



Practical instructions to good working practices

Perchloroethylene (PER) - Exposure of staff working in dry-cleaning

These practical instructions are acknowledged by AGS as process- and substance-specific criteria (VSK) standardised working technique



Staatliches Gewerbeaufsichtsamt
Hildesheim
Behörde für Arbeits-, Umwelt- und Verbraucherschutz



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These practical instructions to good working practices were compiled by the “Dry-Cleaning” Working Group on the basis of the “Projektbericht Tetrachlorethen-Exposition in Chemischreinigungen” (Project report Perchloroethylene exposure in dry-cleaning).

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Contents

1	<i>General background</i>	5
2	<i>Scope</i>	6
3	<i>Obtaining information</i>	7
3.1	Work processes and activities	7
3.2	Hazardous substances and exposure	8
4	<i>Determination and assessment of exposure</i>	10
4.1	Operating machines	10
4.2	Ironing workplaces	11
4.3	Biomonitoring	12
5	<i>Protective measures</i>	14
5.1	Protective measures to minimise inhalation exposure	14
5.2	Measures to minimise dermal exposure	17
5.3	Fire and explosion protection	17
6	<i>Effectiveness check</i>	19
7	<i>Bibliography</i>	20
	<i>Annex: Checklist</i>	22

1 General background

According to the Occupational Safety and Health Act (OSH Act) [1] employers are required to draw up a risk assessment for all activities performed and, if necessary, to implement measures to ensure the safety and protect the health of employees. When determining protective measures, the following order of precedence must be observed: substitution (replacement by less hazardous substances or processes), technical minimisation of contamination, organisational measures and personal protection measures.

The Ordinance on Hazardous Substances (OHS) [2] specifies this requirement of the OSH Act for activities involving hazardous substances. Inhalation exposure to all hazardous substances present in the air at the workplace must be measured or determined by comparable methods of assessment (TRGS 402 [3]). The results for substances identified as having an occupational exposure limit (OEL) determined in TRGS 900 [4] are assessed on the basis of these values. For substances without OEL other criteria and methods of assessment shall be applied.

These practical instructions to good working practices “Perchloroethylene (PER) - Exposure of staff working in dry-cleaning” are a sectoral aid to assessing hazards and to selecting appropriate protective measures for workplace-related activities of employees. They help employers to carry out a risk assessment and test the effectiveness of protective measures. These practical instructions were compiled on the basis of the “Projektbericht Tetrachlorethen-Exposition in Chemischreinigungen” (Project Report Perchloroethylene exposure in dry-cleaning) [5], compiled by the regional measuring agencies and authorities of the federal states Baden-Württemberg, Bavaria, Berlin, Brandenburg, Hamburg, Hesse, Lower Saxony, Rhineland-Palatinate and Saxony-Anhalt as well as the Federal Institute for Occupational Safety and Health.

These practical instructions can be used as a standardised working method according to TRGS 400 [6] in relation to hazards caused by the release of perchloroethylene (PER) and on the basis of the OHS [2]. The required protective measures were derived from measurements in workplaces according to TRGS 402 [3].

If they are applied, it is assumed that the occupational exposure limits (OEL) for PER according to TRGS 900 [4] are complied with.

In order to ensure the long-term effectiveness of any measures introduced, they must be checked regularly. These practical instructions are a useful aid in this respect. Normally measurements at the workplace are not necessary then.

Textiles for cleaning can be contaminated with biological agents such as moulds, bacteria or endotoxins. BGI S 050 [7] and DGUV 100-500, Chapter 2.6 [8] contain supplementary instructions regarding this type of hazard.

Further aspects of the risk assessment according to the OSH Act, except the OHS, are not dealt with in these practical instructions. They have to be considered on the spot.

2 Scope

These practical instructions apply to businesses operating dry-cleaning facilities using PER.

Dry-cleaning facilities accept primarily textiles, but also furs and leather, which are then cleaned in cleaning machines using solvents. Other, primarily manual, activities are connected with the actual machine cleaning.

These practical instructions apply to the following processes/activities:

- Receiving goods for cleaning
- Inspection/sorting
- Stain removal
- Cleaning in a solvent bath
- Ironing
- Final inspection
- Returning cleaned goods to customers

Scheduled cleaning and maintenance work, insofar as they are part of the daily work routine (e.g. cleaning needle catchers and lint filters), are also covered by these practical instructions.

These practical instructions do not apply to work where a higher level of PER is released, e.g.

- resolving disturbances/leaks in cleaning machines
- service and maintenance work

nor to

- industrial cleaning (e.g. cleaning leather gloves or cleaning carpets)
- or biological hazards.

3 Obtaining information

3.1 Work processes and activities

The individual steps in work processes that are part of chemical cleaning are described below:

- When receiving goods, the textiles for cleaning are handed over by the customer/client. This is generally accompanied by a conversation with the customer in order to obtain information about more persistent stains and spots and to advise the customer accordingly.
- When inspecting/sorting goods, the dirty textiles are labelled and inspected for damage, stains and for applications requiring greater care, buttons, buckles, etc. Pockets are checked and the textiles sorted into various batches according to different cleaning needs (textile, soiling, colour, etc.).
- Stain removal implies the professional, manual removal of stains using a corresponding stain remover (some of which contain solvents). The aim is to completely remove stains without damaging the fibres or affecting the colour. Stain removal is carried out at special workplaces using stain remover, water, steam and a spray or stain remover device. Stains can be removed both before and after cleaning in the machine. Pre-spotting is intended to remove water-based stains that cannot be removed using PER. Post-spotting is intended to remove persistent stains that were not removed in the machine.
- The chemical cleaning process itself takes place in the drum of the dry-cleaning machine, in a solvent bath. Staff loads the drum of the dry cleaning machine with the pre-sorted textiles and starts the appropriate programme. The textiles are cleaned by the machine and impregnated automatically, where appropriate. When the programme finishes, the textiles are removed from the machine, inspected carefully for stains or damage and hung up.
- Ironing removes any wrinkles; afterwards the textiles can be stored in the wardrobe or are ready to be worn. Hand-held steam irons are used with a steam ironing board or, in larger establishments, steam dummies are sometimes used, especially for jackets and trousers, collar & cuff presses or trouser toppers.
- Once ironed, the textiles undergo a final inspection to check they are clean and to pull them into shape; then they are placed in cleaner bags ready for collection.
- Servicing, inspection and maintenance work not related to daily cleaning activities are carried out on the dry cleaning machines at regular intervals or as needed; this can be carried out by the operator him/herself or by specialist firms (customer service). The type, extent and frequency of these activities depend largely on the length of use as well as the type and age of the machine.

3.2 Hazardous substances and exposure

PER is volatile, with good degreasing qualities, non-flammable and has low acute toxicity [9]. These characteristics, combined with its good cleaning properties, have made it the most used cleaning agent in the world. The occupational exposure limit (OEL) stipulated in TRGS 900 is 138 mg/m³.

Table 1: Occupational exposure limit

Substance	OEL [mg/m ³]	Peak limit	
		Exceedance level	Peak concentration [mg/m ³]
Tetrachloroethylene (PER)	138	2 (II)	276

Inhalation of PER is the main route of exposure in dry cleaning establishments. Liquid PER can be readily absorbed via the skin. PER is an irritant to mucous membranes and to skin. In acute cases, high levels of exposure can result in disorders of the central nervous system; very high levels of exposure can result in damage to liver and kidneys. Chronic exposure to high concentrations causes liver and renal impairment [9], in addition to disorders of the central nervous system; PER is a substance suspected of having a carcinogenic effect (in accordance with CLP Regulation [10] category 2 carcinogenic, H351). In TRGS 905 [11] PER has been classified as category 3 (K3) carcinogenic and furthermore as category 3 (R_E3) reproductive toxicant.

As a halogenated hydrocarbon PER is toxic for aquatic organisms with long-lasting effects category 2 effect; it is classified as H411 [10]. Its adverse effect on the environment and suspected carcinogenic effect have resulted in strict regulations being introduced to protect the environment in the form of the 2nd BImSchV [12].

In accordance with the requirements of the 2nd BImSchV, dry-cleaning machines manufactured after 1990 are all closed systems.

The principle of a closed system for textile cleaning machines includes delivery of PER in double walled safety containers fitted with vapour return systems; transfer of PER from these containers to the textile cleaning machine via appropriate connecting systems and drawing off the wet PER residue from the distillation kettle into containers for waste substances with gas displacement systems, also via appropriate systems [13].

PER is released into the ambient air when the machine drum is opened and the cleaned textiles are removed as well as when they are sorted, hung up and ironed. When cleaning the needle catcher and lint filter, the closed system of the textile cleaning machine is opened for a short time; during these activities the operator of the machine is exposed to a higher concentration of PER. Higher emissions can occur if the machine leaks and during cleaning, maintenance and machine repair work.

In order to bind the acidic decomposition products, PER for dry-cleaning contains stabilisers, mostly amines, alkyl phenols and epoxides. PER intended for use in dry cleaning machines is frequently stabilised with N-methylmorpholine and 2-tert-butylphenol. The final concentration of these stabilisers in PER is between 0.001 to 0.01 % weight so that exposure from inhalation of these substances is negligible during regular cleaning activities. Chemical burns to the skin pose a potential risk. When carrying out activities using these stabilisers, in particular when adding them to further stabilise PER, the protective measures stipulated in the safety data sheets, particularly wearing appropriate safety gloves made of nitrile rubber, must be observed.

In addition to PER, numerous stain removers are used at de-spotting workplaces to remove stains. The majority are solvent-based blends that contain highly flammable or flammable solvents as well as ionic or non-ionic surfactants. Acid based products are also available commercially for special applications. The numerous substances contained in commercially available de-spotting agents include substances with an occupational exposure limit (OEL) according to TRGS 900, for example hydrocarbon mixtures (isoalkanes C₁₁-C₁₅), (2-methoxymethylethoxy)-propanol, dipropylene glycol methyl ether, 2-(2-butoxyethoxy)-ethanol, 2-phenoxyethanol and n-butyl acetate.

The necessity of additional technical or personal protective measures when using de-spotting agents must be checked on an individual basis during risk assessment on the basis of safety data sheets. In general their contribution to overall exposure of employees to hazardous substances is low since de-spotting agents are normally only used in small quantities and for limited periods.

4 Determination and assessment of exposure

The updated version of TRGS 900 [4] in December 2011 set the occupational exposure limit (OEL) for PER at 20 ppm (138 mg/m³). This value was lowered significantly from the air limit as valid until 2005. This lowering of the threshold value and the lack of data on the current situation were the cause of the regional measuring centres and regional authorities of the federal states Baden-Württemberg, Bavaria, Berlin, Brandenburg, Hamburg, Hesse, Lower Saxony, Rhineland-Palatinate and Saxony-Anhalt for initiating a joint project on PER exposure in dry-cleaning facilities.

From April 2012 to November 2013 measurements were carried out in 92 dry-cleaning facilities. Sampling was carried out using active sampling systems when operating machines and during ironing/incidental activities. TWA concentrations and short term exposure values were measured. The 95 percentile was used as a basis for evaluation. In addition, in 8 dry-cleaning facilities a total of 30 employees had their internal PER exposure measured by the BAuA (Federal Institute for Occupational Safety and Health) by using biomonitoring exhaled air.

A dry-cleaning facility operating as described in Chapter 3.1 can relate its risk assessment to the results of this project and conclude it with the finding “**Protective measures satisfactory**”.

The reason for this is the analysis of the extensive workplace measurements, see Chapters 4.1. to 4.3. A detailed description of the project can be found in the “Projektbericht Tetrachlorethen-Exposition in Chemischreinigungen” (Project Report Perchloroethylene exposure in dry-cleaning) [5].

In order for this finding to be adopted by individual dry cleaners, the documentation on hazardous substances and the description of activities and protective measures must match the conditions described.

4.1 Operating machines

Machine operation includes pre-sorting and pre-spotting the textiles to be cleaned, operating the cleaning machine (preparing for cleaning operations, loading textiles, selecting the programme, starting, opening the machine and removing the textiles, cleaning and maintenance tasks) as well as sorting the cleaned textiles for further processing. The operators of machines, frequently the owner him/herself, often deal with accepting and returning customers' textiles. Machines may only be operated by skilled persons.

Table 2 summarises the PER concentrations and substance index measured for the activity of operating cleaning machines.

In the dry cleaners inspected, the index for PER during normal cleaning operations when operating the machines was adhered to with one exception. The percentage of measuring results with a substance index of $I < 0.5$ clearly predominates.

Table 2: Measuring results during machine operation

Number of TWA concentrations: 93		
	PER concentration [mg/m³]	Substance index I
Minimum	1.0	0.01
Average value	23	0.17
Median	13	0.09
95 percentile	98	0,71
Maximum	173	1.3
Percentage (number) of measured values < 0.5 OEL	91.4% (85)	
Percentage (number) of measured values 0.5 OEL - ≤ OEL	7.5 % (7)	
Percentage (number) of measurements > OEL	1.1 % (1)	

Table 3 shows the PER concentration determined while loading and unloading the machine as a 15 minute short-term value (STV).

Table 3: Measuring results – short-term values when operating machines

Number of short-term values: 245	
	PER concentration [mg/m³]
Minimum	1
Average value	35
Median	20
95 percentile	112
Maximum	444
Percentage of measurements < STV	99.6 % (244)
Percentage of measurements > STV	0.4 % (1)

4.2 Ironing workplaces

The activity of *ironing* comprises smoothing the cleaned textiles with an steam iron and/or steam dummy, collar and cuff press or trouser topper. Furthermore, this activity can include subsequently inspecting the finished textiles, packaging them in dry cleaner bags and serving customers.

Table 4 contains the results for this activity.

The PER threshold value was not exceeded in any of the dry cleaning establishments during ironing operations. In the majority of cases the substance index is $I < 0.25$.

Table 4: Measuring results during ironing

Number of TWA concentrations: 92		
	PER concentration [mg/m³]	Substance index I
Minimum	0.8	0.01
Average value	14	0.10
Median	7.3	0.05
95 percentile	79	0.57
Maximum	106	0.77
Percentage (number) of measured values < 0.5 OEL	93.5 % (86)	
Percentage (number) of measured values 0.5 OEL - ≤ OEL	6.5 % (6)	
Percentage (number) of measurements > OEL	–	

4.3 Biomonitoring

The results of biomonitoring are summarised in Tables 5 and 6. All internal PER exposure levels were below the assessment value (BEI/ACGIH/USA) of 20 µg PER/l exhalation air. These results confirm the finding: “Protective measures satisfactory”.

Table 5: Measuring results of biomonitoring: Operating machines

Number of measurements: 14 employees operating machines	
	PER concentration [µg/l]
Minimum	0.15
Average value	3.5
Median	1.3
Maximum	18
Percentage (number) of measuring values < 0.5 BEI	86 % (12)
Percentage (number) of measuring values 0.5 BEI - ≤ BEI	14 % (2)
Percentage (number) of measurements > BEI	–

Table 6: Measuring results of biomonitoring: Ironing/incidental activities

Number of measurements: 16 employees ironing/incidental activities	
	PER concentration [$\mu\text{g/l}$]
Minimum	0.05
Average value	1.5
Median	0.49
Maximum	8.1
Percentage (number) of measuring values < 0.5 BEI	100% (16)
Percentage (number) of measuring values 0.5 BEI - \leq BEI	–
Percentage (number) of measurements > BEI	–

5 Protective measures

The protective measures to be implemented for the various activities involved in chemical cleaning are listed below. When implementing the required measures, these practical instructions are valid as a standardised working method according to TRGS 400 [6].

This considerably reduces the work needed to derive protective measures as part of risk assessment. Furthermore, these practical instructions contain further advice for employers, e.g. additional information on hazardous substances including information on alternative methods, technical minimisation measures and other substance-related health and safety measures.

Furthermore it explains the required measures for fire and explosion safety and skin protection for employees.

5.1 Protective measures to minimise inhalation exposure

When applying these practical instructions, the following conditions must be complied with. When these practical instructions are applied, it can be assumed that the occupational exposure limit for PER is complied with.

The basic obligations set out in Art. 7 of Ordinance on Hazardous Substances (GefStoffV) [2] must be fulfilled for all workplaces and the protective measures listed in Art. 8 to 11 of Ordinance on Hazardous Substances must be applied in order to avoid risks when working with hazardous substances.

TRGS 500 [14] further specifies Art. 8 to 11 of Ordinance on Hazardous Substances with regard to the technical, organisational or personal protective measures, in particular for inhalation exposure.

These basic obligations include:

- Carrying out a risk assessment, compilation of operating instructions, provision of instruction guidance for employees and its documentation
- Implementation of the necessary measures according to the Occupational Safety and Health Act [1] and also according to the Ordinance on Hazardous Substances to ensure the health and safety of employees, also including compliance with the Technical Rules for Hazardous Substances
- Determination and application of protective measures in order to exclude risks to health and safety of employees in activities using hazardous substances and, if this is not possible, to reduce them to a minimum, in particular by designing appropriate processes and technical control devices for processes, the implementation of emission-free or low-emission options as well as the use of suitable state-of-the-art equipment and materials and/or application of collective protective measures of a technical nature at the source of the risk, such as appropriate ventilation and exhaust systems and the application of appropriate organisational measures

- Provision of personal protective equipment, e.g. PER-resistant protective gloves (nitrile rubber, coating thickness ≥ 0.35 mm, penetration time ≥ 4 hours), face masks with A2 filters in the event of an incident
- Regular inspection of the function and effectiveness of technical protective measures
- Ensuring that occupational limit values are adhered to, in particular by checking exposure through measurements of hazardous substances at workplaces or the application of process-specific criteria, where compliance indicates adherence to limit values
- Eating, drinking, smoking or snorting drugs is not permitted at these workplaces. Break areas must be designed so that no noise, hazardous substances, dust, dirt or smells can penetrate to these areas in particular; they may not be accessible to customers or other public (Art. 8(3) of the Ordinance on Hazardous Substances, No. 4.2 of the Annex in combination with Art. 6(3) of the Workplaces Ordinance [17]).

Dry-cleaning facilities using PER are subject to the provisions of the 2nd BImSchV [12]. The primary aim of the requirements of this regulation is to prevent the release of volatile halogenated hydrocarbons into the environment. The implementation of these technical and organisational measures also leads to a significant reduction in the exposure of employees to PER; therefore these represent parallel protective measures to the Ordinance on Hazardous Substances. DGUV 100-500, 2.14 [15] contains protective measures regarding the operation of dry-cleaning machines and can be applied as a sectoral supplement to TRGS 500.

When applying these practical instructions, in addition to the requirements of the Ordinance on Hazardous Substances, the following requirements of the 2nd BImSchV and furthermore DGUV 100-500, 2.14 must be complied with:

- The mass concentration of PER in the drying air may not exceed 2 g/m^3 at the outlet (2nd BImSchV, Art. 4(1)).
- A locking device on the door must ensure that, after drying, the door is not released above 2 g/m^3 (2nd BImSchV, Art. 4(2)).
- Compliance with this concentration limit must be monitored by measuring devices tested for their suitability (2nd BImSchV, Art. 4(2)).
- Exhaust gases from dry-cleaning machines must be fed into a separator (2nd BImSchV, Art. 4(2)).
- Working areas must be ventilated using only ventilating installations that suction off the ambient air (2nd BImSchV, Art. 4(4)).
- No volatile halogenated organic compounds may be used in working areas outside the installations (2nd BImSchV, Art. 4(5)).
- Dry-Cleaning machines may only be operated if skilled operating personnel are present (2nd BImSchV, Art. 4(6)).
- Textile cleaning machines must undergo an annual inspection conducted by an expert (2nd BImSchV, Art. 12(5)).

- Filling the installations with solvents and additives and the extraction of used solvents must be carried out so that emissions are minimised using the latest techniques, either by suctioning off the displaced exhaust gases containing solvents and feeding them to a separator, or using a vapour return system (2nd BImSchV, Art. 13(1)).
- The residues containing PER may only be removed from the installation using a closed device (2nd BImSchV, Art. 13(2)).
- PER or PER waste may only be stored, transported and handled in sealed containers (2nd BImSchV, Art. 13(3)).
- Premises for dry-cleaning installations must be ventilated so that employees are not exposed to the effects of noxious solvent vapours. The air volume in m³/h that is suctioned off must be at least 60 times the permissible capacity in kilograms. However, if this figure is greater than 5 times the air exchange rate, 5 times the air exchange rate will be sufficient (DGUV 100-500, 2.14, para. 3.1.4).
- The function and effectiveness (ventilation output) of the ventilation system must be checked regularly, but at least every three years (Ordinance on Hazardous Substances, Art. 7(7)). However, the ventilation system must be checked annually by an expert to ensure it is reliable and safe for operation (DGUV 100-500, 2.14, para. 6).
- The results of these inspections must be recorded and preferably kept in a safe place together with the risk assessment (Ordinance on Hazardous Substances Art. 7(7)).

In addition the following measures can help to minimise PER contamination:

- When starting work, immediately switch on the ventilation system in order to remove the concentration of PER, which increases during the night, from the ambient air.
- Check for leaks on a daily basis using an appropriate electronic leak detector, especially to the rear of the dry-cleaning machine [15]. Measurements have shown that leaks can occur in the machine that experts cannot detect visually or by smell.
- It also has to be ensured to suction off the exhaust fumes from the rear of the machine as well. Leaks in this area, in combination with a less than optimum or unsuitable exhaust system, can result in high time-weighted average concentrations.
- Install a suctioning device near the drum door to prevent peak concentrations when the door is opened.
- When using double-channel measuring devices to measure the PER concentration in the ambient air, set an alarm threshold below the current OEL so that an alert is triggered if leaks occur while the installation is in operation. The sampling point should be selected so that measurements are representative of the concentration in the ambient air. If these measuring devices are to be used for continuously monitoring the OEL, the requirements of TRGS 402, Annex 4 must be complied with.

- When the cleaning programme has finished, empty the machine immediately since the PER concentration within the drum rises again if the cleaned textiles are left in for a longer period. Run the drying programme again if the drum cannot be emptied immediately.
- Lower the maximum concentration of 2 g/m^3 prescribed to release the drum door.
- The design of the ventilation system should take the thermal and humidity loads into account in order to ensure a pleasant indoor climate.

5.2 Measures to minimise dermal exposure

PER only poses a minimal risk to the skin for employees in dry-cleaning, even if they have prolonged contact with freshly cleaned garments. Particularly their hands can be affected.

General hygiene measures as stipulated in TRGS 401 [18] and TRGS 500 [14] should be applied for activities with a low level of risk.

These measures include the provision of washing facilities with a mild cleanser, immediate gentle washing of the skin after contact with the hazardous substance and the use of skin care products.

A skin protection plan related to the various tasks must be compiled and displayed on the premises. The skin protection plan must show, in a clear and understandable manner, the required protection, cleansing and care measures for tasks where skin is at risk. The assistance of occupational health experts is recommended when compiling the skin protection plan.

The aids listed in TRGS 401 for assessing risks and selecting and evaluating personal protection equipment and skin protection products must be used. The results must be documented.

5.3 Fire and explosion protection

According to Art. 5 OSH Act [1] in combination with Art. 6 and 11 of the OHS [2], the employer must determine the risk to employees posed by fire and explosions, as part of the risk assessment, and introduce minimum measures at work to protect against fire and explosions. In case of doubt, a fire safety inspection report must be requested from an independent expert.

Measures regarding structural, technical, operational and organisational fire and explosion protection may be necessary as a result of the risk assessment.

The development of an explosive atmosphere is not expected in textile cleaning establishments, since the PER used is not flammable.

In accordance with Annex 1 No. 1 para. 1.4 of the OHS work areas must

- be fitted with a sufficient number of escape routes and exits, so that employees can leave their work areas quickly, unimpeded and safely in case of danger and injured persons can be rescued at any time;

- be designed so that fire cannot spread and fires and explosions are prevented from affecting adjacent areas;
- be fitted with sufficient fire extinguishing devices that are identified, easy accessible and easy to handle.

6 Effectiveness check

The application of these practical instructions for good working practices requires compliance with the measures and requirements stipulated in Section 5.

The function and effectiveness of existing technical protective measures must be checked at regular intervals and when processes and installations are changed. The intervals prescribed by manufacturers for inspections and maintenance in particular must be adhered to. All inspections and repairs carried out on the installations must be documented.

Users of these practical instructions must check that these conditions are still valid and document the results following changes to processes and otherwise regularly, but at least once a year. This includes checking that these practical instructions are still current. Annex 1 to these practical instructions contains a simple and easily understood *checklist* which facilitates compliance with general requirements on the organisation of health & safety at work as well as checking the preconditions for running dry-cleaning machines using PER. If all questions are answered with “yes”, then the necessary requirements have been satisfied and these practical instructions can be applied. This checklist must be filled out *annually*.

When applying these practical instructions, other requirements of the OHS remain applicable, in particular for collecting information and risk assessment for work areas not named here, where activities using hazardous substances are carried out to which these practical instructions do not apply.

These practical instructions to good working practices are available at www.baua.de. It is reviewed regularly and adapted to reflect the latest technical and legal developments. Therefore users of these practical instructions should always ensure the latest version is available.

7 Bibliography

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Annex: Checklist

RISK ASSESSMENT AND PROTECTIVE MEASURES

In accordance with the Occupational Safety and Health Act and the Ordinance on Hazardous Substances employers must carry out a risk assessment and update it annually. It records all hazardous substances that occur (as a list), creation of a plan of protective measures, implementation of measures and checks of the effectiveness of the protective measures implemented. For substances with occupational exposure limits, compliance with these limits must be ensured.

Occupational exposure limit for tetrachloroethylene (PER) 20 ppm or 138 mg/m³

The checklist is intended to help you carry out the risk assessment. It applies to workplaces in businesses where primarily textiles, but also furs and leather are cleaned according to the latest techniques using PER.

Using the checklist:

Check the premises using the checklist and put a cross next to the relevant answer. If you answer all requirements in sections 1 and 2 of the checklist with “yes”, you can use the finding “The occupational exposure limit for PER is complied with - the protective measures are adequate” for your risk assessment.

If one or more questions were answered with “no”, the corresponding protective measures must be implemented. If the answer is still “no” in a subsequent check, the checklist cannot be used for your risk assessment as proof that the limit values are not exceeded. You will have to carry out workplace measurements to demonstrate that your business complies with the limit value.

Section 3 contains further measures to minimise PER exposure. We recommend you to check them in your business and implement them as far as possible and also document them.

BASIS OF THE CHECKLIST

This checklist is based on the **practical instructions for good working practices** “Perchloroethylene (PER) - Exposure of staff working in dry-cleaning”. It was compiled on the basis of extensive workplace measurements (project report of the regional measuring agencies,

<http://www.laendermessstellen.de/html/expositionsbeschreibung.html>).

You will find these practical instructions and flyer on the internet at: http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/Arbeiten-mit-Gefahrstoffen/Arbeiten-mit-Gefahrstoffen_content.html

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Perchloroethylene (PER) - Exposure of staff working in dry-cleaning

Checklist for risk assessment



SECTION 1: GENERAL REQUIREMENTS FOR ORGANISING HEALTH & SAFETY AT WORK

You as an employer must comply with the following general requirements for handling hazardous substances in accordance with the Ordinance on Hazardous Substances.

You will find extensive information on this in the Occupational Safety and Health Act and the Ordinance on Hazardous Substances, in particular Art. 7.

- Do you have a documented risk assessment available for your business, together with experts' reports, maintenance and inspection documents? YES NO
- Have you appointed a specialist for occupational safety and a company medical officer? YES NO
- Is preventive occupational medical care offered when working with PER? YES NO
- Have you appointed a first-aider? YES NO
- Have you compiled working instructions for handling PER and are they displayed? YES NO
- Have the employees been informed of how to handle PER based on the working instructions and other hazards and have they confirmed this with their signature? YES NO
- Have you taken care to ensure that staff do not eat or drink in work areas? YES NO
- Are masks (A2 filters) and chemical protection gloves (nitrile rubber, coating thickness > 0.35 mm, penetration time ≥ 4 hours) available for maintenance and disturbance? YES NO

SECTION 2: PRECONDITIONS FOR OPERATING A CHEMICAL CLEANING FACILITY USING PER

Chemical cleaning facilities using PER are subject to the provisions of the Second Ordinance to Implement the Federal Immission Control Ordinance (2nd BImSchV). The primary aim of the requirements of this regulation is to prevent the release of volatile halogenated hydrocarbons into the environment. The implementation of the necessary technical and organisational measures also leads to a significant reduction in the exposure of employees to PER. Therefore you must also implement the legal requirements on emission control for PER facilities in accordance with the 2nd BImSchV Art. 4 and Art. 12 and additionally with DGUV Rule 100-500, Chapter 2.14.

- Are your chemical cleaning installations only operated if competent operating personnel are present? YES NO
- Is PER only used in closed installations? YES NO
- Is compliance with the concentration limit of 2 g/m³ monitored by a measuring device that is inspected annually by an expert? YES NO
- Are your dry-cleaning machines and ventilation systems checked regularly, but at least once a year, by an expert to ensure they are reliable and safe to operate? YES NO
- Is the ventilation system maintained regularly (at least once every 3 years) and the ventilation performance measured? YES NO
- Have you ensured that the ventilation system is switched on while the cleaning machines are in operation? YES NO

- Is PER or residues containing PER always stored, transported and handled in sealed containers? (vapour return line) YES NO
- Are all inspections and services documented? YES NO

SECTION 3: FURTHER IMPORTANT MEASURES

In order to minimise PER contamination, checks and implementation of the following measures and their documentation are recommended.

- When starting work in the morning, do you immediately switch on the ventilation system since the PER concentration can rise overnight in work areas? YES NO
- Is leak detection carried out on a daily basis using a leak detector in order to identify leaks in the machine? YES NO
- Have you set an ambient air concentration of max. 100 mg/m³ as the alarm threshold? YES NO
- Have you checked whether the release mechanism on the door lock operates correctly even at a lower concentration limit (less than 2 g/m³) and, if possible, can you have it adjusted to this setting? YES NO
- Is the machine emptied immediately after the cleaning programme had finished? YES NO

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Date Signature

