

Easy-to-use workplace control scheme for hazardous substances



A practical guide for the application of the German Hazardous Substance Ordinance by small and medium-sized enterprises working with hazardous substances without workplace limit values

This set of measures was drawn up by the project group "Easy-to-use workplace control scheme for hazardous substances" of the Federal Institute for Occupational Safety and Health (BAuA)

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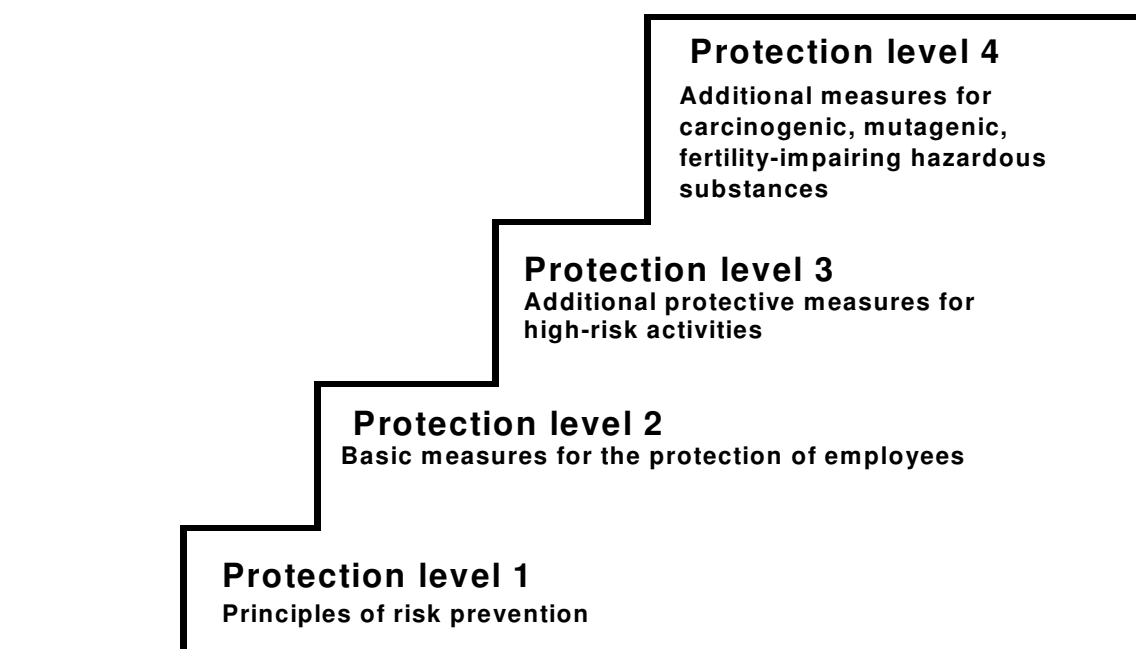
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The new German Hazardous Substance Ordinance 2005

(Hazardous Substance Ordinance of 23 December 2004, Bundesgesetzblatt I, page 3855)

The new German Hazardous Substance Ordinance came into force on 1 January 2005. In addition to the Chemicals Act it is now also based on the Occupational Safety Act. As in the case of other workplace hazards, working conditions must be assessed before work with hazardous substances is started (risk assessment). This comprises hazards by inhalation (inhalatory), in contact with skin (dermal) and caused by physical and/or chemical effects of hazardous substances such as fires or explosions. The hazard assessment results in measures for the protection of employees and third persons. In the new Hazardous Substance Ordinance – similarly to the biological substances ordinance – these measures are grouped in sets of measures called protection levels¹:

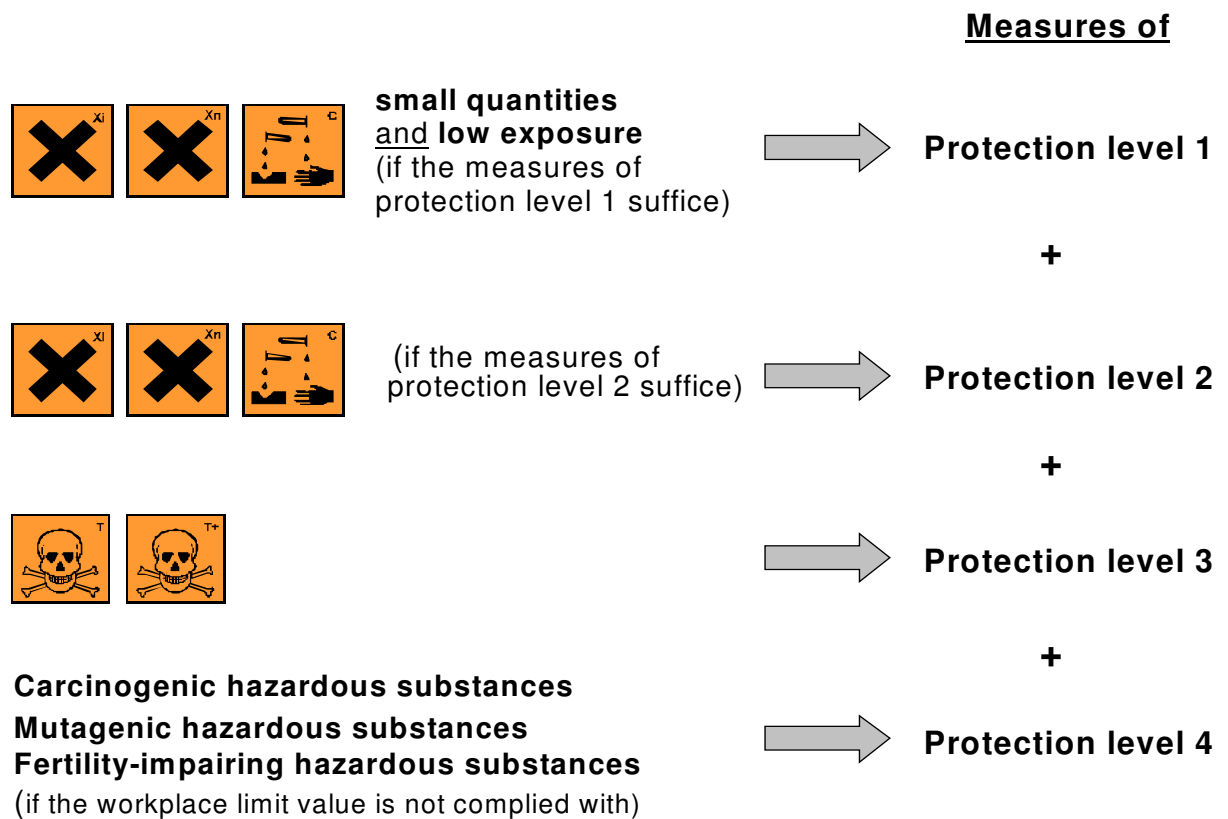


The protection levels build on each other. Every protection level describes measures (alternative solutions, technical aspects, organisation, protective equipment), as well as standards and criteria for checking the efficacy of protection measures taken (or already in place).

If there are no concrete substance-specific or activity-specific standards for protective measures, for example in Technical Rules for Hazardous Substances (TRGS), a decision will usually have to be taken in the course of risk assessment as to which protection level applies to an activity involving hazardous substances. The relevant provisions are found in

¹ For substance-related explosion and fire hazards the Hazardous Substance Ordinance provides an additional set of measures.

the Hazardous Substance Ordinance. Carcinogenic, mutagenic and fertility-impairing hazardous substances require protection level 4, all other hazardous substances marked with the „skull and crossbones“ symbols, are assigned protection level 3. If an enterprise uses only hazardous substances without the „skull and crossbones“ symbol, protection level 2 is usually sufficient. Protection level 1 is adequate for low-hazard situations entailing minimal risk.



The protection levels describe the set of measures required in principle for an activity involving hazardous substances. However, when it comes to selecting, defining and implementing the measures, further decisions have to be taken on site. The easy-to-use control scheme for activities involving labelled hazardous substances without workplace limit values was designed to help you with these decisions. We encourage you to use this opportunity to improve the quality of your work, products and services through better protection from chemical hazards.

The idea underlying the easy-to-use control scheme

The easy-to-use control scheme is designed to help you start implementing the provisions of the new German Hazardous Substance Ordinance in the case of activities involving labelled hazardous substances. It applies in particular to activities with hazardous substances marked Xi (irritant), Xn (harmful), C (corrosive), T (toxic) or T+ (very toxic) and for which no workplace limit values² have been defined as yet.

The easy-to-use control scheme support hazard assessment by providing a manageable number of hazard factors and straightforward categories.³ All you need are the hazard symbols, the hazard substance classification, information on the release potential (boiling point, tendency to form dust) and the quantities used, as well as on the type and extent of possible contact with skin. The easy-to-use control scheme will indicate the protection level necessary under the new Hazardous Substance Ordinance and the requirements associated therewith. It also offers suggestions as to how the work process might be organised and describes model solutions for common activities. In addition, the easy-to-use control scheme indicate which activities require specialist advice related to occupational health and safety so as to ensure greater safety when working with hazardous substances.

The easy-to-use control scheme is intended to help in particular small and medium-sized enterprises in Germany and their consultants to implement practical steps leading to greater safety and health when working with hazardous substances. In doing so, it follows the example set by similar practical guides established by member states of the European Union⁴. The easy-to-use control scheme make these attempts accessible to German companies, in keeping with the requirements of the new Hazardous Substance Ordinance.

² A list of the workplace limit values applicable in Germany is contained in the Technical Rule for Hazardous Substances 900. Please refer also to the specifications under point 8. of the Safety Data Sheet of the hazardous substance.

³ This is also known as „control banding“.

⁴ See the European Agency for Safety and Health at Work, Forum 10: "Hazardous substances in the workplace – minimising the risks" at: www.agency.osha.eu.int/publications/forum/10/en/

Who is the easy-to-use control scheme intended to help?

The easy-to-use control scheme is directed at management, safety specialists and expert consultants (including industry-wide consultants) who assess the risks posed by activities involving hazardous substances. It gives special consideration to the needs of small and medium-sized enterprises using or manufacturing hazardous substances.

The easy-to-use control scheme also offer valuable assistance to

- public authorities and accident insurers working to ensure the implementation of the Hazardous Substance Ordinance;
- Experts charged with drawing up safety data sheets for chemical substances and preparations;
- Decision-makers working with the purchase and use of chemicals, product information and product marketing;
- Workers' councils, staff councils and interested employees.

Examples of activities with hazardous substances include:

- Production, manufacture, dismantling
- Use of materials, raw materials and chemical products: handling, use, consumption, storage, treatment and processing, filling, transferring, mixing
- Repair and maintenance
- Operation and monitoring
- Warehousing and storage for later use
- Transportation
- Waste disposal and treatment

What does the easy-to-use control scheme offer?

Important note

If the manufacturer or distributor of the hazardous substance **supplied you with a hazard assessment** (containing detailed information for the safe use of the substance) under paragraph 7.7 of the German Hazardous Substance Ordinance, you may apply these measures directly. The same applies if you can rely on a recognised, **hazardous-substance-specific, industry-wide solution for safety and health at work⁵**, or on processes described in **Technical Rules for Hazardous Substances (TRGS)**.

The easy-to-use control scheme is intended to help you with the implementation of sections 3 and 4 of the new German Hazardous Substance Ordinance. It applies to activities involving hazardous substances marked with hazard symbols to indicate health hazards (Annex 2) for which no substance-specific workplace limit values⁶ are specified in TRGS 900.

In the case of hazardous substances without workplace limit values, the easy-to-use control scheme assists with ...

- the **assessment of the risk posed by inhalation and contact with skin**, and the incorporation thereof into the hazard assessment (paragraph 7(5) Hazardous Substance Ordinance);
- the determination of **low-hazard activities** for which protection level 1 is sufficient (§ 7(9) Hazardous Substance Ordinance);
- the assessment as to whether the measures stipulated in **paragraphs 8 and 9** are sufficient for the hazardous substances handled (paragraph 7(9,10) Hazardous Substance Ordinance);
- the checking of the measures taken under **paragraph 8** (paragraphs 8(2) – (8) Hazardous Substance Ordinance);
- the **designing of appropriate measures** for activities falling under protection levels 2 and 3 (paragraph 9(2) and paragraph 10(1) Hazardous Substance Ordinance);

⁵ TRGS 440 (www.baua.de/prax/ags/trgs440.htm) contains information on industry-specific solutions.

⁶ The general dust limit value is considered a substance-specific workplace limit value only for the types of dust specified under no. 2.5 of the TRGS 900.

- the **provision of information to employees**, including occupational health and toxicology counselling (paragraph 14(3) Hazardous Substance Ordinance).

The easy-to-use control scheme further supports manufacturers and distributors of chemical substances and preparations in the drawing up of an **anticipated workplace risk assessment** to accompany their products (paragraph 7(7) Hazardous Substance Ordinance).

The easy-to-use control scheme for Hazardous Substances (version of January 2005) does not apply to:

1. Activities involving **hazardous substances for which TRGS 900 specifies a workplace limit value**. Point 8 of the Safety Data Sheet indicates whether workplace limit values have been fixed for a hazardous substance or individual components thereof.⁷ However, in this case the easy-to-use control scheme may be used to assess the risk posed by contact with skin (paragraph 7(5) Hazardous Substance Ordinance);
2. Activities involving hazardous substances which can result in **physical and/or chemical hazards** (for example, a substance-related risk of fire or explosion). In this case a separate hazard assessment must be carried out; note should also be taken of the additional protection measures outlined in paragraph 12 of the Hazardous Substance Ordinance and the provisions of the Occupational Safety Ordinance;
3. Activities during which **hazardous substances are produced or released from products**⁸, for instance soldering and welding fumes, products of pyrolysis, exhaust gases, chemical reactions and decomposition processes. In these cases it is not possible to determine adequate protective measures using the hazard factors described;
4. Activities with hazardous substance **requiring special measures**, for example wet work, demolition, renovation, cleaning and recycling work during which hazardous substances are released not used knowingly. The Technical Rules for Hazardous Substances, the recommendations of the institutions for statutory accident insurance and prevention and of the Federal states committee on occupation health (LASI) provide relevant protection measures for these specific situations;
5. The industrial or commercial **handling of gases**,
6. Substance-related **environmental hazards**.

⁷ Pending more concrete information by the Committee on Hazardous Substances, the procedures outlined in TRGS 402, 403, 420 and 440 should be followed in these cases.

⁸ In this case different information and assessment concepts are necessary for hazard assessment and the definition of protective measures (see also TRGS 002 at www.baua.de/prax/ags/trgs002.htm)

Instructions for use

The easy-to-use control scheme use readily available information provided by the supplier of the hazardous substance, that is to say, the hazard symbol and the Safety Data Sheet. The nature, scope and quality of this information can significantly influence the results achieved using the easy-to-use control scheme, and hence it is important to bear in mind the following:

1. Hazard categories, hazard symbols or Safety Data Sheets which are incorrect or have not been updated will result in incorrect protective measures. Therefore, always make sure you have up-to-date information and request an updated Safety Data Sheet from the manufacturer of the hazardous substance, especially if the Sheet is older than a year. When using substance mixtures, make sure that the hazard categories used in the easy-to-use control scheme and the boiling point refer to the mixture and not to the individual substances.
2. The hazard symbols applied to hazardous substances indicate only those hazardous properties which are known to the manufacturer or in regard to which an official decision was taken at the European Union level. There is still a lot we do not know about the harmful effects of chemicals; to change this a great deal of work is being done at present at the national, European and international levels. The easy-to-use control scheme explicitly do not take into consideration "data gaps" of this kind. However, to err on the safe side, a substance should be assigned at least to the hazard groups B and HC if, for example, the "Toxicology" section of the Safety Data Sheet indicates that no tests have been carried out regarding possible hazardous properties of the substance.⁹
3. Scientific and technical background information on the easy-to-use control scheme for Hazardous Substances may be found in the sources cited at www.baua.de.

⁹ This is not necessary if the Safety Data Sheet contains a warning such as „The acute toxicity, skin irritation, irritation of the mucous membranes, mutagenic potential and skin sensitisation of this preparation were assessed by the manufacturer and/or distributor on the basis of the data available for the components. In the case of individual components the data available are not complete.. However, in the manufacturer's/distributor's experience, hazards going beyond those indicated are not to be expected.“ (see TRGS 220 " Safety Data Sheet")

How to apply the easy-to-use control scheme

I. Gathering the necessary information

The hazardous substance information needed to apply the easy-to-use control scheme is found in the Safety Data Sheet. The work-related information can be obtained by visiting the workplace, for example, during an assessment of working conditions (workplace risk assessment) pursuant to the Occupational Safety Act. Ensure that **all activities involving hazardous substances** are taken into consideration (see also TRGS 440). **Annex 1** contains a form for recording the necessary data¹⁰. This form can also be used as a **hazardous substance register** (paragraph 7(8) Hazardous Substance Ordinance) and to document the **workplace risk assessments** (paragraph 7(6) Hazardous Substance Ordinance).

You will require the following information:

1. **The hazard symbols and R phrases** of the hazardous substance (Safety Data Sheet, label)

Note the definitions of the health-related hazard symbols (Xn, Xi, C, T, T+) and the numbers of the **R phrases** (for example, R 20), located in the Safety Data Sheet or on the label next to or below the orange hazard symbols (see **Annex 2**). Please note that sometimes, in the case of preparations (substance mixtures), not all the R phrases are written on the label. The information provided in the Safety Data Sheet (under point 15) should therefore be used first. In some cases, for example with consumer products, the label contains only the text of the R phrases, which describe the dangerous effects of the hazardous substance¹¹.

2. **The boiling point or boiling range** of the hazardous substance (in the case of liquid, see Safety Data Sheet under point 9)
3. **The dustiness** of the hazardous substance (in the case of solids, an approximate assessment should be made by visiting the workplace)
 - If the hazardous substance is in the form of **pellets, a wax or granules** or if the activity produces only very little dust, dustiness is low.

¹⁰ A template for a WORD document may be found at "www.baua.de".

¹¹ The remaining phrases (that is, S phrases) offer important safety advice which you should always take into consideration when choosing safety measure.

- If the hazardous substance is in the form of a coarse powder or if the activity produces **dust which settles again quickly** and dust is present on the surrounding surfaces, dustiness is **medium**, examples include washing powder or sugar.
- If the hazardous substance is in the form of a fine powder or if the activity produces **clouds of dust which remain in the air for up to several minutes**, dustiness is **high**; examples include flour, toner, cement.

4. The **quantity of hazardous substance** used in the course of the activity (manufacturing instructions, tour of the workplace).

Establish in what quantities the hazardous substance is usually used in the course of the activity in question and use the table below to determine the appropriate **quantity group**:

Quantity group	Solids in the order of:	Liquids in the order of:
low	g	ml
medium	kg	l
high	t	m³

Please note that the total quantity of hazardous substance present does not always determine the quantity group. For example, the withdrawal of 30 litres of a liquid from a tank would fall under the quantity group „medium“. If in doubt, use the higher quantity group.

If liquid hazardous substances are used on large surface areas (for example when painting or cleaning) no more than **1 litre** of the substance **per full working day** should be used in order to qualify for the quantity group „low“.

5. **Duration of the activity** (tour of the workplace)

Establish whether the hazardous substance is **not used for more than 15 minutes** a day. If this is the case, enter "**short**" in the table (Annex 1).

6. In the case of liquids, **the temperature at which they are used** (manufacturing instructions, tour of the workplace)

If the hazardous substance is not used at room temperature (ca. 20 °C), the application **temperature** should be noted.

7. **Contact with skin – active quantity and duration of effective contact**

If it is possible that the skin might come into contact with the hazardous substances during an activity, the active quantity and the duration of effective contact must be determined, except when the possibility of contact with skin can be excluded, as in that case there is no need for additional measures to protect against contact with skin.

As regards the active quantity, a distinction is drawn between small-scale and large-scale contact with skin. The possibility of indirect contact owing to contaminated work clothes and equipment must be borne in mind.

	Active quantity
small	Small-scale contact (splashes)
large	Large-scale contact (hands and lower arms)

The **duration of effective contact** begins with the contamination and ends only when it has been removed effectively. If there is repeated contact with skin, the periods of contact with each hazardous substance throughout the day must be added.

	Duration of effective contact
short	Fewer than 15 minutes / day
long	More than 15 minutes / day

When determining the active quantity and duration of active quantity, do not take into consideration protective gloves or other personal protective equipment already being used.

II. Determining the hazard and release categories

a) Hazard groups

The easy-to-use control scheme works with categories. The hazardous properties of the hazardous substances are assigned to five hazard groups (A-E) on the basis of the R phrases. In addition, there are a further five hazard groups for the hazard potential owing to contact with skin (HA – HE). The hazard groups roughly correspond to the degree of harmfulness of a hazardous substance, which increases from A to E.

Hazardous substances not marked with the skull and crossbones symbol (T, T+) are assigned to the following hazard group(s):

Hazard group	Corresponding R phrases
A	No R-phrase concerning health, R 36, R 37, R 65, R 67
B	R 20, R 22, R 41, R 68/20, R 68/22, properties not sufficiently well known
C	R 34, R 35, R 40, R 42, R 48/20, R 48/22, R 62, R 63, R 68
HA	R 66
HB	R 21, R 38, R 48/21, R 68/21
HC	R 34, R 40, R 62*, R 63*, R 68*, properties not sufficiently well known
HD	R 43
HE	R 35

* Does not fall in this group if the hazardous are not absorbed by the skin

Hazardous substances marked with the skull and crossbones symbol (T, T+) are assigned to the following hazard group(s):

Hazard group	Corresponding R phrases
C	R 23, R 25, R 29, R 31, R 39/23, R 39/25
D	R 26, R 28, R 32, R 39/26, R 39/28, R 48/23, R 48/25, R 61
E	R 45, R 46, R 49, R 60
HC	R 24, R 39/24, R 48/24
HE	R 24 <u>and</u> R 34, R 27, R 39/27, R 61*

* Does not fall in this group if the hazardous are not absorbed by the skin

Using the table, note the hazard group(s) corresponding to each R phrase. In many cases combinations of R phrases are given; for the sake of clarity not all of these combinations are listed in the table. Select the hazard groups for all the R phrases in the combination, for example, in the case of R 20/21/22 the hazard groups B, HB and B. The R phrases 48/ and 39/ always occur in combination with other R phrases and are therefore listed in the table. This also applies to R phrase 68, which in combination has a different meaning than when it stands alone.

For every hazardous substance, note the **highest hazard group** and, if relevant R phrases exist, the **highest skin hazard group**.

Hazardous substances marked **only with hazard symbols indicating physical and chemical hazards** or **only the symbol „environmental hazard“** (Annex 2) can be assigned to hazard group A. Please note that, owing to the hazardous properties of these hazardous substances, **additional measures**, going beyond the Basic Measures, **may have to be taken to prevent fires or explosions or to protect the environment**.

We would like to point out, once again that the **incorrect classification** of a hazardous substance or **the failure to classify** a hazardous substance **may lead to inadequate or excessive protection measures**. In case of doubt, **contact the manufacturer or distributor** of the hazardous substance. If the data available are insufficient, you should err on the safe side and choose at least the hazard groups B and HC.

b) Release categories

In the case of **solid hazardous substances** (for example powders) you will already have determined their dustiness while gathering the necessary information¹². Using the table below you may directly assign it to a release category.

In the case of **liquid hazardous substances** used at room temperature the release category depends on the boiling point of the hazardous substance. If a boiling range is specified, choose the lowest value.

If the hazardous substance is **used at other temperatures**, the release category is determined using a diagram (see the figure) or on the basis of the options given in the table. Alternatively (if available) the vapour pressure for the application temperature can be used.

Aqueous solutions are assigned to the release category „low“ if the dissolved components (for example salts) are characterised by low volatility and are not sprayed.

¹² In the case of some volatile solids (for example naphthalene) the vapours can cause significant contamination of the workplace in the same way as liquids. In such cases, check whether the vapour pressure of the substance leads to a higher release category.

Assigning the release categories

Release category	Solids	Liquids		
	Dustiness (see Section I)	Normal temperature (T ~ 20 °C)	Any application temperature (°C)	Vapour pressure (kPa at AT)
low	low	boiling point above 150 °C	b. p. $\geq 5 \times AT + 50$	< 0.5
medium	medium	boiling point between 50 and 150 °C	other cases	0.5 - 25
high	high	boiling point below 50 °C	b. p. $\leq 2 \times AT + 10$	> 25 kPa

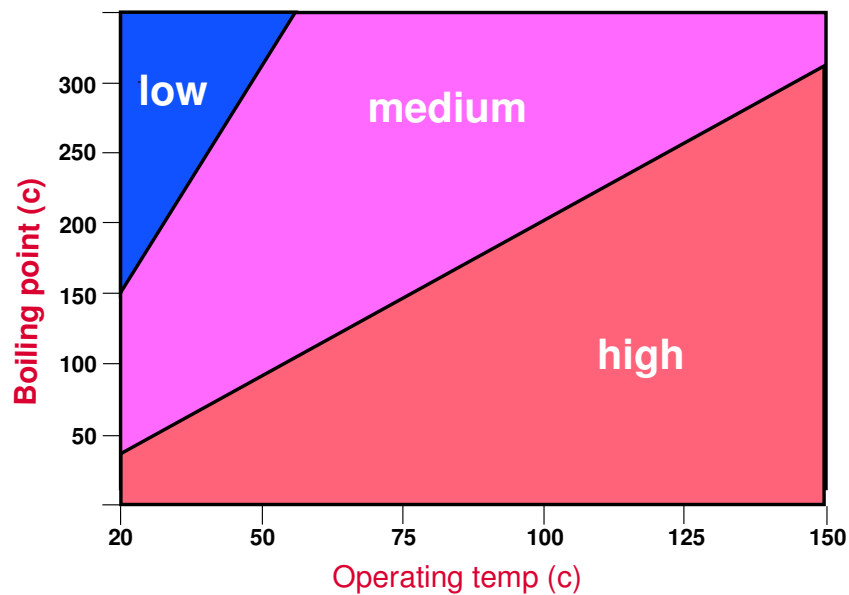


Figure: Diagram for determining the release category for liquid hazardous substances at elevated application temperatures.

III. Determining the protection level under the Hazardous Substance Ordinance



Protection level 4

If the hazardous substance is marked with the **skull and crossbones symbol** and assigned to the hazard group E, protection level 4 applies. This requires a special hazard assessment, which is not included in the easy-to-use control scheme for Hazardous Substances (need for expert advice). The Technical Rules for Hazardous Substances (TRGS) contain substance-specific and activity-specific hazard assessments and protective measures for a large number of carcinogenic hazardous substances (for example asbestos, dioxins, wood dust, ceramic fibres, pyrolysis product, Diesel engine emissions)¹³ to which enterprises can refer in practice.

Protection level 3

Protection level 3 applies to all other hazardous substances marked with the **skull and crossbones symbol**. The measures provided under protection levels 1, 2 and 3 must be applied with these hazardous substances.



Protection level 2

Protection level 2 applies to hazardous substances marked with the „**St. Andrew's cross**“ symbol (Xn, Xi) or „**corrosive**“ (C). With these hazardous substances the measures prescribed for protection levels 1 and 2 must be applied. In some cases, protection level 3 measures be required in addition (see Section IV „Protection level 2 – designing the work processes“).

¹³ TRGS 002 contains an up-to-date overview of all TRGS.

Protection level 1:

If the risk assessment for an activity involving hazardous substances concludes that, owing to

1. the working conditions,
2. the fact that only a small quantity of the hazardous substance is used and,
3. the fact that the extent and duration of exposure is low,

workers are at a low risk and if the protection measures taken under paragraph 8 Hazardous Substance Ordinance (protection level 1) are adequate, no further measures under paragraphs 9 to 17 Hazardous Substance Ordinance have to be taken. A sub-statutory decision has yet to be taken by the *Ausschuss für Gefahrstoffe* (committee on hazardous substances, AGS) as to when exactly the criteria for the application of this regulation concerning minor cases are satisfied. „Protection level 2 – designing the work process“ in section IV indicates activities for which protection level 1 may be sufficient.

IV. Defining the protection measure for the protection levels determined

Now that you have determined the protection level for every activity, the appropriate measures must be defined. The paragraphs below specify the measures corresponding to the different protection levels. Some of these you may be using already.

Protection level 1 applies to all hazardous substances (even those with a higher protection level). It is the basis for the effectiveness of all the tighter measures. The corresponding measures, most of which are described in TRGS 500 "Protection measures: minimum standards" should be gone over using the checklist in Annex 3 and, if necessary, improved as soon as possible. Make sure that unnecessarily high exposure to hazardous substances will not take place in the first place.

Protection levels 2, 3 and 4 always begin with a search for alternative substances or methods with reduced hazard. Especially in the case of activities to which protection levels 3 and 4 apply, alternative solutions can permit considerable savings. If in your particular case no alternative solution could be found, the section „Designing the work process“ provides detailed information on the necessary technical, organisational and personal protection measures in the workplace. These are supplemented by guidelines for protection, which have been established at the request of the institution for statutory accident insurance and prevention in the chemical industry and the Federal Institute for Occupational Safety and Health (BAuA). The protection guidelines also describe model solutions for common activities involving hazardous substances.¹⁴

¹⁴ The protection guidelines are based on the Control Guidance Sheets of the COSHH Essentials (www.coshh-essentials.org.uk)

Please note that the protection levels build on each other. If in your particular case protection level 3 applies you must read through the sections „Protection level 1” „Protection level 2“ and „Protection level 3“.

Protection level 1

Principles of hazard prevention during activities involving hazardous substances (minimum standards)

The measures of protection level 1 represent the minimum standard and as a matter of principle must be applied to all activities involving hazardous substances:

- Design the workplace and work organisation in such a way as to keep workplace contamination and the hazard risk for workers as low as possible;
- Provide suitable means and use appropriate methods of maintenance which ensure the health and safety of workers at work;
- Limit the number of workers who are or might be exposed to hazardous substances;
- Restrict the duration and extent of the exposure;
- Take suitable hygiene measures, particularly regular cleaning of the workplace,
- Restrict the quantity of hazardous substance present at the workplace to the amount needed for the activity in question;
- Use suitable working methods and processes which do not damage the health or jeopardise the safety of the workers; this includes measures to ensure that hazardous substances and waste material containing hazardous substances are handled, stored, transported and disposed of safely;
- Identify and label hazardous substances present in the business;
- Store and warehouse hazardous substances without endangering health or the environment;
- Take measure to prevent abuse or misuse,
- Safely store and handle contains that can contain hazardous substance residues.

The requirements of protection level 1 are described in detail in the Technical Rule for Hazardous Substances TRGS 500¹⁵.

¹⁵ TRGS 500 "Protection measures: minimum standards". This TRGS still has to be brought into line with the new Hazardous Substance Ordinance.

Designing the work process – protection guidelines

Further information on the designing of work processes in protection level 1 may be found in the following protection guidelines¹⁶:

- Minimum requirements – general ventilation: Guideline 100
- Minimum requirements – general storage: Guideline 101

Checking the effectiveness of measures

Measures taken under protection level 1 can be gone over using the **checklist in Annex 3**. If technical protection devices have been installed, their function and effectiveness must be checked regularly, but at least every **three years**. The result of the check must be documented.

Low-hazard activities

If, owing to substance properties, working conditions, low substance quantities and low exposure for short durations the risk assessment has determined a low-hazard risk, no measures going beyond those of protection level 1 are necessary. However, if, exceptionally, particularly sensitive persons complain of irritation even when handling only very small quantities of a hazardous substance, the advice of occupational health experts should be sought.

¹⁶ The protection guidelines have been released in co-operation with the institution for statutory accident insurance and prevention in the chemical industry (Berufsgenossenschaften der chemischen Industrie), see www.baua.de, type: "schutzleitfäden". The number of the protection guidelines correspond to the "COSHH Essentials" Control Guidance Sheets.

Protection level 2

Basic measures for activities involving hazardous substances

If possible, opt for alternative solutions

Always begin by looking for alternative solutions. By using products or methods with a lower risk, unnecessary costs for technical, organisational and personal protection measures can be avoided. Alternative solutions should be examined for suitability in three steps:

The first step looks at whether the alternative solution is suitable from a technical point of view. Product or industry-specific information may be helpful with this. The TRGS series 600 describes the latest alternative solutions for different activities involving hazardous substances.

The second step compares the risks of the alternative solution with those of the original hazardous substance or method. As regards health risks this can be done using the Basic Measures. To do so, the hazard factors for the alternative solution must be known (for example from the Safety Data Sheet). The form in Annex 1 can be used to carry out the comparison and to document it under paragraph 9.1 of the Hazardous Substance Ordinance.

However, when choosing possible alternative products it is important to remember that the Basic Measures do not take into consideration the substance-related risks of fire and explosion, nor environmental protection. For a comparative analysis of these aspects the column-based model in TRGS 400 may be used.

In addition, it does not make sense to replace hazardous substances known to have hazardous properties with products whose risks are not known. Therefore, a comparative risk analysis should also take into account possible unknown hazardous properties of the replacement product („data gaps“). The relevant information is contained in the „Toxicology“ section of the Safety Data Sheet; in some cases it may be useful to send a query to the manufacturer of the replacement product, using the form letter provided in TRGS 440. The effective factor model in TRGS 440 offers a practical tool for comparative risk analyses taking into consideration data gaps and workplace limit values.

If an alternative solution which in principle would be suitable is deliberately not used, this decision must be motivated and documented. Economic reasons can be given. TRGS 440 contains a checklist „How reasonable are alternative solutions“ to assist businesses with step three.

Designing the work process – protection guidelines

The risk related to activities involving hazardous substances should be eliminated or reduced to a minimum by designing the work process accordingly. In some cases, the rigorous and consistent application of the minimum standards according to TRGS 500 may suffice. In other cases, emission-reducing technical measures (technical measures) must be taken. In isolated scenarios additional measures according to protection level 3 may be necessary. Using the tables below you can determine for hazard groups A, B and C (with the exception of hazardous substances marked with the skull and crossbones symbol) which option is best in your particular case:

Hazard group	Quantity group	Release group		
		low	medium	high
A	low	TRGS 500*	TRGS 500*	TRGS 500*
	medium	TRGS 500	TRGS 500	Technical measures
	high	TRGS 500	TRGS 500 (liquids) Technical measures (solids)	Technical measures
B	low	TRGS 500*	TRGS 500*	TRGS 500*
	medium	TRGS 500	Technical measures	Technical measures
	high	TRGS 500	Technical measures (liquids) Measures of protection level 3 (solids)	Measures of protection level 3
C	low	TRGS 500*	TRGS 500* (solids) Technical measures (liquids)	Technical measures
	medium	Technical measures	Measures of protection level 3	Measures of protection level 3
	high	Technical measures	Measures of protection level 3	Measures of protection level 3

* Protection level 1 may be sufficient (under current discussion)

If the **activity is carried out for less than 15 minutes a day** (entry "short"),

- „technical measures“ can be used instead of „ protection level 3 measures“ and.
- „TRGS 500“ can be used instead of „technical measures“.

However, this does not apply to hazardous substances which cause local irritation (R 37), are corrosive (R 34 or R 35), cause sensitization by inhalation (R 42) or having an intense odour.

If the result for an activity is “technical measures“, the release (emission) of hazardous substances must, if possible, be restricted at their point of origin. To achieve this you should seek advice from a qualified specialist. Exhaust and ventilation devices must be carefully adjusted to the conditions at the workplace to ensure that they are effective enough¹⁷. Further information and model solutions for designing work processes requiring „technical measures“ may be found in the following guidelines:

- Local exhaust ventilation: Guideline 200
- Fume cupboards / fume hoods: Guideline 201
- Removing dust from separator systems: Guideline 204
- Filling bags: Guideline 206
- Loading tanks from bags or small containers: Guideline 210
- Filling drums: Guideline 212
- Emptying drums using drum pumps: Guideline 213
- Weighing solids: Guideline 214
- Mixing solids with other solids or with liquids: Guideline 215
- Mixing liquids with other liquids or solids in drums: Guideline 217
- Producing pellets: Guideline 230

¹⁷ The BAuA as part of its series of publications (FB 834) offers a two-volume "Katalog technischer Maßnahmen zur Luftreinhaltung am Arbeitsplatz" (catalogue of technical measures for ensuring clean air at the workplace), which can be obtained from Wirtschaftsverlag NW, Bremerhaven, info@nw-verlag.de

Protection measures

To determine the need for additional measures in the case of activities when hazardous substances may come into contact with skin, you will require

1. the **skin hazard group (HA – HE)** of the hazardous substance used (if several hazardous substances are used the highest hazard group applies);
2. the **active quantity** of the hazardous substance(s) used
3. the **duration of effective contact** of the hazardous substance(s) used.

The above information will indicate the need for additional measures for the prevention of contact with skin. This need can be low, high or very high. In some cases it will not be possible to reach a clear decision on the basis of the easy-to-use control scheme. In that case a special activity-specific hazard assessment is necessary, which can be carried out as part of general occupational health consultancy at the enterprise. No additional measures are needed if contact with skin can be excluded completely. However, owing to the labelling of the substance the measures applicable under protection level 2 (for example substitution) must nonetheless be complied with.

Skin hazard group HA (R 66):

The need for measures is **low** if the duration of effective contact is short and the active quantity small. In all other cases there is a **high need for additional measures**.

Skin hazard group HB (R 21, R 38, R 48/21, R 68/21):

The need for measures is **low** if the duration of effective contact is short and the active quantity small. However, in case of

- a long duration of effective contact and a small active quantity, or
- a short duration of effective contact and a large active quantity

there is a **high need for additional measures**. Other cases must be assessed separately with the help of occupational health specialist counselling.

Skin hazard group HC (R 34, R 40, R 62, R 63, R 68):

In case of

- a long duration of effective contact and a small active quantity, or
- a short duration of effective contact and a large active quantity

there is a **high need for additional measures**. Other cases must be assessed separately with the help of occupational health specialist counselling

Skin hazard group HD (R 43):

These hazardous substances can lead to allergic reactions. The possibility of contact with skin always results in a **high need for measures**. Specialist occupation health counselling is recommended. TRGS 540 must be complied with.

Skin hazard group HE (R 35):

The possibility of contact with skin results in a **very high need for additional measures**.

The need for measures can be classified as follows¹⁸:

Low need for measures

The organisational measures specified in TRGS 500 are sufficient.

High need for measures

Suitable tools, instruments, devices or work techniques should be used to prevent or at least reduce significantly any contact of the skin with the hazardous substances. If this is not possible, personal protective equipment must be used (chemical protective gloves, protective aprons and protection suits) – information on the nature, type and material of the protective equipment must be provided in the Safety Data Sheet¹⁹. The procurement, maintenance, storage and disposal of personal protective equipment in the business should be well organised and documented in the operating instructions. If protective gloves are used, care should be taken to ensure they offer sufficient protection from the hazardous substance in question – the use of gloves not suitable for chemicals (for example gloves made from leather) can have fatal consequences.

Very high need for measures

Particularly intensive efforts should be made to look for alternative solutions and technical means (for example closed systems) for preventing exposure. If after all technical and organisational means have been exhausted skin contact with the hazardous substance remains possible, the personal protective equipment must be selected and used with great care. The advice of occupational health specialists should be sought in this regard. Furthermore, workers should be given practical instructions in the use of the personal protective equipment.

¹⁸The assessment of dermal hazards and the recommended measures are based on a draft Technical Rule "Hazards through contact with skin" which the Ausschuss für Gefahrstoffe is due to issue in 2006. The TRGS will contain more detailed information.

¹⁹ If this is not the case (for instance, „Protective gloves: yes“) you should ask the manufacturer of the chemical product for this information. Remember that you are entitled to it. Many makers of personal protective equipment also give out information on suitable protective gear.

Eye protection

In the case of some activities, particularly those involving hazardous substance with the R phrases R 36, R 41, R 34 and R 35, additional eye protection may be required (consult the Safety Data Sheet).

Further measures for protection level 2 and up

- Eating and drinking areas not exposed to hazardous substances
- separate areas for storing street clothes and work clothes, if workers can be expected to be at risk owing to a contamination of their work clothes. This can be the case especially with hazardous substances in the hazard groups HB, HC, HD and HE;
- Safety measures when employees work alone or different businesses collaborate;
- Danger warning measures in case of breakdowns, accidents or emergencies;
- Operating instructions / instruction of workers in the dangers associated with the relevant hazardous substances and activities / occupation health and toxicological counselling;
- Using a simple layout and straightforward language, the operating instruction should inform workers of the hazardous substances occurring at the workplace, the hazards to health, the relevant protection measures and how to act in case of an accident. It also serves as the basis for the oral instruction which workers must receive annually or before taking up a new activity and for which they must sign.

The instruction must be supplemented **by occupation-health and toxicological counselling of the workers**. It must be carried out in the presence of the appointed industrial physician, should this be necessary for reasons concerning occupational health. This may be the case in particular with activity presenting a risk owing to

- sensitising hazardous substances (R42, R43),
- chemical substances or preparations labelled „*Contains „.....“*“. *May produce an allergic reaction*“ or
- prolonged exposure to hazardous substances in contact with skin or through inhalation (for example R48/20, R48/21).

During the occupational-health and toxicological counselling workers can be given specific medical advice concerning the risks to health and protective measures associated with the prevailing working conditions. This also applies to the use of personal protective equipment.

- Preventive occupational medicine:
 - Assessing hazardous substance-related and activity-related health hazards from an occupational health perspective;
 - Recommending suitable protective measures,
 - Counselling workers on health hazards associated with the activity,
 - Carrying out preventive examinations for the early detection of health problems and occupation illnesses,
 - Recommending workplace inspections,
 - Further developing the company's health protection policies.

In the case of specific hazardous substances and activities listed in Annex V of the Hazardous Substance Ordinance, occupation-health preventive examinations must be carried out or offered²⁰. This applies in particular if, despite protective measures

- there is a risk to health through direct contact with skin,
- there is a risk to health through inhalation,
- health problems or illnesses are suspected to be related to hazardous substances at the workplace.

As part of the occupational-health preventive examination a worker can receive individual medical counselling on hazardous substances which, owing to their hazardous properties in combination with his or her working conditions and personal conditions, require a tailor-made strategy approved by the worker concerned (for example technical and personal occupational safety measures, targeted follow-up examinations).

The use of personal protective equipment does not mean that occupational-health preventive examinations can be dispensed with. Many chemical protective gloves contain allergenic components and should therefore be tailored to the user. When respiratory protection devices are used, care should be taken that health requirements are satisfied.

Under paragraph 11 of the Occupational Safety Act a worker's request for an occupational-health examination must be met, unless the assessment of working conditions and the protective measures suggest that damage to health is unlikely.

²⁰ Nothing further will be said here regarding preventive occupational medicine in the case of hazardous substances with workplace limit values (Annex V No. 1).

Restrictions on activities

In the case of hazardous substances with the R phrase R63 the provisions of the maternity protection guideline ordinance must be complied with²¹.

Checking the effectiveness of protective measures

Even in the case of hazardous substances without workplace limit values, any measures taken should be examined regularly. If technical protective device are installed, their function and effectiveness must be checked regularly, but at least **every three years**. The result of the check-up must be documented, for example in the form of appropriate control variables (e.g. suction speeds, air exchange rates). In future some control variables will be specified in the protection guidelines.

Even with hazardous substances without workplace limit values, representative hazardous substance measurement offer an opportunity to document exposures and to draw comparisons with different workplaces. Particularly when the hazard arises from contact with skin, analyses of biological material (biomonitoring)²² are of great value if one wishes to check the efficacy of protective measures. This requires a decision by the industrial physician and the consent of the worker concerned.

The measures of protection level 2 can be sufficiently effective only if the minimum standards of protection level 1 are likewise adhered to. Consequently, these should be checked regularly using the checklist (Annex 3). In addition, the efficacy of the measure also depends to a considerably extent on the health and safety awareness of the workers. Individual occupational-health counselling and preventive examinations, regular instructions using language readily understood by the workers and practical operating instructions are therefore the essential to ensuring the quality of the protective measures taken.

²¹ Mutterschutzrichtlinienverordnung (maternity protection guidelines ordinance), Ordinance on the protection of pregnant and nursing women at the workplace, version of 15 April 1997, last amended on 25 November 2003.

²² TRGS 710 "Biomonitoring", TRGS 903 "Biological tolerance values at the workplace – BAT values "

Protection level 3: Additional measures for highly hazardous activities

State-of-the-art alternative solutions

Under protection level 3 less hazardous alternative substances and methods must be used whenever technically possible. To determine whether this is the case you can proceed as described for protection level 2. The decision not to use an alternative substance and/or method must be justified in the hazard assessment documentation.

Designing the work process – protection guidelines

If alternative solutions are not technically possible the production and use of the hazardous substance must take place in a closed system. This must be guaranteed by tightly sealed containers for storage, handling, transport and waste disposal. Only if the use of a closed technical system is not technically possible may other measures be taken to reduce employees' exposure to hazardous substances as much as possible. It goes without saying that the sequence specified for protection level 2 must be adhered to.

The tables below describe the minimum standards experts have found to be necessary for the design of work processes falling under protection level 3:

TRGS 500: Minimum standards (TRGS 500)

Technical measures: emission-reducing technical measures

Closed: closed system or process

Technical advice: the closed system must be designed particularly carefully – need for technical advice

Please note that alternative solutions and closed methods should always be used whenever possible.

Hazard group	Quantity group	Release group		
		low	medium	high
C	low	TRGS 500	TRGS 500 (solids) technical measures (liquids)	technical measures
	medium	technical measures	closed	closed
	high	technical measures	technical advice	technical advice
D	low	technical measures	technical measures (solids) closed (liquids)	closed
	medium	closed	technical advice	technical advice
	high	closed	technical advice	technical advice

Protection guidelines

Further information and model solutions for designing work processes falling under protection level 3 may be found in the following protection guidelines:

- Closed system: guidelines 300
- Filling and emptying tanker vehicles: Guideline 310
- Transferring liquids by pumping: Guideline 312

If the table above calls for „technical measures“ but closed methods are not technically possible, the guidelines of protection level 2 may be consulted.

Additional protection measures for hazards through contact with skin

When a closed method is used, hazardous substance contact with skin can as a rule be excluded. However, additional measures to protect skin may be necessary if

- a) a closed system is not possible for technical reasons or
- b) an existing closed system has to be opened for the activity, for example for adding reactive components, drawing samples, maintenance, cleaning, servicing.

Skin hazard group HC (R 24, R 39/24, R 48/24):

In case of

- a long duration of effective contact and a small active quantity, or
- a short duration of effective contact and a large active quantity

there is a **high need for additional measures**. Other cases must be assessed separately with the help of occupational health specialist counselling

Skin hazard group HE (R 24 and R 34, R 27, R 39/27, R 61)

There is a **very high need for additional measures** in case of possible contact with skin.

The corresponding measures can be found under „protection level 2“.

Further general measures going beyond protection level 2

- Toxic and very toxic substances must be sealed during storage (TRGS 514)
- Access to work areas must be restricted (for example by means of an access pass system)

Checking the effectiveness of protection measures

Closed systems should be inspected regularly by measurements or other adequate methods. In all other respects you should consider the possibilities described under „Protection level 2“. The measures of protection level 3 are likewise effective only if the minimum standards of protection level 1 are complied with. Therefore, they should be checked regularly, using the checklist in Annex 3. Given that the failure of technical and personal protection measures can result in potentially serious hazards, the safety and health responses to malfunctions, accidents and breakdowns should regularly be rehearsed with employees.

Work restrictions

When hazardous substances with the R phrase R 61 are used, the restrictions set out in the maternity protection guideline ordinance for pregnant and nursing women must be complied with.

Annex 1

Model sheet for gathering information for the Basic Measures for Hazardous Substances

Hazardous substance	Hazard symbol(s)	Protection level	Classification			Release capacity				Activity			Skin contact		Designing the work process	
			R phrases	HG	HG (skin)	solid/liquid	Boiling point	Temperature	Release group	Type	Quantity group	Short duration ?	Effective quantity	Duration of contact	Inhalation	Skin contact
	Identifying letters															

Hazard symbols and definitions

E, O, F, F+, T, T+, C, Xn, Xi and N are not part of the hazard symbol.

Physical and chemical hazards



Oxidising



Flammable



Highly flammable



Explosive

Health hazards



Irritant



Harmful



Corrosive



Toxic



Very toxic

Environmental hazards



Environmental hazard

Checklist for the minimum standards for activities with hazardous substances²³

Information management and labelling on the business premises

- Chemical materials used in the business are known
 - Purchased substances or products have hazard labelling
 - Up-to-date Safety Data Sheets are available
 - Purchased substances or products do not contain hazard labelling
 - Substances or products which are produced on site
- Hazardous substance register
 - Is kept and updated
 - Is not necessary (low hazard, protection level 1)
- Collection of safety data sheets
 - complete
 - up-to-date
 - accessible to all employees
- Hazardous substances are easily identifiable
 - Containers and packaging clearly labelled
 - Hazard identification (also on apparatus, pipes)
 - No invalid labels / identifications

Workplace layout

- Ventilation supplies sufficient healthy air
- Air ducts do not exposure third parties to hazardous substances
- A room or area for break is available (if required owing to the number of employees or for health or safety reasons)
- Wash facilities or washrooms with running water and means for cleaning and drying hands
- Lockers or changing rooms
- Easily cleaned surfaces (for examples walls and ceilings in work rooms)
- Few areas on which dust can settle
- Non-slip floors which are easy to clean

Work processes and method for avoiding high exposure to hazardous substances

- Little dust in dropping, filling and pouring sections
 - Achieved by low fall heights
 - Achieved by dust-proof coverings
- Work and disposal technique produce little dust
- Activities generating dust carried out in the open, with the back facing into the wind
- Containers are kept closed and opened only when needed
- Dipping, painting or rolling methods are used instead of spray methods

Work organisation

- Quantity of hazardous substances at the workplace is limited to daily requirements
- Number of employees exposed to hazardous substances is limited
 - By alternating activities with hazardous substances with other activities, and
 - through spatial separation from other activities

²³This checklist refers to the minimum standards pursuant to paragraph 8 of the Hazardous Substance Ordinance, which for activities falling under protection levels 2 to 4 form the basis for all additional measures. In the case of a „low-hazard“ activity under the Hazardous Substance Ordinance, not all the items on this checklist may be relevant.

Hygiene measures

- the necessary work clothes are worn
- Rooms or areas for breaks or standby rooms are not entered with severely contaminated work clothes
- Meals and snacks are stored and eaten away from the work areas
- Splashes or other forms of contamination with hazardous substances are immediately removed from the skin
- Contaminated work clothes are changed
- Dusty work clothes are not shaken out or blown clean
- Cleaning cloths are not used for the hands
- Eye protection (if necessary) is used
 - With some hazardous substances (safety data sheet)
 - When working overhead
 - During activities producing a lot of dust
 - During activities entailing a risk of splashing
 - Eye baths available near the activity area
- Work gloves (if necessary to protect against mechanical irritation by fibres, rock wool, coarse materials)

Cleanliness and cleaning

- Work places are tidied and cleaned regularly
 - Dust is not blown off using compressed air
 - Wet cleaning or use of industrial vacuum cleaners
- Containers are kept clean
- Dust deposits are removed regularly
- Contaminated work items and apparatus are cleaned
- Hazardous substance spills are cleaned up immediately
 - Means for cleaning up are available and easily accessible
- Containers for eliminating waste (clearly labelled and possibly identified as such) are available
- Hazardous substances no longer required, completely emptied containers and cleaning cloths are disposed of correctly.

Storage and warehousing of hazardous substances (minimum standards)

- Hazards are recognisable
 - Original container or original packaging with identification
 - Container or packaging with label and identification
- Arranged in a clearly visible manner
- Not kept in containers in which they might be confused with food or drink
- Not kept next to medicines, food or animal feed (and additives)
- Powdery hazardous substances are stored and warehoused in a low dust-producing manner (silo, bunker, transport container with lid, bags, container with cover, sheets for pourable goods)