

Radiation Health Series

No. 8

Safe Handling of Nuclear Moisture and Density Gauges



Radiation Health Division

Department of Health

This purpose of this booklet is to provide technical information on radiation protection in the use of portable nuclear moisture/density gauges in construction industries. It may also be helpful to those managing road-building or repair projects where these gauges may be used.

Regulatory requirement

2. Work including the use, keeping, transportation and disposal of the gauges is subject to the **Radiation Ordinance (Cap 303)**, Laws of Hong Kong and the **Radiation (Control of Radioactive Substances) Regulations**. It is a fundamental requirement of the ordinance that employers take all steps to ensure that exposure of employees (and other people) to ionizing radiation is restricted to a level below the regulatory dose limits. This booklet contains information to help employers to achieve this.

Radiation risk

3. Gauges usually have two radioactive sources – typically a Caesium-137 gamma source and an Americium-241/Beryllium neutron source. When the gauge is not in use, some shielding of the sources is provided by the body of the gauge; however, the gamma source can be projected downwards out of the base of the gauge. The neutron source remains fixed within the body of the gauge. Radiation levels around the gauge depend on:
 - i) the type and activity of the sources,
 - ii) the mode of operation of the gauge, since the gamma source may be projected out from the base of the gauge,
 - iii) the amount of extra shielding (such as the plate guard and ground), and;
 - iv) the direction in which the gauge is pointing.
4. Radiation levels are highest near the source and the base plate, and decrease with distance from the gauge. Damage to the gauge or poor work practices may lead to an increased risk of radiation exposure for operators and other people. These include gauges being crushed by site vehicles, loss or theft, or failure of the shutter.

Prior risk assessment

5. Before you are allowed to use the gauge, you must have obtained a licence from the radiation Board and have assessed the risks of exposure to ionizing radiation, both to workers and other people. This is to ensure that all radiation exposures are kept As Low As Reasonably Achievable (ALARA). You should carry out a new risk assessment, or at least review the existing one, whenever your work with ionizing radiation changes – for example, when you move to a new site or use a different piece of equipment.

Controlled areas

6. You must designate a controlled area when the gauge is in use. This will include when the gauge is within its transport container, e.g. during storage or transport. A controlled area is one in which normal working conditions, including the possible occurrence of minor mishaps, require the workers to follow well-established procedures and practices aimed specifically at controlling radiation exposures. In particular, a controlled area should be designated if radiation levels in an area to which people can gain access exceed 3 μSv per hour. Radiation levels around the gauge will exceed this figure and your risk assessment should therefore conclude that a controlled area will ***always be necessary***. The size of the area will depend on the type of gauge but, as a rough guide, it is usually about 2 metres around the gauge when in use. Only classified persons (see paragraph 8) (or those working under written arrangements) can enter controlled areas but they should not remain inside the area when it is not necessary to do so; for example, during measurements. You must ensure that other people are kept out of the area. Your risk assessment should help you identify the best way to achieve this - either by using barriers and warning signs or, if the work is of short duration, by the operator's constant supervision.

Local rules, radiation protection supervisor and training

7. You must write local rules on the safe handling of the gauges. These are clearly written procedures including arrangements for designating, demarcating and working in controlled areas, together with suitable contingency plans for reasonably foreseeable radiation accidents and

incidents. You must also appoint a radiation protection supervisor (RPS) who has been named in your Radiation Substance Licence to supervise that work is carried out in accordance with those rules and provide them with appropriate training to enable them to do so. You should ensure that all operators and drivers are trained in safe working practices, including the requirements of the local rules.

Classified persons and personal monitoring

8. If doses for adult employees are likely to exceed 6 mSv in a year, you have to designate them as classified persons. You will then have to supply personal monitoring devices to them to assess and record their exposures to both neutron and gamma radiations. If people who are not classified has to work with the gauges, you still have to show that their exposure is ALARA and below the level that would require them to be classified.

Area monitoring

9. You will need to provide a suitable monitor for checking radiation levels around the controlled area periodically and also checking that the gauge shutter is closed before leaving the area after use. A gamma radiation monitor is sufficient to check shutter closure and gamma levels around the gauge, but you must also consider neutron radiation when designating controlled areas during gauge use, transport or storage. The radiation monitor should be checked by an approved competent laboratory annually for accuracy and reliability. Employees should receive appropriate training in use of the monitor and interpretation of results

Storage and location records

10. The gauge should be stored in the licensed premises. You will need a store to prevent theft and provide shielding from both gamma and neutron radiation. A locked vehicle is only acceptable as a store for short periods when the gauge is in transit. Keeping gauges in a vehicle overnight is **NOT** acceptable. Any controlled area should not extend outside the store, which should be locked and marked with an appropriate radiation warning sign. You may need to designate the inside of the store as a controlled area, particularly if more than one

gauge is in store. You must know where the gauge is at all times and keep source location records. The records should be sufficient to easily locate the source and quickly identify loss or theft and should be updated daily when the gauge is in use. Any loss or theft must be reported immediately to the police and the Radiation Board. Any verbal report to the Radiation Board must be followed up by a report in writing within 48 hours of the loss.

Working on site

11. When the gauge is used on a site controlled by another employer, both employers will need to co-operate to manage the work properly. Local rules and contingency plans should be modified as appropriate. When on site, the operator should contact the site manager, who can ensure that other site workers know that the gauge is being used and do not enter the controlled area. When in transit, the gauge should always be transported in its original transport packaging and with the base of the gauge as far away from the vehicle occupants as possible.

Maintenance and cleaning

12. You should ensure that the gauge and its safety features are properly maintained and tested as appropriate. Your gauge supplier should be able to advise you on what you need to do. Dirt on the base of the gauge may stop the shutter closing, leaving the gamma radiation source exposed. If the base is cleaned by the operator, **point it away, view with a mirror and use long-handled tools**. The operator should be trained in the safe performance of this operation. Only people trained in the additional radiation risks should do further maintenance work on the gauge – for example the gauge supplier. In addition to routine gauge maintenance, the radioactive sources within the gauges should be tested for leakage annually by an approved competent laboratory.

Contingency plans

13. These must deal with any radiation accidents that you consider could happen. For example: shutter jammed open, gauge run over or gauge body damaged, gauge lost or stolen, transport vehicle involved in road accident, unretracted source; and fire on site or in transit.

You must have plans to handle these contingencies. The operator will need training on how to deal with them. You should provide an emergency kit which includes long-handled tools, a mirror, extra barrier tape and warning signs.

Transfer to another users

14. Transfer of the gauge to another user without the permission of the Radiation Board is not allowed.

Disposal

15. Local disposal of the gauge is **NOT** allowed. You should return the gauge to the manufacturer directly or through a licensed radioactive waste management agent for disposal.

Enquiry: If you have questions on the contents of this document or have suggestions on improvements, please contact us at the

Radiation Health Division
Department of Health
3/F, Sai Wan Ho Health Centre,
28 Tai Hong Street,
Sai Wan Ho, Hong Kong

Tel: 2886 1551

Fax: 2834 1224

e-mail: rhd@dh.gov.hk

Domain: <https://www.rhd.gov.hk/>

Radiation Health Series

- No. 1 Guidance Notes on Radiation Protection for Diagnostic Radiology**
- No. 2 Safe Handling of Radioactive Consignments**
- No. 3 Techniques to Reduce the Radiation Hazards from Using Phosphorus-32**
- No. 4 Guidance Notes on Radiation Protection for Medical and Dental Radiography**
- No. 5 Code of Practice for the Handling, Storage, Packaging, Transportation and Disposal of Radioactive Wastes**
- No. 6 Ionising Radiation**
- No. 7 Guidance Notes on the Design of Protective Shielding for Medical, Dental and Veterinary Diagnostic X-ray Facilities**
- No. 8 Safe Handling of Nuclear Moisture and Density Gauges**