



DEPARTMENT OF HEALTH
Republic of South Africa

CODE OF PRACTICE FOR THE SAFE USE OF INDUSTRIAL GAUGES CONTAINING RADIOACTIVE SOURCES

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1. INTRODUCTION

Radioactive sources used in industrial gauges are subject to regulatory control in terms of the South African Hazardous Substances Act, 1973 (Act 15 of 1973). The body responsible for administering this legislation is the Directorate: Radiation Control, Department of Health.

These standards apply to all gauges installed in fixed positions and are used for measuring or process control purposes. These include density gauges, level gauges, belt mass meters, thickness gauges and various other analytical units.

The radioactive sources used in these gauges are generally sufficiently radioactive to constitute a significant health hazard unless adequately shielded and handled with proper care. These standards have been set in order to limit the risk of over-exposure of workers, as well as the public, to ionizing radiation, and to ensure that radiation doses are kept as low as reasonably achievable (ALARA principle).

2. ADMINISTRATIVE REQUIREMENTS

- 2.1 An application for authority to possess and use a nuclear gauge must be submitted to the Department on form RN787. The applicant must nominate a radiation protection officer (RPO) as well as an acting radiation protection officer (acting RPO).
- 2.2 Authorities are valid for a limited period. Applications for renewal of authorities must be submitted to the Department on form RN787 before the date of expiry.
- 2.3 Should the radiation protection officer (RPO) or acting RPO change at any stage, the Department must be informed of the change on form RN785.
- 2.4 Once a year, the holder of the authority must furnish the Department with a declaration, on form RN784, confirming that all of the sealed sources which are reflected on his current authority, are in his possession, and that the details on this authority are complete and correct. This declaration is due each year before 31 January.
- 2.5 Internal rules must be compiled according to Regulation 7 of the Regulations relating to Group IV Hazardous Substances. The Regulations, Code of Practice and Minimum requirements for internal rules should be utilized in compiling the internal rules.

The above documents can be found on the following website:

<https://sites.google.com/site/radiationcontroldoh/>

A copy of the Act, Regulations, authority, internal rules and any amendments must be kept on the premises of the holder in a place accessible to all employees.

3. EQUIPMENT SPECIFICATIONS

- 3.1 All sources and source containers incorporated in nuclear gauges must be of a design approved by the Department.
- 3.2 The shutter or source control mechanism of the radioactive source container must be designed with an effective mechanism to ensure that it can be secured in the "beam off" position. Padlocks and/or keys must be available for this purpose.
Note: Open shutters (beam on position) must not be padlocked.
- 3.3 The source container must incorporate an indicator that clearly shows whether the source is in the "beam on" or the "beam off" position.
- 3.4 The source container must bear a radiation warning sign as well as a durable label indicating the source serial no, date, type and activity of the radionuclide contained therein. The sign and label must be permanently attached to the container and be legible at all times.
- 3.5 The dose rate on the surface of the source container may not exceed 2 mSv/h (200 mR/h). (Ref 1)
- 3.6 The source container must at all times be in a good condition with no excessive rust.

4. STORAGE REQUIREMENTS

- 4.1 No radioactive material or instrument or apparatus containing such material may be stored on any premises zoned for domestic purposes.
- 4.2 When in storage the source assembly of a nuclear gauge must be secured in the "beam off" position
- 4.3 Warning signs, of a design approved by the Department, must be displayed at the entrance to the storeroom or storage area to indicate the presence of radioactive material.
- 4.4 Dose rates outside the store must not exceed 2.5 μ Sv/h (0.25 mR/h).
- 4.5 A notice containing the names and telephone numbers of persons who can be telephoned in the event of an emergency, must be displayed at all storage facilities for radioactive material.
- 4.6 The storage facility must be duly lockable and no unauthorised entry shall take place.

- 4.7 No radioactive material may be stored with, or in close proximity to any corrosive, combustible or explosive material.

5. OPERATING PROCEDURES

5.1 General Requirements

- 5.1.1 The radiation protection officer shall ensure that all persons handling or working near the gauge are fully aware of the associated radiation hazard and are familiar with correct work procedures.
- 5.1.2 A radiation warning sign must be posted in the vicinity of the gauge to discourage loitering in the area. The sign must have an emergency after-hours telephone number written on it, unless a 24-hour security system exists on the premises. Any doors or openings giving access to the direct radiation beam must be provided with a radiation warning to prevent any unauthorised entry.
- 5.1.3 As a general rule, the dose rate at the nearest accessible position (NAP) to the gauge must not exceed 7.5 $\mu\text{Sv/h}$ (0.75 mR/h). If the area near the gauge has a low occupancy rate, a higher dose rate may be permitted at the nearest accessible position (NAP), provided that the average dose rate to any person over any 8 hour period does not exceed 2.5 $\mu\text{Sv/h}$ (0.25 mR/h). Extra protection may be added, the position of the gauge changed, barriers may be erected or warning signs prohibiting loitering in the area may be displayed to ensure that this requirement is met. If necessary, a cage or screen must be erected around the gauge to restrict access to the direct radiation beam of the gauge. Cages or screens however, must be erected in such a way that source containers are visible and shutter mechanisms easily accessible.

(The NAP is the closest distance that an employee, that is also a member of the public, could get to the radiation source under normal working circumstances. If a radiation source is, e.g. mounted at a height of 3 meters above the walkway, the NAP will be the closest position that a person can approach this source while standing on the walkway.)

- 5.1.4 When a gauge is not required to function (e.g. if a line is closed down temporarily, or if a tank is emptied for maintenance) the source container must immediately be **secured** in the shielded or "beam off" position.
- 5.1.5 The source container must be properly mounted to the application. All bolts and nuts must be present and tightened and with no excessive rust. Source containers installed in excessively wet or dirty applications should be protected to promote the correct functioning of the gauge and to prevent excessive rust.

5.1.6 When a gauge is moved to a new position or when a gauge is removed from service, such moving or removal may take place only under the direct supervision of the radiation protection officer. It is the responsibility of the holder of the authority to ensure that all personnel are aware of this rule, and that they adhere to it. The Department must be informed of such a move.

5.1.7 When a gauge is removed from service, the radiation protection officer shall ensure that it is immediately locked in an approved storage facility.

5.2 Repairs and Maintenance

5.2.1 Maintenance work which does not involve the source directly (eg fixing of electronics, working on the detector, relocation of equipment, or the performance of non-related tasks in the vicinity of the gauge) may be performed by competent personnel under the supervision of the radiation protection officer. The radiation protection officer should evaluate the potential radiation hazard and give advice on any precautionary measures that need to be taken.

5.2.2 No person may do maintenance work on a gauge which directly involves the source (e.g. replacing defective sources, working on the shutter mechanism, etc.) unless he is a registered radiation worker and is authorised by the Department to perform such work.

5.3 Leak Tests

5.3.1 Leak tests must be performed at least every two years. (Please consult the Department of Health Code of Practice for Leak Tests for more details on leak tests)

5.3.2 Leak tests may be performed by any person or persons responsible for the gauge, by the company responsible for servicing the gauge, or by any company who offers a leak testing service.

5.3.3 The leak tests should be performed with wet or dry cotton wool, tissue, or soft paper.

5.3.4 Method: Wipe the moving part closest to the source, or along any joint or opening where it is feasible that contamination might occur. Do NOT put your hands, or any part of your body, in the direct beam from the gauge. Do NOT dismantle the gauge in order to do the leak test, and do NOT wipe the source itself.

5.3.5 If the company has access to a suitable contamination monitor, the analysis of the leak test samples may be performed and recorded by the company themselves.

- 5.3.6 If the company does not have a suitable monitor, the wipe samples must be sent to a company or institution who performs such analyses. Samples should be placed in sealed plastic bags before dispatching. Samples may not be sent via the post.
- 5.3.7 If a source is found to be leaking (i.e. a positive result) the Department must be notified immediately.
- 5.3.8 The results of all leak tests must be recorded on form RN608 or a similar document containing the same information, and must be available for inspection purposes.

6. RADIATION MONITORING REQUIREMENTS

- 6.1 If a company possesses a large number of gauges, or if relatively high activity sources are being used, the Department will require that the company obtain a radiation monitor. Radiation monitors must be calibrated at an approved facility at least every 14 months.
- 6.2 The radiation monitor must be used to ensure that radiation dose rates in the vicinity of the gauges do not exceed prescribed limits. Typical applications would be routine monitoring programmes, checking of new installations, confirming "beam off" status before relocating a gauge and, if the gauge is sufficiently sensitive, leak testing.
- 6.3 Personal dosimeters (TLD badges) must be worn by persons doing maintenance work involving the source itself, or by any worker whom the responsible person feels is likely to receive more than 3/10 of the dose limit for radiation workers. (The annual dose limit for radiation workers is 20 mSv (2000 mR).

7. TRANSPORTATION

- 7.1 An enclosed vehicle must be used for transporting the gauge by road. If a "bakkie" is used, a lockable canopy must be installed, or the gauge must be secured to the vehicle.
- 7.2 The vehicle may not be left unattended with the gauge in (or on) it.
- 7.3 Three removable transport radiation warning signs (See Annexure 1 - fig 5) must be displayed on the vehicle during transportation; one sign on each side and one at the rear of the vehicle. The name and telephone number of a person to be contacted in the event of an emergency must appear adjacent on each sign.
- 7.4 The gauge must be secured in the shielded ("beam off") position.
- 7.5 The gauge shall be positioned as far as possible from the driver of the vehicle and should be so stowed as to prevent any shift under normal conditions of transport.

- 7.6 The maximum radiation level at the position of any person in the vehicle shall not exceed 20 $\mu\text{Sv/h}$ (2 mR/h) (Ref 2).
- 7.7 Nuclear gauges may be despatched by public transport (i.e. by ship, air freight or road) provided that the following additional requirements are met:
- 7.7.1 The source container shall be packed in an outer shipping container which is of strong, rigid construction.
 - 7.7.2 The source container shall be effectively immobilised within the outer container.
 - 7.7.3 The outer shipping container shall bear approved transport labels (See Annexure 1 - fig 2, 3, 4) in accordance with the radiation levels associated with the gauge.
 - 7.7.4 The gauge shall be accompanied by properly completed transport documents specifying the radioactive content.

8. EMERGENCY PROCEDURES

- 8.1 The Directorate must be **notified immediately by telephone, e-mail or facsimile** and the information must be reported to the Directorate in writing within **7 days** in the following instances (See Regulation 16):
- 8.1.1 If the authority holder is not able to deal with an emergency situation in a safe and acceptable manner with the equipment at his disposal, or if he does not have personnel who are trained to handle such situations.
 - 8.1.2 If there is the likelihood of radioactive contamination occurring, or having occurred as a result of an incident.
 - 8.1.3 If any person is overexposed, or suspected of being overexposed a form RC010 must be submitted.
 - 8.1.4 If a radioactive source and/or container is lost or missing or damaged, in which case form RN900 must be submitted to the Directorate.

The Department of Health - Directorate: Radiation Control can advise on further action to be taken and can provide radiation monitoring equipment, if required. During office hours, phone 021-948 6162; Fax: 021-946 1589. After hours, call the Necca 24-hour National Emergency Centre on 012-305 3333.

- 8.2 Priority must be given to the rendering of first aid and other actions to protect human life or to limit injury BEFORE the radiation hazard is considered.

- 8.3 If the area where nuclear gauges are stored is threatened by fire, or some other potential hazard exists, the gauges must be moved to a safe place and secured against unauthorised access. (Ensure that the gauge is secured in the "beam off" position before moving.)
- 8.4 If it is suspected that there has been loss of, or damage to the shielding material, persons should maintain as large a distance from the gauge as possible. However, if the emergency situation requires it, the gauge could be approached for short periods, without significant risk.
- 8.5 If it is suspected that a source itself may have been damaged (e.g. if the gauge is severely crushed or burned) the following precautions should be taken to avoid the spread of radioactive material:
- 8.5.1 Care should be taken not to touch the gauge, or anything in the vicinity of the gauge, unless with a gloved hand. The gauge should not be approached unless the emergency situation requires it.
 - 8.5.2. If available, a mask with a filter should be worn by persons who have to approach the gauge, to prevent possible inhalation of airborne radioactive particles.
 - 8.5.3. Once the emergency has been dealt with, persons who were in the vicinity of the gauge should gather in a central place. Clothing or shoes suspected of being contaminated must be removed and placed in a plastic bag and sealed.

9. DISPOSAL

- 9.1 The Department strongly recommend that any unused radioactive sources be disposed of in the prescribed manner. Any Radiation Control office may be contacted should you require more information on the disposal of radioactive sources.
- 9.2 The holder of authority shall not dispose of a sealed source, or a nuclear gauge containing a sealed source, without the approval of the Department. "Dispose" here includes sale, lend, donate, exchange, as well as return of the gauge or source to the supplier. An application form RN526 to dispose of the gauge or source must be submitted to the Department in the above cases.
- 9.3 Should the holder wish to dispose of a source or gauge at the Nuclear Liabilities Management (NLM) section of NECSA at Pelindaba, application must be made to the Department of Health on form RN525.

10. REFERENCES

1. Report on the Applicability of International Radiation Protection Recommendations in the Nordic Countries, Stockholm, 1976.

2. Code of Practice for the Safe Use of Radiation Gauges, NH & MRC, Canberra, Australia, 1982.
3. Working Safely with Nuclear Gauges, Atomic Energy Control Board, Canada.
4. Government Gazette no. 14596 26 February 1993.
5. Code of Practice for the Safe Use of Sealed Radioactive Material in Industry, NRL, Christchurch, New Zealand, 1981.

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ANNEXURE 1

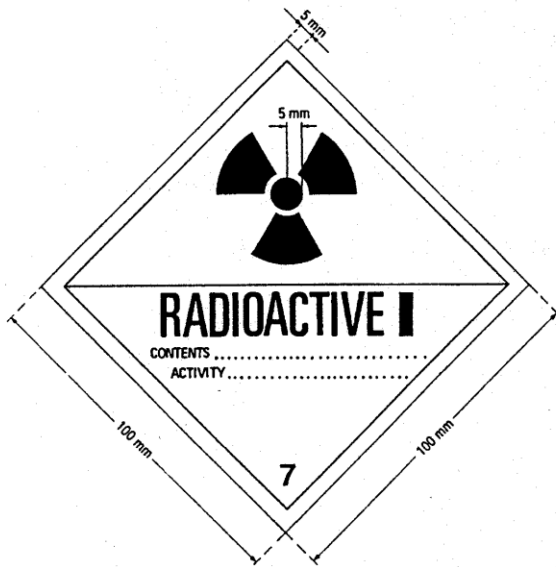


Fig 2: Category I-WHITE label. The background colour of the label shall be white, the colour of the trefoil and the printing shall be black, and the colour of the category bar shall be red.

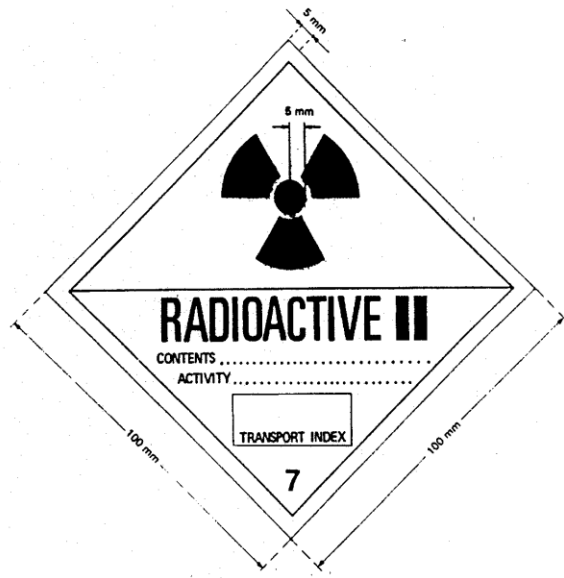


Fig 3: Category II-YELLOW label. The background colour of the upper half of the label shall be yellow and of the lower half white, the colour of the trefoil and the printing shall be black, and the colour of the category bars shall be red.

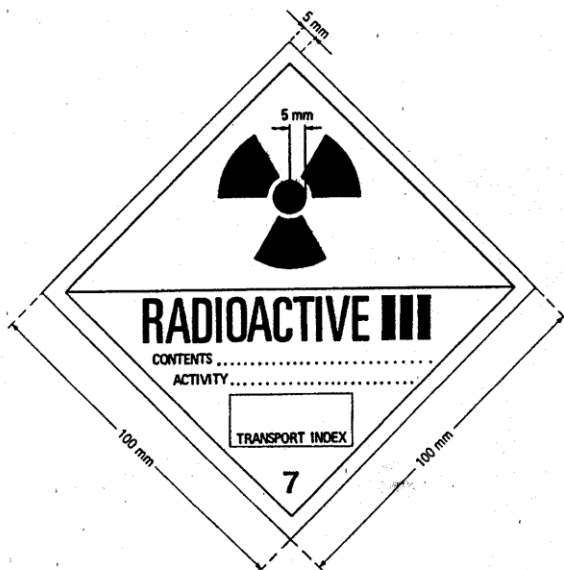


Fig 4: Category III-YELLOW label. The background colour of the upper half of the label shall be yellow and of the lower half white, the colour of the trefoil and the printing shall be black, and the colour of the category bars shall be red.

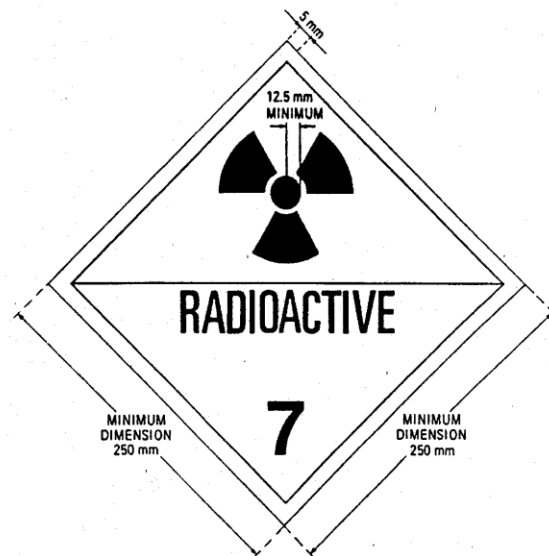


Fig 5: Placard. Minimum dimensions are given; when larger dimensions are used the relative proportions must be maintained. The figure '7' shall not be less than 25mm high. The background colour of the upper half of the placard shall be yellow and the lower half white, the colour of the trefoil and the printing shall be black.