SAFETY GUIDELINE SG-C-0-0-3
SAFE HANDLING AND STORAGE OF LEAD AT CERN
1 INTRODUCTION

Safety Guidelines provide detailed instructions as to the implementation of a CERN Safety Rule. Compliance with a Safety Guideline provides a presumption of conformity with the associated CERN Safety Rule. Unless a CERN Safety Rule stipulates it to be binding, deviation from a Safety Guideline is permitted but requires a demonstration to the HSE Unit by the Department or Large Experiment concerned that compliance with the relevant CERN Safety Rule is maintained.

The CERN Safety Rules associated to this Safety Guideline are:

- Safety Regulation SR-C, Chemical agents;
- General Safety Instruction GSI-C-1, Prevention and protection measures;
- General Safety Instruction GSI-C-3, Monitoring of exposure to hazardous chemical agents in workplace atmosphere.

1.1 Purpose and scope

This Safety Guideline provides guidance for the handling and use of lead.

Reminder: As lead is a hazardous substance, the general prevention principles (Substitution, Technical Protection measures, Organisational measures, Personal protective measures – STOP principle) apply (cf. SR-C).

2 HAZARDS AND POTENTIAL EXPOSURE TO LEAD

2.1 Health effects of lead

The presence of lead in the blood can cause a wide variety of symptoms, from headaches and tiredness to nausea and anaemia depending on the dose absorbed.

Exposure (i.e. absorption) to lead can happen through:

- inhalation of lead dust, fume or vapour;
- ingestion of lead powder, dust, paint or paste; for example, when eating, drinking or smoking without washing hands after the handling of lead.

Lead dust or powder is not absorbed through the skin.

In case of continued exposure (i.e. absorption) more serious symptoms can develop including damage to the kidneys, brain and nervous system, infertility or cancer. Small amounts of lead absorbed will be excreted in the urine, but some can remain in the body for many years, stored mainly in the bones.

During pregnancy or breastfeeding a developing unborn child or a new-born baby are at particular risk from exposure to lead. For this reason, women who are pregnant or breastfeeding must not be allowed to work in areas where there is a risk of absorption of lead. The same applies to young people under the age of 18.
2.2 Potential exposure to lead

2.2.1 Activities not liable to result in significant exposure to lead

Work exposure

Work that is not liable to result in significant exposure to lead includes:

- low-temperature melting of lead (below 500°C);
- work with materials which contain less than 1% total lead.

Drinking water

CERN’s drinking water is regularly monitored for contaminants, including lead. A certified independent laboratory takes and analyses samples to verify that the water complies with national and European regulations for safe drinking water.

2.2.2 Activities liable to result in significant exposure to lead

Work exposure

Work that is liable to result in significant exposure (unless adequate controls are in place) includes:

- working with metallic lead and alloys containing lead (e.g. welding or soldering at temperatures > 500°C, machining or cutting lead);
- stripping old lead paint (including undercoat) from doors, windows etc;
- hot cutting in demolition and dismantling operations and recovering lead from scrap and waste.

For works liable to cause damage to the integrity of the paint (or undercoat) and producing fumes and/or dust (such as cutting, drilling, sanding, welding, grinding) a lead diagnostic must be carried out via the HSE Unit (see also 4.3).

3 SAFETY MEASURES TO BE IMPLEMENTED IN CASE OF POTENTIAL EXPOSURE TO LEAD

Any potential exposure to lead requires a risk assessment (e.g. for CERN members of the personnel by using Safety Form SF-C-0-0-1, Chemical Risk Assessment).

The risk assessment will identify the necessary prevention and protection measures that must be put into place.

The risk assessment shall be based on the safety data sheet for the substance containing lead, which must be obtained from the supplier or from the CERN stores (EDH).

3.1 Substitution

Whenever possible, lead shall be replaced with a non-hazardous or less hazardous alternative, for example using a lead-free solder.

3.2 Technical protection measures

The protection measures are based on the type of activity and the findings of the risk assessment.

Activities generating lead dust or fumes will normally require Local Exhaust Ventilation (LEV) systems. For example, see Figures 1 and 2, and Safety Guideline SG-C-1-0-3.
3.3 Organisational measures
Eating, drinking and smoking is prohibited in an area where lead is handled or which is contaminated with lead and the corresponding signs must be displayed.

In addition workers must observe a high standard of hygiene:
- work post and work area must be kept as clean as possible;
- workers must wash their hands and face and scrub their nails before eating, drinking or smoking;
- workers must wash and/or shower and change before going home;
- protective equipment or work clothing must be worn, kept separate from personal clothing and not be taken home.

Access to areas liable to be contaminated with lead must be controlled to avoid exposure of unprotected persons.

3.4 Personal protective measures
3.4.1 Training
Training for workers likely to be exposed to lead must include information regarding:
- the nature of the hazard and risk;
- potential routes of entry into the body and elimination from the body;
- hygiene measures to respect; and
- protection measures to reduce the risk.
3.4.2 Personnel Protective Equipment

Wherever the risk assessment concludes that Personal Protective Equipment (PPE) must be used, such equipment must be provided by the supervisor and used by the worker concerned in accordance with the relevant instructions.

In some situations, (e.g. where the results of exposure monitoring show that the concentration of lead in the air is > 50% of the occupational exposure limit (cf. par. 4.1) Respiratory Protective Equipment (RPE), e.g. mask with a P3 filter, SCEM no. 50.49.20.BD must be used. In general it is recommended to wear such Respiratory Protective Equipment when handling or stacking lead bricks for periods of time greater than 1 hour.

Prior to the use by employed members of the CERN personnel or by associated members of the CERN personnel of the category “Associates for the purpose of training” (MPA-t) of Respiratory Protective Equipment (RPE), to control the exposure to lead, the Safety Form SF_C-1-0-4, Respirator Use must be completed. A Fit Test must be successfully completed by the wearer for all the types of tight-fitting masks to be worn. Register here: Fit-Test.

Examples of PPE to be worn for specific works:

a. The following PPE must be worn by workers carrying out clean-up work following a confirmed contamination (cf. par 4.2):
   - disposable nitrile gloves (e.g. SCEM no. 50.43.20.AD);
   - disposable coverall with/without bonnet (e.g. SCEM no. 50.43.90.G);
   - disposable respiratory protective equipment (e.g. FFP3, SCEM no. 50.49.20.BD);

b. The following PPE must be worn when handling or stacking lead bricks:
   - respiratory Protective Equipment (RPE), e.g. mask with a P3 filter, SCEM no. 50.49.20.BD when handling exceeds one hour;
   - suitable gloves, which must also be robust and offer the required grip and dexterity to handle the bricks (e.g. from CERN Catalogue, SCEM no. 50.43.20.BE);
   - safety shoes.

Disposable PPE should be regularly changed (e.g. at the end of each shift).

4 LIMITS

4.1 Exposure Limits

The occupational exposure limit for lead in air must be respected for all activities where there is the potential for exposure to lead dust, fumes or vapour. The occupational exposure limits currently applicable at CERN are:

- 0.1 mg/m³ for the exposure limit averaged over 8 hours per day;
- 0.8 mg/m³ for the short term exposure limit averaged over 15 minutes each, for up to a maximum of 4 times per day.

The instantaneous concentration of lead may exceed either of these limits provided that the average exposure over 8 hours per day does not exceed 0.1 mg/m³ and the average exposure over any period of 15 minutes during the day does not exceed 0.8 mg/m³.
(Ref. [1]). The HSE Unit can assist with calculation of exposure limits and associated work organisation.

Where there is a risk of significant exposure (as identified in the risk analysis), exposure monitoring is compulsory, in accordance with GSI-C-3.

4.2 **Lead surface contamination**

Areas which are suspected to be contaminated with lead should be sampled by a competent person according to an agreed procedure (Ref. [2]) and the samples analysed in an accredited laboratory to verify whether or not they exceed the acceptable surface concentrations. The HSE Unit will provide an up-to-date list of accredited laboratories.

For areas where lead is routinely handled and which is subject to organisation measures to prevent undue exposure to lead the acceptable surface contamination is less than or equal to 10 mg/m².

For all other areas the acceptable surface contamination is less than or equal to 1 mg/m².

If the respective thresholds indicated above are exceeded a clean-up of all affected surface areas must be organized.

This work shall be carried out by a firm specialised in chemical decontamination if the upper concentration of 10 mg/m² is exceeded. Otherwise the safety measures defined by the risk assessment apply.

4.3 **Lead concentration in paint and construction materials**

For works liable to cause damage to the integrity of paint (or undercoat) and producing fumes and/or dust (such as cutting, drilling, sanding, welding, grinding), a lead diagnostic must be carried out via the HSE Unit.

The results will be communicated in absolute values via the HSE unit to the CERN requestors (e.g. Project Leaders, Technical Contract Managers, Works and Services Supervisors). The CERN requestors shall communicate the results to the entity(ies) executing the work (e.g. contractors, collaborating institutes, CERN services) before the start of the works and shall ensure that adequate safety measures are put in place by the executing entity.

Where the lead diagnostic shows a concentration of lead higher than 0.2 mg/cm², adequate safety measures according to general prevention principles, such as working methods avoiding dust and fume production, prior stripping, local extraction or containment, must be put in place to avoid exposure (i.e. absorption) to lead to workers and/or contamination of the area. Such safety measures shall be based on the risk assessment and shall take into account applicable regulations.

Where the works are carried out directly by CERN or a collaborating institute, safety measures shall take into account the relevant directives and best practices (Ref. [3]). The HSE unit may advise on adequate safety measures upon request.

Where the works are carried out by a contractor, safety measures shall comply with the laws applicable to them and with any instructions given by the competent host states authorities, if any.
4.4 Biological monitoring – Health surveillance

Employed members of the CERN personnel or associated members of the CERN personnel of the category “Associates for the purpose of training” MPA-t, who are potentially exposed to lead dust, fume or vapour must inform the CERN Medical Service and update their Safety Form SF-OHS-0-0-3 for the ‘Identification of occupational risks’. The Medical Service will determine whether regular biological monitoring (e.g. of the blood lead-level) needs to be established. For the monitoring CERN follows the levels applicable in Switzerland (Ref. [4]) which are currently more stringent than those in France.

Biological monitoring and health surveillance of all other persons potentially exposed to lead dust, fume or vapour at CERN is the responsibility of their employer in accordance with applicable national laws.

5 HOUSEKEEPING

Areas where lead dust or shavings are present should be kept clean, either using a high-efficiency particulate air (HEPA) vacuum cleaner or wet paper towels (using disposable nitrile gloves, SCEM no. 50.43.20.AD). In particular the regular cleaning of floors, walls and other surfaces, appropriate to the activity, must be ensured where there is a risk of lead contamination of the work environment, cf. GSI-C-1.

Lead oxide in the form of dust can form on lead bricks, plates or rolls, which are used for example as as moveable radiation shielding in CERN’s radiation areas or radioactive laboratories. To prevent exposure to dust it is recommended to paint such materials with a suitable paint (e.g. STELLUX ANTICORROSION – 1291.RALX) (Ref. [5]).

6 STORAGE

Lead that is not in use should be removed from buildings, facilities and experimental areas for storage in a suitable location. Non-activated lead should be stored in building 879 and building 940, radioactive or radiologically contaminated lead has to be handed over to Radiation Protection Group for storage in building 131. Other storage locations must be first agreed with the HSE Unit.

The lead should be stored in such a way that direct contact with the lead oxide dust is prevented as well as avoiding the risk of lead contamination of the building or other equipment by keeping shielding bagged or covered, and identified. This can be achieved using durable plastic sheeting or an upturned plastic box, as illustrated.

In cases where lead is in direct contact with palettes or other material used for storage, the material must be of a type that is easily decontaminated of lead, hence the use of
wooden pallets is excluded. Metal or plastic pallets/material will enable easy cleaning/decontamination since they can be wiped down easily.

7 WASTE MANAGEMENT

Non-activated lead declared as waste should be transported to the “storage, recuperation & sales” service of the IPT Department, at building 133.

Radioactive lead declared as waste has to be sorted, packaged and transported in conformity with the Acceptance Criteria for Radioactive Waste at CERN (Ref. [6]) and handed over to the HSE Unit’s Radioactive Waste Service.

Used towels and protective clothing or equipment contaminated with lead must be disposed of in a labelled and sealed plastic bag or other suitable container and transported to SMB Department’s Special Waste service.

8 LEAD USED AS SHIELDING IN RADIATION AREAS

Lead used for radiation shielding (gamma/X-rays) should not be used for other purposes. Other uses require an authorization from the Radiation Protection Group of the HSE Unit. In general, the use of lead is prohibited in hadron accelerator premises during beam operation.

As for any other material, lead shielding that was exposed to particle beams must be treated in accordance with the procedures applicable to radioactive materials and must, in particular, be traced and measured by the Radiation Protection Group of the HSE Unit (Ref. [7]).

9 BEST PRACTISE

An example of a procedure for the control, handling, transport and storage of lead, which also addresses waste, can be found in EDMS 1816068

10 REFERENCES

[1] Valeurs limites d’exposition aux postes de travail, SUVA, April 2018;
[3] Diagnostic Plomb avant travaux, STEB (EDMS 2093288), Assainissement de peintures contenant du plomb, STEB (EDMS 2093428), Interventions sur les peintures contenant du plomb, Assurance maladie – INRS (EDMS 2093443), Traitement des peintures au plomb, OPP BTP (EDMS 2093451);
[4] Plomb et ses composés [7439-92-1] SUVA (EDMS 1857056);
[5] Lead bricks painting procedure (EDMS No. 1697818);
[6] CERN’s Internal acceptance criteria for radioactive waste (EDMS 1364231) (CADRA);


**Further Reading:**

- *Dossier Plomb au travail*, INRS.fr, Juin 2010;
- Safety data sheets from suppliers of lead and lead-containing products;