Aufbewahrungseinrichtungen und deren Aufstellungsräume zum Strahlen-, Brand- und Diebstahlschutz (Storage and keeping of radioactive materials – Requirements on protection against radiation, fire and theft to be met by storage facilities)
- (84) DIN EN 2: Classification of fires
- (85) DIN EN 14470-1: Fire safety storage cabinets – Part 1: Safety storage cabinets for flammable liquids
- (86) DIN EN 14470-2: Fire safety storage cabinets – Part 2: Safety for pressurised gas cylinders

5. Online databases and information on the internet

- (87) Download centre “Prävention” (“Prevention”) of the BG RCI: downloadcenter.bgrci.de
- (88) Hazardous substances information system “GisChem” of the BG RCI: www.gischem.de
- (89) Verband der Chemischen Industrie e. V. (VCI): www.vci.de VCI's Packaging Handbook: <https://extranet.vci.de/Themen/Logistik-Verkehr-Verpackung/Verpackung/Seiten/Handbuch-fuer-Verpackungen.aspx>
- (90) Industriegaseverband e. V. (IGV): www.industriegaseverband.de
- (91) Industrie-Gemeinschaft Aerosole e. V. (IGA): www.aerosolverband.de Brochure: “Aerosol-Lager“, Fachinformation der Industrie-Gemeinschaft Aerosole e. V.
- (92) Industrieverband Agrar e. V. (IVA): www.iva.de
- (93) Verband Chemiehandel e. V. (VCH): www.vch-online.de
- (94) Specialist information “Prävention” of the BG RCI: www.bgrci.de/praevention

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