Beryllium

CLEAN-UP GUIDE RG-652

WORKPLACE HOUSEKEEPING AND DECONTAMINATION

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Preamble

CLEAN-UP GUIDE Beryllium

This document is intended to provide information and practical prevention answers relating to the clean-up of premises where beryllium is used, for housekeeping as well as for decontamination work. It was designed to help clean-up activity managers in establishments containing beryllium in developing a housekeeping or decontamination protocol in order to achieve acceptable levels of this metal. It will also be a reference tool for companies specialized in the housekeeping or decontamination of workplaces.

This guide was produced from a review of the scientific and technical literature, from results and observations originating from laboratory and workplace studies, as well as from consultations with people involved in decontamination work WHERE BERYLLIUM IS PRESENT. A complete report presenting the results of the studies carried out to produce this guide is available on the IRSST's website.[1]

This guide contains information on work methods, sampling strategies, Québec reference values, clean-up procedures, preventive measures, and personal protective equipment for workers directly involved in decontamination operations. A decision tree and data collection sheets for air and surface samples are also included.

1. VIAU, S., C. Dion, G. Perrault, A. Dufresne, V. Turcotte, H. Golshahi, B. Campbell, T. Mocanu, A. Ouellet, P.-J. Désormeaux, Cleaning and decontamination of workplaces containing beryllium - Techniques and cleaning solutions, Studies and Research Projects / Report R-614, Montréal, IRSST, 2009, 74 pages. (http://www.irsst.qc.ca/files/documents/PubIRSST/R-614.pdf)

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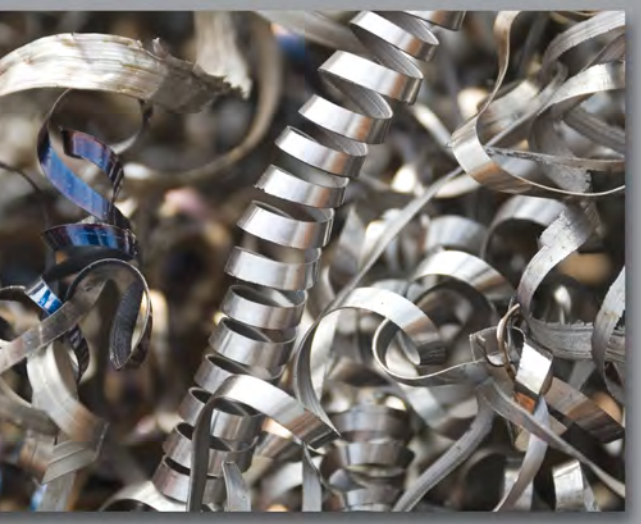


Definitions

AUTHORIZED PERSON:
Any person qualified to perform clean-up tasks who must enter controlled areas.

BERYLLIUM (Be):
Elemental beryllium, as well as all compounds or alloys containing at least 0.1% (1000 mg/kg) beryllium,[2] that can be emitted into the air in the form of fumes or dusts.

BERYLLIUM LYMPHOCYTE PROLIFERATION TEST (BeLPT):
In vitro immunologic test that detects sensitization by measuring the specific antigen for beryllium.

BREATHING ZONE:
Zone within a hemisphere having a 300-mm radius extending in front of a person's face and measured from the midpoint of an imaginary line joining the ears.

CHRONIC BERYLLIUM DISEASE (CBD):
Debilitating granulomatous inflammatory disease. It occurs following beryllium exposure causing an immunologic hypersensitivity reaction (allergy).[3]

CLEAN-UP:
The removal of a chemical substance or hazardous material from the environment to prevent, minimize or mitigate damage to public health, safety or welfare, or the environment, that may result from the presence of the chemical substance or hazardous material. The clean-up is carried out to specified clean-up criteria.[4] In this document, clean-up work is considered from a housekeeping standpoint as well as a decontamination standpoint.

CONTROLLED AREA:
Delimited area inside of which the beryllium concentration exceeds, or may exceed, the reference value of 0.2 µg/100 cm^2.

DECONTAMINATION:
Operation consisting of eliminating or reducing to an acceptable level the presence of beryllium in a contaminated environment.

ENCAPSULATION:
Confinement technique that consists of enclosing contaminated materials in a protective material or surrounding them with leakproof barriers to prevent their dispersion in solid, liquid or gaseous form.

ENCLOSURE:
Completely closed fixed barrier or structure consisting of (airtight) leakproof materials.

HIGH EFFICIENCY PARTICULATE FILTER (HEPA):
Any filter that can retain particles with a dimension of 0.3 micrometres (µm) with an efficiency rate of 99.97%.

HOUSEKEEPING:
All of the work necessary for maintaining normal hygiene and cleanliness conditions in an establishment.

REFERENCE VALUES FOR SURFACE CONTAMINATION:
Concentrations of surface contamination on the basis of which corrective measures must be implemented, including housekeeping or decontamination.

RESIDUAL HAZARDOUS MATERIAL:
Substance that, due to its properties, presents a health or environmental hazard and that is explosive, gaseous, flammable, toxic, radioactive, corrosive, combustive or leachable, as well as any substance or object considered to be a hazardous material.

SENSITIZATION:
Reaction of the body, in the form of an allergic (immunologic) response of the respiratory tract, mucous membranes, conjunctiva or the skin.[3]

TIME-WEIGHTED AVERAGE EXPOSURE VALUE (TWAEV):
The time-weighted average concentration for an 8-hour workday and a 40-hour workweek of a chemical substance (in the form of gases, dusts, fumes, vapours or mists) present in the air in a worker's breathing zone.[5]

WIPE SAMPLING:
Surface sampling technique using a support (moistened wipe).

2. Certain materials containing less than 0.1% beryllium can generate surface contamination above the reference values.
3. INSPQ, Direction des risques biologiques, environnementaux et occupationnels. Document d'appui à la définition nosologique – bérylliose. Maladies à déclaration obligatoire, d'origine chimique ou physique, 2006. (http://www.inspq.qc.ca/pdf/publications/612-DefNosologiqueBerylliose.pdf)
4. Containment Sites Management Working Group. Government of Canada. A Federal Approach to Contaminated Sites, 2007. (https://www.ec.gc.ca/etad/csmwg/pub/fed_aprch/en/glossary_e.htm)
5. (http://www.csst.qc.ca/prevention/theme/beryllium/informations_base.htm)

1. BERYLLIUM IN BRIEF

Beryllium (Be) is a metallic element, silver grey in colour, used in alloys due to its particular properties. It is light, non-magnetic, corrosion-resistant and a good thermal and electrical conductor. It is present in a large variety of materials used by various activity sectors (aerospace, smelting, automobile, dental techniques, telecommunications industries, etc.). Besides its use in alloys (Be-Cu, Be-Ni, etc.), beryllium is also found in workplaces in the form of beryllium oxide (BeO), soluble salts and, more rarely, in its elemental form (Be).

Beryllium and its compounds can cause disorders of the mucosa as well as respiratory diseases such as chronic beryllium disease (CBD) and lung cancer.[6]

Chronic beryllium disease is preceded by a sensitization phase, meaning a reaction of the body that manifests itself by an allergic (immunologic) response. However, not all individuals sensitized to beryllium (BeS) will develop the disease.

The potential absorption of Be and its compounds through the skin is being increasingly studied. Skin absorption of soluble beryllium salts can cause contact dermatitis, whereas ultrafine insoluble beryllium particles (≤ 1 µm) can penetrate the body through the skin. However, inhalation remains the main route of entry of Be into the human body.

Beryllium exposure can be reduced, thus limiting the risk of sensitization and chronic beryllium disease, by complying with stringent means of control of processes, hygiene and prevention. For more information about beryllium, consult the CSST's web site.[7]

2. ACTIVITY SECTORS WHERE BERYLLIUM MAY BE PRESENT

Beryllium, in the form of alloys or as natural contamination of a starting material, is found in a wide variety of materials used by various activity sectors:

NOTE: Beryllium producing and consuming companies, as well as their subcontractors, can be affected by contamination by this metal.

- Smelting
- Metal recycling
- Aerospace and aeronautics industry
- Environmental industry (waste processing and recycling)
- Plastics industry using moulds made of beryllium alloy
- Manufacture of moulds and dies
- Companies that machine and weld beryllium-containing alloys
- Manufacture of dental prostheses
- Manufacture of some electrical and electronic components
- Manufacture of some automobile parts
- Manufacture of ball bearings
- Manufacture of certain weapons parts
- Manufacture of semiconducting ceramic
- Nuclear energy industry
- Manufacture of some sports articles (bicycles, golf clubs, tennis rackets)
- Distribution and manufacture of welding electrodes

6. Beryllium is classified in Group 1 of the International Agency for Research on Cancer (IARC): sufficient evidence of human carcinogenicity.
7. (http://www.csst.qc.ca/prevention/theme/beryllium/informations_base.htm)

3.

TASKS THAT CAN RELEASE BERYLLIUM PARTICLES IN AEROSOL FORM

All tasks performed with a beryllium-containing material can release particles or fumes and must therefore be considered as potential sources of contamination. For example:

- machining, cutting, welding, polishing, etc.;
- fusion and moulding;
- heat treatment;
- research and development activities;
- manipulation of metallic beryllium and its compounds;
- recycling of beryllium-containing products, residues or debris;
- industrial maintenance and housekeeping services.

In the construction sector, the following activities in particular must be monitored in any building or company that has used beryllium:

- decontamination;
- renovation;
- demolition.

4.

QUÉBEC REGULATIONS AND REFERENCE VALUES

4.1 Air contamination

The Regulation respecting occupational health and safety (ROHS) specifies a time-weighted average exposure value (TWAEV) of 0,15 µg/m³ for beryllium (metal and its compounds).[8] This threshold value is accompanied by the following notations: The carcinogenic effect is detected in humans (C1). Recirculation is prohibited, in accordance with section 108 (RP). Exposure must be reduced to a minimum, in accordance with section 42 (EM). Repeated exposure can cause sensitization (S: SENSITIZER).

4.2 Surface contamination

In Québec, there is no regulatory value for surface contamination by beryllium. In the United States, the Department of Energy (DOE) has proposed limit values in its prevention program.[9]

In Québec, the technical committee of the board of directors of the CSST on beryllium (no. 3.69) has retained these levels as threshold values.

Therefore, the beryllium concentration must not exceed 0.2 µg/100 cm² on work surfaces, equipment and objects for them to be considered as not contaminated. In work areas where activities involving beryllium are ongoing, a maximum value of 3.0 µg/100 cm² must be respected. This value must be measured during periods of inactivity or, if the work is done continuously, after a sufficient time to allow the dust to settle.

General and personal protective measures as well as a housekeeping program must be implemented when the beryllium concentration is between 0.2 and 3.0 µg/100 cm².

For sedimented dusts, the reference value as criterion for the presence of beryllium has been set at 10 ppm (mg/kg).[10]

8. Éditeur officiel du Québec, Gouvernement du Québec. Regulation respecting occupational health and safety. S-2.1, r.19.01, 0.C. 1120-2006, 2007. (http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=%2F%2FS_2_1%2FS2_1R19_01_A.htm)
9. US Federal Register. Chronic beryllium disease prevention program; final rule, DOE 10 CFR Part 850, 68854-68914, 1999. (http://www.hss.doe.gov/healthsafety/WSHP/be/docs/berule.pdf)
10. CSST. L'exposition au béryllium dans les milieux de travail. (http://www.csst.qc.ca/prevention/theme/beryllium/informations_base.htm)

CLEAN-UP TECHNIQUES

The techniques used for the maintenance of Be-contaminated areas or equipment must prevent the dispersion and resuspension of dusts.

Thus, the following clean-up techniques are prohibited:

- Use of compressed air, except inside a confined ventilation system designed to collect dusts.
- Use of dry processes, such as shovelling, sweeping or brushing, except inside completely contained enclosures that isolate the worker from the dusts (glove box, closed and ventilated cabin with remote control, etc.).

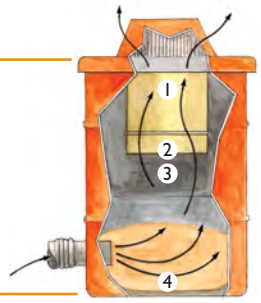
Two processes are commonly used to limit surface contamination by dusts: vacuum cleaning using a vacuum equipped with a high efficiency particulate filter (HEPA), and wet cleaning using a detergent. For maximum effectiveness, it is recommended that these two methods be used, one after the other (clean-up cycle).

It may be necessary to repeat the clean-up cycle in order to achieve levels of contamination below the recommended reference value.

Figure 1: Vacuum cleaning using a vacuum equipped with a HEPA filter

5.1 Vacuuming with a HEPA filter

Vacuum cleaning using a vacuum equipped with a HEPA filter is a first step for potentially removing the majority of debris and dusts (Figure 1). The vacuum system must not allow recirculation of contaminated air and must have an evacuation duct to the outdoors, in accordance with section 108 of the ROHS.[11] Also, when combustible dusts (for example, magnesium or aluminum dusts) are present, the HEPA vacuum must be explosion-proof or operate with compressed air.[12]



1. The HEPA filter eliminates fine particles.
2. The microfilter or pre-filter protects the HEPA filter.
3. The fabric filter ensures a uniform airflow.
4. The bag filters out the denser dusts.

Periodic maintenance of the vacuum systems (mobile or stationary) is essential for their proper operation. A partially or completely obstructed filter can compromise their efficiency. The instruction manual on the use and maintenance of this equipment must be consulted.

Workers who maintain vacuum systems (changing filters and bags or removing vacuumed debris) can be exposed to BERYLLIUM DUST. Appropriate measures must be planned to minimize their exposure and to protect them: opening the equipment inside the work area, and the wearing of personal protective equipment (respirator, coveralls and gloves).

The cleaning equipment used in work areas that include beryllium-containing material must be clearly labelled and must not be used in Be-free areas. If such equipment must be used in another environment, it must be cleaned well (according to the manufacturer's instructions), making sure that the threshold value of 0.2 µg/100 cm^2 is respected in order to avoid cross-contamination.

Beryllium-contaminated dusts and debris collected using a portable (mobile) or central (stationary) vacuum as well as the equipment's filters and bags must be considered as residual hazardous materials (see section 7). Central vacuum systems with an outdoor air exhaust should comply with environmental requirements.

11. Éditeur officiel du Québec. Gouvernement du Québec (2007). Regulation respecting occupational health and safety. S-2.1, r.19.01, O.C. 1120-2006. (http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=%2F%2FS_2_1%2FS2_1R19_01_A.htm)
12. NFPA 241: Standard for Safeguarding Construction, Alteration and Demolition Operations.

5.2 Wet cleaning with detergent

Wet cleaning loosens the dust from a surface. Wet processes include the use of:

- low-pressure water jets (1500 psi);
- motorized scouring equipment using water;
- dusting with sponges or cloths impregnated with water containing a wetting agent, a solution, or a commercial soap;
- damp mops.

Figure 2: Wet clean-up technique with three pails

A three-pail system is suggested.

1. First, the operator uses a pail containing water mixed with a cleaning solution to wash the surface.
2. An empty pail is used to wring out the dirty cloth, sponge or mop before returning it to the first pail to continue washing.
3. A third pail containing only water is used for rinsing the surface after washing. The operator must be vigilant in regularly changing the wash water to ensure that the surfaces are not recontaminated. He must take the same care with sponges, cloths and mops.

The wash water used for clean-up work must be collected in appropriate containers.

Representative samples must be submitted to a certified laboratory for analysis of all standardized parameters to verify whether these waters comply with the requirements of the Regulation respecting hazardous materials and the disposal standards applicable to sewer networks. If the water quality does not allow its disposal into the sewer network, it must be managed by a contaminated water management or treatment centre (see section 7).

Figure 3: Washing technique with low-pressure water jets

Companies currently use different commercial and industrial products for cleaning contaminated surfaces (Alconox®, Citranox®, Luminox®, Fantastik®, Z-99®, Ledizolv®, Resolvev®).[13] According to an evaluation done by the IRSST, these products have comparable efficiency on a surface where BERYLLIUM PARTICLES have settled. To ensure that the necessary preparation methods and precautions are applied, it is strongly recommended that the safety or technical data sheets for these products be consulted.[14]

13. http://www.alconox.com/static/msds/msds_alconox.asp
http://www.alconox.com/static/msds/msds_citranox.asp
http://www.alconox.com/static/msds/msds_luminox.asp
http://www.scjohnson.ca/ftss/06-08_350000004768_Fantastik_Disinfectant_Lemon_FR.pdf
http://www.ledizolv.com/LearnAbout/LedizolvMSDS/lszmsds.asp
http://maunco.com/photos/custom/MSDS/Z-99%20msdseng.pdf
http://www.resolvesolvents.co.uk/pages/index.asp?area=4&area2=7

14. VIAU, S., C. Dion, G. Perrault, A. Dufresne, V. Turcotte, H. Golshahi, B. Campbell, T. Mocanu, A. Ouellet, P.-J. Désormeaux, Cleaning and decontamination of workplaces containing beryllium - Techniques and cleaning solutions, Studies and Research Projects / Report R-614, Montréal, IRSST, 2009, 74 pages. (http://www.irsst.qc.ca/files/documents/PubIRSST/R-614.pdf)

CLEAN-UP WORK

Clean-up work is usually required in three types of situations:

- for cleaning surfaces of materials made of beryllium (alloys);
- for housekeeping of areas that continue to carry out activities using beryllium;
- for decontaminating contaminated equipment or work areas to eliminate beryllium from them.

6.1 Cleaning surfaces of materials made of beryllium (alloys)

Tools and equipment made of beryllium alloy are potential sources of skin exposure. Their use should therefore be backed up by appropriate prevention measures. An object containing beryllium, whose surface has been cleaned, always retains its potential to release Be.

To clean these objects, a neutral or alkaline product (Alconox®, Luminox®, Fantastik®, Ledizolv®, Z-99®, Resolve®), less strong than an acid solution (Citranox®), allows the surface contamination to be kept at a level below 3 µg/100 cm^2 (value for compliance in a beryllium-contaminated area, with exposure control measures and appropriate protective equipment).[15]

Depending on the case, the exposure control measures in such situations are:

- storage of these objects in a closed location, with the entry having a sign indicating the presence of beryllium and the required protective equipment;
- packaging of the object to move it;
- a contained enclosure surrounding the object during its use;
- a label installed on the object (or on its packaging) mentioning the exposure risks and the required protective equipment;
- skin protection for handling these objects (gloves, long sleeves);
- respiratory protection complying with the ROHS;[16,17]
- training and informing employees.

6.2 Housekeeping of areas that continue to carry out activities using beryllium

In companies using beryllium, housekeeping must prevent the accumulation of dusts that contain it, and limit the propagation of contamination towards other areas.

Housekeeping, whose frequency is based on the activities and processes, allows the surface contamination to be kept below levels that prevent the risks of worker exposure to beryllium through the resuspension of dust. Housekeeping must cover the areas adjacent to the work areas (changing rooms, bathrooms, offices, etc.), the dust and fume control systems, as well as the equipment and tools used for the production of materials that contain beryllium.

The manufacturers' instructions for maintenance of the different equipment and tools must be followed.

The level of surface contamination is periodically checked, during the periods when work is stopped, using wipe sampling (moistened wipe) according to a pre-established procedure. If the work is done continuously, the samples are collected after a sufficient time for the dust to settle. This wipe sampling evaluates the situation in areas at risk of being contaminated and is therefore not done in closed systems, such as equipment confinement, glove boxes, contained enclosures with remote or automatic handling, ventilation systems, etc.

Surface contamination in a beryllium-contaminated area (with exposure control measures and appropriate protective equipment) must remain below the value of 3 µg/100 cm^2.

Housekeeping can itself result in exposure to Be-containing dusts. The appropriate clean-up techniques are described in section 5.

15. VIAU, S., C. Dion, G. Perrault, A. Dufresne, V. Turcotte, H. Golshahi, B. Campbell, T. Mocanu, A. Ouellet, P.-J. Désormeaux, Cleaning and decontamination of workplaces containing beryllium - Techniques and cleaning solutions, Studies and Research Projects / Report R-614, Montréal, IRSST, 2009, 74 pages. (http://www.irsst.qc.ca/files/documents/PubIRSST/R-614.pdf)
16. CSST. Guide de protection respiratoire, 2002. (http://www.prot.resp.csst.qc.ca/GuideTM.shtml)
17. CSST. Info-Be, 2007. (http://www.csst.qc.ca/NR/rdonlyres/89824715-DB59-4DE9-8068-F6BCCAA4974F/2819/DC_600_450_2.pdf)

6.3 Decontamination of equipment or a work area

Decontamination of premises or equipment consists of eliminating the presence of beryllium or reducing it to an acceptable level, so as to make these premises or equipment available to the public, to active workers in beryllium-free areas, or to industries that do not use Be.

The reference value to ensure effective decontamination is 0.2 µg/100 cm^2. Decontamination is an essential step in the demolition of a contaminated structure, area or establishment.

6.3.1 Decontamination and recovery of equipment or other objects contaminated by Be

Before equipment or other objects (tools, merchandise, documents, etc.) are released for use in a beryllium-free location, one must ensure that the surface contamination does not exceed the established value, 0.2 µg/100 cm^2, or the concentration of Be in the soils at the location where they will be used.[18]

The inside surfaces of the equipment must be decontaminated when dusts can escape, become airborne, and present risks for other people (during repairs, for example).

When it is impossible to clean the inside of equipment, this equipment cannot be considered as being decontaminated, and therefore cannot be made available to the public or another industry, or sent to a beryllium-free area. The components or the equipment itself must be labelled to ensure their traceability and to prevent risks for workers who may be called on to dismantle them later.

The equipment receiver must apply the appropriate controls to prevent Be exposure during future use, considering the nature of the equipment and the possibility of residual contamination.

Paper documents that are in an area containing beryllium are also considered as contaminated. A contaminated document can be photocopied on a machine located in a controlled area, with the copies emerging towards a clean area. The originals, which remain in the contaminated area, must then be disposed of with beryllium-containing waste. Electronic copies are favoured when possible.

6.3.2 Decontamination of a Be-contaminated work area in order to convert it to a Be-free environment

Specific practices apply to the decontamination of premises or a building (Table 1).

Various techniques are used to isolate the contaminant when it is difficult to remove it from some surfaces:

- cover rough, porous, damaged surfaces or ones difficult to clean with paint, resin or any other durable coating in order to prevent the emission of beryllium dusts into the air;
- use encapsulation, a confinement technique for enclosing contaminated materials in a protective material, or surround them with leakproof barriers to prevent migration of the dusts;
- use a contained enclosure by installing a barrier or a fixed structure made of leakproof materials, completely tight.

The use of these techniques does not constitute decontamination. Instead, these techniques are ways of managing the risk while waiting for the contaminated environments to be treated or when no decontamination solution exists.

Appropriate labelling and periodic examination of the condition of the surfaces or components must be carried out.

6.4 Demolition of a structure or a work area

To demolish a structure, an area or an establishment, including the dismantling of a ventilation system, the decontamination steps must be followed beforehand (Table 1). When the demolition area is free of beryllium (< 0.2 µg/100 cm^2), the work can then be started.

18. Contaminated Sites Management Working Group. Government of Canada. A Federal Approach to Contaminated Sites, 2007. (https://www.ec.gc.ca/etad/csmwg/pub/fed_aprch/en/glossary_e.htm - g)

Table 1

DECONTAMINATION STEPS

	STEPS	TOOLS AND TECHNIQUES
PREPARATION		
1	Isolate the areas for decontamination from the rest of the facilities or building.	Seal the entries and openings in the walls with polyethylene sheet.
2	Keep the area for decontamination at negative pressure (from 1 to 4 Pa).	Install a system with HEPA filters. The exhaust duct towards the outdoors must comply with local public and environmental protection regulations.
DECONTAMINATION		
3	First clean the equipment and objects that will be kept, and store them in an uncontaminated area.	Do the clean-up using a compliant HEPA vacuum, followed by wet cleaning with detergent if it is not a safety hazard (presence of electrical installations, for example).
4	Clean the objects for disposal or destruction and transport them to a waiting area planned for this purpose, or place them in a waste disposal container with a cover and an inside protective coating, or in leakproof bags or containers.	Refer to section 7 (Residual materials management).
5	Do the clean-up in steps so as not to recontaminate the clean areas.	Begin the clean-up at the point farthest away from the air exhaust duct of the negative pressure maintenance system.
6	Proceed with clean-up and removal of the exhaust ducts of the heating, ventilation and air conditioning systems as well as the stationary vacuum systems (hoods), either to destroy them, replace them, or for reinstallation purposes.	Clean the outside of the ducts. Close and seal the ends of the components. Remove the ducts, one section at a time, and transport them to a preparation area. Inspect the inside of the ducts; if dust is visible, clean them using a vacuum equipped with a HEPA filter. Separate the sections or cut them into lengths that can be handled. Separation must be done by mechanical cutting or by dismantling at the junction points. Do not cut the ducts with a torch. All dismantling and cutting operations must be done by keeping the ducts under negative pressure, using an air exhaust system equipped with a HEPA filter.

STEPS	TOOLS AND TECHNIQUES
DECONTAMINATION	
7 Clean the ceiling tiles, grates and the retaining rods.	Ceiling tiles (porous) must be cleaned only with a vacuum equipped with a HEPA filter (do not use wet cleaning). Package the tiles for disposal in plastic bags.
8 Clean the walls and frames of fixed structures.	The clean-up, removal or dismantling of permanent components (structures and walls) of each room must begin at the ceiling and go towards the floor. Clean the surfaces of walls and structures that remain in the building with a vacuum equipped with a HEPA filter. Then proceed with wet cleaning (see section 5). A second clean-up with the vacuum may be necessary to collect the dust that was loosened from the surface and not collected during wet cleaning. It is preferable to wait one hour to give the particles time to settle and thus be able to observe their presence on surfaces. Clean the vacuum well after each use.
9 Cover rough, porous, damaged surfaces or ones difficult to clean with paint, resin or any other durable coating in order to prevent the emission of beryllium dusts into the air (encapsulation).	Place a label indicating the presence of Be to ensure traceability and do a periodic follow-up of the state of the surfaces or components.
10 Make sure that the work area is free of beryllium contamination before continuing the work.	Collect surface samples and make sure that the beryllium concentration on all the surfaces is < 0.2 µg/100 cm^2.
RECOVERY OF PREMISES	
11 Decontaminate all tools and equipment used during the decontamination process. Rinse all the floor drains.	
12 Remove the temporary installations used for isolating the work area.	

RESIDUAL MATERIALS MANAGEMENT

The Regulation respecting hazardous materials[19] of the Environment Quality Act considers as toxic the materials and substances targeted in sections 46 to 63 of the Controlled Products Regulations (SOR/88-66).[20]

According to these sections, beryllium is classified as a very toxic material causing other toxic effects (class D2A) due to its carcinogenicity and its chronic toxicity.

It is also classified as a toxic material with other toxic effects (class D2B), mainly because it can cause skin sensitization in humans.[21]

In the case of beryllium decontamination, residual materials (solids or liquids) are considered hazardous when the Be reaches a concentration of 0.1% or 1000 mg/kg (RHM, section 3, "toxic material" paragraph 3; CPR, section 58).[20] Furthermore, according to the application guide for the Regulation respecting hazardous materials (RRHM) of the Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), an object is deemed to be a residual hazardous material (RHM) if the surface concentration of beryllium (D2A), measured by wipe sampling is equal to or greater than 1 mg/m^2 (0.01 mg/100 cm^2 or 10 µg/100 cm^2).

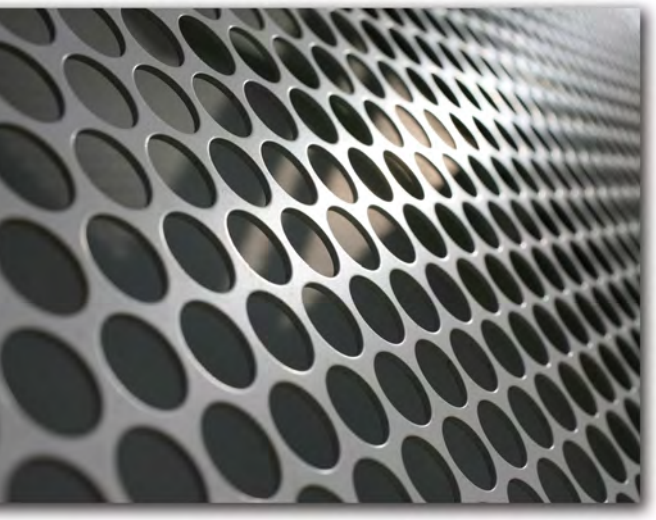
This final criterion must not be interpreted as being a threshold value according to which an object can be reused without a risk to health.

Beryllium-contaminated waste (from clean-up or decontamination work) that has been classified among the RHMs must be disposed of in compliance with the regulations applicable in Québec.

All disposable equipment, such as cloths, sponges and mops, as well as disposable coveralls and the filters of respirators, vacuums and ventilation systems are considered as RHMs. Where applicable, non-hazardous residual materials containing beryllium must be managed and disposed of according to the Regulation respecting the landfilling and incineration of residual materials.[22]

The manager of clean-up or decontamination work is responsible for managing the waste produced by these operations until a disposal centre or a transfer centre authorized by the MDDEP takes charge of it.

This includes the choice of disposal chain, conditioning, the use of standardized containers, packaging, labelling, temporary storage, and transportation of the waste according to the requirements of the Transportation of Dangerous Goods Regulations.[23] The document published by the MDDEP (2003) provides guidelines in this regard.



19. Gouvernement du Québec. Regulation respecting hazardous materials (RHM), c. Q-2, r.15.2, 2009. (http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=%2F%2FS_2_1%2FS2_1R19_01_A.htm)
20. Government of Canada (2009). Controlled Products Regulations CPR, DORS88-66. (http://lois.justice.gc.ca/eng/SOR-88-66/index.html)
21. CSST. Service du répertoire toxicologique. Béryllium. Classification selon le SIMDUT. (http://www.reptox.csst.qc.ca/DetailSimdut.asp?no_produit=2568&langue=F)
22. Gouvernement du Québec. Regulation respecting the landfilling and incineration of residual materials (REIMR), c. Q-2, r.6.02., 2009. (http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=3&file=/Q_2/Q2R6_02_A.HTM)
23. Government of Canada. Transportation of Dangerous Goods Regulations (TMD DORS, 2008-34), 2008. (http://www.tc.gc.ca/eng/tdg/clear-tofc-211.htm)

SURFACE SAMPLING

Monitoring of surface contamination is useful for controlling beryllium dust emissions. Sampling is an effective means of doing this monitoring. It can be used for:

- detecting the presence of beryllium in establishments;
- identifying sources of beryllium contamination;
- verifying the effectiveness of housekeeping procedures or decontamination activities;
- verifying the absence of cross-contamination between the areas that are considered as containing beryllium and those considered as beryllium-free;
- ensuring the effectiveness of the decontamination of an object, a piece of equipment or an establishment.

Ideally, the same qualified person should perform all the surface sampling in the context of a housekeeping or decontamination activity so that the technique is applied in a homogeneous way and the samples are comparable.

NOTE: The results for wipe sampling or sedimented dusts are not always related to the results of the measurements of the beryllium samples collected in the air in the worker's breathing zone. The beryllium concentrations in the surface dusts must not be used to evaluate the workers' exposure.

8.1 Sampling strategy

The sampling strategy must be developed in such a way as to cover different situations and to follow a logical progression in the clean-up or decontamination process.

The following page presents a decision tree and a description of the main steps to be followed to ensure appropriate clean-up.

Decision tree

CLEAN-UP WORK

1. Surface sampling according to a compliant sampling strategy

Location of samples

Based on the information collected in the workplace (identification of sources of dust contamination and propagation) and the intervention's objectives, one must ensure that the different locations and surfaces that could be directly or indirectly contaminated by beryllium are covered:

- check the locations where equipment, parts and materials containing beryllium are used or stored;
- determine the types of surfaces (glass, plastic, metal, cement or concrete, wood, painted or not, etc.);
- evaluate the characteristics of the surfaces (porous, smooth, friable, etc.);
- check the locations with difficult access or that are not generally cleaned during regular housekeeping, namely dust deposits at heights, mainly on ventilation ducts, pipes and lighting systems, as well as on window edges and frames, doors, walls, ceilings (mainly suspended ceilings), floors, shelves and stored objects.

Number of samples

The required number of surface samples depends on several factors:

- the type of beryllium-containing material as well as its frequency of use;
- the surface area of the contaminated zone;
- the layout of the premises.

Control samples (field blanks) must also be planned, which are used to compare samples collected in the same work environment. The control is subjected to the same manipulations as the other samples (opening, sealing and transport), except that it is not used for sampling. It must come from the same lot as the samples.

Sampling frequency

The sampling frequency must be established by taking the objectives into account. In the context of housekeeping, occasional samples can be sufficient for monitoring contamination control during activities that are not likely to increase the levels on the surfaces, such as punctual operations in ventilated enclosures or in rooms adjacent to work areas where beryllium dust is emitted into the air.

However, it may be necessary to collect samples every work shift in industries whose activities are likely to contaminate the surfaces in a regular and continuous way. The surface samples should be collected after normal clean-up at the end of the work shift and during periods of non-occupancy of the premises to ensure that the threshold of 3 µg/100 cm² is respected.

During decontamination activities, surface sampling is done in order to verify the effectiveness of the different clean-up steps. Their frequency therefore depends on how the work proceeds.

Appendix A presents an example of a surface sampling data collection sheet.

2. Surface contamination > 0.2 µg/100 cm²?

Decontamination activities allow the surface beryllium concentration to be reduced to a level below 0.2 µg/100 cm² (threshold for a Be-free zone). When the surface contamination is below 0.2 µg/100 cm² and homogeneous in all of the samples in the zone, these values must be shown to be well below the limit. There is no universal definition for contamination well below the reference value. The professional must define this concept based on the intervention's objectives and the decision-making context. Therefore, in a zone where the contamination is homogeneous, it may be necessary to establish acceptance guidelines such as:

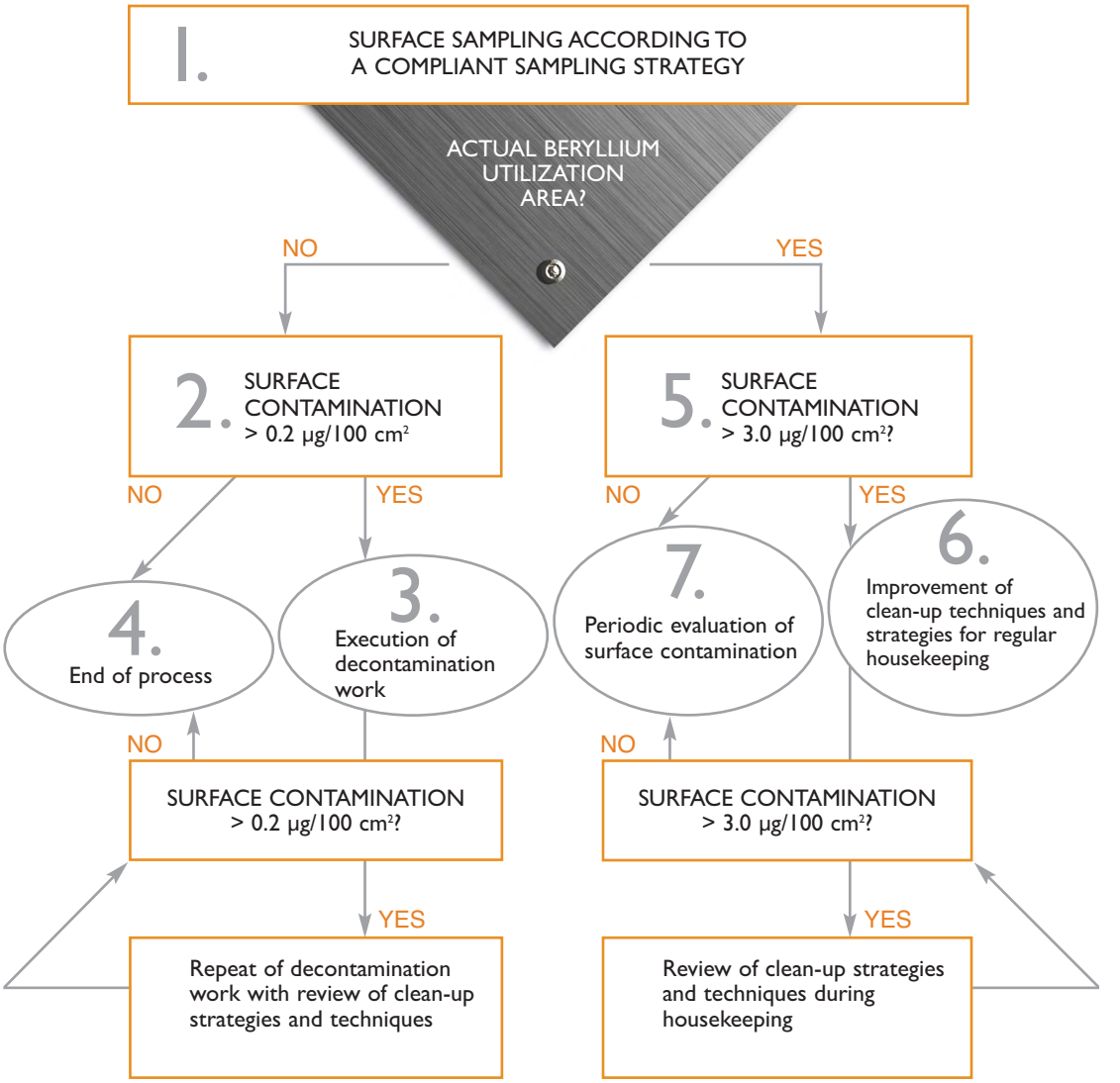
- < 0.1 µg/100 cm²;
- from 0.1 to 0.15 µg/100 cm²;
- from 0.15 to 0.2 µg/100 cm².

3. Execution of decontamination work

See section 6.3.

4. End of process

This step is final, on condition that there is no longer any source of beryllium in the decontaminated zone. Situations in which beryllium is still present (sealed, encapsulated surface, or contained enclosure) must be taken into account. Periodic monitoring is then required to ensure the tightness and effectiveness of the confinement.



5. Surface contamination > 3 µg/100 cm²?

In an industry that uses beryllium-containing material, work surfaces should not be contaminated with more than 3 µg/100 cm². Surface contamination is measured by means of wipe sampling during periods when the work is stopped or, if the activity is done continuously, after a period sufficiently long to allow the dust to settle. General and personal protection measures must be applied (or maintained) and a housekeeping program must be implemented.

6. Improvement of regular housekeeping techniques and clean-up strategies

See section 6.2.

7. Periodic evaluation of the surface contamination

Even if the surface sampling results are below the threshold value, the contamination must be monitored. The interval between the surface contamination evaluations should take into account the following factors:

- the cycles in the process, including normal operations, maintenance or repairs;
- the consequences of breakdown of the equipment for control or elimination at source;
- an increase in ambient concentrations;
- the effectiveness of the means of control;
- the temporal variability in the results.

8.2 Sampling techniques

There are three main surface sampling techniques. They are described in detail and evaluated in an IRSST report.[24]

Wipe sampling performed with a moistened wipe, individually wrapped (Ghost Wipe®), is recommended for surface sampling.[25]

Figure 4: Wipe sampling with a moistened wipe

For rough or porous surfaces, vacuum sampling (microvacuuming) can be considered. However, this technique has limitations, which are expressed as an underestimation of the value of the surface contamination.

Figure 5: Vacuum sampling

A colorimetric technique (ChemTest®) allows the results to be read on the sampling site itself, only a few hours following the sampling.

However, the use of this type of sampling is not recommended due to its poor reliability, mainly for beryllium oxide (BeO).

Figure 6: Colorimetric technique (ChemTest®)

8.3 Analysis of samples

Be analyses must be performed according to the procedures described in IRSST method 359,[26] by a laboratory accredited by the American Industrial Hygiene Association (AIHA)[27] for metal analysis, or by a laboratory that can demonstrate that it applies an equivalent quality assurance program. It is important to keep a record of these results to ensure their traceability.

24. VIAU, S., C. Dion, G. Perrault, A. Dufresne, V. Turcotte, H. Golshahi, B. Campbell, T. Mocanu, A. Ouellet, P.-J. Désormeaux, Cleaning and decontamination of workplaces containing beryllium - Techniques and cleaning solutions, Studies and Research Projects / Report R-614, Montréal, IRSST, 2009, 74 pages. (http://www.irsst.qc.ca/files/documents/PubIRSST/R-614.pdf)
25. IRSST. Consignes d'utilisation de la trousse # 3080, frottis de surface pour le béryllium avec chiffon humide. (http://www.irsst.qc.ca/files/documents/fr/Labos/consigne3080.pdf)
26. IRSST. Determination of beryllium [7440-41-7] in workplace air, Analytical method M-359, 2008, 18 pages. (http://www.irsst.qc.ca/files/documents/PubIRSST/M-359-en.pdf)
27. American Industrial Hygiene Association (AIHA). (http://www.aiha.org/)

EXPOSURE MONITORING

9.1 Environmental monitoring

Environmental monitoring is done with air samples collected in the workers' breathing zones (personal sampling) or in the work areas (ambient air) to achieve different objectives (Table 2).

Table 2: Types of air samples

SAMPLING	LOCATION	MAIN OBJECTIVE
Personal	Workers' breathing zones	To evaluate the workers' exposure during the performance of their different tasks
Ambient	Work area	To ensure that the work methods limit dust production
	Changing room	To ensure that the enclosure isolating the work area (negative pressure) is leakproof and that the procedures for leaving the contaminated zone are respected
	Adjacent room	

9.1.1 Sampling strategies and techniques

Sampling strategies, air sampling techniques, as well as information on data processing are described in the *Sampling Guide for Air Contaminants in the Workplace*.[28] Air sampling is done using a cassette connected to a pump, as shown in Figure 7.

Appendices B present examples of air sample data or information collection sheets.

Figure 7: Negative pressure system

9.2 Medical supervision

Workers exposed to Be dusts and fumes run the risk of becoming sensitized and of contracting chronic beryllium disease. The link between sensitization and the onset of the disease is still not completely understood. In the first stages of berylliosis, affected workers do not necessarily present symptoms.

A blood screening test determines whether a worker is sensitized to beryllium (BeLPT). The test is used according to the instructions in a guide of medical practices of the Comité médical provincial en santé au travail (CMPSATQ, provincial workplace health medical committee).[29] The worker must receive all the information necessary to make an "informed decision".

This test is already available to workers in companies covered by a Programme de santé spécifique à l'établissement (PSSE, health program specific for the establishment).

Other workers can have access to the BeLPT on the recommendation of their physician.

For more information, contact the occupational health team in your region.

28. IRSST Sampling Guide for Air Contaminants in the Workplace, 2005, 144 pages. (http://www.irsst.qc.ca/en/_outil_100038.html)
29. Institut national de santé publique du Québec. Comité d'experts sur le dépistage et la surveillance médicale en santé au travail. Cadre de référence pour le dépistage et la surveillance médicale en santé au travail. 2009, 77 pages. (http://www.inspq.qc.ca/pdf/publications/990_CadreDepistageSanteTravail.pdf)

PREVENTIVE MEASURES

During clean-up work (either housekeeping or decontamination), technical, administrative and personal control measures must be applied to make the work environment safe.

10.1 Technical control measures

- A partitioned work area to ensure leak tightness.
- An environment at negative pressure (from 1 to 4 Pa).
- General or local ventilation by means of a system equipped with filters (HEPA) without air recirculation, or with an exhaust towards the outdoors.
- A ventilation system providing at least four air changes per hour (work area and contaminated changing room).
- Access to the work area separated by a double changing room (a clean changing room and a contaminated changing room separated by a shower).
- Appropriate signage (beryllium poster[30]).
- A contaminated waste transport and storing system.
- A work method minimizing the propagation of particles.

10.2 Administrative control measures

- Limiting the number of workers with access to beryllium-contaminated areas.
- Rotating workers based on workload.
- Collecting air samples and surface dust samples to ensure that the contamination in the work environment is monitored.
- Ensuring the availability of a first-aid kit and a person trained in giving first aid in the event of accidents.
- Establishing an exposure monitoring program.
- Implementing cleaning procedures for contaminated clothing.
- Establishing an efficient communication system (mainly for isolated workers).
- Implementing a decontamination procedure (before each break, at meals, and at the end of the work day).
- Establishing training and information on the risk and on the preventive measures.

10.3 Personal control measures

- Having good occupational hygiene (washing face, hands and forearms before eating, drinking, smoking or applying cosmetics).
- Never eating, drinking, chewing or smoking in contaminated areas.
- Wearing the required personal protective equipment (see section 11).
- Following the decontamination procedure when leaving the contaminated area.

30. CSST. (http://www.csst.qc.ca/prevention/theme/beryllium/informations_base.htm)

PERSONAL PROTECTIVE EQUIPMENT

The people who do the clean-up work and those who collect the samples in the decontamination area, laboratory personnel, and the technicians responsible for maintaining the pumps and sampling equipment must wear the protective equipment described below to minimize their exposure to Be and the propagation of its dusts outside the contaminated areas. This equipment is:

- disposable or washable coveralls in order to limit skin exposure, closed at the ankles and wrists, and equipped with a hood;
- safety glasses or a visor connected to a respirator or to a safety helmet;
- a safety helmet for work that can cause materials to fall: use of a high-pressure water jet, demolition, etc.;
- cloth gloves to protect the skin and to handle objects (heavy loads);
- polymer gloves for better dexterity;
- safety boots or shoes with safety toe caps;
- leakproof clothing, gloves and boots when necessary;
- ear plugs or ear muffs if the noise level of the cleaning equipment used exceeds 90 dB(A) equivalent.

Figure 8: Personal protective equipment

11.1 Respiratory protection

A respiratory protection program must be applied throughout the decontamination procedures or housekeeping work on premises contaminated by beryllium.

This program must include worker training, fit tests, equipment maintenance, and record keeping.

The respirator chosen and the protection program must comply with the requirements of the Regulation respecting occupational health and safety.[31]

31. Regulation respecting occupational health and safety (ROHS), c. S-2.1, r.19.01. (http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=%2F%2FS_2_1%2FS2_1R19_01_A.htm)

TRAINING AND INFORMATION PROGRAM

Employers have the obligation of ensuring that their employees receive training in the hazards of beryllium exposure, and of providing them with information on this subject. This should be offered to all workers when they are hired, and subsequently at regular intervals.

This training must cover health, safety, and accident risks, as well as provide specific information on beryllium issues, mainly about:

- its health effects;
- personal and collective protective equipment, and bodily hygiene;
- applicable standards and the sampling to be done;
- the tasks to perform as well as the equipment and tools to use;
- safe clean-up and decontamination procedures;
- prevention and control procedures;
- the procedure to follow in the event of an accident;
- the employer's general obligations;
- the worker's rights and obligations.

Also, training in first-aid in the workplace must be offered to ensure the presence of at least one first-aider per work shift where 50 or fewer workers are assigned to the shift.[32]

32. First-aid Minimum Standards Regulation. C. A-3, r.8.2. (http://www.canlii.org/en/qc/laws/regu/rq-c-a-3-r8.2/latest/rq-c-a-3-r8.2.html)

Appendices

APPENDIX A – SURFACE SAMPLING

- Example of a surface sampling data collection sheet
- Collection sheet to be photocopied

APPENDICES B – AIR SAMPLING

APPENDIX B1 WORKERS' BREATHING ZONES – PERSONAL SAMPLING

- Example of a collection sheet for air sample data collected in the workers' breathing zones – Personal sampling
- Collection sheet to be photocopied

APPENDIX B2 CHANGING ROOM OR ADJACENT AREA

- Example of a collection sheet for air sample data collected in the changing room or adjacent area
- Collection sheet to be photocopied

APPENDIX B3 WORK AREA – AMBIENT AIR

- Example of a collection sheet for air sample data collected in the work area – Ambient air
- Collection sheet to be photocopied

Example

APPENDIX A – SURFACE SAMPLING

EXAMPLE OF A SURFACE SAMPLING DATA COLLECTION SHEET

Sample number

Floor, above the ventilation system, window edge, etc.

Painted wood, metal, concrete, etc.

After vacuuming, after wet cleaning, final sampling

Generally 100 cm²

Reference values:
Maintenance in a contaminated area: 3 µg/100 cm²
Decontamination: 0.2 µg/100 cm²

Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Sample no.	Room	Structure	Type of surface	Clean-up step	Analytical result (µg Be)	Area (cm²)	Be conc. (µg/100 cm²)	Test	Remark
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

Reference value: _____

Page _____ of _____

APPENDIX A – SURFACE SAMPLING

SURFACE SAMPLING DATA COLLECTION SHEET
DOWNLOAD OR PHOTOCOPY AS NEEDED

Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Sample no.	Room	Structure	Type of surface	Clean-up step	Analytical result (µg Be)	Area (cm^2)	Be conc. (µg/100 cm^2)	Test	Remark
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	
								☐ Failure ☐ Success	

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

Reference value: _____

Page _____ of _____

Example

APPENDIX B1 AIR SAMPLING – PERSONAL SAMPLING

EXAMPLE OF A DATA COLLECTION SHEET FOR AIR SAMPLES COLLECTED IN THE WORKERS' BREATHING ZONES – PERSONAL SAMPLING

Sample number

Collection of debris, vacuuming of debris and dust, wet cleaning, end of activities, etc.

Low-pressure jet, HEPA vacuum

Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Type of collector: _____

Sample no.	Activities carried out and tools used	Flow rate (l/min)	Time (min)	Volume (l)	Analytical result (µg Be)	Be conc. (µg/100 cm²)	Remark

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

Reference value: _____

Page _____ of _____

APPENDIX B1 AIR SAMPLING – PERSONAL SAMPLING

DATA COLLECTION SHEET FOR AIR SAMPLES COLLECTED IN THE WORKERS' BREATHING ZONES – PERSONAL SAMPLING
DOWNLOAD OR PHOTOCOPY AS NEEDED

Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Type of collector: _____

Sample no.	Activities carried out and tools used	Flow rate (l/min)	Time (min)	Volume (l)	Analytical result (µg Be)	Be conc. (µg/100 cm^2)	Remark

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

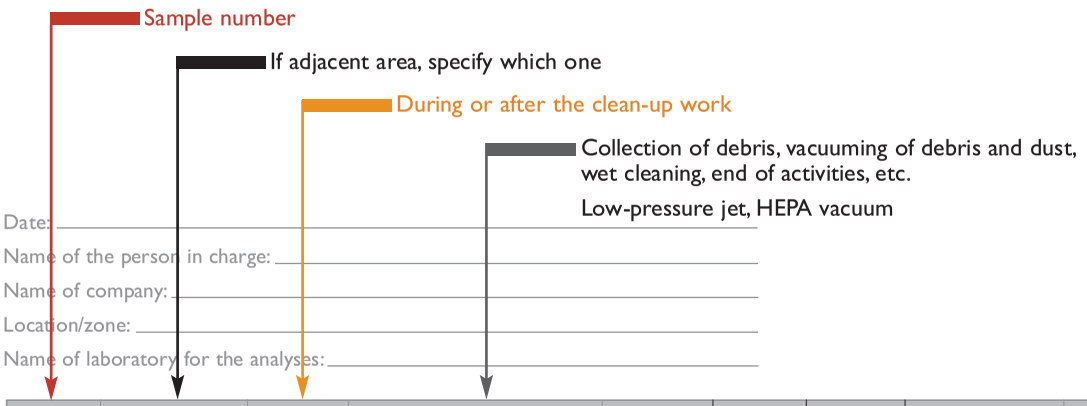
Reference value: _____

Page _____ of _____

Example

APPENDIX B2 AIR SAMPLING – CHANGING ROOM OR ADJACENT AREA

EXAMPLE OF A DATA COLLECTION SHEET FOR AIR SAMPLES COLLECTED IN THE CHANGING ROOM OR ADJACENT AREA



Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Type of collector: _____

Sample no.	Location	Period	Activities carried out and tools used	Flow rate (l/min)	Time (min)	Volume (l)	Analytical result (µg Be)	Be conc. (µg/100 cm²)	Remark
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

Reference value: _____

Page _____ of _____

APPENDIX B2 AIR SAMPLING – CHANGING ROOM OR ADJACENT AREA

DATA COLLECTION SHEET FOR AIR SAMPLES COLLECTED IN THE CHANGING ROOM OR ADJACENT AREA
DOWNLOAD OR PHOTOCOPY AS NEEDED

Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyse: _____

Type of collector _____

Sample no.	Location	Period	Activities carried out and tools used	Flow rate (l/min)	Time (min)	Volume (l)	Analytical result (µg Be)	Be conc. (µg/100 cm²)	Remark
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							
		☐ During ☐ After							

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

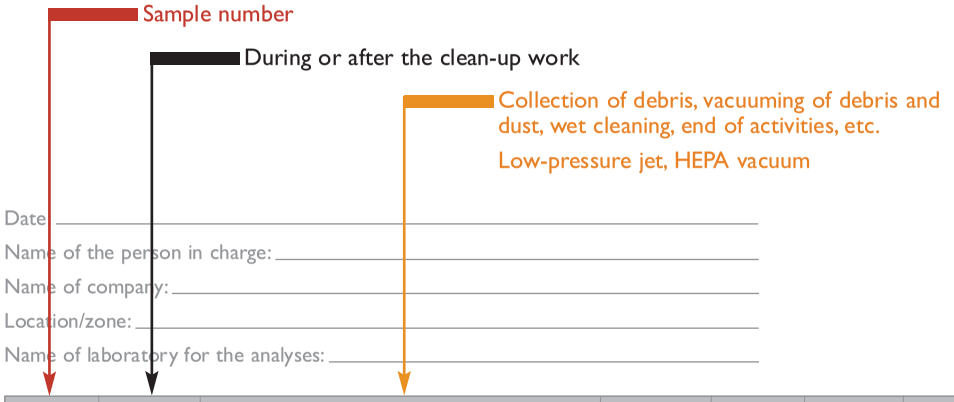
Reference value: _____

Page _____ of _____

Example

APPENDIX B3 AIR SAMPLING – AMBIENT SAMPLING

EXAMPLE OF A DATA COLLECTION SHEET FOR AIR SAMPLES COLLECTED IN THE WORK AREA – AMBIENT SAMPLING



Date _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Type of collector: _____

Sample no.	Period	Activities carried out and tools used	Flow rate (l/min)	Time (min)	Volume (l)	Analytical result (µg Be)	Be conc. (µg/100 cm²)	Remark
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

Reference value: _____

Page _____ of _____

APPENDIX B3 AIR SAMPLING – AMBIENT SAMPLING

DATA COLLECTION SHEET FOR AIR SAMPLES COLLECTED IN THE WORK AREA – AMBIENT SAMPLING
DOWNLOAD OR PHOTOCOPY AS NEEDED

Date: _____

Name of the person in charge: _____

Name of company: _____

Location/zone: _____

Name of laboratory for the analyses: _____

Type of collector: _____

Sample no.	Period	Activities carried out and tools used	Flow rate (l/min)	Time (min)	Volume (l)	Analytical result (µg Be)	Be conc. (µg/100 cm²)	Remark
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							
	☐ During ☐ After							

Number of samples: _____

Sampling date: _____

Date of analysis: _____

Signature: _____

Reference value: _____

Page _____ of _____

CLEAN-UP GUIDE

Beryllium

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en santé et en sécurité du travail
June 2010

Beryllium

CLEAN-UP GUIDE RG-652

WORKPLACE HOUSEKEEPING AND DECONTAMINATION

irsst