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Technical rules for biological agents	**Protective measures for activities involving biological agents in Laboratories**	**TRBA 100**

The Technical Rules for Biological Agents (TRBA) reflect the state of the art, occupational medicine and occupational hygiene, as well as other established ergonomic findings for activities involving biological agents.

They are determined or adapted by **the Committee for Biological Agents (ABAS)** with the participation of the Committee for Occupational Medicine (AfAMed) and published by the Federal Ministry of Labour and Social Affairs (BMAS) in the Joint Ministerial Gazette.

Within its scope of application, this TRBA specifies the requirements of the Biological Agents Ordinance. If Technical Rule 100 is complied with, the employer can assume that the relevant requirements of the ordinances are met. If the employer chooses a different solution, it must achieve at least the same level of safety and health protection for employees.

Contents

1. Scope

(1) This TRBA applies to targeted and non-targeted activities involving biological substances in laboratories. It regulates measures to protect the safety and health of all employees working in laboratory areas, regardless of whether they carry out activities involving biological substances or not. Other persons also fall within the scope of this TRBA if they may be endangered by the use of biological substances by employees or entrepreneurs without employees. These include, for example, external cleaning and maintenance personnel, suppliers and all other persons from outside the company.

(2) Furthermore, TRBA 100 specifies the requirements of the Biological Agents Ordinance (BioStoffV), in particular Annex II [1]. It lays down the minimum requirements for structural, technical, organisational and personal protective measures in laboratories for the four protection levels required for activities involving biological agents of different risk groups. The requirements are intended to prevent hazards to employees and other persons that may arise from activities involving biological substances and, if this is not possible, to reduce them to a minimum.

(3) Activities involving genetically modified forms of biological substances are subject to both genetic engineering legislation and the BioStoffV. If there are no equivalent regulations for the protection of employees, the stricter regulations apply.

(4) Protective measures for activities involving biological substances in the biotechnological production of biopharmaceuticals, diagnostics and vaccines are described in TRBA 110 "Protective measures for activities involving biological substances in the biotechnological production of biopharmaceuticals, diagnostics and vaccines" [3].

(5) Activities on a pilot plant scale are subject to the requirements of TRBA 100.

Note[1] : General protective measures for work in laboratories are regulated in TRGS 526 "Laboratories"; these must also be observed [4].

(6) For laboratory activities in medical practices, veterinary practices, pharmacies and dental laboratories, it is not mandatory to refer to TRBA 100, provided that these activities are minor in nature and scope and are covered by TRBA 250 "Biological agents in the health service and welfare sector", TRBA 252 "Activities with risk group 4 biological substances in the health service and funeral industry" or TRBA 260 "Protective measures for activities with biological agents in veterinary medicine and comparable activities" [11, 51, 52].

Such laboratory activities include in particular:

1. Pre-analytical activities such as sample preparation and processing for analysis (e.g. addition of reagents such as EDTA, centrifugation for plasma collection or for urine sediment),
2. the use of simple rapid laboratory tests and microscopic detection methods,
3. the use of preliminary diagnostic cultivation methods in closed systems, such as immersion culture media, without further diagnostics,
4. sample storage and sample packaging for transport.

If further diagnostic work (in particular cultivation) is carried out, this is subject to the requirements of TRBA 100.

(7) The risk assessment must determine which TRBA is to be applied in each individual case.

[1] Notes are more detailed explanations or references to related areas of law; their inclusion in this TRBA does not give rise to any presumption within the meaning of Section 8 (5) sentence 3 BioStoffV, unless they already have such presumption under other legal regulations.

2. Definitions

2.1 Hazard

A hazard within the meaning of these TRBA is the possibility that the safety and health of employees may be impaired by infections, acute or chronic diseases caused by infections, toxin formation or sensitising effects of biological substances.

2.2 Classification of biological substances

Biological substances are classified into risk groups 1 to 4 according to the risk of infection they pose. The EU legal classifications (Annex III to Directive 2000/54/EC) and additional national classifications can be found in TRBA 460-468 [5-10].

2.3 Laboratories

(1) Laboratories within the meaning of these TRBA are rooms in which activities involving biological substances are carried out for research, development, teaching or investigation purposes, e.g. in human and veterinary medicine, biology, biotechnology, the production of biologicals, environmental analysis and quality assurance. This also includes, for example, investigation rooms in wastewater treatment plants.

(2) The term "laboratories" includes functional rooms such as cell culture rooms, incubation rooms, centrifuge rooms, refrigeration or deep-freeze rooms, and rooms for the inactivation of biological substances, if activities in accordance with Section 2 (7) BioStoffV are carried out here [1].

(3) Facilities and practices in laboratory medicine, medical microbiology, hygiene and environmental medicine also fall under TRBA 100. This also includes laboratories for transfusion medicine, pathology and, where applicable, laboratories in medical practices, e.g. dermatology, urology and internal medicine.

2.4 Protection level range

The protection level area comprises a spatial unit that is assigned to a specific protection level. The protection level area also includes the associated airlocks.

2.5 Work area

For the purposes of these TRBA, the work area is the spatially or organisationally limited area within a protection level area in which employees carry out activities involving biological substances and which can be summarised in a risk assessment. It may comprise one or more workplaces or work processes.

2.6 Hygiene plan

The hygiene plan within the meaning of the TRBA is a compilation of personal and object-related measures to minimise contamination by biological substances, e.g. of hands, equipment, materials, floors and other surfaces. It contains information on the disinfectants and cleaning agents to be used (concentration, exposure time, frequency of use) and specifies the target group that carries out these measures. The hygiene plan must be communicated in a suitable manner (e.g. tabular display and instruction).

Note: A sample hygiene plan can be found in DGUV Information 213-086 [12].

2.7 Inactivation

Inactivation is the destruction of the reproductive and infectious capacity of biological substances.

2.8 Sterilisation

Sterilisation is the killing of all microorganisms capable of reproduction, including their permanent forms and dangerous effects, by physical or chemical means.

2.9 Decontamination

Decontamination is the reduction of the concentration of biological substances after contamination so that there is no risk of infection for employees.

2.10 Disinfection

Disinfection is the targeted reduction of the number of organisms capable of reproduction or infection on surfaces, materials or objects using physical or chemical methods to such an extent that they no longer pose any harmful effects and, in particular, no risk of infection.

2.11 Safety-related equipment

Safety-related equipment refers to technical equipment that is necessary for achieving protection goals and preventing the release of biological substances. This includes microbiological safety cabinets (MSW), autoclaves, wastewater inactivation systems, emergency call and monitoring equipment, and ventilation and air conditioning systems (HVAC systems), including ventilation systems. Incubators and refrigerators are not generally considered safety-related equipment.

2.12 Validation

A procedure is considered validated if its effectiveness has been reproducibly demonstrated and it can be used effectively and safely in practice. The number of repetitions required is usually at least three.

3. Information gathering and risk assessment

3.1 Responsibility and organisation

(1) Before commencing work with biological substances, the employer must carry out a risk assessment in accordance with Section 4 of the BioStoffV and document the results in accordance with Section 7 of the BioStoffV [1]. The aim of this risk assessment is to determine what measures need to be taken to prevent the identified potential hazards to employees. The employer is responsible for ensuring that the risk assessment is carried out correctly.

(2) The employer may use the specifications of this TRBA for their risk assessment, provided that the activities and exposure conditions described here can be applied to the specific situation to be assessed. If this is not possible or is not applicable, the relevant activities and the associated hazards must be assessed in accordance with TRBA 400 "Guidelines for risk assessment and for instructing employees in activities involving biological agents" [13].

(3) If activities are carried out by external companies, the results of the risk assessment must be passed on to the external company by the client. If necessary, the risk assessment must be carried out jointly and, in particular, the implementation of protective measures must be coordinated. For each type of activity, the employer must ensure that employees of other employers also have access to appropriate instructions in a language they understand regarding the risks to their safety and health. Compliance with the protective measures must be monitored.

(4) The measures specified in the risk assessment also serve to protect other persons insofar as they may be endangered by the use of biological substances.

Note: In addition, other hazards caused by the activity must also be taken into account and appropriate measures defined, e.g. in accordance with the Infection Protection Act (IfSG) or Animal Health Act (TierGesG), Plant Health Act (PflGesG) or Genetic Engineering Act (GenTG) [14-17].

The necessary measures under other laws remain unaffected and must be coordinated with each other.

3.2 Formal requirements

(1) The risk assessment must be reviewed at least every two years in accordance with Section 4 (2) BioStoffV and updated if necessary. If the review shows that an update is not necessary, the employer must note this in the risk assessment documentation in accordance with Section 7 BioStoffV, stating the date of the review [1]. An update must also be carried out whenever changes that could affect the safety of employees or new information about hazards make this necessary. This includes, for example:

1. Findings that the specified protective measures are not effective
2. the planned use of new work equipment, work procedures or work processes,
3. findings from accidents, occupational health precautions or illnesses that have occurred among employees that are directly related to the work performed,
4. new, reliable findings in occupational science or announcements by the Committee for Biological Agents (ABAS).

(2) Repair, maintenance, cleaning and servicing work as well as testing activities (e.g. for pressure equipment, centrifuges) are also subject to risk assessment.

(3) The risk assessment must be carried out by experts and occupational health aspects must be taken into account. For explanations of the requirements to be met with regard to expertise, see TRBA 200 "Requirements for expertise according to the Biological Agents Ordinance" [18].

(4) Occupational health expertise must be consulted in particular for

1. activities involving infection hazards, where occupational health care is mandatory or offered, or in the case of

2. activities where

   a) there may be exposure to sensitising or toxic biological substances,

   b) Hygiene measures and/or special disinfection measures are necessary,

   c) the organisation of special first aid measures and post-exposure prophylaxis is necessary,

   d) Personal protective equipment (PPE) must be worn (e.g. protective gloves, respiratory protection) or

   e) skin irritation may occur, requiring skin protection measures.

The doctor responsible for occupational health care, who has specific knowledge of the hazards at the relevant workplaces, must be involved as a matter of priority.

(5) As part of the documentation of the risk assessment, the employer must compile a list of the biological substances used or occurring (biological substances list), insofar as these are known. The list must contain information on the classification of the biological substances into a risk group in accordance with Section 3 of the Biological Substances Ordinance (BioStoffV) and on their sensitising and toxic effects [1].
The list of biological substances is not required if only activities involving biological substances in risk group 1 without sensitising or toxic effects are carried out.

(6) For activities classified as protection level 3, including activities involving risk group 3 biological agents (**), and protection level 4, the employer must also keep a list of the employees who carry out these activities. The register must specify the type of activities and the biological substances involved, as well as any accidents and operational disruptions that have occurred. It must be kept for at least ten years after the end of the activity. The employer must make the information in the register accessible to the employees concerned; the protection of personal data must be ensured. Upon termination of employment, the employee must be given an extract from the register containing the information relating to them; proof of delivery must be kept by the employer as part of the personnel records. The register of employees may be kept together with the register of biological substances.

(7) For activities involving material that contains or may contain TSE-associated agents, the ABAS recommendation on "Protective measures for activities involving transmissible spongiform encephalopathy (TSE)-associated agents in TSE laboratories" stipulates a retention period of 40 years for accident reports and documentation of medically necessary examinations [19].

3.3 Hazards

(1) The potential hazards for employees in biological laboratories depend on the respective task, the associated type and quantity of materials used

examination materials or the biological substances used, as well as the specific working procedures and activities. Accordingly, both biological substance-specific and activity-specific information must be determined.

(2) As part of the risk assessment, the employer must, in accordance with Section 4(3) of the BioStoffV, obtain information, in particular on the identity of the biological substances used and the health hazards they pose (infectious, sensitising or toxic effects), taking into account the specific activities [1]. Information on the risk of infection is provided in the relevant Technical Rules for Biological Agents TRBA 460-468 on the classification of biological substances into risk groups [6-10]. If a biological substance is not listed there, the employer must classify it in accordance with the current state of scientific knowledge and document this classification. In the case of attenuated biological substances, it is possible to deviate from the classification of the wild type if the reduction in virulence is sufficiently proven and genetically stable. This requires reliable identification and precise knowledge of the type and extent of attenuation. If the parent strain is classified in risk group 3 or 4, a downgrading can only be made on the basis of a scientific assessment, which can be carried out by the ABAS. For biological substances that are not listed, the Federal Ministry of Labour and Social Affairs (BMAS) can classify them into a risk group after consulting the ABAS. TRBA 450 describes criteria for classifying biological substances into risk groups [20].

(3) The sensitising or toxic effects of biological substances must be determined in addition to their infection potential. Information on respiratory sensitising and toxic properties can be found in Annex III of Directive 2000/54/EC, TRBA/TRGS 406
"Respiratory sensitising substances" and in the Technical Rules for Biological Agents (TRBA) for classification [5, 21].

(4) General information on biological substances and their hazards can be found in Annex 1 of TRBA 400 [13]. Specific information on biological substances is provided by, among others:

1. the Robert Koch Institute (RKI),
2. the Friedrich Loeffler Institute (FLI),
3. the GESTIS biological substances database and
4. the Central Commission for Biological Safety (ZKBS).

(5) In the case of activity-related information, operational processes and working procedures must be recorded in such a way that the individual activities can be checked with regard to:

1. the possibility of release of biological substances and exposure of employees,
2. the type of exposure and the associated transmission and absorption pathways, and
3. the level, duration and frequency of exposure, especially in the case of biological substances with sensitising or toxic effects.

(6) Depending on the activity, biological substances can be absorbed during laboratory work in the following ways:

1. aerogenously – via the air (inhalation)
2. orally – via the mouth (ingestion)

3. percutaneous/parenteral – through broken skin (e.g. cracked skin, micro-injuries, punctures, cuts) or via the mucous membrane (contact infection)

(7) Activities with increased exposure risk include, for example:

1. Opening sample containers
2. working with open cultures,
3. pipetting,
4. centrifuging,
5. breaking down cells,
6. Emptying vessels,
7. cutting samples (e.g. from tissue),
8. Maintenance and repair work on equipment (e.g. filter replacement) and
9. maintaining the functionality of automated processes (e.g. disposal of contaminated washing buffers, replacement of contaminated cannulas).

Particular hazards may arise from accidental contamination, e.g. through spillage, breakage, leaks, injuries from sharp instruments (e.g. syringes, cannulas) or incorrect operation.

(8) If activities involving endoparasites are planned, the stages in the life cycle of these parasites that are potentially infectious to humans and relevant to the activity must be taken into account in the risk assessment.

(9) The activity-related information must also include information on known diseases and occupational health precautions.

(10) Other aspects that may have an impact on the safety and health of employees must be included in the risk assessment. These include, for example

1. the organisation of work (e.g. work approval for maintenance),
2. the qualifications of those carrying out the work, and
3. psychological stress, e.g. due to increased requirements for protective measures (PPE), fear of infection, time pressure, insufficient staffing, unfavourable working hours and break arrangements.

3.4 Deriving protective measures

(1) When deriving protective measures, the following order of priority must be observed:

1. Substitution of biological substances or processes
2. Structural and technical protective measures
3. Organisational protective measures
4. Personal protective measures

(2) The necessary protective measures selected for the respective effect (infectious, sensitising, toxic) of a biological agent must be coordinated within the overall assessment.

(3) When determining the protective measures, measures from other areas of law must also be taken into account and integrated into the coordinated action plan.

(4) When deriving protective measures, not only the hazards to employees from working with biological substances must be taken into account, but also the hazards to other persons caused by such work. In addition, other hazards, such as those to the environment (e.g. under genetic engineering law and the Animal Disease Agents Ordinance), should also be included. The necessary measures must be coordinated with each other.

(5) If biological substances in risk group 1 have sensitising or toxic effects, additional special protective measures may need to be specified in addition to the general hygiene measures (see also 3.7.).

3.5 Assignment to protection levels

3.5.1 General

(1) Activities within the scope of this TRBA must be assigned to a protection level.

(2) The decisive factor in determining the required protection level is the classification of activities as targeted or non-targeted (see also Section 5 (1) BioStoffV). Typical laboratory workflows often include both types of activities.

(3) Targeted activities are directly aimed at a specific biological substance known to the species/subspecies, and the exposure of the employee is sufficiently known or assessable during normal operation. A targeted activity is, for example, the propagation of a bacterial species in pure culture or the propagation of a viral species using cell cultures.

(4) Non-targeted activities are those that do not meet any of the above criteria for targeted activities. For example, the examination of human sample material (e.g. blood, swabs, tissue samples) and environmental samples as part of microbiological, clinical-chemical or other special diagnostics is a non-targeted activity. This also applies to activities involving sample material from a donor with a clear suspicion of infection or a positive infection finding, provided that these activities are not directed at the relevant biological substance. Cytological or histological examinations of non-inactivated material also do not constitute targeted activities.

3.5.2 Protection level classification for targeted activities

For targeted activities, the required protection level corresponds to the risk group of the biological substance used. For targeted activities with biological substances from different risk groups, the classification of the biological substance in the highest risk group is decisive for the assignment of the protection level.

3.5.3 Protection level classification for non-targeted activities

(1) For non-targeted activities, the range of expected or potentially present biological agents must be determined. When assessing the potential risk of infection, the risk groups and properties of the biological agents must be taken into account. An overall activity-related assessment must be carried out on the basis of the individual assessments. The biological agent with the highest risk group is not necessarily decisive for the assignment to a protection level, but rather the overall hazard determined after assessing the exposure situation.

(2) The following factors in particular may be decisive for the assessment of the overall risk:

1. specific classification-relevant properties,
2. the infectious dose,
3. stage-specific infection risks,
4. probabilities of occurrence (e.g. incidence, prevalence),
5. concentrations and culture volumes,
6. activities involving bioaerosol formation,
7. type and proportion of manual work steps,
8. Activities with a risk of injury.

(3) Examples of protection level classifications for non-targeted activities are listed in section 3.6 .

3.5.4 Distinction between non-targeted and targeted activities

(1) In various areas of work, such as medical diagnostics or microbiological research, investigations may involve a transition from non-targeted activities to targeted activities. This is the case, for example, when the biological material known after the initial diagnosis of a sample is specifically propagated for further characterisation.

This can take place, among other things, in

1. further characterisation of isolates,
2. subtyping or
3. the determination of chemotherapeutic resistance.

As these are targeted activities, the protection level depends on the risk group of the biological agent in question.

(2) If defined control strains are used in diagnostic detection methods, these are also considered targeted activities.

(3) Non-targeted activities also include the storage or, in the context of waste disposal, the inactivation of sample material or isolated biological material after identification or diagnosis, provided that no further targeted activities follow.

(4) The risk assessment must take into account the appropriate storage of biological substances. The storage of reference strains, (virus) isolates and enriched cultures should be carried out in accordance with

protection level corresponding to the risk group of the biological material to be stored. This does not apply to samples from medical diagnostics (see section 3.6.1).

3.6 Examples of safety level classification for non-targeted activities

3.6.1 Medical/veterinary laboratories

(1) Clinical sample materials (body fluids, tissues, cell cultures, etc.) whose infection status has not been further characterised are to be regarded as potentially infectious. For this reason, corresponding activities are generally to be carried out under the conditions of protection level 2 in accordance with sections 4.1 and 4.3.

(2) If there is suspicion of infection with a risk group 4 biological agent, all preliminary tests (initial diagnostics) of samples containing non-inactivated material must be carried out under at least the conditions of protection level 3 in accordance with section 4.4.2. If test samples are available from an acutely ill patient infected with a risk group 4 biological agent, laboratory diagnostic tests with non-inactivated material must be carried out under the conditions of protection level 4 in accordance with section 4.5.

(3) If, after characterisation of human sample material from clinically unremarkable donors, no biological substances of risk group 2 and higher are present, the conditions of protection level 1 according to section 4.2 are sufficient. This is the case, for example, if the sample materials are HIV-, HBV- and HCV-negative. It can then be assumed that although the risk of infection from other biological substances (pathogens) cannot be ruled out, it is negligible if the general hygiene measures specified in TRBA 500
"Basic measures for activities with biological agents" [30].

(4) If the infection status of the sample material is known, biological substances in risk group 3, e.g. HIV, HBV or HCV, and the activities are not focused on these, the risk assessment can be used to check, in accordance with the criteria specified in section 3.5.3, whether the protective measures of protection level 2 in accordance with section 4.3, with individual additional protective measures to be specified if necessary, are sufficient. If this is not the case, the activities must be carried out under the conditions of protection level 3 in accordance with section 4.4.2.

(5) Activities in the context of tuberculosis diagnostics based on primary material (test material), e.g. sample preparation and processing/pre-treatment, direct microscopic examination for the detection of acid-fast bacilli, cultural cultivation in liquid and solid culture media, inactivation for the performance of molecular biological techniques (polymerase chain reaction - PCR), may be carried out under the conditions of protection level 2. If the culture media (cultural cultivation) are positive and the further work steps do not involve targeted activities, it can be checked on an activity-specific basis in accordance with the criteria specified in section 3.5.3 whether the protective measures of protection level 2, possibly with individual additional protective measures to be specified, are sufficient. This is the case, for example, if the sample material taken is immediately inactivated or does not undergo further multiplication. The prerequisite is that employees are safely protected from bioaerosol exposure. Further diagnosis of risk group 3 mycobacteria grown in the culture media, i .e. final differentiation/identification using physiological

tests or phenotypic susceptibility testing against antituberculosis drugs, are specific activities. These must be carried out under the conditions of protection level 3 in accordance with section 4.4.2.

(6) Activities related to anthrax diagnostics are classified as protection level 2 in accordance with Section
4.3 if they involve preliminary examinations (initial diagnostics) of

1. samples of human or animal origin, such as swabs, blood, etc., or
2. environmental samples, e.g. soil samples, that may contain anthrax pathogens. For the examination of suspected samples in biological hazard situations, Annex 3 of TRBA 130 "Occupational safety measures in acute biological hazard situations" [22] applies.

Preliminary investigations include the preparation and evaluation of microscopic specimens, the creation and evaluation of cultures and, if necessary, serological and molecular biological investigations directly on the test material. In addition to the recording of morphological characteristics, the evaluation of cultures may also include the performance of PCR and other methods (such as MALDI-TOF mass spectrometry) using inactivated bacterial material.
If the preliminary tests on the primary samples or primary cultures have provided clear indications of the presence of *Bacillus anthracis* (e.g. positive PCR signal for the detection of virulence plasmid DNA, MALDI-TOF with corresponding reference database), the pathogen may be anthrax. Further diagnostics, i.e. the final differentiation (exclusion or confirmation of anthrax pathogens) of the enriched bacteria using microbiological, biochemical and molecular biological techniques (unless the material is inactivated) and diagnostic animal testing, must be carried out in biosafety level 3 according to Section
4.4.2.

(7) For activities involving material that contains or may contain TSE-associated agents, the ABAS recommendation on "Protective measures for activities involving transmissible spongiform encephalopathy (TSE)-associated agents in TSE laboratories" [19] applies.

(8) Laboratories in which activities involving animal sample materials from vertebrates (excluding primates and, where applicable, wild animals) are carried out are to be assigned to protection level 1 in accordance with section 4.2, provided that the donor animals show no symptoms of disease. As a rule, it can then be assumed that although the risk of infection from other biological substances (pathogens) cannot be ruled out, it is nevertheless negligible if the general hygiene measures specified in TRBA 500 are observed. If there is reasonable suspicion of infection with a zoonotic pathogen, at least the protective measures of protection level 2 according to section 4.3 must be observed.

(9) Activities involving uncharacterised material from primates are to be assigned to protection level 2 in accordance with section 4.3. If, due to the disease of the donor animal or other indications, biological substances of a higher risk group are to be expected (e.g. in samples from wild animals), the protection level must be determined on a case-by-case basis as part of the risk assessment.

(10) Activities involving sample material from laboratory and wild animals that are known to be carriers of human pathogenic biological substances or have been infected with them must be assigned a protection level corresponding to the risk group of the biological substance. Under certain circumstances, deviations from this rule are possible if the risk assessment determines that

has significantly reduced the risk of infection (see TRBA 120 "Laboratory Animal Husbandry", Section 3.4) [23].

3.6.2 Microbiological quality assurance/sterility testing

(1) Laboratories in which sterility tests, colony count determinations and other microbiological quality assurance work are carried out that do not serve the specific detection of biological substances in risk group 2 and above can be operated under protection level 1 conditions in accordance with section 4.2. This includes, for example, samples from the manufacture of food, medical devices, medicinal products, biologicals or cosmetics.

(2) If, in the course of the activities, there is selective propagation or enrichment of biological substances in risk group 2 or 3, the activities must be carried out at least under the conditions of protection level 2 in accordance with sections 4.1 and 4.3.

(3) Samples from the manufacture of biologicals, such as plasma proteins, recombinant proteins or other products produced from biological material, are tested for contamination with bacteria, viruses and other microorganisms. Since these intermediate and end products originate from tested starting material, these tests can be carried out under protection level 1 conditions in accordance with sections 4.1 and 4.2.

3.6.3 Other microbiological laboratories, environmental testing laboratories

(1) The vast majority of sample materials from the environment (water, soil, sediments, air, etc.) are generally considered non-infectious, even if they may contain some risk group 2 biological substances. For this reason, activities involving these materials can generally be carried out under protection level 1 conditions in accordance with sections 4.1 and 4.2. If there are suspicions of particular contamination of environmental habitats by human pathogenic biological substances, a risk assessment must be carried out to determine whether the activities should be carried out under the conditions of protection level 2 in accordance with sections 4.1 and 4.3.

(2) Activities involving enriched microbial fractions, produced e.g. by specific purification or selective propagation, must be carried out under the conditions of protection level 2 in accordance with sections 4.1 and 4.3 if a concentration of biological substances in risk group 2 and higher can be assumed. In individual cases, the risk assessment must determine whether a higher protection level is necessary.

(3) Wastewater (sewage) and sewage sludge contain human pathogenic biological substances, the composition and concentration of which can vary greatly depending on their origin and the process involved. Occasional activities of minor scope, such as occasional turbidity measurements, may be carried out under the conditions of protection level 1 in accordance with sections 4.1 and 4.2. Depending on the results of the risk assessment, more extensive activities involving corresponding sample materials, such as analysis of wastewater for polioviruses, may be carried out under the conditions of protection level 2 in accordance with sections 4.1 and 4.3. Annex 1 of TRBA 220 "Wastewater Treatment Plants: Protective Measures" contains an overview of biological substances found in wastewater [24].

(4) Sample materials from waste, compost and rotting material usually contain biological substances in risk groups 1 and 2. If the examination of such samples could lead to the accumulation or proliferation of infectious biological substances, these must be

activities must generally be carried out under protection level 2 conditions in accordance with sections 4.1 and 4.3.

(5) Such sample materials usually also contain biological substances with sensitising and toxic effects (see Section 3.5).

3.7 Determination of protective measures based on sensitising or toxic effects of the biological substances

(1) Biological substances with sensitising or toxic effects can play a role in particular:

1. in research laboratories with corresponding research focuses,
2. in environmental testing laboratories and
3. in microbiological quality assurance, e.g. in the food industry.

(2) If biological substances in risk group 1 have sensitising or toxic effects, additional protective measures must be specified in addition to the general hygiene measures in accordance with TRBA 500 protection level 1. As a rule, these are measures that serve to minimise or prevent contact with biological substances and/or the formation of bioaerosols, such as the use of an MSW (see section 4.2.2).

(3) In protection levels 2 and 3, it can be assumed that the implementation of the required structural, technical and organisational measures will sufficiently minimise the release of biological substances with sensitising or toxic effects.

(4) Since the sensitising or toxic potential may remain after the inactivation of biological substances with sensitising or toxic effects, the appropriate protective measures must therefore be implemented as part of the risk assessment even after the inactivation of these biological substances.

3.8 Instruction, permission and notification requirements

(1) Before activities from protection level 3 onwards are carried out in laboratories for the first time, a permit in accordance with §15 BioStoffV must be obtained from the competent authority. Activities involving biological substances in risk group 3(**) must be notified [1].

(2) Furthermore, notification requirements may apply to various activities in accordance with § 16 BioStoffV. Notification requirements also apply to specific activities at protection level 2, among others [1].

(3) According to Section 17(1) of the BioStoffV, there is a duty to notify the authorities in the event of illness or death during activities involving biological substances of any risk group and in the event of accidents and operational disruptions during activities involving biological substances of risk groups 3(**), 3 and 4 [1].

4 Protective measures

4.1 General (applicable to protection levels 1 to 4)

(1) Before using biological substances that are hazardous to health, the employer must check whether they can be replaced by less hazardous substances (substitution test). In the case of specific activities, this is possible in individual cases, e.g. if a less pathogenic strain is available and the test objective can be achieved with this strain in the same way as with the corresponding wild-type strain. In the case of non-specific activities, the employer
usually not be able to substitute the biological substances. When using human sample material for research purposes, characterised test material (HIV-, HBV- and HCV-negative) should be used where possible.

(2) Working methods and equipment must be designed in such a way that biological substances cannot be released into the workplace, e.g. through protected mechanical or automated processes. If this is not possible, exposure of employees must first be reduced to a minimum through appropriate technical protective measures and then through organisational measures. These always take precedence over individual protective measures. Only when technical and organisational measures alone are not sufficient to achieve the protection objective should suitable personal protective equipment (PPE) be worn. This must be taken into account in the risk assessment (see section 3).

(3) Taking into account the state of the art and scientific knowledge, working methods are to be preferred:

1. that are largely automated,
2. require only a few manual steps with as small volumes as possible,
3. in which bioaerosol formation is minimised,
4. in which the material is inactivated,
5. where the equipment used can be decontaminated.

If the state of the art has advanced and this significantly improves the safety and health protection of employees, it must be introduced within a reasonable period of time.

(4) In all activities, care must be taken to avoid bioaerosol formation as far as possible.

(5) Safety-related equipment and systems such as MSW, laboratory centrifuges subject to testing, autoclaves and air conditioning systems must be maintained. This requires regular checks of their functionality and operational safety and, if necessary, their repair.

(6) When working with infected vectors (arthropods) and hosts that can transmit pathogens, these animals must be prevented from escaping. TRBA 120 must be taken into account accordingly [23]. From protection level 2 onwards, access should be via an arthropod-proof airlock.

(7) For activities involving biological substances in laboratories, the necessary hygiene rules must always be observed. These also include a ban on cosmetics, food and

luxury foods in the corresponding containment levels. The employer must set up suitable, easily accessible areas outside the containment level area for this purpose.

(8) Mobile devices and accessories, e.g. laptops, smartphones, headphones, which are not required for work purposes, must not be stored in the work area or used with protective gloves. Mobile devices required for work purposes generally remain in the protection level area. Their use, including cleaning and disinfection, must be regulated in the hygiene plan.

(9) Long hair and headgear should be worn in such a way that they do not interfere with activities and do not restrict the field of vision. If necessary, additional measures must be specified.

(10) Operational hygiene measures must be recorded in a hygiene plan for activities involving sensitising or toxic biological substances and for activities in protection level 2 and above. The specific cleaning and decontamination procedures must be specified. The hygiene plan must be communicated in an appropriate manner (see paragraphs 13 and 14) and complied with.

Note: A template for a hygiene plan is provided in DGUV Information 213-086 (biological laboratories) [12].

(11) When selecting effective disinfectants and specific disinfection procedures, care must be taken to ensure that their effectiveness has been proven in accordance with the planned area of application (e.g. hand disinfection, surface disinfection) and pathogen spectrum [25-28].

(12) Pipetting aids must be used.

(13) In accordance with Section 14 (1) of the BioStoffV, operating instructions must be drawn up and updated if necessary in the event of changes to the risk assessment [1]. This is not necessary if only activities involving biological substances in risk group 1 without sensitising or toxic effects are carried out.

The operating instructions must contain the following points in particular:

1. the hazards arising from the activities, in particular
   a) the biological substances used or likely to occur and their risk groups, as well as
   b) the relevant transmission routes or absorption pathways.
2. Protective measures and rules of conduct:
   a) Measures to prevent exposure,
   b) internal hygiene measures, reference to the hygiene plan if applicable,
   c) wearing, using and removing personal protective equipment.
3. Behaviour in emergencies, accidents and operational disruptions.
4. First aid measures, if applicable, information on post-exposure prophylaxis (PEP).
5. Disposal measures for contaminated solid and liquid waste.

Note: Examples of model operating instructions are contained in TRBA 250 and DGUV Information 213-016 "Operating instructions according to the BioStoffV" [30, 11, 29].

(14) Employees and persons treated as employees within the scope of application must be instructed on the hazards associated with their work with biological substances and the necessary protective measures. This must be done verbally and in relation to the workplace before the start of work and in the event of significant changes to the work, and thereafter at regular intervals, at least once a year.

(15) Other persons who may be endangered by the use of biological substances by employees or by entrepreneurs without employees must also be instructed in an appropriate manner about the possible health hazards of the biological substances used. The basis for this is the risk assessment.

(16) Employees shall be instructed on the basis of the operating instructions and the company hygiene measures (hygiene plan). The content and timing of the instructions shall be recorded in writing and confirmed by the signatures of those instructed.

(17) The training must be designed in such a way that it creates safety awareness among employees. It must be ensured that those receiving the training have understood the content.

(18) General occupational health advice must also be provided as part of the training. This must be carried out with the participation of the doctor responsible for occupational health care. Participation is
also provided, for example, by training the persons who carry out the instruction or by participating in the preparation of suitable teaching materials on occupational health prevention.

(19) The topics on which employees must be informed and advised are to be determined depending on the results of the risk assessment. They include, among other things:

1. possible activity-related health hazards posed by the biological substances used or present. In particular,
   a) the typical transmission routes or absorption pathways associated with the activity,
   b) the possible clinical pictures and symptoms,
   c) medical factors that may increase the risk of infection, such as
      - a reduced immune response (e.g. due to immunosuppressive treatment or a disease such as diabetes mellitus),
      - the presence of chronic obstructive respiratory diseases in connection with activities involving potentially sensitising biological substances,
      - impaired skin barrier function,
      - any other individual predisposition, or
      - pregnancy and breastfeeding, as well as
   d) the possibilities of vaccination prophylaxis,

must be taken into account.

2. the rules of conduct to be observed, e.g. hygiene requirements, skin protection and care, and their consistent implementation.
3. the medical aspects of the necessity, suitability and use of personal protective equipment (e.g. protective gloves, protective suit, respiratory protection), including handling, maximum wearing times, replacement intervals and possible physical and psychological stress.
4. First aid and post-exposure prophylaxis measures, as well as procedures for cuts and puncture wounds.
5. The necessary occupational health care, both mandatory and optional, as well as the possibility of voluntary preventive care, including vaccinations, their scope and benefits.
6. The offer of occupational health care in the event of illness if there is a suspected causal link with the activity.

(20) If employees from different employers (e.g. cleaning companies, construction and maintenance companies) are working, the coordination obligation under Section 8 of the Occupational Safety and Health Act must be observed [31]. The protective measures of these TRBA, including responsibilities and the implementation and content of training, must be agreed between the employers involved on an activity-specific basis. The agreement must be in writing and is binding.

(21) The number of employees who carry out activities with biological substances from risk group 2 onwards must be limited to the necessary minimum. The same applies to activities with biological substances that have sensitising or toxic effects.

(22) In the case of specific activities, the identity of the biological substances used must be regularly checked and documented, insofar as this is necessary for the assessment of the hazard potential. This is not necessary if other procedures, e.g. the use of master cultures, can already ensure that the identity is preserved.

(23) When implementing the measures set out in these TRBA, it is necessary to take into account the individual circumstances on site and the nature of the activity. Deviations from the measures set out in these TRBA are permitted if the results of the risk assessment allow this or if measures are taken that are at least comparable in terms of employee protection. Equivalence must be documented and proven at the request of the authorities.

(24) In the event of illness or death attributable to activities involving biological substances, the employer is obliged to report this to the competent authority in accordance with the BioStoffV (Section 17 BioStoffV) [1].

(25) Sections 4.2 to 4.5 below cover all specific protective measures for the corresponding protection levels.

4.2 Protection level 1

4.2.1 Activities of protection level 1 without hazards due to sensitising or toxic effects

In these activities, there is unlikely to be a risk of infection for employees.

Structural and technical protective measures

(1) Protection level 1 laboratories should consist of separate rooms that are sufficiently large. Depending on the activity, sufficient work space must be ensured for each employee.

(2) Laboratory doors should open in the direction of escape and be equipped with a viewing window for personal safety reasons.

Note: This applies in principle to laboratories that fall under TRGS 526 [4].

(3) A washbasin with hand washing liquid and disposable towel dispenser should be available in the work area.

(4) Surfaces (e.g. work surfaces, floors, storage containers) should be easy to clean and must be resistant to the substances and cleaning agents used.

Organisational protective measures

(5) Windows and doors should be closed during work.

(6) Protection level areas should be kept tidy and clean. Only the work equipment that is actually needed should be kept on the work surfaces. The protection level area should be cleaned regularly. Supplies should only be stored in small quantities and only in areas or cupboards provided for this purpose. Storage rooms should be provided for larger quantities.

(7) After completing the task or after contamination with biological substances, hands must be thoroughly cleaned and cared for in accordance with the skin protection plan. Suitable hand cleansers, skin protection and skin care products must be provided for this purpose. As part of the risk assessment, it must be checked whether the use of disinfectants is necessary.

(8) When performing tasks that require hand disinfection, nothing may be worn on the hands or forearms. Fingernails should be cut short.

(9) Liquid and solid waste containing biological substances must be collected and disposed of properly. They can be disposed of without pre-treatment if other regulations (e.g. water, waste or genetic engineering legislation) do not prevent this.

(10) Needles, syringes and other sharp instruments and laboratory equipment should only be used when absolutely necessary. After use, they must be collected in puncture-proof and break-proof disposable containers in accordance with TRBA 250 and inactivated [11].

(11) Needles must not be returned to the needle cover. If piercing and cutting instruments are used in connection with animal experiments, Annex 2 of TRBA 120 must be taken into account [23].

Personal protective measures

Laboratory coats or other protective clothing must be worn in the protection level area. Used laboratory coats must be stored separately from street clothing.

4.2.2 Protection level 1 activities with hazards due to sensitising or toxic effects

(1) Activities involving risk group 1 biological substances that have sensitising or toxic effects may pose a health risk to employees. For this reason, in addition to the measures specified in section 4.2.1, further protective measures must be defined as part of the risk assessment to minimise employee exposure.

(2) The following measures may be considered in particular:

Structural and technical protective measures

(3) Activities in which airborne biological substances (e.g. during the spore-forming development phases of fungi or actinomycetes) are released or other bioaerosols may be produced must be carried out under a MSW or in a facility comparable in terms of personal protection (e.g. fume cupboards in accordance with DIN EN 14175) [32]. For protective measures for respiratory sensitising substances, see also TRBA/TRGS 406 [21].

Note: DGUV Information 213-086 contains further information on working safely at microbiological safety cabinets [12].

Organisational protective measures

(4) Depending on the specific properties of the biological substances used, effective inactivation, disinfection and cleaning measures must be specified in the hygiene plan in accordance with Section 4.1, Paragraph 6.

The risk of puncture wounds and cuts must be prevented or minimised as far as technically possible.

Personal protective equipment/protective measures

(5) Depending on the risk assessment, additional personal protective equipment may be necessary, such as protective gloves or respiratory protection.

(6) When performing activities that require hand disinfection or the wearing of protective gloves, nothing may be worn on the hands or forearms. Fingernails must be cut short. For effective hand hygiene when using protective gloves, short-cut fingernails must be flush with the fingertips. Artificial and gel nails are not permitted.

4.3 Protection level 2

(1) The protective measures of protection level 2 serve to prevent exposure of employees to biological substances that can cause infectious diseases in humans.

(2) These measures also serve to protect employees who work in the work areas without themselves carrying out activities with biological agents in protection level 2, and to protect other persons who may be endangered by the use of biological agents.

Note: They are also suitable for protecting the environment.

(3) The requirements described below must be observed to protect employees.

(4) Protection level 2 measures that protect against the infectious effects of the biological substances present may also provide adequate protection against sensitising or toxic effects. This may not apply to inactivation measures. Adequate protection must be determined on a case-by-case basis as part of the risk assessment.

(5) The relevant reporting requirements in accordance with Section 16 of the BioStoffV must be observed before activities are commenced for the first time [1].

Structural and technical protective measures

(6) Laboratories must consist of sufficiently large rooms that are structurally separated from other rooms and areas of use in which no activities involving biological substances are carried out.

(7) Laboratory doors should open in the direction of escape and be equipped with a viewing window for personal safety reasons.

(8) A washbasin, preferably a separate hand washbasin, with disinfectant, hand soap and disposable towel dispensers must be available for disinfecting and cleaning hands. Water taps and disinfectant dispensers should be operable without touching them by hand. A device for rinsing the eyes, supplied with drinking-quality water, must be available and should be as continuous as possible. The installations must be easily accessible and preferably located near the laboratory door. Eye wash bottles with sterile rinsing fluid are permitted if running water of drinking quality is not available. Used eye wash bottles must be replaced immediately. It must be ensured that the eye wash bottles do not exceed the expiry date specified by the manufacturer. To this end, the eye wash bottles must be checked regularly (at least once a year) and the check must be documented.

Note: In laboratories for the cultivation of cell cultures, the sink may also be located in an adjacent area within the same protection level area for product protection reasons. A disinfectant dispenser must be provided in a suitable location in the laboratory if necessary.

(9) Surfaces (work surfaces and adjacent wall surfaces, floors, surfaces on equipment and apparatus, surfaces of furniture that may come into contact with biological substances) must be easy to clean and resistant to the substances, chemicals, cleaning agents and disinfectants used. The work surfaces, adjacent wall surfaces and floors, as well as the wall-floor connection, must be liquid-tight.

(10) If an air conditioning system is necessary to ensure suitable breathing air, the operation of the air conditioning system must not pose a potential hazard to employees due to biological substances within the laboratory rooms.

Note: Requirements for the operation of air handling units in protection level 2 laboratories are contained in ABAS Recommendation 1/2022 of 14 January 2022, "Description of the technical requirements for air handling units in protection and safety level 2 laboratories" [33].

(11) A sufficiently dimensioned autoclave or equivalent sterilisation unit suitable for the requirements of inactivation shall be available in the same building if the waste is not inactivated on the premises or by a proper contract disposal service. The success of the inactivation shall be documented. This can be done, for example, by means of the autoclave's batch documentation.

Note: For off-site transport, the dangerous goods regulations for class 6.2 "Infectious substances" [34]. ABAS Recommendation 13/2023 of 24 May 2023 "Process validation of waste inactivation processes in autoclaves in the laboratory area" contains information on the validation of waste inactivation processes. [35].

(12) Suitable sealable containers must be provided in which contaminated liquid and solid waste (e.g. cultures, tissue, samples containing body fluids) can be safely collected and sent for inactivation appropriate for this type of waste (see paragraph 6). Physical or chemical methods that are proven to be effective against the specific pathogens must be used for inactivation (see paragraph 6).

TRBA 120 specifies the treatment of animal carcasses [23].

(13) Equipment that does not release bioaerosols, such as centrifuges with aerosol-tight rotors or centrifuge buckets, must be used. Equipment that is not aerosol-tight may be operated in an MSW or in an equivalent safety device. In both cases, it must be ensured that the protective properties of the respective safety device are not impaired. This also includes systems for extracting liquids from cell cultures.

Note: DGUV Information 213-086 [12] can be consulted for information on working safely with centrifuges with regard to the avoidance of aerosols.

(14) Activities in which there is a risk of exposure to bioaerosols must be carried out in a biosafety cabinet or in a facility that offers comparable personal protection (e.g. fume cupboards in accordance with DIN EN 14175 with high-performance particulate filters) [32].

Note: For information on working safely at microbiological safety cabinets, see DGUV Information 213-086 [12].

(15) Emergency power supplies are recommended for emergency facilities and technical facilities designed to prevent the release of biological substances.

(16) Contaminated process exhaust air must be treated in such a way that the release of biological substances into the work area is prevented. It must be decontaminated using suitable methods such as filtration through high-performance particulate filters, thermal post-treatment or another tested method. This applies, for example, to exhaust air from autoclaves, pumps or bioreactors. For the treatment of exhaust air from autoclaves, see also the ABAS recommendation "Installation recommendations for new systems, retrofitting or additions for choosing of autoclave exhaust air treatment" [28].

(17)

Organisational protective measures

(1) The access door to the protection level area must be clearly and permanently marked from the outside with protection level 2 and the "biohazard symbol" (Appendix I BioStoffV) [1].

Note: For requirements regarding the symbol, see warning sign W 009 "Warning of biological hazard" in accordance with Annex 1 ASR A 1.3 [36].

(2) The number of persons authorised to access the area must be limited to those employees who have been instructed accordingly. Persons who are not authorised to access the area may only enter the containment level area after receiving instruction and with the permission of the person responsible for laboratory safety.

(3) If activities involving dual-use human and animal pathogenic biological substances listed in Regulation (EU) 2021/821 are carried out, controlled access (e.g. through personalised electronic access control) to the containment area is necessary [37].

(4) Windows and doors must be kept closed during activities involving biological substances.

(5) Risk group 2 biological substances must be stored safely in tightly sealed containers. If these are human pathogenic biological substances listed in Regulation (EC) 2021/821, they must be kept under lock and key [1, 37].

(6) Protection level areas should be kept tidy and clean. Only the work equipment that is actually needed should be kept on the work surfaces. The protection level area must be cleaned regularly. Supplies should only be stored in small quantities and only in designated areas or cupboards. Storage rooms must be provided for larger quantities. Work surfaces must be disinfected and cleaned in accordance with the hygiene plan after completion of the activity and contaminated work equipment must be disinfected and cleaned after use. Accidental contamination must be removed immediately.

Note: Recommendations can be found in DGUV Information 213-086 [12].

(7) Wipe disinfection is preferable to spray disinfection for disinfecting surfaces. Spray disinfection is only recommended for areas that are difficult to access. When using alcoholic preparations, the potential risk of fire and explosion must be taken into account. The regulations governing hazardous substances must be observed.

(8) Before testing, cleaning, maintenance, modification and demolition work on potentially contaminated equipment or facilities, the employer must arrange for decontamination. This also applies to equipment/work equipment that is sent away for maintenance. If decontamination is not possible, suitable personal protective equipment must be provided for the company's own and external maintenance personnel. The additional protective measures required must be specified in writing in a work instruction for each activity and communicated to the personnel. Any unavoidable residual risks must be pointed out. This also applies to external personnel. The instruction must be documented. The responsible person must issue a written work release for all of the above-mentioned work.

(9) If contamination of the secondary packaging and request forms is detected in the sample delivery area, these must be disinfected and, if necessary, relabelled. Sample containers must be safe to open.

(10) Needles, syringes and other sharp instruments and laboratory equipment should only be used when absolutely necessary. Where technically feasible, the risk of puncture wounds or cuts should be prevented or minimised. After use, these must be collected in puncture-proof and break-proof disposable containers in accordance with TRBA 250 and inactivated. Cannulas must not be returned to the cannula cover. If piercing and cutting instruments are used in connection with animal experiments, Annex 2 of TRBA 120 must be taken into account [11, 23].

(11) If blood samples are to be taken from patients in diagnostic facilities, the requirements of TRBA 250 Number 4.2.5 on the use of safety equipment apply.

(12) If biological substances or material that contains or may contain biological substances, including waste, are transported internally outside the protection level area, this must also be done in closed, dimensionally stable, break-proof, liquid-tight and disinfectable transport containers. These must be permanently marked or labelled. They must be marked with the symbol for "biological hazard" and must not be able to be opened accidentally by external influences. The containers must be disinfected and cleaned regularly and after each contamination, both inside and outside.

(13) After completing the activity and before leaving the protection level area, hands must be disinfected, carefully cleaned and cared for in accordance with the skin protection plan. Skin protection and skin care products must be provided by the employer.

TRGS 401 "Hazards due to skin contact: Determination – Assessment – Measures" must be observed [38].

Personal protective equipment/protective measures

(1) In the protection level area, laboratory coats or comparable protective clothing and, depending on the risk assessment, any additional suitable PPE that may be required
e.g. disposable protective gloves in accordance with DIN EN 374-5 (with an AQL value ≤ 1.5), respiratory protection and eye protection must be worn [39]. Protective clothing and PPE must be provided by the employer in sufficient quantities and worn by employees.

(2) Protective gloves must be worn depending on the risk assessment,
e.g. when hands may come into contact with biological substances, potentially infectious materials, and contaminated objects, surfaces or equipment.

(3) If there is a potential risk of splashes in the face area, face protection (e.g. safety goggles or face shield in accordance with DIN EN 166) must be worn [40].

(4) Protective clothing and PPE must not be worn outside the protection level area and must be removed before leaving the protection level area. Appropriate facilities (e.g. sufficient coat hooks) must be provided for storage. Coats should be hung up in such a way as to avoid cross-contamination. Separate storage facilities must be provided for used PPE, including protective clothing and street clothing, so that contamination of street clothing can be ruled out. Street clothing, bags, etc. must not be stored in the protection level area.

(5) The procedure for disposing of used PPE, including protective clothing, must be regulated in the hygiene plan, e.g. provision of suitable containers.

(6) PPE, including protective clothing, must not be taken home by employees for cleaning. Disinfection and cleaning must be carried out or arranged by the employer. Contaminated protective clothing and work clothing must be cleaned by a certified laundry service or by the employer itself in accordance with recognised technical rules [25]. PPE, including protective clothing made of disposable materials, must be disposed of properly. If additional work clothing is required based on the risk assessment, changing facilities separate from the workplace must be available. Work clothing must be changed regularly and as needed.

(7) Depending on the risk assessment, the laundry (work clothing and/or PPE, including protective clothing) must be subjected to a suitable sterilisation or inactivation process before being handed over to a certified laundry service.

(8) For activities that require hand disinfection or the wearing of protective gloves, nothing may be worn on the hands or forearms. Fingernails must be cut short. For effective hand hygiene when using protective gloves, short-cut fingernails must be flush with the fingertips. Artificial and gel nails are not permitted.
Painted fingernails can compromise the effectiveness of hand disinfection. Therefore, a risk assessment must be carried out to decide whether nail polish must be avoided.

(9) When working with infectious tissue, e.g. during cutting or microscopic examinations, personal protective equipment must be supplemented with disposable aprons. Safety goggles are required when opening cavities, and respiratory protection (at least an FFP-2 mask) may be required when cutting cysts and lymph nodes and when performing quick sections, depending on the risk assessment. In histological laboratories, suction cutting tables are recommended due to the risk posed by formalin.

4.4 Protection level 3

The protective measures of protection level 3 serve to prevent exposure of employees to risk group 3 biological agents that can cause serious infectious diseases in humans. These measures also serve to protect employees who work in the work areas without themselves carrying out activities with biological substances in protection level 3 and to protect other persons who may be endangered by the use of biological substances. At the same time, they are suitable for protecting the environment.

Note: The requirements for mobile laboratory units of protection level 3 for use in crisis and disaster areas, in the context of acute biological hazards within the country and in Bundeswehr operations are described in detail in the ABAS Technical Recommendation of 12 November 2020 "Requirements for mobile laboratory units of protection level 3" [41].

4.4.1 Activities with risk group 3 biological substances marked with (**)

(1) Certain biological substances in risk group 3, which are not normally transmitted via the air, have been classified with two asterisks

. For the sake of simplicity, they are referred to below as *"risk group 3(**)* biological agents*"*. For these biological agents, certain level 3 protection measures may be waived under Directive 2000/54/EC [5]. It is the responsibility of the Member States to determine which measures are to be taken, taking into account the specific characteristics of the biological agents concerned.

(2) This section covers all specific protective measures for activities involving risk group 3 (**) biological agents in laboratories.

(3) Before commencing activities involving risk group 3 (**) biological substances in laboratories, the notification requirements pursuant to Section 16 of the BioStoffV must be observed [1].

(4) Activities involving certain developmental stages of risk group 3(**) parasites or without the presence of the corresponding vectors/intermediate hosts can be carried out at protection level 2, as they are associated with a low risk of infection [8].

Structural and technical protective measures

(1) The protection level area must be structurally separated from other work areas and must consist of sufficiently large rooms. Access control (e.g. electronic) is mandatory.

(2) A personnel shower must be included in the design if this is necessary based on the risk assessment. The shower water must be treated as contaminated wastewater.

(3) Visual connections or comparable devices to the outside must be sealed and must not be able to be opened [53].

(4) For personal protection, the doors of the laboratory must be equipped with viewing windows to allow visibility into the laboratory area and should open in the direction of escape. If there are several laboratories in the protection level area, their doors must also be equipped with viewing windows.

(5) A separate hand washbasin with disinfectant, hand soap and disposable towel dispensers must be provided for hand disinfection and cleaning. Water taps and disinfectant dispensers should be operable without touching them by hand. The installations must be easily accessible and preferably located near the laboratory door. A device for rinsing the eyes, fed with drinking water quality water, must be available and should be as continuous as possible. Eye wash bottles with sterile rinsing fluid are permitted if no running water of drinking water quality is available. Used eye wash bottles must be replaced immediately. It must be ensured that the eye wash bottles do not exceed the expiry date specified by the manufacturer. To this end, the eye wash bottles must be checked regularly (at least once a year) and the check must be documented.

(6) All surfaces (e.g. work surfaces, adjacent wall surfaces and the floor, as well as the wall-floor connection, walls, floors and surfaces of the inventory) must be liquid-tight, easy to clean and resistant to the substances, chemicals, cleaning agents and disinfectants used.

(7) If an air conditioning system is necessary to ensure suitable breathing air, the operation of the air conditioning system must not pose a potential hazard to employees due to biological substances within the laboratory rooms.

(8) Whether all laboratory exhaust air must be filtered using HEPA filters or comparable filters and whether negative pressure is necessary must be determined in the risk assessment, taking into account the specific activity and quantity of the respective biological substance.

(9) If the risk assessment determines that room fumigation is necessary due to the activity and quantity of the biological material, the rooms in the protection level area and the contaminated part of the air handling unit, up to and including the HEPA filter, must be sealable with a fumigant for the purpose of disinfection.

(10) Suitable equipment must be available for communication between the laboratory area and the outside area. Employees may only work alone if the activities can be safely controlled alone and if an emergency call device or comparable device that can be operated from the inside is available. The employer must determine in the risk assessment whether the emergency call signal should be triggered manually or automatically.

Note: According to DGUV Rule 100-001, working alone is defined as a person working alone, out of earshot and out of sight of other people [42].

(11) Safety lighting must be installed so that work can be safely stopped and the work area safely left in the event of a power failure.

(12) Suitable sealable containers must be provided in which contaminated liquid and solid waste (e.g. cultures, tissue, samples containing body fluids) can be safely collected and sent for inactivation appropriate for this type of waste. Physical or chemical methods that are proven to be effective against the specific pathogen must be used for inactivation (see paragraph 10). Technical measures for the collection and treatment of animal carcasses are contained in TRBA 120 [23].

(13) Validated physical or chemical processes must be used for the inactivation of waste. For this purpose, a sufficiently dimensioned autoclave or comparable equipment (e.g. chemical sterilisation equipment) suitable for the requirements of sterilisation must be available in the same building. The success of the inactivation must be documented. This can be done, for example, via the batch documentation of the autoclave. Proper contract disposal (preferably incineration) may only be carried out in sufficiently justified individual cases if the same protection objective is achieved. Reference is made to the relevant information in TRBA 214 "Plants for the treatment and recovery of waste" [43].

Note: For external transport, the dangerous goods regulations for class 6.2 "Infectious substances" [34] apply to external transport.

(14) Equipment that does not release bioaerosols, such as centrifuges with aerosol-tight rotors or centrifuge buckets, must be used when working with airborne biological substances. Non-aerosol-tight equipment may be operated in an MSW or in an equivalent safety device. In both cases, it must be ensured that the protective properties of the respective safety device are not impaired. This also includes systems for extracting liquids from cell cultures.

Note: For information on working safely with centrifuges with regard to the avoidance of aerosols, see DGUV Information 213-086 [12].

(15) Activities in which there is a risk of exposure to bioaerosols must be carried out in a biosafety cabinet or in a facility that offers comparable personal protection (e.g. fume cupboards in accordance with DIN EN 14175 with high-performance particulate filters) [32].

Note: For safe working in microbiological safety cabinets, see DGUV Information 213-086 [12].

(16) The protection level area must have its own equipment (laboratory equipment).

(17) An emergency power supply must be set up for safety-related equipment such as MSWs, emergency call and monitoring systems.

(18) Contaminated process exhaust air must be treated in such a way that the release of biological substances into the work area is prevented. It must be decontaminated using suitable methods such as filtration through high-performance particulate filters, thermal after-treatment or another tested method. This applies, for example, to exhaust air from autoclaves, pumps or bioreactors. For the treatment of exhaust air from autoclaves, see also the ABAS recommendation "Installation recommendations for new systems, retrofitting or additions, for the selection of exhaust air treatment for autoclaves" [28].

(19) All wastewater generated in the protection level area must undergo thermal post-treatment. Alternatively, other validated inactivation methods may also be used. Post-treatment is not necessary if the risk assessment has shown that there is no risk from the wastewater outside the containment area. During normal operation, it can be assumed that the wastewater from the hand washbasin is not contaminated with biological substances and therefore does not require post-treatment.

Organisational protective measures

(1) In addition to the "biohazard symbol", the access door to the safety level area must also be clearly and permanently marked from the outside with the words "Safety level 3, restricted to biological substances in risk group 3(**)" and a notice of restricted access. Doors must be kept closed during activities involving biological substances.

(2) Access to the containment level area is only permitted to authorised, competent and reliable employees who have been instructed in the safety requirements. The responsible person defines the group of persons authorised to access the area and may, in justified individual cases, also authorise access by other persons (e.g. service personnel) under expert supervision. These persons must be instructed before access. The instruction must be documented.

(3) Biological substances in risk group 3(**) must be stored in tightly sealed containers, secure and protected from unauthorised access in the safety level area. It must be ensured that only authorised persons have access. If these are human pathogenic biological substances listed in Regulation (EC) 2021/821, they must be kept under lock and key [37].

(4) In the event of a leak (accidents, operational disruptions) of biological substances, effective disinfectants and specific disinfection procedures must be available, as well as, if necessary,

If a contaminated area (e.g. after organisms have been spilled) is to be cordoned off and disinfected immediately.

(5) In the event of injury, first aid measures must be initiated immediately. The employer must be informed and, if necessary, medical assistance must be sought. If there is a possibility that the injured person is contaminated with biological substances or has ingested biological substances, or if infection with biological substances appears possible, the medical personnel treating the injured person must be informed of the biological substance. According to the BioStoffV, the employer is obliged to report the incident to the competent authority (Section 17 BioStoffV) [1].

(6) Protection level areas should be kept tidy and clean. Only the work equipment that is actually needed should be kept on the work surfaces. The protection level area must be cleaned regularly. Supplies should only be stored in small quantities and only in areas or cupboards provided for this purpose. Storage rooms must be provided for larger quantities. Work surfaces must be disinfected and cleaned in accordance with the hygiene plan after completion of the activity and contaminated work equipment after use. Accidental contamination must be removed immediately.

Note: Recommendations can be found in DGUV Information 213-086 [12].

(7) Wipe disinfection is preferable to spray disinfection for disinfecting surfaces. Spray disinfection is only recommended for areas that are difficult to access. Alcohol-based preparations should not be used for surface disinfection (wipe disinfection) in order to avoid fire and explosion hazards. The regulations governing hazardous substances must be observed.

(8) When selecting effective disinfectants and specific disinfection methods, care must be taken to ensure that their effectiveness has been proven for the intended area of application (e.g. hand disinfection, surface disinfection) [25-28].

(9) All waste must be inactivated promptly, in particular without creating a risk of infection.

(10) Before inspection, cleaning, maintenance, modification or demolition work is carried out on potentially contaminated equipment or facilities, the employer must arrange for decontamination. This also applies to equipment/work equipment that is sent away for maintenance. If decontamination is not possible, suitable personal protective equipment must be provided for the company's own and external maintenance personnel. The additional protective measures required must be specified in writing in a work instruction for each activity and communicated to the personnel. Any unavoidable residual risks must be pointed out. This also applies to external personnel. The instruction must be documented. The responsible person must issue a written work release for all of the above-mentioned work. The work must be carried out under expert supervision.

(11) If contamination of the secondary packaging and request forms is detected in the sample delivery area, these must be disinfected and, if necessary, relabelled. Sample containers must be safe to open.

(12) Needles, syringes and other sharp instruments and laboratory equipment should only be used when absolutely necessary. Where technically feasible, safety devices should be used. After use , these in should be placed in and puncture-resistant

disposable containers in accordance with TRBA 250 [9] and inactivated [11]. Needles must not be returned to the needle cover. If piercing and cutting instruments are used in connection with animal experiments, Annex 2 of TRBA 120 must be taken into account [23].

(13) The method of removal and decontamination of HEPA filters or similar must be specified in the risk assessment. Removal must be carried out in such a way that there is no risk to maintenance personnel or other persons. The HEPA filters of microbiological safety cabinets should preferably be treated in situ using a recognised or validated inactivation method (e.g. evaporation of hydrogen peroxide and flow through the filters). The HEPA filters can then be disposed of as non-infectious waste.

(14) Accidental contamination must be removed immediately in accordance with the hygiene plan. Work equipment and surfaces must be disinfected after completion of the activity.

(15) If biological substances or material that contains or may contain biological substances, including waste, are transported within the company outside the protection level area, this must also be done in closed, dimensionally stable, break-proof, liquid-tight and disinfectable transport containers. These must be permanently marked or labelled. They must be marked with the symbol for "biological hazard" and must not be able to be opened accidentally by external influences. The containers must be disinfected and cleaned regularly and after each contamination, both inside and outside.

Note: For external transport, the regulations of Class 6.2 of the Dangerous Goods Act must be observed [34].

(16) After completing the activity and before leaving the protection level area, hands must be disinfected, carefully cleaned and cared for in accordance with the skin protection plan. Skin protection and skin care products must be provided by the employer.
TRGS 401 "Hazards due to skin contact: Determination – Assessment – Measures" must be observed [38].

(17) Work instructions must be available for all activities.

Personal protective equipment/protective measures

(1) Laboratory coats or comparable protective clothing must be worn in the protection level area. Protective clothing must include at least a lab coat with identification (e.g. in a different colour from the lab coats worn in other protection level areas), closed shoes and suitable disposable protective gloves in accordance with DIN EN 374-5 (with an AQL value ≤ 1.5) [39]. The protective clothing and PPE must be provided by the employer in sufficient quantities and worn by the employees.

(2) Depending on the results of the risk assessment, additional PPE (safety goggles/splash protection in accordance with DIN EN 166) may also be required, depending on the activity [40]. Protective clothing and PPE must not be worn outside the protection level area and must be removed before leaving the protection level area. Appropriate facilities (e.g. sufficient coat hooks) must be provided for storage. Coats should be hung up in such a way as to avoid cross-contamination.

(3) Separate storage facilities must be provided for PPE, including protective clothing and street clothing, so that contamination of street clothing

Street clothing, bags, etc. must not be stored in the protection level area. Suitable, decontaminable collection containers must be provided in the protection level area for used protective clothing intended for disinfection and cleaning, as well as for used PPE.

(4) PPE, including protective clothing, must not be taken home by employees for cleaning. Disinfection and cleaning must be carried out or arranged by the employer. Contaminated protective and work clothing must be cleaned by a certified laundry or by the employer itself in accordance with recognised technical rules [25]. PPE, including protective clothing made of disposable materials, must be disposed of properly. If additional work clothing is required based on the risk assessment, changing facilities separate from the workplace must be available. Work clothing must be changed regularly and as needed.
Before handing over used laundry (work and/or protective clothing) to a certified laundry, it must be ensured that it no longer poses a risk of infection. To this end, the laundry must be subjected to a suitable sterilisation or inactivation process.

(5) For activities that require hand disinfection or the wearing of protective gloves, nothing may be worn on the hands or forearms. Fingernails must be cut short. For effective hand hygiene when using protective gloves, short fingernails must be flush with the fingertips. Artificial and gel nails are not permitted.
Painted fingernails can compromise the effectiveness of hand disinfection. Therefore, a risk assessment must be carried out to decide whether nail polish must be avoided.

(6) When working with infectious tissue, e.g. during dissection or microscopic examination, personal protective equipment must be supplemented with disposable aprons. Safety goggles are required when opening cavities, and respiratory protection may be required when dissecting cysts and lymph nodes and during rapid sectioning, depending on the risk assessment.

(7) Due to the hazards posed by formalin, suction-equipped cutting tables are recommended in histological laboratories.

4.4.2 Activities involving risk group 3 biological substances

(1) The following protective measures must be observed for specific activities involving risk group 3 biological substances and non-specific activities that must be carried out in biosafety level 3 laboratories.

(2) These activities are subject to authorisation in accordance with Section 15 (1) BioStoffV [1]. A competent and reliable person in accordance with Section 10 (2) BioStoffV must be appointed, see TRBA 200 "Requirements for expertise in accordance with the Biological Agents Ordinance" [18].

Structural and technical protective measures

(1) The containment level area must be structurally separated from other work areas and must consist of sufficiently large rooms. Laboratories in which containment level 3 activities take place must be separated from other areas by an airlock with two interlocking doors with viewing windows. The outer door must

self-closing. The airlock must be sufficiently dimensioned for the use of the containment level area. Technical measures should prevent unintentional or unauthorised entry into the area.

Note: Doors that open in the direction of escape should be equipped with a panic function to enable employees to leave the work area in case of danger. Sufficient storage space must be taken into account when planning the laboratory.

(2) Visual connections or comparable devices to the outside must be sealed and must not be openable [53].

(3) For personal safety, laboratory doors must be equipped with viewing windows to allow visibility into the laboratory area and should open in the direction of escape. If there are several laboratories in the protection level area, their doors must also be equipped with viewing windows.

(4) A personal shower in the airlock area must be included in the design if this is necessary based on the risk assessment. The shower water must be treated as contaminated waste water.

(5) A disinfectant dispenser that can be operated without touching it must be available in the airlock for hand disinfection. A hand washbasin with hand soap and disposable towel dispenser, whose water tap is touch-free, must be available.

(6) Skin protection and care products must be available outside the protection level area. Hands must be cared for in accordance with the skin protection plan.

Note: When operated as intended and in compliance with organisational safety measures, no contaminated waste water is produced in the airlock.

(7) Suitable facilities for eye rinsing must be provided in the laboratory. A device for rinsing the eyes, supplied with drinking water quality water, must be available and operate as continuously as possible. The installations must be easily accessible and preferably located near the laboratory door. Eye wash bottles with sterile rinsing fluid are permitted if running water of drinking water quality is not available. Used eye wash bottles must be replaced immediately. It must be ensured that the eye wash bottles do not exceed the expiry date specified by the manufacturer. To this end, the eye wash bottles must be checked regularly (at least once a year) and the check must be documented.

(8) A constant, controlled negative pressure must be maintained in the protection level area. There must be a pressure gradient between the airlock and the laboratory. The negative pressure must be easily verifiable by laboratory users – preferably also from the inside – and monitored by an alarm device with visual and acoustic signals. The exhaust air must be passed through a high-performance HEPA filter or a comparable device. The recirculation of contaminated exhaust air into work areas is not permitted. It must be possible to check the filter of the air handling unit on site while it is installed to ensure that it is functioning properly. It should be possible to change the filter without releasing biological substances. This must be taken into account in the planning of the air handling unit.

The ventilation duct routes to the HEPA filters should be as short as possible.

Note: ABAS Recommendation 22/2009 of 26 October 2009 "Replacement, inactivation and disposal of filters from microbiological safety cabinets in TSE laboratories" refers to the use of HEPA filters [44]. ABAS Recommendation 16/2010 of 2 December 2010
"Use of HEPA filters in ventilation and air conditioning systems in protection/safety levels 3 and 4 – laboratories and animal husbandry areas" provides information on the pressure difference between the airlock and the laboratory [45].

(9) The rooms in the protection level area and the contaminated part of the air handling unit must be sealable with a fumigant for the purpose of disinfection, including the HEPA filter.

Note: ABAS Recommendation 16/2017 of 7 December 2017, "Minimum requirements for the tightness of room-enclosing components in areas of protection and safety level 3", can be consulted for this purpose [46].

(10) When planning safety-relevant facilities, such as the air handling unit, the wastewater inactivation system and the autoclave, the procedure for maintenance and malfunctions must also be taken into account. Care should be taken to ensure easy accessibility, if possible from outside the protection level area.

(11) All surfaces (e.g. work surfaces, adjacent wall surfaces and the floor, as well as the wall-floor connection, walls, floors and surfaces of the inventory) must be liquid-tight, easy to clean and resistant to the substances, chemicals, fumigants, cleaning agents and disinfectants used. The ceiling area (including installations) must also be resistant to at least the fumigants used.
The floor should generally be designed with a coving to form a trough. The transitions between permanently installed furniture and the floor or wall must be sealed.

(12) Surfaces of equipment and apparatus that may come into contact with biological substances should be easy to decontaminate and clean.

(13) Suitable facilities must be available for communication between the laboratory area and the outside area. Employees may only work alone if the activities can be safely controlled alone and if an emergency call device or comparable device that can be operated from inside is available. It must be possible to trigger the emergency call signal both manually and automatically. The conditions under which working alone is possible must be specified in the risk assessment.

Note: According to DGUV Rule 100-001, working alone is defined as a person working alone, out of earshot and out of sight of other people [42].

(14) Safety lighting must be available. It must be designed in such a way that work can be safely stopped and the work area safely left in the event of a power failure.

(15) All solid and liquid waste from the laboratory must be autoclaved before disposal. Alternatively, an equivalent recognised or validated sterilisation method may be used. The success of the sterilisation must be documented. This can be done, for example, using the autoclave's batch documentation.

(16) The protection level area must have its own equipment (laboratory equipment).

(17) An emergency power supply must be set up for safety-related equipment such as MSW, ventilation systems, emergency call and monitoring equipment.

(18) Equipment that does not release bioaerosols, such as centrifuges with aerosol-tight rotors or centrifuge buckets, must be used. Equipment that is not aerosol-tight may be operated in an MSW or, in the case of large equipment, in an equivalent technical safety device. In both cases, it must be ensured that the protective properties of the respective safety device are not impaired. This also includes systems for extracting liquids from cell cultures.

Note: For information on working safely with centrifuges with regard to the avoidance of aerosols, see DGUV Information 213-086 [12].

(19) Open handling of risk group 3 biological substances must be carried out in an MSW or in a facility with comparable protective effects. This also applies to corresponding activities with, for example, sample materials that, according to the results of the risk assessment, must be carried out in a biosafety level 3 laboratory (see section 3.4.1).

(20) An autoclave must be available in the protection level area, which must not be located in the airlock. The autoclave must be designed in such a way that contaminated condensate and contaminated exhaust air are not released. As a rule, the condensate is sterilised in the pressure vessel.

Note: For the treatment of animal carcasses, see TRBA 120 [23].

(21) Contaminated process exhaust air must be treated in such a way that the release of biological substances into the work area is prevented. It must be decontaminated using suitable methods such as filtration through high-performance particulate filters, thermal post-treatment or another tested method. This applies, for example, to exhaust air from autoclaves, pumps or bioreactors. For the treatment of exhaust air from autoclaves, see also the ABAS recommendation "Installation recommendations for new systems, retrofitting or additions, for the selection of exhaust air treatment for autoclaves" [28].

(22) Wastewater produced in the work area must always undergo thermal post-treatment: central wastewater inactivation or a device for thermal wastewater inactivation in the laboratory (e.g. via an under-table device). Small amounts of wastewater can also be collected in collection containers and then autoclaved. Alternatively, other validated inactivation methods can also be used.
A sink may only be present in the laboratory if the above-mentioned post-treatment of wastewater is guaranteed.

Organisational protective measures

(1) The access door to the airlock must be clearly and permanently marked from the outside with "Protection Level 3", the "biohazard symbol" and a prohibition of access for unauthorised persons. Access to the protection level area is only permitted to authorised, competent and reliable employees who have been instructed in the safety requirements. The responsible person defines the group of persons authorised to access the area and may, in justified individual cases, approve access for other persons (e.g. service personnel) under expert supervision. These persons must be instructed before access. The instruction must be documented.

(2) Biological substances in risk group 3 must be stored in tightly sealed containers, secure and protected from unauthorised access in the safety level area. It must be ensured that only authorised persons have access. If these are human pathogenic biological substances listed in Regulation (EC) 2021/821, they must be kept under lock and key [37]. Measures must be defined that are to be taken if the precautions taken against theft and other misuse have not been effective.

(3) Activities in biosafety level 3 laboratories may only be carried out by reliable and competent employees. The requirements for competence are described in more detail in TRBA 200 [18].

Note: The reliability of an employee must be assessed by the employer in order to prevent hazards arising from non-compliance with rules of conduct and protective measures. The "reliability of a person" includes general factors such as working properly and following work instructions or guidance. Ultimately, it is at the employer's discretion to define further criteria for reliability. A reliability check in accordance with security screening laws is not required under the BioStoffV. A security screening may be appropriate for activities involving biological substances that could cause significant harm to other persons if misused (including dual use).

(4) An internal plan must be drawn up to regulate the measures to be taken to avert dangers that may arise from the release of biological substances in the event of a containment measure failing. In addition to information on the possible specific dangers, the plan must also contain the names of the persons responsible for carrying out the rescue measures.

(5) In the event of injury, first aid measures must be initiated immediately. The employer must be informed and, if necessary, medical assistance must be sought. If there is a possibility that the injured person is contaminated with biological substances or has ingested biological substances, or if infection with biological substances appears possible, the medical personnel treating the injured person must be informed of the biological substance. According to the BioStoffV, the employer is obliged to report the incident to the competent authority (Section 17 BioStoffV) [1].

(6) Protection level areas should be kept tidy and clean. Only the work equipment that is actually needed should be kept on the work surfaces. The protection level area must be cleaned regularly. Supplies should only be stored in small quantities and only in areas or cupboards provided for this purpose. Storage rooms must be provided for larger quantities. Work surfaces must be decontaminated and cleaned in accordance with the hygiene plan after completion of the activity and contaminated work equipment after use. Accidental contamination must be removed immediately.

Note: DGUV Information 213-086 contains information on decontamination [12].

(7) Work instructions must be available for all activities.

(8) When selecting effective disinfectants and specific disinfection procedures, care must be taken to ensure that their effectiveness has been proven for the intended area of application (e.g. hand disinfection, surface disinfection) [25-28]. Wipe disinfection is preferable to spray disinfection for the disinfection of surfaces. Spray disinfection is only recommended for areas that are difficult to access. To avoid fire and explosion hazards during surface disinfection (wipe disinfection), care should be taken to ensure that

. The regulations governing hazardous substances must be observed.

(9) All waste must be inactivated promptly, in particular without creating a risk of infection.

(10) Accidental contamination must be removed immediately in accordance with the hygiene plan. Work equipment and surfaces must be disinfected after completion of the activity.

(11) If contamination of the secondary packaging and request forms is detected in the sample delivery area, these must be disinfected and, if necessary, relabelled. Sample containers must be safe to open.

(12) Needles, syringes and other sharp instruments and laboratory equipment should only be used when absolutely necessary. Where technically feasible, safety devices should be used. After use, these must be collected in puncture-proof and break-proof disposable containers in accordance with TRBA 250 and inactivated [11]. Cannulas must not be returned to the cannula cover. If piercing and cutting instruments are used in connection with animal experiments, Annex 2 of TRBA 120 must be taken into account [23].

(13) If biological substances or material that contains or may contain biological substances, including waste, are transported within the company outside the protection level area, this must also be done in closed, dimensionally stable, break-proof, liquid-tight and disinfectable transport containers. These must be permanently marked or labelled. They must be marked with the symbol for "biological hazard" and must not be able to be opened accidentally by external influences. The containers must be disinfected and cleaned regularly and after each contamination, both inside and outside.

Note: For external transport, the regulations of the dangerous goods law for class 6.2 (usually category A) must be observed [34].

(14) Before testing, cleaning, maintenance, modification and demolition work on potentially contaminated equipment or facilities, the employer must arrange for decontamination. This also applies to equipment/work equipment that is sent away for maintenance. If decontamination is not possible, suitable personal protective equipment must be provided for the company's own and external maintenance personnel. The additional protective measures required must be specified in writing in a work instruction for each activity and communicated to the personnel. Any unavoidable residual risks must be pointed out. This also applies to external personnel. The instruction must be documented. The responsible person must issue a written work release for all of the above-mentioned work. The work must be carried out under expert supervision.

(15) The type of removal and decontamination of HEPA filters must be specified in the risk assessment. Removal must be carried out in such a way that any risk to all employees (including maintenance personnel) and other persons can be ruled out. The following procedures can be used when changing filters in air handling units and MSW:

1. Disinfection with hydrogen peroxide (MSW and air handling units)

The HEPA filters are disinfected *in situ* using a validated procedure with hydrogen peroxide. The HEPA filters can then be disposed of as non-infectious waste. For room disinfection with hydrogen peroxide, see Reichenbacher et al. [48].

2. Bag-in-bag replacement system (air handling units)

   The HEPA filters are replaced using the bag-in-bag method, followed by thermal inactivation of the packaged filter in an autoclave (fractional pre-vacuum method, preferably at 134°C). It must be ensured that the outer packaging (bag-in-bag) is or becomes vapour-permeable during the first vacuum stage. Alternatively, the HEPA filter can also be sent to an approved incineration plant. For filter replacement, see the ABAS statement [44].

3. Disinfection with formaldehyde (MSW and RLT systems)

   The HEPA filters are disinfected *in situ* with formaldehyde (room disinfection procedure in accordance with the lists of disinfectants and procedures tested and approved by the Robert Koch Institute (RKI) and TRGS 522) in order to reduce the biological load [25, 47]. The filters are then autoclaved as described in 1. For room disinfection with formaldehyde, see TRGS 522 "Room disinfection with formaldehyde" [47].

If the specific procedures listed by the RKI are not followed, the effectiveness of the measures taken must be validated. The list of disinfectants and procedures tested and approved by the Robert Koch Institute describes specific special procedures for the treatment of HEPA filters in MSW [25].

Personal protective equipment/protective measures

(1) Laboratory coats or comparable protective clothing must be worn in the protection level area. Protective clothing must include at least a lab coat with identification (e.g. in a different colour from the lab coats worn in other protection level areas), closed shoes and suitable disposable protective gloves in accordance with DIN EN 374-5 (with an AQL value ≤ 1.5) [39]. The protective clothing and PPE must be provided by the employer in sufficient quantities and worn by the employees.

(2) Nothing may be worn on the hands and forearms in order to ensure efficient hygienic hand disinfection and not to impair the protective function of the gloves. Fingernails must be cut short. For effective hand hygiene when using protective gloves, short-cut fingernails must be flush with the fingertips. Artificial and gel nails are not permitted.
Painted fingernails can compromise the effectiveness of hand disinfection. Therefore, a risk assessment must be carried out to determine whether nail polish should be avoided.

(3) Depending on the outcome of the risk assessment, suitable respiratory protection and safety goggles (splash protection in accordance with DIN EN 166) may also be required, depending on the activity [40].

(4) The protective clothing and PPE specified for protection level 3 must be put on in the airlock and taken off after the activity has been completed.

(5) Appropriate areas must be set up in the airlock to ensure that worn PPE, including protective clothing, is stored separately from other laboratory clothing. Protective clothing that has been used and is intended for disinfection and cleaning, as well as

used PPE.

(6) PPE, including protective clothing, must not be taken home by employees for cleaning. Disinfection and cleaning must be carried out or arranged by the employer. Contaminated protective and work clothing should be cleaned by a laundry service or by the employer themselves in accordance with recognised technical rules [25]. PPE, including protective clothing made of disposable materials, must be disposed of properly. If additional work clothing is required based on the risk assessment, changing facilities separate from the workplace must be available. Work clothing must be changed regularly and as needed.
Before handing over used laundry (work and/or protective clothing) to a laundry service, it must be ensured that it no longer poses a risk of infection. To this end, the laundry must be subjected to a suitable sterilisation or inactivation process.

(7) When handling infectious tissue, e.g. during cutting or microscopic examination, personal protective equipment must be supplemented with disposable aprons. Safety goggles are required when opening cavities, and respiratory protection (at least an FFP-3 mask in accordance with DIN EN 149) must be worn when cutting cysts and lymph nodes and when performing rapid sections, depending on the risk assessment [49].

Note: Due to the hazard posed by formalin, suction cutting tables are recommended in histological laboratories.

4.5 Protection level 4

(1) The protective measures of protection level 4 serve to reliably prevent exposure of employees to risk group 4 biological agents, which pose a serious risk to employees and other persons of contracting a life-threatening, untreatable infectious disease. The requirements described below must be observed to protect all employees working there and other persons. At the same time, the measures are suitable for protecting the environment.

(2) The following section covers all specific protective measures for targeted and, where applicable, non-targeted activities involving risk group 4 biological agents in biosafety level 4 laboratories.

(3) Activities classified as protection level 4 are subject to authorisation in accordance with Section 15(1) of the BioStoffV [1]. A competent and reliable person must be appointed in accordance with Section 10(2) of the BioStoffV (see TRBA 200 "Requirements for expertise in accordance with the BioStoffverordnung") [18].

Structural and technical protective measures

(1) Protection level 4 areas must be structurally separated from other work areas. This can be achieved by constructing a separate building or by structurally partitioning off part of a building.

(2) The containment level area must have its own laboratory equipment.

(3) Technical measures (e.g. electronic access control, self-closing access door) must be taken to ensure that only authorised persons can enter the containment level area.

(4) The protection level area comprises the laboratory area and, following a risk assessment, potentially contaminated areas, including components of the airlock system as entrances and exits.

(5) The four-chamber airlock system must have the following components:

1. Outer airlock chamber (first airlock chamber) for removing street clothes and putting on undergarments,
2. personal shower with space for take off your undergarments (second airlock chamber),
3. changing room for putting on and taking off full protective suits (third airlock chamber) and
4. inner airlock chamber with the chemical shower for disinfecting the full protective suits (fourth airlock chamber).

Note: In some circumstances, it may be advisable to provide two airlock systems for complex structures (multiple laboratories and functional rooms). This allows part of the area to be shut down while the remaining rooms continue to be used. It also improves the escape route situation.

(6) A facility for bringing material or equipment in and out must be provided.

(7) Depending on the results of the risk assessment, the doors of the airlock systems must be sufficiently sealed to prevent any possibility of biological substances escaping. They must be interlocked room by room so that they cannot be opened simultaneously.

(8) Preferably, there should be visual connections to the outside, made of material that is sealed and shatterproof. Windows that can be opened are not permitted.

(9) The work area (laboratories including functional rooms) must have a viewing window with continuous visibility or camera surveillance. A continuous, suitable means of communication to the outside must be available.

(10) If there are several laboratories in the protection level area, their doors must also be equipped with viewing windows and should open in the direction of escape.

(11) All surfaces must be liquid-tight, easy to clean and resistant to the substances, chemicals, fumigants, cleaning agents and disinfectants used. Surfaces must be seamless, and the corners and edges of the room should preferably be rounded for easier cleaning/disinfection.

(12) The protection level area (including the room air) must be safely disinfectable. There must be no possibility of biological substances escaping at any time.

(13) The protection level area must have a controlled, staggered negative pressure that increases from the airlock chambers to the work area, depending on the results of the risk assessment, in order to prevent air from escaping from this area. The negative pressure must be easily verifiable from both inside and outside, including for laboratory users, and must be indicated by an alarm system with visual and acoustic signals.

The supply and exhaust air system must be operated independently of other air handling units. It must be non-returnable and redundant, have an emergency power supply connected to an uninterruptible power supply (UPS) and be designed in such a way that no contaminated air can escape, even if the air handling unit fails. Supply and exhaust air must be routed through two HEPA filters (at least H14) connected in series and secured with gas-tight flaps. The proper functioning of the filters must be verifiable when installed.

Note: For the use of HEPA filters in air conditioning systems, see the ABAS statement [45].

The design of the air handling unit must take into account the concept for room disinfection and disinfection of the contaminated part of the air handling unit (including the filter systems) as well as safe filter replacement. The air handling unit must be designed in such a way that filters can be changed without compromising safety standards, as otherwise the protection level area would have to be shut down and disinfected beforehand. In larger systems, it is advisable to divide the air handling unit in such a way that partial operation is possible in the event of a malfunction or during maintenance work. The supply and exhaust air ducts must be gas-tight and suitable for disinfection. The duct routes should be as short as possible. The climatic conditions outside must be taken into account with regard to the operating requirements of the air handling unit (e.g. protection against icing).

(14) A sufficiently dimensioned pass-through autoclave must be available in the protection level area, whose automatic locking system only allows the door to be opened once the sterilisation cycle has been completed without interruption. The inactivation of contaminated process exhaust air and condensation water must be ensured. Contaminated process exhaust air must be treated in such a way that the release of biological substances into the work area is prevented. It must be decontaminated by suitable methods such as filtration through high-performance particulate filters, thermal post-treatment or another tested method. This applies, for example, to exhaust air from autoclaves, pumps or bioreactors. The autoclave must not be located in the airlock area.
For the treatment of animal carcasses, see TRBA 120 [23].

Note: For the treatment of exhaust air from autoclaves, see the technical recommendation of the ABAS [28].

(15) Wastewater produced in the work area must always undergo suitable thermal or chemical-thermal post-treatment (central wastewater inactivation). Depending on the results of the risk assessment, post-treatment may also be necessary for other areas of the protection level area.

(16) Supply and disposal lines must be protected against contamination by organisms that may be caused by the backflow of media (e.g. by a non-return valve).

(17) Centrifuges must have aerosol-tight centrifuge inserts or a closed and aerosol-tight rotor. Where possible, centrifuges should be operated in the MSW or a comparable facility. If this is not possible, the centrifuge inserts or centrifuge rotors must always be opened in the MSW. It must be ensured that the protective properties of the MSW are not impaired.

(18) For safety-related equipment such as respiratory air supply systems for externally ventilated protective suits, ventilation systems, general monitoring equipment

and the MSW, an uninterruptible power supply must be provided which takes over until the emergency power supply is activated.

(19) The safety lighting in the protection level area must be designed in such a way that work can be safely stopped and personnel safely evacuated in the event of a power failure.

(20) When planning safety-relevant technical systems, such as air handling units, wastewater inactivation systems and autoclaves, the procedure for malfunctions, testing and maintenance must also be taken into account.

(21) Employees may only work alone if the activities can be safely controlled alone and there is a continuous means of communication (e.g. via headphones). Personal emergency signal devices must be worn. As part of the risk assessment, the conditions under which individual work is possible must be specified in concrete terms; in particular, sufficient personnel must be available in case of an emergency.

Note: According to DGUV Rule 100-001, working alone is defined as a person working alone, out of earshot and out of sight of other people [42].

(22) Since the personal protective equipment described in paragraphs 3 and 4 of the following section must be worn, it is sufficient if the open handling of risk group 4 biological substances takes place in a class II MSW.

(23) A submersible lock or submersible bath must be provided for the safe transfer of samples.

Organisational and personal protective measures/PPE

(1) The protection level area must be clearly and permanently marked from the outside with protection level 4, the
Marked with a "biohazard symbol" and a no-entry sign for unauthorised persons.

(2) Work areas must be kept tidy and clean. Only the work equipment that is actually needed may be left on the work surfaces. Work equipment and surfaces must be disinfected after completion of the activity in accordance with the hygiene plan. Accidental contamination must be removed immediately and properly.

Note: Recommendations can be found in DGUV Information 213-086 [12].

(3) Employees working in a biosafety level 4 laboratory must be protected by a fully enclosed suit with external ventilation, whereby the air supply must be provided by a self-contained air supply system. The fully enclosed suit should preferably have welded-on boots and fastening straps for gloves and must meet the following criteria:

1. Mechanical properties: abrasion-resistant, tear-resistant and impermeable to air
2. Chemical properties: resistant to the disinfectant used in the disinfection shower.

(4) To protect the hands, at least two pairs of Category III gloves (with an AQL value ≤ 1.5) must be worn, whereby at least the outer glove must be securely fastened to the cuffs of the protective suit (e.g. clamp bracket device).

(5) The lock-in and lock-out process is as follows:

1. Inbound: All clothing, watches and jewellery are in the first lock chamber and light undergarments for the full protective suits

. Disposable gloves are put on. The protective suit is put on in the dressing room and the laboratory is entered through the fourth airlock chamber without activating the disinfection shower. After leaving the fourth airlock chamber, it undergoes a short shower cycle with decontamination agent and a short water phase.

2. Exit: After completing the work, a shower cycle is performed in the disinfection shower (in the fourth airlock chamber) to decontaminate the full protective suit. After rinsing with water, it is stored in the suit room and usually remains there. Undergarments are stored in the personal shower and, if necessary, a hygiene shower is taken.

The disinfection shower must ensure that the entire surface of the protective suit is thoroughly wet. The shower duration must ensure complete disinfection of the protective suit. The subsequent rinsing with water must completely remove the disinfectant to avoid contact with the corresponding chemical components. The disinfection procedure must be validated.

(6) Activities in the protection level area may only be carried out by competent and reliable employees. The requirements for expertise are described in more detail in TRBA 200 [18].

Notes: The reliability of an employee must be assessed by the employer in order to prevent hazards arising from non-compliance with rules of conduct and protective measures. The "reliability of a person" includes general factors such as working properly and following work instructions or guidance. Ultimately, it is at the discretion of the employer to define further criteria for reliability. A reliability check in accordance with security screening laws is not required under the BioStoffV.
A security check may be appropriate for activities involving biological substances that could cause significant harm to other persons if misused (including dual use).

(7) The time of entry and exit of laboratory users must be documented directly and the activities performed must be recorded promptly.

(8) All solid and liquid waste must be collected safely and sterilised using the pass-through autoclave. Waste water must be disposed of via the central waste water inactivation system.

(9) Risk group 4 biological substances must be stored in tightly sealed containers, safely and protected from unauthorised access in the protection level area. It must be ensured that only authorised persons have access. If these are human pathogenic biological substances listed in Regulation (EC) 2021/821, they must be kept under lock and key [37]. Measures must be defined that are to be initiated if the precautions taken against theft and other misuse have not been effective. The inventory and whereabouts of risk group 4 biological substances must be documented.

(10) The internal transport of risk group 4 biological substances or material containing such substances must be carried out in closed, dimensionally stable, break-proof, liquid-tight containers (primary containers) that have been disinfected on the outside and can be permanently marked or labelled. They must not be able to be opened accidentally by external influences.

The primary containers must be transported in a second break-proof, tightly sealed and externally disinfected secondary container marked with the "biohazard symbol". It must be ensured that no risk group 4 biological substances can be carried outside when they are removed from the protection level area.
When removing inactivated material for further processing in another laboratory, a secondary container with perforations can be used, for example, to allow decontamination of the surface of the primary container in an immersion bath or by disinfection.

(11) The type of removal and decontamination of HEPA filters must be specified in the risk assessment. Removal must be carried out in such a way that any risk to all employees (including maintenance personnel) and other persons can be ruled out.

The following procedures can be used when changing filters in air handling units and MSW:

1. Disinfection with hydrogen peroxide (MSW and air handling units)

   The HEPA filters are disinfected in situ using a validated procedure with hydrogen peroxide. The HEPA filters can then be disposed of as non-infectious waste. For room disinfection with hydrogen peroxide, see Reichenbacher et al. [48].

2. Bag-in-bag replacement system (air handling units)

   The HEPA filters are changed using the bag-in-bag method, followed by thermal inactivation of the packaged filter in an autoclave (fractional pre-vacuum method, preferably at 134°C). It must be ensured that the outer packaging (bag-in-bag) is or becomes vapour-permeable during the first vacuum stage. Alternatively, the packaged HEPA filter can also be sent to an approved incineration plant.

3. Disinfection with formaldehyde (MSW and HVAC systems)

   The HEPA filters are disinfected in situ with formaldehyde (room disinfection procedure in accordance with the lists of disinfectants and procedures tested and approved by the Robert Koch Institute (RKI) and TRGS 522 [30]) in order to reduce the biological load [25, 47]. The filters are then autoclaved as described in section 1. For room disinfection with formaldehyde, see TRGS 522 "Room disinfection with formaldehyde" [47].

If the specific procedures listed by the RKI are not followed, the effectiveness of the measures taken must be validated. The list of disinfectants and procedures tested and approved by the Robert Koch Institute describes specific special procedures for the treatment of HEPA filters in MSW [25].

Note: For filter replacement, see the ABAS statement [45].

(12) For all activities that take place in the protection level area, work instructions must be available in accordance with Section 14 (4) BioStoffV [1]. In addition to the activities specified in the BiostoffV, this applies in particular to:

1. the entry and exit of users,

2. putting on and taking off PPE and the corresponding disinfection steps,
3. the entry of materials (e.g. test material, animals if applicable),
4. the disposal of liquid and solid waste,
5. cleaning and disinfection measures in accordance with the hygiene plan,
6. the procedure for accidental contamination,
7. the procedure in the event of accidents, and
8. repair, testing and maintenance.

(13) The behaviour in the event of operational disruptions, accidents and emergencies, as well as the corresponding information, reporting and notification obligations, are regulated in an internal plan in accordance with
Section 13 (3) and (4) BioStoffV [1].
This internal plan must also include regulations for averting dangers that may arise from the release of highly pathogenic biological substances in the event of a containment measure failing.

The plan must:

1. Information on specific hazards
2. The names of the persons responsible for implementing the rescue measures, and
3. details of the scope of safety drills and their regular implementation.

It must be coordinated with the responsible internal and external rescue and security forces and must be designed in such a way that the security forces are able to determine their rescue and hazard control measures.
Warning systems and communication facilities must be set up to immediately warn employees and alert rescue and safety services, and their functionality must be ensured.

(14) Employees working in the protection level area must be instructed before starting work, after long breaks from work and when work processes and procedures change. To ensure smooth operation, the instructions must include practical exercises/training on safety-related activities, work processes and work procedures. The person appointed in accordance with Section 10 (2) BioStoffV must be involved in this [1]. The training must be documented.

(15) Needles, syringes and other sharp instruments and laboratory equipment must not be used under any circumstances. However, if it is necessary in connection with animal experiments or when handling pathologically relevant material and no other suitable procedure is available, the extent to which safety equipment can be used must be examined. Needles must not be returned to the needle cover. Used instruments must be disposed of safely in appropriate puncture-proof waste containers.
For animal experiments, see Appendix 2 of TRBA 120 [23].

(16) Maintenance work always takes place at regular, agreed times when laboratory operations are interrupted and the protection level 4 area is disinfected. If

If additional protective measures are necessary, these must be specified in writing in a work instruction for the activity in question and the relevant internal or external personnel must be instructed accordingly. This also applies to information on possible unavoidable risks. The instructions given must be documented. The person responsible must issue a written work permit for all necessary maintenance work. Maintenance work must be carried out under supervision.

(17) If laboratory animals are used in biosafety level 4 laboratories, section 4.5 of TRBA 120 "Laboratory Animal Husbandry" must also be observed [23].

5 Occupational health precautions

(1) Occupational health care is regulated in the Ordinance on Occupational Health Care (ArbMedVV) [2]. The aim of occupational health care is to detect and prevent work-related illnesses, including occupational diseases, at an early stage. Occupational health care should also contribute to maintaining employability and further developing occupational health and safety. Occupational health care is divided into mandatory, optional and voluntary care. It may be limited to a consultation.

(2) The following section only mentions direct or indirect hazards posed by biological substances. Other reasons for occupational health care may arise due to hazards not caused by biological substances (e.g. hazardous substances) or due to activities that fall within the scope of healthcare (e.g. blood sampling). Technical Rule TRBA 250 "Biological Agents in Health Care and Welfare Services" [11] applies to activities in the healthcare sector.

(3) As part of occupational health care, vaccinations should be offered after appropriate medical consultation if the risk of infection is increased due to the nature of the work and in comparison to the general population.

5.1 Mandatory preventive care

If mandatory preventive care is required, it must be arranged before the start of employment and then at regular intervals. Mandatory preventive care in accordance with Annex Part 2 (1) of the Occupational Health Care Regulation (ArbMedVV) is mandatory in the cases listed below [2].

(1) Activities involving biological substances

Mandatory preventive care must be arranged for:

1. specific activities involving a biological agent in risk group 4 or the pathogens listed in ArbMedVV Part 2 (1) No. 1,
2. non-specific activities involving risk group 4 biological agents with the possibility of contact with infected or suspected samples or sick or suspected sick persons or animals, including their transport,
3. non-specific regular activities involving possible contact with infected samples or suspected samples, zu infected animals or animals suspected of being ill

or to objects or materials containing pathogens or contaminated with pathogens with regard to a biological agent in accordance with ArbMedVV Part 2 (1) No. 1 [2].

(2) Activities involving other hazards resulting from protective measures against biological substances

Mandatory precautions must be taken in the following cases:

1. wet work of four hours or more per day on a regular basis (Annex Part 1, Paragraph 1, Number 2, Letter a ArbMedVV in conjunction with TRGS 401) [2, 38],
2. Activities or special circumstances (e.g. a shortage of FFP masks) that require the wearing of group 2 or 3 respiratory protective equipment.

5.2 Preventive care

Provision of services in accordance with Annex Part 2 Paragraph 2 of the ArbMedVV must be offered in the cases listed below if no mandatory provision of services is required due to the circumstances specified in 5.1 of this TRBA [2].

(1) Activities involving biological substances

Preventive care must be offered for activities involving biological substances in the following cases:

1. for specific activities involving biological substances in risk group 3 of the Biological Substances Ordinance and non-specific activities that are classified as protection level 3 of the Biological Substances Ordinance or for which there is a comparable risk,
2. for targeted activities with biological substances in risk group 2 of the Biological Substances Ordinance and non-targeted activities that are classified as protection level 2 of the Biological Substances Ordinance or for which there is a comparable risk, unless, according to the risk assessment and on the basis of the protective measures taken, there is no risk of infection,
3. for activities involving exposure to toxic or sensitising biological substances, such as certain moulds,
4. if exposure is likely to result in a serious infectious disease and post-exposure prophylaxis measures are possible (e.g. in the case of risk of infection with HIV) or if infection has occurred,
5. In the event of infection as a result of occupational exposure to biological agents, preventive care must also be offered to employees in comparable positions if there are indications that they may also be at risk.
6. at the end of an activity for which mandatory preventive care was to be arranged in accordance with Annex Part 2 (1) of the ArbMedVV.

(2) Activities involving other hazards resulting from protective measures against biological substances.

Preventive care must be offered for activities involving other hazards resulting from protective measures against biological substances in the case of

1. wet work of more than two hours per day on a regular basis (Annex Part 1, Paragraph 2, Number 2, Letter e ArbMedVV in conjunction with TRGS 401) [2, 38]

2. Activities that require the wearing of Group 1 respiratory protective equipment (e.g. FFP2 masks).

Note: In some cases, respiratory protective equipment is not assigned to any group – see Occupational Health Regulation AMR 14.2 "Classification of respiratory protective equipment into groups" [50].

5.3 Genetic engineering work with human pathogenic organisms

Sections 5.1 and 5.2 on mandatory and optional precautions apply accordingly to genetic engineering work with human pathogens.

5.4 Optional preventive care

(1) At the request of employees, the employer must enable them to undergo regular occupational health check-ups in accordance with Section 11 of the Occupational Safety and Health Act, unless an assessment of the working conditions and the protective measures taken indicates that no damage to health is to be expected [31].

(2) The possibility of voluntary preventive care must be pointed out as part of the annual training to be carried out in accordance with Section 14 of the Biological Agents Ordinance [1].

References

Laws, regulations and technical rules

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Further links:

BAuA: Federal Institute for Occupational Safety and Health, http://www.baua.de

ABAS: Committee for Biological Agents, http://www.baua.de/abas **TRBA:**

Technical Rules for Biological Agents,www.baua.de/trba **RKI:** Robert Koch

Institute, http://www.rki.de/

ZKBS: Central Commission for Biological Safety, https://zkbs-online.de

BVL: Federal Office of Consumer Protection and Food Safety, http://www.bvl.bund.de

BfR: Federal Institute for Risk Assessment, http://www.bfr.bund.de

EBSA: European Biosafety Association, http://www.ebsaweb.eu

ABSA: American Biosafety Association, http://www.absa.org **NIH:**

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ATTC: American Type Culture Collection, https://www.atcc.org

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