


Requirements for BSL2 facilities from the safety and biosafety perspectives

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**Requirements for BSL2 facilities
from the safety and biosafety perspectives**
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Basler & Hofmann

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Think outside the biosafety box



Biosafety

Chemical Safety

Radiological Safety

Physical and Electrical Safety

Fire safety

Environmental Safety

Natural Hazards

Intrusion Theft (IT)- Security Biosecurity DURC

Quality GLP GMP

Environment Health and Safety

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Chemical hazards in BSL-2 labs



Photo: B&H

- Often, in BSL-1 or BSL-2 labs chemical hazards are more significant than biological hazards.
- Other lab hazards can also be significant: radiation, radio-nuclides, compressed gases, heat sources
- Trip, slip, fall, bump hazards

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Temperature comfort – compliance with PPE SOP

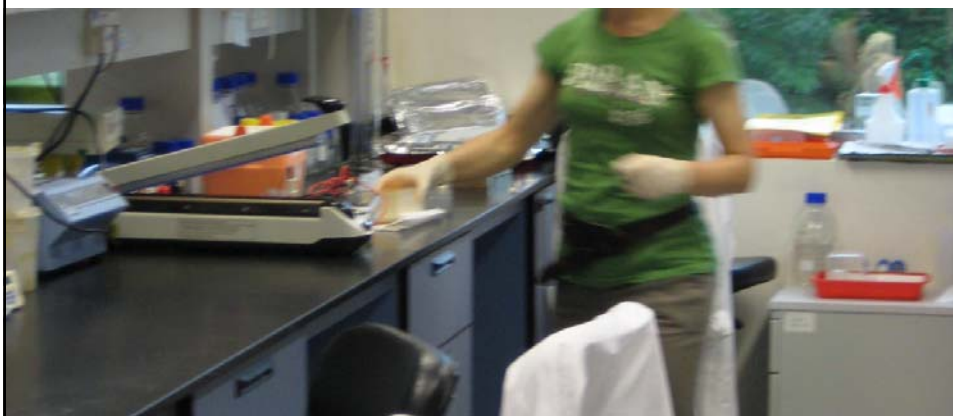


Photo: B&H

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Ergonomic issues – musculoskeletal illnesses



Photo: B&H

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Biosafety legislation in Switzerland

German	French	English
ESV: Verordnung über den Umgang mit Organismen in geschlossenen Systemen	OUC: Ordonnance sur l'utilisation des organismes en milieu confiné	ContainO: Ordinance on Handling Organisms in Contained Systems
SAMV: Verordnung über den Schutz der Arbeitnehmerinnen und Arbeitnehmer vor Gefährdung durch Mikroorganismen	OPTM: Ordonnance sur la protection des travailleurs contre les risques liés aux microorganismes	PEMO: Ordinance on Protection of Employees from Dangerous Microorganisms
StFV: Verordnung über den Schutz vor Störfällen (BSL-3 & BSL-4)	OPAM: Ordonnance sur la protection contre les accidents majeurs (BSL-3 & BSL-4)	MAO: Ordinance on Protection against Major Accidents (BSL-3 & BSL-4)

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Other relevant safety resources and information

German	French	Comment
EKAS-Richtlinie 1871: Chemische Laboratorien (2013) "EKAS 1871"	CFST directive 1871: Laboratoires chimiques (2013)	Applies to all medical, biological, physical and other laboratories if chemical substances are used
Wegleitung zu den Verordnungen 3 und 4 zum Arbeitsgesetz (2018) "SECO-Guidelines"	Commentaire des ordonnances 3 et 4 relatives à la loi sur le travail (2018)	Applies to all workplaces
Vereinigung Kantonalen Gebäudeversicherungen "VKF"	Association des établissements cantonaux d'assurance	Fire prevention and control directives and norms
Schweizerischer Ingenieur- und Architektenverein	société suisse des ingénieurs et des architectes	Swiss society of engineers and architects norms
Gefahrenkarten	Cartes de dangers	Hazard maps

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BSL-2 laboratory safety measures as per CO

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CO Annexe 4.1: General safety measures

“Compliance with the generally recognised codes of building practice in the **construction and maintenance** of buildings and installations, in particular with a view to their **stability, the safety of persons and property and fire prevention**”

- _ Space programming, access/escape routes, workspaces
- _ Fire protection
- _ Air quality, comfort (temperature, humidity, drafts)
- _ Noise

Details see EKAS 1871, SECO-Guidelines, VKF, and norms

Shell and core of a building

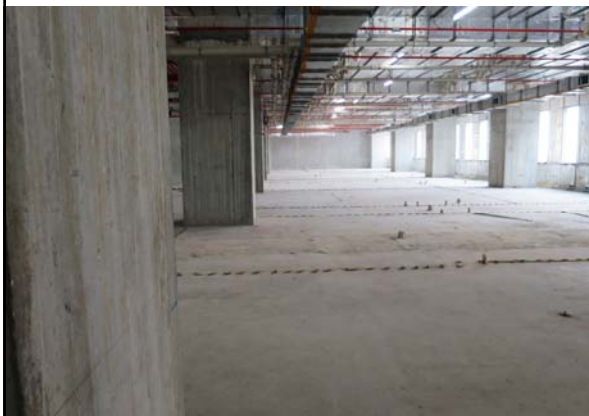


Photo: B&H

- _ Floor height
- _ Columns
- _ Stairwells, lifts
- _ Shafts
- _ Risers
- _ Sprinklers

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Structural grid is the base of lab design

Typical grid widths for labs:
7.0 – 7.5 m

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Flexible room arrangements

12 EBSA 2018 Breakout Session: Sustainable labs **Basler & Hofmann**

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Flexible room arrangements

The diagram illustrates a cross-section of a laboratory suite. It features three horizontal rectangular zones: an orange zone at the top labeled 'Laboratories', a white zone in the middle labeled 'Circulation: Corridor', and a green zone at the bottom labeled 'Offices'. Vertical dashed lines represent room boundaries. A double-headed arrow at the bottom left indicates a width of 7.5 m.

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13 EBSA 2018 Breakout Session: Sustainable labs

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Escape route distances (fire protection)

The diagram shows a plan view of a staircase. A central staircase symbol is connected by two diagonal lines to the corners of a rectangular room. Each line is labeled with a running figure icon and '35 m', indicating the maximum escape route distance from any point in the room to the staircase.

Treppenanlage ohne Korridor

Photo: B&H

Source: SECO-Guidelines, VKF

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Width of working spaces



Photo: B&H

Minimum widths for safety and quality reasons

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Width of working spaces (Source: EN 12128:1998)

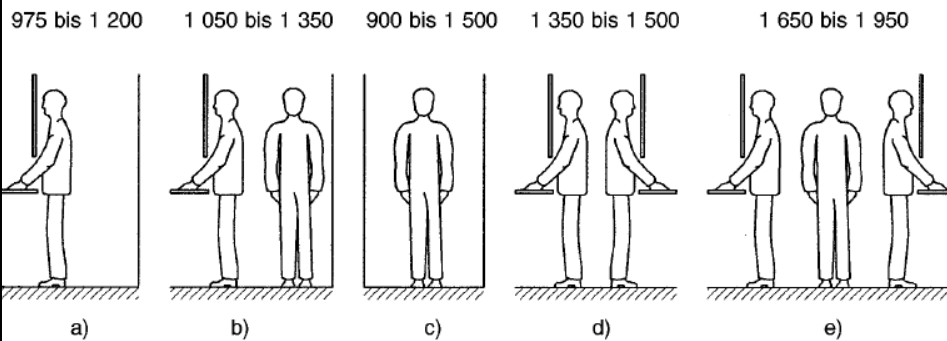


Bild A.1: Erforderlicher Abstand zu Arbeitsflächen und/oder Ausrüstung

EN 12128:1998

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Ergonomic issues



Photo: B&H

- _ Space planning
- _ Laboratory design

- _ Awareness training
- _ OHS review and audit

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Ventilation: Air quality & comfort pointers



Photo: B&H

- _ Maintain comfort-zone environment
 - _ Temperature control: 20-22°C
 - _ Comfort humidity: 35-35° rH at 22°CSource: SECO-Guidelines
- _ Air quality
 - _ No air-recirculation (single pass)
 - _ $12 \text{ m}^3 / \text{h} \cdot \text{m}^2 \approx 5$ air changes per hour
 - _ Directional inward airflow
 - _ If in doubt consult industrial hygienistSource: DIN 1946-7, TRGS 526 (HVAC systems for laboratories)

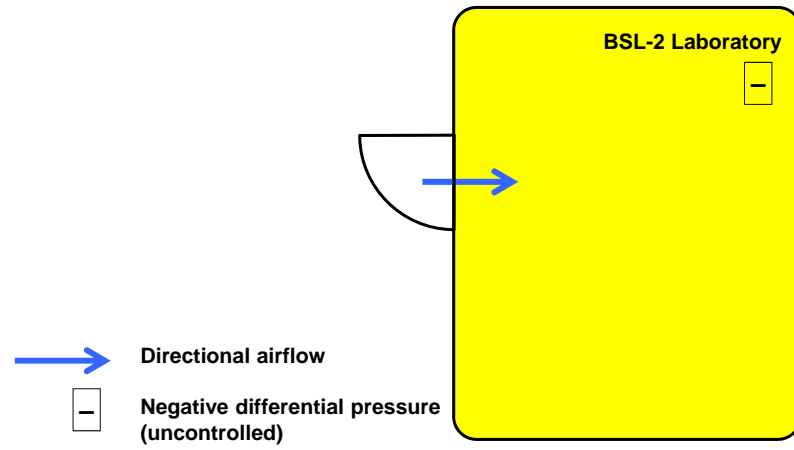
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BSL-2 directional inward airflow



BSL-2 Laboratory

Directional airflow


Negative differential pressure (uncontrolled)

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Noise pointers



- Noise level: ≤ 50 dB(A)
- Details see SECO-Guidelines
- Encase noisy equipment
- Hearing protection
- If in doubt consult industrial hygienist

Photo: B&H

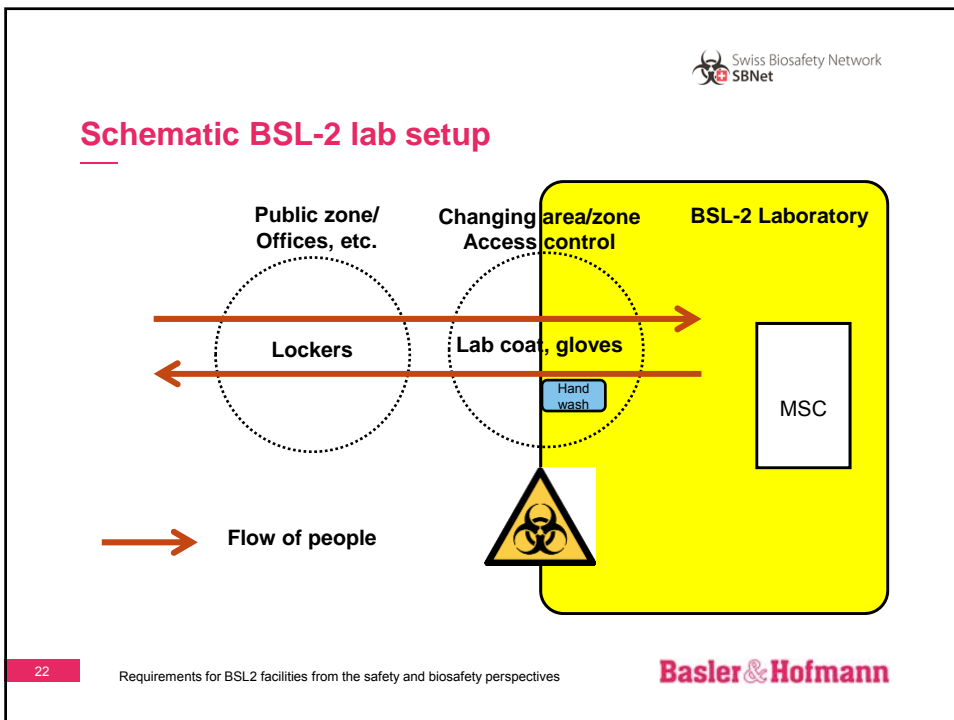
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CO Annexe 4.2: BSL-2 lab special safety measures

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Restricted access to the work area



Source: www.artguardsecurity.com

- _ Choice of access control depends on building/floor design, and budget:
 - _ Organisational control is an option
 - _ Lock and key
 - _ Non-intelligent / intelligent readers
 - _ Combinations

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Facilities for personal decontamination in the work area

- _ Hand-wash basin
- _ (Emergency-)Shower
- _ Eye-wash

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Hand-wash basin and locker pointers

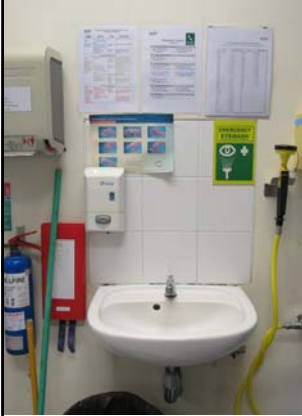


Photo: B&H

Best practice:

- Hand-wash basin preferably with truly hands-free taps (sensor or mechanical).
- Wrist and elbow levers are not truly hands-free.
- Lockers and racks for personal clothing and belongings should be separate from lab clothes.

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Emergency shower pointers



Photo: B&H

- Not suitable for managing biological spills on person
 - Depends on risk assessment (use of corrosive/toxic liquids)
 - Requirements see EKAS 1871, SECO-Guidelines
 - 10 seconds rule (“distance”)
 - Floor drains in BSL-2 labs are not allowed or must be sealed
 - Curb/pan to contain water?
 - Testing of shower?
 - Combination shower/eyewash (see photo)

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Eye wash pointers



Photo: B&H

- _ Reduce risks of eye injuries
- _ Eye protection as and if required
 - _ (EKAS 1871, SECO-Guidelines)
 - _ 10 seconds rule ("distance")
- _ In microbiology labs eye wash bottles may be sufficient (mind the expiry date)

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Biohazard warning sign



BSL-2 Clinical Laboratory
Authorised staffs only
Biosafety Coordinator:
XY, Office #
Mobile Phone #

Sign: Wikipedia

- _ Biosafety level
- _ Contact information
- _ Authorised staffs only
- _ Information on microorganisms:
 - _ Pathogen, zoonotic, enzootic
 - _ Plant pathogens or diseases
 - _ Animal species
 - _ Quarantine organisms
- _ Optional: PPE requirements

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Rooms with easily cleanable floors



Photo: B&H

Additional pointers:

- _ Slip-resistant, even when wet
- _ Mind tile joints, welded seams
- _ Ideally monolithic and floor to wall coving
- _ Note resistance to cryogenic nitrogen

Details see SECO-Guidelines

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Doors and window pointers



Photo: Florian Achtriner

Doors

- _ Should open outwards (escape route) with vision panel (accident prevention)
- _ Recessed doors for increased safety
- _ Should remain closed during work (door closer)
 - _ Option: Automated door openers (proximity sensor; recessed door/safety controls)
 - _ Option: Sliding doors

Windows

- _ Should remain closed during work

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Surfaces resistant...



Photo: Markus Linke

... to water, acids, alkalis, solvents, disinfectants and decontaminants

- Benches, furniture
- Walls where it applies
- Wood and laminated wood chip materials can be very problematic
- Suitable: Epoxy and phenolic resins, metal, PP, HDPE, glass
- Flexible vs. fixed furniture

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MSC pointer: Location (BS 5726:2005)



Photo: B&H

- Separation of undisturbed zones around MSC (see photo).
- Spacing between multiple MSCs and from MSC to benches, walls, doors, etc. to minimize perturbation of MSC.
- Note: MSC guidelines and directives published by Federal Office for the Environment and Swiss Expert Committee for Biosafety.

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Autoclave: heat, humidity and odour



Photo: B&H

- _ Heat, humidity and odour removal:
 - _ Partitioning off unloading side (heat, humidity and odour trap)
 - _ Directional inward airflow
 - _ High air exchange rate (swift dilution)

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**Additional good practice
BSL-2 lab safety measures**

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Storage of chemicals, corrosives, flammables, etc.



Photo: B&H

- _ Storage of small amounts in labs in suitable cabinets with collecting/drip pans
- _ Cabinets may need to be vented
 - _ EKAS-Richtlinie 6501 Corrosives
 - _ SUVA Form 1825 Flammable liquids
 - _ EKAS-Richtlinie 1875

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Poisons, carcinogens, mutagens...

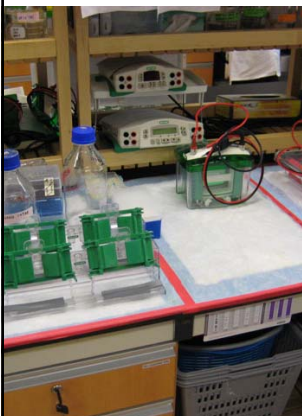


Photo: B&H

- _ Chemical fume hoods, isolators, etc.
- _ Policies and SOPs
- _ Housekeeping rules
- _ Internal audits

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Light levels



Photo: B&H

- ≥ 750 lux on lab work surface (SECO-Guidelines)
- Light levels can be lower and higher for less demanding and more demanding work, respectively.
- Details see SECO-Guidelines and corresponding Swiss norms.

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Cryogenic liquids/gases



Photo: B&H

- Well ventilated rooms
- Gas sensors
- Cold resistant flooring material
- Safety instructions and PPE

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Electrical hazards



Photo: B&H

- _ Common issues
 - _ Electrical loads
 - _ Extension cords

- _ Electrical safety regulations (SEV/SUVA)

- _ Fault-current circuit breakers

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Space constraints, combustible material storage

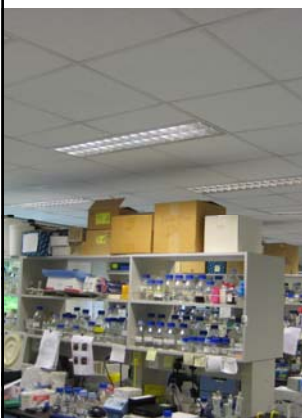


Photo: B&H

- _ Housekeeping rules

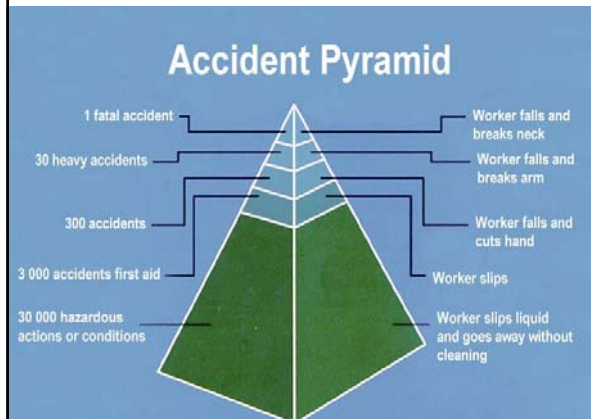
- _ Internal audits

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Last but not least: Practices, training, audits



Heinrich Pyramid (1931) by DuPont

Eliminate hazardous actions and conditions

- Policies and SOPs
- Safety training
- Safety culture
- Internal audits

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Thank you

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