



Maintenance handbook for safety level 2 and 3 laboratories and other facilities

in accordance with ContainO and PEMO

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1. Foreword

The Swiss Expert Committee for Biosafety (SECB) is an independent expert committee which advises the Federal Council on drawing up laws and ordinances, and the federal and cantonal authorities on implementing these regulations.

The SECB also draws up recommendations – sometimes in collaboration with external experts – for specialists working with genetically modified or pathogenic organisms.

The present maintenance handbook for laboratories and other facilities of biosafety levels 2 and 3 is intended to support biosafety officers (BSO) and technical staff in maintenance of the technical safety systems required by the Containment Ordinance (ContainO). The maintenance handbook deliberately goes beyond the systems described in the ContainO, since the SECBN considers biosafety to be a part of overall laboratory safety.

The tables given in the Appendix are intended to enable those responsible for laboratory safety to keep maintenance and inspection journals, thereby ensuring the maintenance of the technical systems that are vital to biosafety.

February 2012

Pascal Meylan, SECB Chair

2. Introduction

2.1 Starting position

The Swiss Expert Committee for Biosafety is concerned with the field of gene technology and biotechnology. One of its tasks is to assess notifications and licence applications for activities involving genetically modified or pathogenic organisms in contained systems.

ContainO

These activities are regulated by the Ordinance on the contained use of organisms (Containment Ordinance, ContainO). According to the species or organism, or the class of activity, laboratories and other facilities must adhere to a particular safety level and fulfil various safety measures. Switzerland has so far lacked uniform instructions for the operation and maintenance of these facilities.

PEMO

In the event of exposure to microorganisms during maintenance, the Ordinance on Protection of Employees from Dangerous Microorganisms (PEMO) must also be observed.

Accident Prevention Ordinance,
APO

Machines, equipment, tools or installations used in these activities are classified as work equipment within the meaning of the Ordinance on the Prevention of Accidents and Occupational Diseases (Accident Prevention Ordinance, APO). Article 32b para. 1 APO states that work equipment shall be kept properly maintained in accordance with the manufacturer's instructions (...) The maintenance shall be documented.

General safety measures
ContainO

Annex 4, point 1, letter a ContainO now requires compliance with the generally recognised rules of the construction industry in the construction and maintenance of buildings and systems, in particular with a view to (...) the safety of persons and property.

Recommendatory nature of the
handbook

In these circumstances, the maintenance handbook for BSL-2 and BSL-3 laboratories and other facilities was drawn up to provide guidance to those responsible for the facilities and specialists charged with their maintenance.

Maintenance according to the present handbook should be in keeping with the state of technology. The suggested procedures should be viewed as a recommendation for how to plan and carry out maintenance in accordance with the APO and the ContainO. There is no obligation to proceed according to this recommendation, i.e. other, equivalent methods for appropriate and safe maintenance planning and implementation are also possible. In no case does mentioning specific systems, parts or components mean that they must be available in every laboratory or facility.

2.2 Scope, objective, target audience

Scope

The maintenance handbook is aimed at safety level 2 and 3 laboratories and other facilities (BSL-2 and BSL-3) in accordance with ContainO and PEMO. It covers facilities for laboratory activities, greenhouses, and facilities for animal experiments. Production activities are not considered.

Objective	<p>The handbook's objective is to describe, in accordance with the state of technology, the necessary maintenance for the safe operation of safety level 2 and 3 laboratories and facilities in accordance with the ContainO and PEMO, and to provide appropriate support for carrying out this maintenance.</p>
Target audience	<p>The target audience consists primarily of persons responsible for safety level 2 and 3 laboratories and facilities, who wish to inform themselves about the necessary maintenance work in accordance with the state of technology.</p> <p>Second, the handbook is aimed at engineers and technicians who are either engaged by the owner or operator, or are acting as consultants to specialist companies. Because of the particular hazard posed by the microorganisms used in these laboratories and facilities, specialist companies and maintenance specialists must be clearly briefed by the owners and operators. Both operations and maintenance work should first be examined with a view to hazard identification or risk assessment.</p>
Protection for specialists	<p>Specialists are generally aware of the maintenance work that is adequate and necessary; in this case, the handbook serves merely as added protection, in summarising all safety systems.</p>
Applicability to laboratories of other safety levels	<p>The handbook was drawn up by Basler & Hofmann in accordance with the scope and the objectives given by the SECB. It would in principle be possible to apply it to safety level 1 facilities or other laboratories not subject to the ContainO and PEMO. The groups of installations it concerns should, however, be assessed on a case-by-case basis. This is not the task of this maintenance handbook.</p>
Requirements and periodicity of servicing	<p>2.3 Scope</p> <p>The handbook indicates the requirements and periodicity of the servicing needed by essential safety-relevant parts and technical components in these classes of laboratory.</p>
Level of detail	<p>Taking safety level 3 laboratories and other facilities as a prototype, this handbook – a work of reference – cannot list parts and components in detail. This would hinder the expressed aim of the handbook to be a clearly arranged, brief work of reference.</p> <p>However, maintenance specialists will then be in a position to go into the detail specific to the individual facility or project, using the forms given in the maintenance handbook.</p> <p>In some cases, the instructions, handbooks and maintenance documents provided by manufacturers and installation companies will be important supplements to this handbook, particularly if the guarantee period for the systems in question has not yet expired.</p>
Structure	<p>A consultation of several users indicated that BSL-2 and BSL-3 facilities should be considered separately, although this necessarily means there is some repetition (in Sections 4 and 5).</p>

The first part of Sections 4 and 5 sets out clearly the ContainO/PEMO requirements for the laboratory type in question, and lists the safety systems that are therefore necessary for maintaining biosafety. The second part then assigns the safety-relevant components and parts to the relevant systems, and gives specific suggestions for their maintenance and inspection.

Necessity of further safety-relevant components and parts

Since not all the essential components and technical parts of safety-relevant installations can be derived from the ContainO and PEMO, this information has been supplemented using Basler & Hofmann's many years of experience in planning and consulting, so that it is now in accordance with the state of technology and covers all safety-relevant areas.

There is also a description of the extent and interval of the maintenance for the individual components, thus enabling the owners and operators of these laboratories and other facilities to estimate the scope responsibly, and to supplement it with specific components according to the individual situation.

Forms

Section 6, "Maintenance and inspection journal templates" explains how to use and adapt the forms provided by SWKI, while Section 7 gives instructions for setting up and using the journals and schedules.

The concluding Section 8 suggests safety guidelines for the owner and maintenance staff.

Appendix 1 provides tables which satisfy the requirements of maintenance and inspection journals, with explanations and examples for consistent further development. These tables are available separately as PDF and Excel files.

The necessary maintenance and inspection journals for all safety-relevant systems, components and parts are given, classified according to safety level 2 and 3, and these can be completed with reference to the SWKI guidelines or together with specialist companies.

These Excel tables focus on the ventilation systems, as experience has shown that these form the major concern of the maintenance and inspection journals.

For further information, Appendix 2 refers to the essential Directives and Standards for the maintenance handbook.

Malfunctions of systems

The handbook does not provide assistance in case of safety system malfunctions or alarms. Today's technical systems have automated devices for such events, connected to building automation, which reports malfunctions and alarms to the responsible safety control centre.

Malfunctions can however be minimised through the established and structured servicing laid down in the maintenance handbook. If there is a major malfunction, systems nowadays automatically switch to a safe state so that the facility is not damaged.

2.4 Organisation and interfaces for maintenance

The interfaces between the laboratory director, the technical operations manager and the maintenance company engaged should be defined clearly in advance. These interfaces vary with the size of the institute and its internal organisational structure, and with the individual training of the staff. Thus this maintenance handbook cannot define a generally binding interface.

The maintenance handbook does however indicate how this interface can be established individually. The maintenance journals in Appendix 1 give a good overview of the detailed steps necessary. Using these detailed steps, the interfaces between laboratory director, technical operations manager and maintenance company can be established individually.

3. Terms and definitions

3.1 Systems, components and parts

The terms systems, components and parts are not defined uniformly in the usual Standards (see Appendix 2). The terms and definitions used are therefore set down here.

Components or parts are the individual parts of a technical system, machine or apparatus. The two words are used interchangeably in the Standards to indicate technical parts that contribute to the function of a technical or safety-relevant installation. This maintenance handbook also attempts to assign a precise function to a part or component.

In addition, the maintenance handbook considers parts of the building or laboratory shell, such as floor, ceiling, walls, windows, doors etc. Only those components and parts that are relevant to safety are recorded, and not those that are only relevant to the normal operation of the laboratories and other facilities.

3.2 Servicing and maintenance

The term “servicing” is synonymous with maintenance. Maintenance of technical systems, machines or equipment is intended to ensure that these devices remain in a functioning state, or that they are restored to this state after a malfunction.

DIN, the German Institute for Standardization, defines maintenance in its DIN 31051 (latest edition 2003-06) as the:

“combination of all technical, administrative and managerial actions during the life cycle of an item intended to maintain it in, or restore it to, a state in which it can perform the required function.”

and also as

“measures to maintain and restore the target condition and to determine and assess the actual condition of the technical means of a system.”

DIN 31051 structures maintenance further into the four basic measures:

1. Maintenance
2. Inspection
3. Repair
4. Improvement

The Swiss Society of Building Technology Engineers (SWKI) follows DIN 31051, DIN EN 13306 and the Swiss Standards SN 113 001 / -1/-2/-3/-4 in its three maintenance guidelines currently available (all in German):

– 95-2 Instandhaltung Lüftungstechnischer Anlagen (Maintenance of ventilation systems)

- _ HE101-01 Instandhaltung heizungstechnischer Anlagen (Maintenance of heating systems)
- _ RE101-01 Instandhaltung kältetechnischer Anlagen (Maintenance of refrigeration systems)

Thus the following terms and definitions are established for the maintenance handbook.

Maintenance

Measures to delay the reduction of the available wear margin.

Parts of a system may be adjusted, lubricated, preserved, cleaned to preserve their function, or their operating supplies or consumables topped up or exchanged. Tests or measurements that are necessary in this connection are carried out.

Inspection

Measures to determine and assess the actual condition of a unit, including ascertaining the causes of wear and drawing the necessary consequences for a future use of the installations.

Parts of a system may be checked, tested or measured.

Repair

Measures to return a unit to a functioning state, without making improvements.

Repairs serve to return an installation to operation, without making technical improvements to it.

Parts of a system may be repaired or exchanged. Tests, measurements or adjustments that are necessary in this connection are carried out after the repair.

Improvement

Combination of all technical, administrative and managerial actions to increase the functional reliability of a unit, without altering its required function.

Measures to eliminate weaknesses support or improve a technical installation in such a way that the probability of reaching an established wear limit lies within the framework of the required availability.

In practice, different maintenance strategies are used, although the three strategies given below are the most important.

3.3 Maintenance strategies

The maintenance strategies described below have in common that they aim both to increase the facility's availability and to reduce the costs of maintenance.

Predictive maintenance

Based on the information available, such as visible evidence of wear, the time points for carrying out maintenance are set down. Example: brake pads in motor vehicles are exchanged once they fall below a particular thickness.

The disadvantage of predictive maintenance is that it is very time-intensive, and makes high demands on the staff entrusted with maintenance, as well as requiring that they are trained.

Preventive maintenance

Here, preventive measures are carried out in order to carry out the necessary maintenance before a fault appears, if possible. These measures may be based on times-of-use schedules (e.g. exchange of a UV lamp after a particular number of hours), or plant operation times (e.g. oil exchange after a particular number of kilometres in motor vehicles).

One disadvantage of this approach is that it may lead to increased personnel expenses or higher costs for replacement parts, as components with less wear may be replaced “preventively”.

Repair after malfunction

Predictive or preventive maintenance is not carried out. It is accepted that a malfunction will occur, and it is repaired after it happens.

Example: exchange of lamps after a defect or breakdown.

The disadvantage of this strategy is the higher costs due to unforeseen downtime, and any overtime this causes. We also use the term “corrective” maintenance for this.

Experience has shown that the maintenance strategies mentioned above and their associated costs justify a risk-based approach. In a risk assessment for each facility, the probability of occurrence of a fault and its possible impact on the facility are evaluated using predefined criteria.

3.4 Maintenance and inspection as laid down by the AMEV and the SWKI

AMEV

In its current edition of "Wartung 2006", the German AMEV (Mechanical and Electrical Engineering Working Party of National, Regional and Local Authorities) defines the German terms "Wartung", "Inspektion" and "Instandhaltung" (maintenance, inspection and repair), in conformity with DIN.

Further, the AMEV distinguishes the following six stages of maintenance and repair intervals:

- _ monthly
- _ quarterly
- _ semi-annually
- _ annually
- _ biennially
- _ as needed.

The maintenance handbook takes up this proven approach in the detailed specifications covering safety level 2 and 3 laboratories and facilities.

The AMEV also publishes the following worksheets ("Arbeitskarten", all in German), which are available online free of charge.

- _ Arbeitskarte für KG 410 Abwasser-, Wasser-, Gasanlagen (Water supply, wastewater and gas systems)
- _ Arbeitskarte für KG 420 Wärmeversorgungsanlagen (Heat supply systems)
- _ Arbeitskarte für KG 430 Lufttechnische Anlagen (ohne Kälteanlagen) (Ventilation systems, excluding refrigeration systems)
- _ Arbeitskarte für KG 435 Kälteanlagen (Cooling systems)
- _ Arbeitskarte für KG 441 Hoch- und Mittelspannungsanlagen (High- and medium-voltage systems)
- _ Arbeitskarte für KG 442 Eigenstromversorgungsanlagen (Private power supply systems)
- _ Arbeitskarte für KG 443 Niederspannungsschaltanlagen (Low-voltage switching systems)
- _ Arbeitskarte für KG 473 Druckluftversorgungsanlagen (Pressurised air supply systems)
- _ Arbeitskarte für KG 480 Gebäudeautomation/MSR-Anlagen (Building automation / measurement & control systems)

SWKI

The Swiss Society of Building Technology Engineers (SWKI) sells the following guidelines for the maintenance of technical systems (all in German):

- _ VSWKI RE101-01 für die Instandhaltung Kältetechnischer Anlagen (for the maintenance of refrigeration systems)
- _ VSWKI HE101-0 für die Instandhaltung Wärmetechnischer Anlagen (for the maintenance of heating systems)

_ Richtlinie 95-2 für die Instandhaltung Lüftungstechnischer Anlagen (for the maintenance of ventilation systems)

The maintenance handbook adopts this proven approach in the structuring of the maintenance and inspection journals in Appendix 1, paying special attention to the individual situation of safety level 2 and 3 laboratories and other facilities.

4. Safety level 2 laboratories and other facilities (BSL-2)

The list below is in conformity with the safety measures described in the ContainO and PEMO.

4.1 Safety-relevant installations

The scope of this maintenance handbook covers only the installations that are necessary for biosafety.

Installations and laboratory equipment that are not relevant to safety will be ignored, for two reasons. First, for clarity of the handbook; and second, due to their number and variety, listing all possible installations and laboratory equipment is impractical.

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
	Building		
1	Separate work area	Production facilities	Not the object of this maintenance handbook
2	Restricted access to the work area	Laboratories Greenhouses Animal facilities (including production facilities)	Access control system, if present
3	Animal rooms separated by lockable doors	Animal facilities Only in facilities using vertebrates	No safety-relevant installations May be a separate wing of the building, or freestanding building (uncommon for BSL-2)
4	Access to work area via airlock (separate room). The inner side of the airlock must be separated from the outer side by changing facilities, and preferably through lockable doors.		Not relevant for safety level 2 facilities
5	Shower facilities in airlock		Not relevant for safety level 2 facilities
6	Facilities for personal decontamination in the work area	Laboratories Greenhouses Animal facilities (including production facilities)	No safety-relevant installations. May have water supply for decontamination station / eye bath
7	Observation window or other means of monitoring the work area		Not relevant for safety level 2 facilities

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
8	Biohazard warning sign	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	No safety-relevant installations
9	Rooms with easily cleanable floors	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	No safety-relevant installations NB: the integrity of the floor and the walls (serviceability) should be observed.
10	Rooms with easily cleanable walls		Not relevant for safety level 2 facilities
11	Work area sealed so that fumi- gation is possible	Production facilities	Not the object of this maintenance handbook
12	Work area under air pressure negative to atmosphere		Not relevant for safety level 2 laboratories and other facilities, in accordance with ContainO/PEMO. NB: Although the ContainO does not require ventilation systems for supply and waste air in BSL-2 laboratories, they are often used in practice.
13	Air supply to the work area via HEPA filter		Not relevant for safety level 2 facilities
14	Exhaust air outlet from the work area via HEPA filter		Not relevant for safety level 2 facilities
15	Microorganisms must be held in a primary contained system that physically separates the process completely from the rest of the work area. This primary con- tained system must be entirely within the work area.	Production facilities	Not the object of this maintenance handbook

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
16	The work area must be so constructed in such a way so that a release of the entire contents of the primary contained system can be captured and retained.	Production facilities	Not the object of this maintenance handbook
17	Requirements for the air outlet from primary contained system	Production facilities To prevent escape of organisms	Not the object of this maintenance handbook
18	The work area must be ventilated so that the contamination of the air with organisms is minimised.	Production facilities	Not the object of this maintenance handbook
	Equipment		
19	Surfaces resistant to water, acids, alkalis, solvents, disinfectants and decontaminants	Laboratories Greenhouses Animal facilities (including production facilities) Work bench	Work bench NB: Work benches may be worn or damaged. Depending on the material they may then lose their resistance. Putty may come loose etc. The integrity of the work bench surface and its joints should be observed.
20	Work area with complete, independent equipment		Not relevant for safety level 2 facilities
21	Microbiological safety cabinet (MSC) when working with microorganisms	Laboratories Greenhouses Animal facilities (including production facilities)	Microbiological safety cabinet

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
22	Measures against aerosol formation and dissemination	Laboratories Greenhouses Animal facilities (including production facilities) To minimise aerosol dispersion	Scientific and diagnostic equipment and machines cannot be discussed individually due to the variation in the use of BSL-2 laboratories. Please refer to the instructions for use and the declaration of conformity supplied with the equipment.
23	Autoclave	Laboratories Greenhouses Animal facilities (including production facilities) in the building	Autoclave
24	For the animal species concerned, suitable systems for keeping animals (e.g. cages), which are easily decontaminated	Animal facilities decontaminable	IVC (individually ventilated cages) on racks with ventilation systems Decontamination devices Exhaust pipes and hoses to connect isolators or cage systems with the ventilation system.
25	Filter on isolation chambers (isolation chamber = transparent container in which the animal is kept when inside or outside a cage) or isolation rooms (for large animals)	Animal facilities	Filter and filter housing, integrity of the room
26	Requirements for seals on primary contained systems	Production facilities To minimise the escape of organisms	Not the object of this maintenance handbook

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
	Work organisation		
27	Suitable clothing for the work area	Laboratories Greenhouses Animal facilities (including production facilities) For laboratory activities: lab coats	No safety-relevant installations
28	Personal protective equipment Personal safety measures must be taken depending on the activity and the organisms used.	Laboratories Greenhouses Animal facilities (including production facilities)	No safety-relevant installations
29	Regular disinfection of the workplaces	Laboratories Greenhouses Animal facilities (including production facilities)	No safety-relevant installations
30	Inactivation of microorganisms in the outflow of sinks, pipes and showers		Not relevant for safety level 2 facilities
31	Escape of contaminated waste water	Greenhouses minimise	No safety-relevant installations NB: Possibly storage tank and decentralised waste water treatment.
32	Escape of reproductive plant parts in the air or via vectors	Greenhouses minimise	If necessary, ventilation system for supply and exhaust air, with the corresponding filters. Measures to counter any pests and vermin: these include the integrity of the building envelope (floor, ceiling, walls, windows, doors etc.)

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
33	Inactivation of microorganisms in contaminated material and waste, and on contaminated equipment, from animals and plants and of process fluid in the case of "P" production facilities	Laboratories Greenhouses Animal facilities (including production facilities) in the building; contaminated material, animal carcasses and diagnostic samples (not including cultures) may be disposed of as special waste.	Autoclave
34	Inactivation of large volumes of culture medium prior to its removal from the culture vessels	Production facilities	Not the object of this maintenance handbook
35	Minimise or prevent the escape of organisms during internal transport between different work areas	Laboratories Greenhouses Animal facilities (including production facilities) minimise	No safety-relevant installations NB: Lockable containers are not considered further here. Please refer to manufacturers' information.

4.2 Maintenance scope and intervals

The maintenance scope and intervals given below are in principle aligned with the Swiss SWKI guidelines for safety level 2 laboratories and other facilities.

However, since the AMEV is currently more detailed and more specific to particular systems, we refer to the AMEV work sheet in question, if available, and give examples of the scope and interval for all necessary safety-relevant installations.

Furthermore, for clarity the safety-relevant installations are listed according to the cost groups in DIN 276 Building costs - Part 1: Building construction: 2008-12 and supplemented with additional safety-relevant installations, which could not previously be drawn from the ContainO and PEMO.

In the authors' view, these additional safety-relevant installations reflect the current state of technology and are therefore to be found in most newly built laboratory buildings. These installations are therefore listed in this maintenance handbook.

The components and parts of the safety-relevant installations are given as examples and make no claim to completeness. The list is intended to provide a solid basis, which can be individually adapted and supplemented.

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Building – structure								
Surfaces surrounding the greenhouses	Walls Ceilings Floors Doors Windows Penetrations	<u>Examples:</u> <u>No AMEV work sheet</u> – Check seals, drains, wire mesh in greenhouse for pests and for damage				X		(X)
Isolated unit for housing animals	Walls Ceilings Floors Doors Windows Penetrations	<u>Examples:</u> <u>No AMEV work sheet</u> – Check wall surfaces for damage – Check window seals for damage				X		(X)
Drainage, water supply, gas systems								
Decentralised wastewater treatment	Effluent tanks under showers and washbasins (if necessary for BSL-2)	<u>Examples:</u> <u>AMEV work sheet 410</u> – Check pipes and storage tanks for damage, corrosion and fastening – Check for incrustation (on free drains, visual check) – Check watertightness – Check insulation for damage – Check drains for corrosion and damage				X		
Service water network	Mains separation using backflow preventer recommended between drinking water and service water (BSL-2 laboratory separate from remaining drinking water supply) Eye washes Emergency showers	<u>Examples:</u> <u>AMEV work sheet 410</u> – Check water pipes and accessories for damage, (external) corrosion and fastening – Check insulation for damage and completeness – Check for watertightness (visual check) – Check sections of pipes for incrustation – Check safety fittings for damage and (external) corrosion – Check functioning – Check watertightness (visual check) – Check pipe interrupter, backflow preventer and tube aerator for incrustation				X		

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Fire extinguishing equipment	Mobile fire extinguishers	<u>Examples:</u> <u>AMEV work sheet 410</u> – Check fire extinguishers for dirt, damage and corrosion – Check label for expiry date				X		
Ventilation systems						X		
Air-conditioning system Supply air	Supply air systems possibly with redundancy (if user requires) Air-conditioning systems (heating, cooling, humidifying, dehumidifying) Heat recovery Silencing Supply air filter (2-level) Pressure monitoring for filters and ducts Cooling pipes Volume flow controller for supply air	<u>Examples:</u> <u>AMEV work sheet 430</u> – Check underpressure in lab area – Check directed air current into laboratory – Check fan for dirt, damage and corrosion – Clean fan parts and drains that are in contact with air to preserve function – Lubricate bearings – Check air cooler air/liquid for dirt, damage and corrosion on the air side – Check condensate tray and droplet separator for dirt, corrosion and functioning – Check functioning of flow and return – Check functioning of water drain and trap				X	(X)	
						X	(X)	
					X			
						X	(X)	
							X	
			X					
			X					
						X		
						X		

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Air-conditioning system Exhaust air	Exhaust air systems possibly with redundancy (if user requires) Air-conditioning systems (heating, cooling, humidifying, dehumidifying) Heat recovery Silencing Exhaust air filter to protect heat recovery Pressure monitoring for filters and ducts Cooling pipes Volume flow controller for exhaust air	<u>Examples:</u> <u>AMEV work sheet 430</u> – Check heat exchanger for dirt, damage and corrosion – Check air filters for inadmissible dirt and damage (leakage); replace the air filter in question if filter stage was last replaced less than 6 months ago; otherwise replace the entire filter stage – Check differential pressure; if necessary replace filter stage – Check volume flow and mixer control for dirt, damage and corrosion – Check functioning of volume flow controller		X	X			
Refrigeration for air coolers in AC system	Cold water generation Recooling plant Split units, possibly with redundancy (if user requires) Cooling pipes	<u>Examples:</u> <u>AMEV work sheet 435</u> – Check piston, screw and turbo compressors for external dirt, damage and corrosion – Check fastening and running noise – Measure suction pressure – Measure suction gas temperature before compressor – Measure final compression pressure – Measure final compression temperature at the pressure port – Check oil level at the sight glass – Check acidity of oil (acid test) – Change oil – Measure oil pressure – Adjust oil pressure – Measure oil temperature before and after oil cooler – Measure water temperature before and after oil cooler – Check functioning of oil trap			X	X	X	X

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Power installations								
Where applicable, UPS / battery system if user requires	Accumulator and charging device	<u>Examples:</u> AMEV work sheet 442 <ul style="list-style-type: none"> – Check accumulator and charging device for dirt, damage, corrosion and functioning, and check environmental conditions – Clean – Check electrolyte – Measure cell or block voltage – Top up or replace electrolyte 					X	
Power supply	Where applicable, safety power supply Generator or accumulators	<u>Examples:</u> AMEV work sheet 441/2 <ul style="list-style-type: none"> – Check generator for functioning, dirt, damage and corrosion – Clean – Lubricate bearings – Check state of slip rings, carbon brushes and brush holders – Check switchgears for dirt, damage and corrosion – Clean installation including machine room – Check functioning of gearbox and drives – Check functioning of electrical and mechanical protective devices 					X	
Lighting / emergency lighting / safety lighting	Central battery for safety lighting Individual or group batteries for safety lighting Uninterruptible power supply (UPS) Normal use (e.g. management, active components)	<u>Examples:</u> No AMEV work sheet <ul style="list-style-type: none"> – Check work safety installation for completeness, damage and if necessary for functioning (e.g. voltmeter, actuating rods, replacement fuses, earthing components, warning signs) – Check functioning of room lighting and safety lighting – Check that electrical connections including connections of busbars are mechanically secured and tighten if necessary 					X	
							X	
								X

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Telecommunications and IT systems								
Fire alarm system	Switch, trigger and display elements Smoke and fire alarm	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check switch and display elements for dirt, damage and corrosion _ Check functioning of trigger and display elements in the fire alarm system _ Check message transfer settings in the fire alarm system				X	X	X
Access control system	Scanners Coder	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check functioning of control panel, check for dirt, damage, corrosion and environmental conditions _ Check functioning of card reader _ Check functioning of electrical door openers _ Check card reader for dirt, damage, corrosion and environmental conditions _ Check electrical door openers for dirt, damage, corrosion and environmental conditions				X	X (X)	X (X)
User-specific installations								
Class I and II safety cabinets	EN 12 469 certified ISO 14644-1 Depending on type, fixed connection to duct network or discharge into laboratory Locking / control through AC system Locking sliding window with UV light Type of HEPA filter	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check fan for dirt, damage and corrosion _ Check differential pressure in HEPA filter; replace filter if necessary, observing safety guidelines _ Check locking of sliding windows under UV light [if UV light is available / generally ineffectual and associated with additional maintenance costs and risks (see EN12469:2000)] _ Check and measure air flow through sliding window into safety cabinet				X	X (X)	X

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Autoclave	Steam or electric steriliser Where applicable, sterilisation of condensate in BSL-2 Door lock Filter for steam and exhaust air	<u>Examples:</u> <u>No AMEV work sheet, where applicable observe FCOS-RL 6516 and DGVV</u> – Check sterilisation using bioindicator or thermologger – Check drainage of condensate water – Check door locking – Check filter for steam and exhaust air (type) – Check temperature range to be used				X		(X)
IVC (individually ventilated cages) racks with ventilation systems	Supply air system Exhaust air system Air filters Where applicable, connection to AC system	<u>Examples:</u> <u>No AMEV work sheet</u> – Check fan for dirt, damage and corrosion – Check air filters for inadmissible dirt and damage (leakage); replace the air filter in question if necessary – Check differential pressure in air filters				X		
Decontamination devices	Generally separate devices adapted to IVC racks and their ventilation systems	<u>Examples:</u> <u>No AMEV work sheet</u> – Devices are not considered individually. Please refer to the instructions for use and the declaration of conformity supplied with the equipment.				X		
Filter for isolators	Filter for supply and / or exhaust air Filter housing	<u>Examples:</u> <u>No AMEV work sheet</u> – Check air filters for inadmissible dirt and damage (leakage); replace the air filter in question if necessary – Check differential pressure in air filters				X		(X)
Work benches	Work surface Connection for technical gases Water connection	<u>Examples:</u> <u>No AMEV work sheet</u> – Check work bench surface for wear or damage, depending on material. Replace putty if necessary. – Check functioning of water connection – Check functioning of gas connection						X
						X		

Level 2 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Building automation								
Building control technology with interfaces to fire alarm and access control systems	Master computer	<u>Examples:</u> <u>No AMEV work sheet</u> – Check master computer for correct and appropriate installation, and check environmental conditions				X		
Measurement and control technology for BSL-2 AC systems	Central control cabinet Manual operating level	<u>Examples:</u> <u>AMEV work sheet 480</u> – Check control cabinets, control panels and controls for correct and appropriate installation, and check environmental conditions – Check for dirt, damage and corrosion – Check protective covers for completeness and fastening – Clean – Check connections for electrical /mechanical functioning; tighten if necessary – Check functional elements (e.g. operation and display units)				X	X	X
						X		

5. Safety level 3 laboratories and other facilities (BSL-3)

The list below comprises all the requirements of the ContainO and the PEMO concerning particular safety measures.

5.1 Safety-relevant installations

This section also considers safety-relevant installations that are necessary for maintaining biosafety. Please refer to the reasons given in Section 4.1.

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
	Building		
1	Separate work area	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	BSL-3 laboratory areas in separate part of the building or in separate building
2	Restricted access to the work area	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	Access control system
3	Animal rooms separated by lockable doors	Animal facilities	Airlock
4	Access to work area via airlock (separate room). The inner side of the airlock must be separated from the outer side by changing facilities, and preferably through lockable doors.	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	Airlock with underpressure provided by air-conditioning system
5	Shower facilities in airlock	Laboratories Greenhouses Animal facilities (including produc- tion facilities) Depending on the risk, this measure may be omitted without needing authorisation from the Federal Office respon-	If shower is available: Separation of drinking water from rest of building (offices, toilets etc.) Wastewater to thermal or chemical decontamination plant

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
		sible.	
6	Facilities for personal decontamination in the work area	Laboratories Greenhouses Animal facilities (including production facilities)	No safety-relevant installations
7	Observation window or other means of monitoring the work area	Laboratories Greenhouses Animal facilities (including production facilities)	Observation window or camera system
8	Biohazard warning sign	Laboratories Greenhouses Animal facilities (including production facilities)	No safety-relevant installations
9	Rooms with easily cleanable floors	Laboratories Greenhouses Animal facilities (including production facilities)	Building envelope and integrity of the rooms Surface condition of building envelope
10	Rooms with easily cleanable walls	Laboratories Greenhouses Animal facilities (including production facilities)	Building envelope and integrity of the rooms Surface condition of building envelope

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
11	Working area sealed so that fumigation is possible	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	Surfaces surrounding laboratory area Walls Ceilings Floors Doors Windows Penetrations
12	Work area under air pressure negative to atmosphere	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	Ventilation system for supply and exhaust air
13	Air supply to the work area via HEPA filter	Production facilities	Not the object of this maintenance handbook
14	Exhaust air outlet from the work area via HEPA filter	Laboratories Greenhouses Animal facilities (including produc- tion facilities)	Exhaust air HEPA filter housing, can be closed with airtight or airtight dampers
15	Microorganisms must be held in a primary contained system that physically separates the process completely from the rest of the work area. This primary contained system must be entirely within the work area.	Production facilities	Not the object of this maintenance handbook

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
16	The work area must be so constructed in such a way so that a release of the entire contents of the primary contained system can be captured and retained.	Production facilities	Not the object of this maintenance handbook
17	Requirements for the air outlet from primary contained system	Production facilities To prevent escape of organisms	Not the object of this maintenance handbook
18	The work area must be ventilated so that the contamination of the air with organisms is minimised.	Production facilities	Not the object of this maintenance handbook
Equipment			
19	Surfaces resistant to water, acids, alkalis, solvents, disinfectants and decontaminants	Laboratories Greenhouses Animal facilities (including production facilities) Work bench and floors	Microbiological safety cabinet and floors
20	Work area with complete, independent equipment	Laboratories Greenhouses Animal facilities (including production facilities)	Scientific and diagnostic equipment and machines cannot be discussed individually. Please refer to the instructions for use and the declaration of conformity supplied with the equipment.

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
21	Microbiological safety cabinet (MSC) when working with microorganisms	Laboratories Greenhouses Animal facilities (including production facilities)	Microbiological safety cabinet
22	Measures against aerosol formation and dissemination	Laboratories Greenhouses Animal facilities (including production facilities) prevent dispersal of aerosols	Microbiological safety cabinet in combination with AC system
23	Autoclave	Laboratories Greenhouses Animal facilities (including production facilities) in working area	Autoclave
24	For the animal species concerned, suitable systems for keeping animals (e.g. cages), which are easily decontaminated	Animal facilities decontaminable	The cages, stalls or containers suitable for housing animals cannot be discussed individually. Please refer to the instructions for use and the declaration of conformity supplied with the equipment.
25	Filter on isolation chambers (isolation chamber = transparent container in which the animal is kept when inside or outside a cage) or isolation rooms (for large animals)	Animal facilities	Filter and filter housing, integrity of the room

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
26	Requirements for seals on primary contained systems	Production facilities To prevent escape of organisms	Not the object of this maintenance handbook
	Work organisation		
27	Suitable clothing for the work area	Laboratories Greenhouses Animal facilities (including production facilities) suitable protective clothing and possibly shoes	No safety-relevant installations
28	Personal protective equipment Personal safety measures must be taken depending on the activity and the organisms used	Laboratories Greenhouses Animal facilities (including production facilities)	No safety-relevant installations
29	Regular disinfection of the workplaces	Laboratories Greenhouses Animal facilities (including production facilities)	Technical systems for fumigation
30	Inactivation of microorganisms in the outflow of sinks, pipes and showers	Laboratories Greenhouses Animal facilities (including production facilities)	Thermal or chemical wastewater deactivation plant

No. under ContainO	Safety measures under ContainO and PEMO	Activities in	Safety-relevant installations
31	Escape of contaminated waste water	Greenhouses prevent	Thermal or chemical wastewater deactivation plant
32	Escape of reproductive plant parts in the air or via vectors	Greenhouses prevent	Ventilation system for supply and exhaust air Measures to counter any pests and vermin: these include the integrity of the building envelope (floor, ceiling, walls, windows, doors etc.)
33	Inactivation of microorganisms in contaminated material and waste, and on contaminated equipment, from animals and plants and of process fluid in the case of "P" production facilities.	Laboratories Greenhouses Animal facilities (including production facilities) in working area; deactivation may take place in the building, with authorisation from the Federal Office responsible.	Autoclave
34	Inactivation of large volumes of culture medium prior to its removal from culture vessels	Production facilities	Not the object of this maintenance handbook
35	Minimise or prevent the escape of organisms during internal transport between different work areas	Laboratories Greenhouses Animal facilities (including production facilities) prevent	No safety-relevant installations NB: Lockable containers are not considered further here. Please refer to manufacturers' information.

5.2 Maintenance scope and intervals

The maintenance scope and intervals given below are also aligned with the Swiss SWKI guidelines for safety level 3 laboratories and other facilities.

However, since the AMEV mentioned above is currently more detailed and more specific to particular systems, we refer also here to the AMEV work sheet in question, if available, and give examples of the scope and interval for all necessary safety-relevant installations.

For clarity, the safety-relevant installations are listed also here according to the cost groups in DIN 276 Building costs - Part 1: Building construction: 2008-12 and supplemented with additional safety-relevant installations, which could not previously be drawn from the ContainO and PEMO.

We refer to the explanations in Section 4.2, which are also valid here.

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Building – structure								
Surfaces surrounding BSL-3 laboratory areas	Walls Ceilings Floors Doors Windows Penetrations	<u>Examples:</u> <u>No AMEV work sheet</u> – Check surface conditions of epoxy resin on concrete wall / floor for damage – Check door seal (inflatable or rigid) for damage – Check windows (e.g. bulletproof, fire protection class etc.) for damage – Check seals to wall penetrations for damage				X		X
Drainage, water supply, gas systems								
Wastewater deactivation plant	Dry/wet labs Sources to connect Catch basin (local, central) Thermal and chemical systems Pipes, valves Controls	<u>Examples:</u> <u>AMEV work sheet 410</u> – Check storage tank, catch basin and pipework for damage, corrosion and fastening – Check for watertightness – Check insulation for damage – Check drains for corrosion and damage – Check temperature and pressure gauges for damage and accuracy of display – Check overpressure relief valve with HEPA filter for functioning and watertightness				X		
Service water network	Holding tank for mains separation between drinking water and service water (BSL-3 laboratory separate from remaining drinking water supply) Pressure booster Water heating Service water for lab sinks and eye washes Emergency showers	<u>Examples:</u> <u>AMEV work sheet 410</u> – Check holding tank, water pipes and accessories for damage, (external) corrosion and fastening – Check insulation for damage and completeness – Check for watertightness (visual check) – Check sections of pipes for incrustation – Check pressure booster, pressure vessels for damage, (external) corrosion and fastening – Check pressure vessels for watertightness – Check functioning of shut-off device and safety equipment – Check pressure relief and shut-off valves in the expansion line (open position, securing)				X		

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Compressed air supply	Compressors Buffer tanks Pressure monitoring Compressed gas cylinders Automatic switching station Removal station Where applicable, HEPA filter	<u>Examples:</u> <u>AMEV work sheet 473</u> _ Check for damage _ Check oil level _ Top up oil _ Replace oil _ Check functioning of compressor _ Check functioning of switches, safety devices and reducing station _ Adjust switches, safety devices and reducing station _ Check functioning of automatic drainage _ Drain boiler and reducing station _ Check filter for dirt _ Clean filter _ Replace filter _ Check functioning of dehumidifier _ Clean				X X X X X X X X X X X		X X X X X
Carbon dioxide supply	Compressed gas cylinders Automatic switching station Gas failsafe device Removal station Non-return valve Where applicable, HEPA filter	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check installation for damage, dirt, corrosion _ Check oil level _ Top up oil _ Replace oil _ Check functioning of compressed gas cylinders _ Check functioning of gas failsafe device _ Check functioning of switches, safety devices and reducing station, and adjust where applicable _ Check filter for dirt _ Clean filter _ Replace filter				X X X X X X X X X X X		X X X X X

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Liquid nitrogen supply	Tank installation with filling level and pressure monitoring Pipes Oxygen deficiency warning system Filling station outside containment	<u>Examples:</u> <u>No AMEV work sheet, observe FCOS-RL 6516 and DGVV</u> <ul style="list-style-type: none"> – Check tank installation for damage, dirt, corrosion – Check functioning of filling level monitoring – Check functioning of pressure monitoring – Check pipes and check functioning of insulation – Check functioning of oxygen deficiency warning system 						
Fire extinguishing system	Sprinkler systems Spraymist systems Mobile fire extinguishers	<u>Examples:</u> <u>AMEV work sheet 410, observe FCOS-RL 6516 and DGVV</u> <ul style="list-style-type: none"> – Check sprinkler for coatings – Check sprinkler settings – Check pressure vessels for tightness – Check functioning of shut-off device and safety equipment – Check pressure relief and shut-off valves in the expansion line – Check pressure pads – Check manometer for damage, check functioning of display – Check functioning of safety valve – Check feed pump for damage, corrosion, fastening, noise and tightness 						
Heat supply systems								
Steam generators (for autoclaves; if separate)	Steam generator Water treatment coordinated with steam quality Supply to autoclaves Where applicable, heat extraction between untreated and pure steam generation Stainless steel pipes	<u>Examples:</u> <u>AMEV work sheet 410 where applicable, observe FCOS-RL 6516 and DGVV</u> <ul style="list-style-type: none"> – Check steam generator for dirt, damage and corrosion – Check functioning of solenoid valve – Check functioning of heating rods – Check functioning of water supply, and check water level – Check functioning of control valve – Adjust stuffing box of control valve – Check functioning of steam distributor and condensation line 						

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Ventilation systems								
Air-conditioning system Supply air	Supply air systems possibly with redundancy (if user requires)	<u>Examples:</u> <u>AMEV work sheet 430</u> – Check underpressure in lab area				X	(X)	
	Air-conditioning systems (heating, cooling, humidifying, dehumidifying)	– Check directed air current into laboratory				X	(X)	
	Heat recovery	– Check fan for dirt, damage and corrosion		X				
	Silencing	– Clean fan parts and drains that are in contact with air to preserve function				X	(X)	
	Supply air filter (2-level)	– Check impeller for imbalance				X		
	Pressure monitoring for filters and ducts	– Check functioning of fan blade adjustment device				X		
	Gastight or airtight dampers	– Check bearings for noise				X		
	Fumigation ports	– Lubricate bearings					X	
	Cooling pipes	– Check flexible connections for tightness				X		
	Volume flow controller for supply air	– Check functioning of vibration damper				X		
		– Check air cooler air/liquid for dirt, damage and corrosion on the air side	X					
		– Check condensate tray and droplet separator for dirt, corrosion and functioning	X					
		– Check functioning of flow and return			X			
		– Check functioning of water drain and trap			X			
Air-conditioning system Exhaust air	Exhaust air systems with 100% redundancy	<u>Examples:</u> <u>AMEV work sheet 430</u> – Check heat exchanger for dirt, damage and corrosion				X		
	Heat recovery	– Check air filters for inadmissible dirt and damage (leakage); replace the air filter in question if filter stage was last replaced less than 6 months ago; otherwise replace the entire filter stage				X		
	Silencing	– Check differential pressure, if necessary replace filter stage						
	Exhaust air filter to protect heat recovery	– Check volume flow and mixer control for dirt, damage and corrosion					X	
	Pressure monitoring for filters and ducts	– Check functioning of volume flow controller					X	
	Gastight or airtight dampers							
	Fumigation ports							
	Cooling pipes							
	Volume flow controller for supply air							

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Air-conditioning system HEPA filter for exhaust air system	Separate particulate air filter (HEPA) for exhaust air side HEPA filter class depending on work done in lab (H13 or H14 or higher) Prefilter for HEPA filter Pressure monitoring for filter Gastight or airtight dampers Fumigation ports	<u>Examples:</u> <u>AMEV work sheet 430</u> <ul style="list-style-type: none"> – Check prefilter and HEPA filter for inadmissible dirt and damage (leakage) – Replace the air filter in question if permissible differential pressure has been reached, or if filter stage was last replaced less than 6 months ago. Then replace the entire filter stage – Before replacing filter, decontaminate by fumigation or replace filter through BIBO (“Bag-in Bag-out”) – Check filter housing for dirt, damage and corrosion – Check differential pressure in prefilter and main filter (HEPA) – Check gastight or airtight shut-off valves for damage and tightness – Check biohazard warning sign 				X	(X)	(X)
Refrigeration for air coolers in AC system	Cold water generation Recooling plant Split units, possibly with redundancy (if user requires) Cooling pipes	<u>Examples:</u> <u>AMEV work sheet 435</u> <ul style="list-style-type: none"> – Check piston, screw and turbo compressors for external dirt, damage and corrosion – Check fastening and running noise – Measure suction pressure – Measure suction gas temperature before compressor – Measure final compression pressure – Measure final compression temperature at the pressure port – Check oil level at the sight glass – Check acidity of oil (acid test) – Change oil – Measure oil pressure – Adjust oil pressure – Measure oil temperature before and after oil cooler – Measure water temperature before and after oil cooler – Check functioning of oil trap 			X	X	X	X

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Power installations								
Emergency power supply, UPS / battery system	Emergency power supply, accumulator and charging device	<u>Examples:</u> <u>AMEV work sheet 442</u> <ul style="list-style-type: none"> – Check functioning of emergency power supply, check for damage, and check environmental conditions – Check accumulator and charging device for dirt, damage, corrosion and functioning, and check environmental conditions – Clean – Check electrolyte – Measure cell or block voltage – Top up or replace electrolyte 				X		
Power supply	General power supply Standby power supply Safety power supply (user-specific) Where applicable, generator or accumulators	<u>Examples:</u> <u>AMEV work sheet 441/2</u> <ul style="list-style-type: none"> – Check generator for functioning, dirt, damage and corrosion – Clean – Lubricate bearings – Check state of slip rings, carbon brushes and brush holders – Check switchgears for dirt, damage and corrosion – Clean installation including machine room – Check functioning of gearbox and drives – Check functioning of electrical and mechanical protective devices 					X	X (X)
Lighting / emergency lighting / safety lighting	Central battery for safety lighting Individual or group batteries for safety lighting Uninterruptible power supply (UPS) Normal use (e.g. management, active components) Task lighting Emergency lighting / safety lighting	<u>Examples:</u> <u>No AMEV work sheet</u> <ul style="list-style-type: none"> – Check work safety installation for completeness, damage and if necessary for functioning (e.g. voltmeter, actuating rods, replacement fuses, earthing components, warning signs) – Check functioning of room lighting and safety lighting – Check that electrical connections including connections of busbars are mechanically secured and tighten if necessary 					X	X

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Telecommunications and IT systems								
Telephone system	Handsets Switchboard Junction boxes	<u>Examples:</u> <u>No AMEV work sheet</u> – Check functioning of handsets – Check speech intelligibility – Check functioning of loudspeakers – Check cables for damage and perfect functioning in junction boxes				X	X	X
Door intercom and door opening systems	Loudspeaker Scanner Coder Card reader	<u>Examples:</u> See also Telephone system Access control system						
Electroacoustic alarm system	Electroacoustic alarm system Movement sensors (including those for access control, intruder detection and CCTV)	<u>Examples:</u> <u>No AMEV work sheet</u> – Check alarm switchboard for dirt, damage and corrosion – Check UPS for dirt, damage and corrosion – Check loudspeakers and connection boxes for damage – Check all loudspeakers for acoustic function, lack of distortion and speech intelligibility – Check functioning of amplifiers – Check functioning of spare amplifier and standby controls – Test alarm activation by making announcement				X	X	X
Hazard alert and alarm systems	Alarm systems for fire, attack, break-in, manned guarding systems, access control systems, and surveillance systems	<u>Examples:</u> See below Fire alarm system Intruder detection system Access control system						
Fire alarm system	Switch, trigger and display elements Smoke and fire alarm	<u>Examples:</u> <u>No AMEV work sheet</u> – Check switch and display elements for dirt, damage and corrosion – Check functioning of trigger and display elements in the fire alarm system – Check message transfer settings in the fire alarm system – Check power-failure bridging – Check capacity of batteries – Replace accumulators in emergency power supply if capacity has fallen below 10%				X	X	X

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Intruder detection system	Surveillance of external doors Surveillance of ground-floor and first-floor windows Surveillance of entrances to lab area and special areas	<u>Examples:</u> <u>No AMEV work sheet</u> <ul style="list-style-type: none"> – Check loudspeaker system – Check functioning of amplifier – Check functioning of peripherals – Check functioning of loudspeaker circuits – Check speech intelligibility – Check functioning of trigger and display elements in the rooms – Check message transfer settings in the intruder detection system – Check display module for functioning, display and control of message transfers 				X		
Access control system	Scanners Coder Card reader	<u>Examples:</u> <u>No AMEV work sheet</u> <ul style="list-style-type: none"> – Check functioning of control panel, check for dirt, damage, corrosion and environmental conditions – Check functioning of card reader – Check functioning of electrical door openers – Check card reader for dirt, damage, corrosion and environmental conditions – Check electrical door openers for dirt, damage, corrosion and environmental conditions 			X			
CCTV	External CCTV Internal CCTV Movement sensors (including those for access control and intruder detection systems)	<u>Examples:</u> <u>No AMEV work sheet</u> <ul style="list-style-type: none"> – Check video cable for damage and perfect functioning in connection boxes with pivot frames – Measure parameters and record all connections from the camera boxes and all other peripheral connection points to central engineering room – Check movement sensors for each line for dirt, damage and fastening 				X		

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
User-specific installations								
Class I and II safety cabinets	EN 12 469 certified ISO 14644-1 Depending on type, fixed connection to duct network or discharge into laboratory Locking / control through AC system Locking sliding window with UV light Type with HEPA filter	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check fan for dirt, damage and corrosion _ Check differential pressure in HEPA filter; replace filter if necessary, observing safety guidelines _ Check locking of sliding windows under UV light [if UV light is available / generally ineffectual and associated with additional maintenance costs and risks (see EN12469:2000)]. _ Check and measure air flow through sliding window into safety cabinet.				X		(X)
Class III safety cabinets	EN 12 469 certified ISO 14644-1 Locking / control through AC system Type with HEPA filter Possible combination with Class II safety cabinet advantageous	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check protective gloves for damage and seal _ Check differential pressure in HEPA filter; replace filter if necessary, observing safety guidelines _ Check connections for supply and exhaust air to the AC system				X		(X)
Pass-through locks	Controls Gastight doors Body (material + seal) Possibly UV tubes Automatic fumigation device	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check door locking _ Check connection for fumigation device _ Check UV tube lock with door opening				X		
Dunk tanks	Locking of dunk tank doors Where applicable, intercom system Drain for disinfectant	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check locking of dampers _ Check intercom system _ Check disinfectant drain and clean where applicable				X		

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Pass-through autoclaves	Steam or electric steriliser Sterilisation of condensate Gastight installation (bi-seal) Door lock Filter for steam and exhaust air (type) Temperature range up to 134 °C (prions) Volumes for sterilisation	<u>Examples:</u> <u>No AMEV work sheet, where applicable, observe FCOS-RL 6516 and DGVV</u> _ Check sterilisation using bioindicator or thermologger _ Check drainage of condensate water _ Check door locking _ Check filter for steam and exhaust air (type) _ Check temperature range to be used				X		(X)
Fumigation	Gas connections (see also AC systems) Fumigation device with measurement and re-recording of concentration	<u>Examples:</u> <u>No AMEV work sheet</u> Devices are not considered individually. Please refer to the instructions for use and the declaration of conformity supplied with the equipment.				X		
Material airlocks for large equipment	Controls / locking Gastight doors Connections Body (material + seal) Possibly UV tubes	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check door locking _ Check connection for fumigation device _ Check intercom system				X		
Building automation								
Building control system with interfaces to hazard alert and alarm systems such as fire alarm, intruder detection and access control systems	Relay to central building control, doorman or safety control centre	<u>Examples:</u> <u>No AMEV work sheet</u> _ Check master computer for correct and appropriate installation, and check environmental conditions				X		

Level 3 safety-relevant installations	Components and parts	Maintenance and inspection tasks	monthly	3-monthly	6-monthly	annually	2-annually	as needed
Measurement and control technology for BSL-3 AC systems	Central control cabinet Manual operating level Control cabinets, control panels, controls, transducers, safety monitoring and container control installations	<u>Examples:</u> <u>AMEV work sheet 480</u> <ul style="list-style-type: none"> – Check control cabinets, control panels and controls for correct and appropriate installation, and check environmental conditions – Check for dirt, damage and corrosion – Check protective covers for completeness and fastening – Clean – Check connections for electrical /mechanical functioning; tighten if necessary – Check functional elements (e.g. operation and display units) 				X		
					X			
					X			
							X	
					X			
					X			

6. Maintenance and inspection journal templates

This Section presents templates for maintenance and inspection journals, for owners and operators of safety-relevant installations, based on the Swiss SWKI guidelines.

6.1 Maintenance journal

The maintenance or servicing tasks for the specialist contractors or the institute's own technical staff should be entered into this form.

For particular project-specific installations, such as autoclaves, it is recommended that this form should be completed together with the manufacturer.

Autoclaves for safety level 3 may vary greatly in their construction. This is generally due to the needs of the equipment of individual laboratory buildings, e.g. for separate steam production.

A maintenance journal should also take into account that some components, such as consumables, will need to be ordered in advance.

Example of a maintenance journal:

Maintenance and Inspection																
Contractor: _____				Object: _____												
Person in charge: _____				Equipment, machine: _____												
City / Date: _____				Commission: _____												
Function	Code	Single Component	Schedule of Maintenance and Inspection										Component - No.			
			Present	Corrosion	Inspection	Re-sig-nal	Function	Cleaning	Lubrication	Replacement	Bleed	Draining		Tune	According to	Complying to
Check																Remarks
Reliability																
Safety Provisions																
Disposal																
Remarks																
Legend:			D = Daily Q = Quarterly B = 2 Yearly W = Weekly H = Half-Yearly Z = if Required M = Monthly Y = Yearly C =													

The execution of all servicing and maintenance measures should be documented and signed for in the inspection journal.

7. How to use journals and schedules

This Section explains the use of and requirements for the journals and schedules already mentioned, using examples.

The maintenance and inspection journals are designed with reference to the SWKI guidelines and should be completed and further refined in collaboration with the laboratory director, technical operations manager or the contracted specialist maintenance companies. The aim is to adapt the journals to the individual situation of the laboratory building or facility in question.

Appendix 1 contains two separate Excel tables with the necessary maintenance and testing diaries for all the safety-relevant installations given here, divided according to safety level 2 and 3 laboratories and other facilities.

7.1 Completing the characteristics of the maintenance journal

Maintenance and Inspection													
Contractor: _____				Object: _____									
Person in charge: _____				Equipment, machine: _____									
City / Date: _____				Commission: _____									
Function	Code	Single Component	Inspection	Action	Component - No.								
			Present	Check	Function	Cleaning	Lubrication	Replacement	Bleed	Testing	According to	Complying to	Remarks
Check													
Reliability													

Maintenance and Inspection <i>Radial Fan</i>													
Contractor: Contractor xyz				Object: Lab xyz									
Person in charge: Mr / Ms xyz				Equipment, machine: No xyz									
City / Date: Bern, 14 December 2011				Commission: Commissioning date									
Remarks													
Legend: D = Daily Q = Quarterly B = 2 Yearly W = Weekly H = Half-Yearly Z = if Required M = Monthly Y = Yearly C = _____													

In the upper half of the journal, enter the installation's components, the name of the specialist company, the direct contact person, and further details of site, object and date.

The following example indicates the level of detail required for the description of the function of the specific components.

Maintenance and Inspection																
Contractor: _____					Object: _____											
Person in charge: _____					Equipment, machine: _____											
City / Date: _____					Commission: _____											
Function		Schedule of Maintenance and Inspection														
		Code	Single Component	Action								Component - No.				
				Inspection	Present	Corrosion	Leakage	Function	Cleaning	Lubrication	Replacement		Blocked	Draining	According to	Complying to
Check																Remarks
Reliability																
Safety Provisions																
Disposal																
Remarks																

Function

The radial fan conveys air in ventilation and air-conditioning systems.

Legend: D = Daily Q = Quarterly B = 2 Yearly
W = Weekly H = Half-Yearly Z = If Required
M = Monthly Y = Yearly C =

A further section establishes the scope of the testing or verification.

Maintenance and Inspection																
Contractor: _____					Object: _____											
Person in charge: _____					Equipment, machine: _____											
City / Date: _____					Commission: _____											
Function		Schedule of Maintenance and Inspection														
		Code	Single Component	Action								Component - No.				
				Inspection	Present	Corrosion	Leakage	Function	Cleaning	Lubrication	Replacement		Blocked	Draining	According to	Complying to
Check																Remarks
Reliability																
Safety Provisions																
Disposal																
Remarks																

Check

Noise, revolution speed, direction of rotation, fouling, mechanical damage, support, flexible cuff

Legend: D = Daily Q = Quarterly B = 2 Yearly
W = Weekly H = Half-Yearly Z = If Required
M = Monthly Y = Yearly C =

Maintenance and Inspection Contractor: _____ Person in charge: _____ City / Date: _____		Reliability Safety is assured, if you follow the manufacturers operation manual.	
Function			
Check			
Reliability			
Safety Provisions			
Disposal			
Remarks			
Legend:		D = Daily W = Weekly M = Monthly	Q = Quarterly H = Half-Yearly Y = Yearly

Maintenance and Inspection												
Contractor: _____						Object: _____						
Person in charge: _____						Equipment / machine: _____						
City / Date: _____						Safety Provisions Switch off the safety switch when checking the fan.						
Function												
Check												
Reliability												
Safety Provisions												
Disposal												
Remarks												

Legend:

D = Daily	Q = Quarterly	B = 2 Yearly
W = Weekly	H = Half-Yearly	Z = If Required
M = Monthly	Y = Yearly	C =

Then give details of the disposal of the serviced and replaced components.

Maintenance and Inspection	
Contractor:	Object:
Person in charge:	Equipment, machine:
City / Date:	Commission:
Function	Disposal Dispose the broken parts professionally and environmental friendly. For support, refer to the manufacturer and the local laws. Remarks Check impeller and touch guard periodically
Check	
Reliability	
Safety Provisions	
Disposal	
Remarks	
Legend: D = Daily Q = Quarterly B = 2 Yearly W = Weekly H = Half-Yearly Z = If Required M = Monthly Y = Yearly C =	

After the characteristics have been completed on the left-hand side, the actual work of providing information on the maintenance work begins. This form assigns work steps to the components in the form of a matrix covering the relevant time intervals.

Maintenance and Inspection																																											
Contractor:	Object:																																										
Person in charge:	Equipment, machine:																																										
City / Date:	Commission:																																										
Function	Schedule of Maintenance and Inspection																																										
Check	<table border="1"> <thead> <tr> <th colspan="10">Schedule of Maintenance and Inspection</th> <th rowspan="2">Component - No.</th> </tr> <tr> <th rowspan="2">Code</th> <th rowspan="2">Single Component</th> <th colspan="8">Action</th> <th rowspan="2">Remarks</th> </tr> <tr> <th>Present Situation</th> <th>Corrosion</th> <th>leak-tightness</th> <th>Function</th> <th>Cleaning</th> <th>Lubrication</th> <th>Replacement</th> <th>Bleed</th> <th>Draining</th> <th>Tune</th> <th>According to Manual Regulation</th> </tr> </thead> </table>										Schedule of Maintenance and Inspection										Component - No.	Code	Single Component	Action								Remarks	Present Situation	Corrosion	leak-tightness	Function	Cleaning	Lubrication	Replacement	Bleed	Draining	Tune	According to Manual Regulation
	Schedule of Maintenance and Inspection										Component - No.																																
	Code	Single Component	Action									Remarks																															
Present Situation			Corrosion	leak-tightness	Function	Cleaning	Lubrication	Replacement	Bleed	Draining	Tune		According to Manual Regulation																														
Reliability																																											
Safety Provisions																																											
Disposal	L42	Radial Fan	Q																																								
	L42.01	Fan Housing	Y	Y		Y																																					
	L42.02	Impeller	Y	Y		Y																																					
	L42.03	Protection against Contact	H	H		H																																					
	L42.04	Imbalance			Y																																						
	L42.05	Belt Drive	M		M					Z																																	
	L42.06	Bearings	H					Z																																			
Remarks	L42.07	Motor	H	Y		Y		Z			C	C Refer to manufacturer instructions																															
	L42.08	Flexible Cuffs	H		H	H		Z																																			
	L42.09	Electrical Connection	Y									Use Swiss Norm																															
	L42.10	Safety Switch	Y		Y																																						

Maintenance and Inspection		Radial Fan	
Contractor: <u>Contractor xyz</u> Person in charge: <u>Mr / Ms xyz</u> City / Date: <u>Bern, 14 December 2011</u>		Object: <u>Lab xyz</u> Equipment, machine: <u>No xyz</u> Commission: <u>Commissioning date</u>	
Schedule of Maintenance and Inspection			
Function The radial fan conveys air in ventilation and air-conditioning systems.	Action		Component - No.
	Inspection		
	Present Situation Corrosion Leak-tightness Function Cleaning Lubrication Replacement Bleed Draining Tune According to Manual Regulation		
	Code	Single Component	Remarks
Check Noise, revolution speed, direction of rotation, fouling, mechanical damage, support, flexible cuff	L42 L42.01 L42.02 L42.03 L42.04 L42.05	Radial Fan Fan Housing Impeller Protection against Contact Imbalance Belt Drive	Q Y Y Y Y H H Y M M
Reliability Safety can only be assured, if one follows the manufacturers operation manual.	L42.06 L42.07 L42.08 L42.09 L42.10	Bearings Motor Flexible Cuffs Electrical Connection Safety Switch	Z Y Y Z H H H Z Y Y Y
Safety Provisions The safety switch must be switched off when checking the fan.			Z C C Refer to manufacturer instructions Use Swiss Norm
Disposal Dispose the broken parts professionally and environmental friendly. For support, refer to the manufacturer and the local standards.			
Remarks Check the impellers and touch guards periodically.			
Legend: T = Daily		D = Daily W = Weekly M = Monthly	Q = Quarterly H = Half-Yearly Y = Yearly
		B = 2 Yearly Z = If Required C =	

[illegible]

8. Occupational health and safety

8.1 Introduction

The procedures and safety measures proposed here should be taken as recommendations. In individual cases, the person in charge of the facility should first make a risk assessment based on his or her knowledge of the facility and the hazards present in it, and with the involvement of the maintenance contractor. Hazards for the maintenance staff should be considered along with those associated with actual operations. The safety concept and the work plan should be drawn up depending on the situation and risks.

Health and safety at work

Maintenance staff are only rarely familiar with biological and other hazards occurring in safety level 2 and 3 facilities. Essentially, the specialist contractors and persons employed in the maintenance of such facilities are subject to the laws and regulations for occupational health and safety (Ordinance on the Prevention of Accidents and Occupational Diseases; APO). Possible exposure to microorganisms when carrying out maintenance work is regulated by the Ordinance on Protection of Employees from Dangerous Microorganisms (PEMO).

This maintenance handbook thus does not discuss the general occupational health and safety of maintenance specialists in detail. Relevant recommendations and guidelines for this are already published by the FCOS and SUVA (see Appendix 2).

It is recommended that those in charge of a facility who are subject to the ContainO/PEMO should ensure that external contractors entrusted with maintenance work are familiar with concepts of occupational health and safety in line with the APO.

Protection of humans, animals and the environment

The person in charge of the facility must take steps to limit or prevent the release of organisms or substances during maintenance work, in accordance with the ContainO.

Facility owner's liability and responsibility

The person in charge of the facility is also responsible and liable for the health and safety of visitors (including the maintenance staff). Only he or she has full knowledge of the microorganisms handled, appropriate decontamination measures, and the suitable personal protective equipment. He/she must therefore check and establish that the contracted maintenance specialists have received all necessary instructions and information on exposure risks, and that they adhere to the agreed safety concept and work plan.

Safety concept

Under the facility's safety concept, the person responsible for the facility (e.g. the owner or operator) must regulate the access and supervision of maintenance staff in accordance with the ContainO/PEMO. This also applies to internal maintenance staff.

8.2 Risks and risk assessment

When maintenance staff enter safety level 2 and 3 facilities in which activities using *natural pathogenic organisms* or *genetically modified pathogenic organisms* are carried out, they face a low or moderate risk. Below, these natural and genetically modified

pathogenic organisms are described as infectious agents, in accordance with ContainO/PEMO.

In addition to the usual hazards in such workplaces (physical, chemical etc.), the maintenance staff are exposed to infectious agents. The person in charge of the facility must make a risk assessment that determines the hazards and the risks of exposure due to planned maintenance work in each case, and must discuss them with the maintenance staff. The risk assessment forms the basis for the consideration of whether rooms, exhaust air ducts or wastewater pipes must first be decontaminated, and which protective measures (including personal protective equipment) need to be applied.

8.3 Hazard identification

If the rooms, systems and components of safety level 2 and 3 facilities have not been subject to correct and controlled decontamination¹ it should be assumed that there is a risk of infection.

Exposure, entry points and transmission paths

Exposure to infectious agents may take place via direct contact, droplets or dust. The entry points and transmission paths to be considered are:

- _ Skin, wounds (contact, and puncture wounds or cuts)
- _ Eyes, nose, mouth (contact with mucous membranes; dust and droplets)
- _ Gastrointestinal tract (swallowing)
- _ Airways (inhalation)

Knowledge of the exposure, entry points and transmission paths is essential for the risk assessment and the choice of safety measures.

Hazardous organisms and substances

8.3.1 Hazards inside the facility

In addition to infectious agents, safety level 2 and 3 facilities handle other substances. Allergenic, irritating, caustic and toxic substances may also present risks to maintenance staff. If the facility uses radioactive substances, preliminary explanations of radiation protection will be necessary. Although this handbook is concerned primarily with the possible release of and exposure to infectious agents, we also mention the other allergenic, chemical or radioactive hazards to which maintenance staff may be exposed at the same time. When carrying out maintenance work it should generally be assumed that – independent of the safety level – the hazard scenarios discussed below will be presented.

8.3.2 Hazards outside the facility

If work is being done outside containment, i.e. on the building or room envelope, or on exhaust air systems or drains, the same risk of exposure exists in principle as inside the facility.

¹ Controlled decontamination is understood as the application of a validated decontamination procedure. The success of this application must be verified using biological indicators, before the facility can be released for maintenance, repair or demolition.

Hazards on the supply air side	<p>There are no specific hazards within the meaning of the ContainO on the supply air side of ventilation systems and devices. Exposure to microorganisms according to the PEMO is, however, still possible, e.g. to moulds. In this area, work in and on air ducts should be carried out observing the usual occupational hygiene measures (see the FCOS Checklist for AC systems in Appendix 2). In safety level 3 facilities with gastight or airtight dampers on the supply air side, there is a risk of exposure from the supply air duct between the damper and the lab space. In safety level 2 facilities (or safety level 3 without gastight or airtight dampers) there is a risk of exposure between the supply air register in the lab and a section of upstream duct approx. 1 m long.</p>
Hazards on the exhaust air side	<p>Safety level 2 facilities harbour the usual laboratory hazards in exhaust ducts (infectious agents, chemicals, allergens etc. according to the range of laboratory activities). If blood-borne infectious agents are being used in the lab, this hazard must be taken into account. Blood-transmissible infectious agents could have been deposited in exhaust ducts (cut and puncture wounds).</p> <p>In safety level 3 facilities, the ducts on the exhaust air side of ventilation systems between the lab space and the HEPA filter carry the same hazards as the laboratory itself, in addition to the usual exhaust duct hazards.</p>
Hazards in drainpipes	<p>When working on drainpipes, the laboratory-specific hazards of infectious agents, chemicals, allergens etc., depending on the range of laboratory activities, should be taken into account in addition to the usual hazards.</p>

8.4 Safety precautions

Using the risk assessment, and depending on the hazard and the maintenance task, suitable safety precautions should be determined and adhered to, both by the facility and by the maintenance staff, as suggested below. The safety precautions affect:

- _ Work preparations and agreements;
- _ Safety measures;
- _ Personal protective equipment;
- _ Decontamination of tools, components, parts etc.;
- _ Completion of work.

8.4.1 Preparation and execution of work

Preparation	<p>The person(s) in charge of the facility must inform the maintenance staff about the possible hazards and discuss the procedures.</p> <p>In particular, the possible hazards, prior decontamination where applicable, the safety concept for maintenance work, and a work plan, should all be communicated and recorded if applicable, before starting work.</p> <p>If no decontamination (e.g. room fumigation, chemical decontamination of surfaces, drains etc.) will or can be carried out before performing maintenance work, for safety reasons it should always be assumed that infectious agents show high tenacity and high survival rate. It cannot be assumed that they will die off.</p>
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Duty to provide information, and agreements

The person in charge of the facility should inform the maintenance staff of at least the following issues:

- _ The components and parts to service.
- _ Natural organisms present in the facility (infectious agents) and animals being housed (allergens).
- _ Details of incubation periods that may apply (for personal employee card; only applies to safety level 3 facilities with infectious agents).
- _ Other hazardous substances that may be present.
- _ Entry points and transmission paths that should be considered.
- _ Prior decontamination carried out (or not carried out), with evidence of efficacy.
- _ Safety concept: instructions for behaviour inside and outside the facility, under normal operating conditions and in emergencies.
- _ Work plan: discussion of work to be done and the safety measures arising.
- _ Plan for completion of work (including decontamination plan) for tools, consumables and wastes.

Tasks of the person in charge of the facility

Before any maintenance work starts, the person in charge of the facility should confirm in writing to the maintenance staff:

- _ Whether systems, components or parts have been successfully decontaminated or not (compulsory for BSL-3).
- _ Which infectious agents may still be present and what the hazards and transmission paths are (applies to BSL-2, for BSL-3 only permissible for category 1 interventions; see below).
- _ The appropriate decontamination measures for surfaces and skin (in the event of exposure).
- _ The appropriate personal protective equipment.
- _ General and special safety measures (including emergency plans).
- _ How the transport of a person for medical treatment will be organised (should be discussed in advance).
- _ Start and end of work: the person in charge of the facility and the maintenance staff (or their representative) must confirm in writing at the beginning and end of the work that the planned maintenance works may be carried out within the agreed framework, and that it has been completed.

Tasks of the maintenance staff

Before work starts, the maintenance company, the leader of the maintenance team, or the contracted specialist should take the following measures:

- _ Obtain written confirmations as described above.
- _ Undertake instruction and training of the maintenance staff. The staff should be given information about exposure risks, the use of personal protective equipment/clean-room clothing, first aid, lines of communication, and medical treatment.
- _ Employees of the maintenance company must carry with them a card showing the possible risk of exposure while working and up to expiry of the incubation periods in question (only applies to safety level 3 facilities with infectious agents).
- _ Provision of first aid measures (as part of general occupational safety).

- _ Securing lines of communication at the site.
- _ Ensure that the usual hygiene measures are observed in the workplace (no eating or drinking).

8.4.2 Safety measures

Principle	Even after controlled decontamination, the survival of infectious agents at inaccessible places cannot always be ruled out. Wearing adequate personal protective equipment (see Section 8.4.3) is therefore always necessary, to protect against allergenic, toxic, caustic or irritating dusts.
Work on ventilation ducts	When carrying out maintenance work on the exhaust air side of ventilation ducts, different hazards are presented by tasks that require dismantling of ducts or large openings (e.g. to replace dampers), and those in which only a small opening (e.g. a cover or screw cap) is opened. In safety level 2 and 3 facilities this includes sections of ducts on the supply air side, as described in Section 8.3.2.
Small openings	<p>Small openings allow the introduction or removal of parts (hoses, cables, sensors etc.) or tools (screwdrivers, probes etc.) from the duct if it is narrow (nozzles, bolted openings etc.).</p> <p>The risk of exposure at small openings is low, but not negligible. Exposure can, however, be prevented using simple measures.</p> <p>Ventilation does not generally have to be turned off when working on small openings, and exhaust ducts do not need to be decontaminated.</p> <p>There is underpressure in exhaust ducts when they are in operation. If procedures are followed correctly, no dusts or droplets will be released from the duct into the working area. To prevent exposure:</p> <p>When removing parts or tools, grasp them tightly with a cloth soaked liberally in a decontamination agent, simultaneously uncover the opening, and pull the object out slowly. The prescribed time required for the decontamination agent to act must be observed, and if necessary followed by a dipping bath.</p>
Dismantling large openings	After turning off the ventilation system, the exhaust air ducts must be subject to correct and controlled decontamination (fumigation) before being dismantled or before dampers etc. are replaced.
Work on drains	Overpressure may occur in drainpipes, depending on the system. Such pipes may not be opened if they contain or have contained contaminated wastewater. In all cases, before maintenance work they should be rinsed with decontamination agent or superheated steam, and may only be opened when the pressure is neutral. Before removing covers or screw caps, or opening valves, the openings should be covered with a cloth soaked liberally in a decontamination agent (splash guard).

8.4.3 Personal protective equipment

Protective equipment must always be chosen on the basis of a situative risk assessment carried out before beginning maintenance.

Personal protective equipment that is appropriate for the safety level and exposures (BSL-2 or BSL-3) should be determined by the person in charge of the facility in consultation with the maintenance staff and in line with the risk assessment, for example in accordance with the suggestions in Table 1.

Work inside safety level 2 and 3 facilities

Personal protective equipment in accordance with the facility's safety concept and instructions from person in charge

Work on exhaust side of ventilation systems*: small openings

Vinyl or nitrile gloves. Where there is a risk of skin wounds, sturdy rubber gloves should be worn (single-use gloves, or decontaminated afterwards in a dipping bath)

Normal work clothing

Disposable lab coat over work clothes

Open safety goggles³

Work on exhaust side of ventilation systems*: dismantling, large openings

Work on drainpipes and wastewater systems

Sturdy rubber gloves should be worn (single-use gloves, or decontaminated afterwards in a dipping bath)

Category III Tyvek suit or other protective suit (with hood and overshoes or shoe covers), at least Type 5 & 6 (EN 14126)⁴. The gloves should be fastened around the cuff with adhesive tape.

FFP3 respirator mask (fitted and tested in advance)

Closed safety goggles⁵

BSL-2 facilities

Animal laboratories BSL-3 facilities

X

X

X

X

X²

X

X

BSL-2 laboratories

Animal laboratories BSL-3 laboratories

X

X

X

X

X

X

X

X

Table 1. Suggested personal protective equipment. The actual choice of protective equipment is the object of a situative risk assessment by the person in charge of the facility in consultation with the maintenance staff.* Sections of ducts on the air supply side are included, as given in Section 8.3.2.

8.4.4 Decontamination of tools, components, parts etc.

Safety level 2

After work in safety level 2 facilities, any necessary decontamination of tools, instruments etc. should be carried out appropriately and in consultation with the person in charge of the facility. Wiping the surfaces of objects with a cloth soaked liberally in a decontamination agent is generally adequate.

When using flammable decontamination agents, the risk of fire should be taken into account.

Safety level 3

In safety level 3 facilities (secondary containment), tools, instruments, consumables and wastes that have entered through the airlock must always be decontaminated when removing them through the airlock, unless there has been prior controlled decontamination of the internal area of the BSL-3 facility, e.g. through fumigation.

Outward transfer through the airlock

The decontamination measures to be taken must be discussed in advance with the person in charge of the facility, and recorded in a decontamination plan.

² Where there is a risk of physical exposure, e.g. when pulling out long pipes or hoses.

³ SUVA definition: protective goggles open at the sides.

⁴ When working on drainpipes, coveralls that are at least liquid-tight must be worn (Type 3, EN 14605).

⁵ SUVA: closely fitting protective goggles.

If the facility has not been, or could not be, decontaminated in advance, tools, instruments, consumables and wastes that are to be removed through the airlock must always be appropriately decontaminated, either thermally (autoclave) or chemically (fumigation, chemical surface decontamination, dipping bath etc.)⁶. It may be simpler to leave particular tools and instruments permanently inside the facility for subsequent maintenance work.

Sensitive tools and instruments can be packed in a sturdy, transparent plastic bag, sealed with adhesive tape, before entering through the airlock. The bag must under no circumstances be opened inside the facility. Damage to the bag means that the object will have to be decontaminated, in consultation with the person in charge of the facility, in an appropriate manner. On removal, the surface of the bag can be chemically decontaminated. Cables, drill heads etc. can be taken out of the bag. Their surfaces can be chemically decontaminated, without affecting the sensitive tool or instrument.

Requirements for cleanliness

In facilities where a high level of cleanliness is demanded (e.g. in cell culture rooms), the tools, replacement parts etc. to be brought in, and the personal protective clothing, must be cleaned or decontaminated by the maintenance staff following instructions from the person in charge of the facility; or clean-room clothing must be worn.

8.4.5 Conclusion of work

After conclusion of the maintenance work, the following steps must be taken:

- _ Checking the functional capability of the serviced components and parts.
- _ Informing the person in charge of the facility that the maintenance work has been concluded. Operations can be resumed in the facility.
- _ Decontamination of tools, parts and components that have been removed from the facility (in accordance with decontamination plan).
- _ Mutual written confirmation of the successful conclusion of work.
- _ Maintenance company employees must carry their personal employee card with them during the agreed period (incubation period, applies only to BSL-3 laboratories).

⁶ Appropriate decontamination or fumigation includes process validation and monitoring.

Appendix 1: Excel tables

Safety level 2 and 3 facilities

The maintenance handbook is supplemented with Excel tables that show the requirements for maintenance and inspection journals, with explanations and examples for consistent further development.

The tables are available in PDF and Excel format.

The necessary maintenance and inspection journals are given for all safety-relevant installations, arranged according to safety level 2 and 3 facilities. They can be completed with reference to the SWKI guidelines, or together with the specialist companies.

In terms of content, these Excel tables focus on ventilation systems, as experience shows that these tend to form the priority of maintenance and inspection journals.

Appendix 2: Legal foundations and references

to Standards for the maintenance handbook

The Standards below reflect the current state of technology for the description of biosafety classification in German-speaking countries.

- _ Ordinance on the contained use of organisms (Containment Ordinance, ContainO, SR 814.912) / Further information at:
www.admin.ch/ch/d/sr/c814_912.html (available online November 2011)
- _ Ordinance on Protection of Employees from Dangerous Microorganisms (PEMO, SR 832.321) / Further information at:
www.admin.ch/ch/d/sr/c832_321.html (available online November 2011)
- _ Ordinance on the Prevention of Accidents and Occupational Diseases (APO, SR 832.30) / Further information at:
www.admin.ch/ch/d/sr/c832_30.html (available online November 2011)
- _ Swiss Society of Building Technology Engineers (SWKI guidelines) /
Further information at: <http://www.swki.ch> (available online November 2013)
- _ European Standard EN 12128 (1998) / Further information at:
<https://www.beuth.de/en/standard/din-en-12128/4534069> (available online January 2013)
- _ German Mechanical and Electrical Engineering Working Party of National, Regional and Local Authorities (AMEV) / Wartung, Inspektion und damit verbundene kleine Instandsetzungsarbeiten von technischen Anlagen und Einrichtungen in öffentlichen Gebäuden (Wartung 2006) (Maintenance, inspection and associated small-scale repairs for technical installations and equipment in public buildings, in German).
Further information at: <https://www.amev-online.de/AMEVInhalt/Betriebsfuehrung/Vertragsmuster/Wartung%202018/> (available online November 2013)

The Swiss SWKI guidelines and the German AMEV guidelines are equivalent in terms of their detail for the maintenance of technical installations. The AMEV's facility specifications are currently more comprehensive.

Sections 4 and 5 are thus primarily focused on the AMEV guidelines, to ensure the handbook's presentation is as comprehensive as possible. Conversely, Sections 6 and 7 are aligned with the information and structure of the SWKI guidelines, in order to simplify the relation to Swiss Standards for users.

International guidelines such as the:

- _ WHO Laboratory Biosafety Manual, 3rd edition 2004
- _ US NIH/CDC criteria published in the "Biosafety in Microbiological and Biomedical Laboratories" guidelines (5th edition)
- _ NIH BSL-3 certification criteria for the NIH's own laboratories.
- _ Canadian Laboratory Biosafety Guidelines, 3rd edition 2004
- _ Australian/New Zealand Standard AS/NZS 2243.3:2010 Laboratory design and construction Part 3: Microbiological aspects and containment facilities
- _ Australian/New Zealand Standard AS/NZS 2982.1:1997 Laboratory design and construction Part 1: General requirements

Have not been considered further for the maintenance handbook, as they are not applied in Switzerland. These guidelines offer interested users the possibility of finding out about further aspects of microbiological work and technical equipment.

SUVA and the FCOS have published the following leaflets and guidelines for maintenance (all in German)

- _ FCOS-RL 6512 Arbeitsmittel (Work equipment)
- _ Suva leaflet 66121 Instandhaltung planen und überwachen (Planning and supervising maintenance)
- _ Suva publication 84040 Acht lebenswichtige Regeln für die Instandhaltung (Eight vital rules for maintenance)
- _ FCOS Checklist 6807 Instandhaltung von raumluftechnischen Anlagen (RLT-Anlagen) (Maintenance of AC systems)
- _ Suva campaign www.suva.ch/instandhaltung

Appendix F of AMEV gives more detailed references to Standards, guidelines and recommendations. The most important of these for the maintenance handbook are listed below, quoted from the AMEV.

AIG – Maintenance information

Arbeitsgemeinschaft Instandhaltung Gebäudetechnik (AIG)

Air-handling Technology Association in the German Engineering Federation (VDMA)

Lyoner Strasse 18

60528 Frankfurt am Main

E-Mail: info@vdma.org

Tel.: +49 69 6603 0

Internet: [Arbeitsgemeinschaft Instandhaltung Gebäudetechnik \(AIG\)](http://Arbeitsgemeinschaft%20Instandhaltung%20Geb%C3%A4udetechnik%20(AIG))

Selected publications concerning the maintenance of technical systems:

- _ AIG 1 Leitfaden zur Vergabe von Instandhaltungsleitungen für die Technische Gebäudeausrüstung (10.04)
- _ AIG 4 Luftbefeuchter in raumluftechnischen Anlagen (8.04)
- _ AIG 6 Wartungsschwerpunkte bei Lüftungs- und Klimaanlageanlagen (9.01)
- _ AIG 7 Hygieneanforderungen in der Raumluftechnik (9.01)

- _ AIG 8 Brandschutzklappen (10.01)
- _ AIG 9 Zusammenstellung instandhaltungsrelevanter Normen, Richtlinien and Veröffentlichungen für die Gebäudetechnik (6.06)
- _ AIG 19 Vergabe von Gebäudemanagementleistungen (8.00)

DIN – Standards

German Institute for Standardization (DIN)

Burggrafenstrasse 6

10787 Berlin

Tel.: (030) 2601 0

Fax: (030) 2601 1231

e-Mail: postmaster@din.de

Internet: www.din.de

Selected publications concerning the maintenance of technical systems:

- _ DIN 31051 Grundlagen der Instandhaltung (6.03) (Fundamentals of maintenance; in German)
- _ DIN 31052 Instandhaltung; Aufbau und Inhalt von Instandhaltungsanleitungen (6.81) (Maintenance; instructions for maintenance; in German)
- _ DIN 31054 Instandhaltung; Grundsätze zur Festlegung von Zeiten und zum Aufbau von Zeitsystemen (9.87) (Maintenance; principles for specification of times and structure of time systems; in German)
- _ DIN EN 13306 Maintenance - Maintenance terminology; Trilingual version (9.01)

VDI – Guidelines

Association of German Engineers (VDI)

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Telefon: +49 211 6214-0

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<https://www.vdi.de/>

Selected publications concerning the maintenance of technical systems:

- _ VDI 2890 Planned maintenance; guide for the drawing up of maintenance lists (11.86)
- _ VDI 2892 Management of maintenance spare parts (6.06)
- _ VDI 2895 Organisation of maintenance - Maintenance as a task of management (12.96)
- _ VDI 2896 Controlling of maintenance within plant management (10.94)

