



# NuRAD INSTRUMENTATION INC.

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15 June, 1988

Valmet-Sentrol Ltd  
8161 Keele Street  
Concord, Ontario  
L4K 1Z2

Att: Dr. S. Panda

Dear Dr. Panda:

This letter is to confirm the check and calibration of your Victoreen Model 471-50, s/n 216, on 13 June, 1988. The source used is Cs-137, US Nuclear Corporation Model SD-10, No. V-985, originally calibrated October 9, 1967, traceable to NBS standards.

Sincerely,

A handwritten signature in cursive script, reading "Howard Greenaway".

Howard Greenaway

# Promethium-147

## Beta sources

### Disc sources

Promethium-147 incorporated in an enamel, mounted in a brass holder with 5µm titanium window, fixed in place with adhesive, capsule type X.8095.

Nominal activity*		Active diameter mm	Overall diameter mm	Code
mCi	GBq			
200	7.40	15.6	22	PHC.80952
500	18.5	15.6	22	PHC.80955

\*Tolerance -10, +25%

**Availability:** within 6 weeks

**Recommended working life:** 5 years

### Line sources

Promethium-147 incorporated in an enamel, mounted in a brass holder with titanium window over the active area, capsule type X.8270

Nominal activity*		Active dimensions		Overall dimensions		Code
mCi	GBq	Length mm	Width mm	Length mm	Width mm	
500	18.5	50	3	63	13	PHC.82705

\*Tolerance -10, +25%

**Availability:** within 4 weeks

**Recommended working life:** 5 years

### Quality Control

Wipe test A

Immersion test L

Beta emission or radionuclide activity is measured using the most suitable detector. Full details are given in the Test Report accompanying the source.

### Specifications:

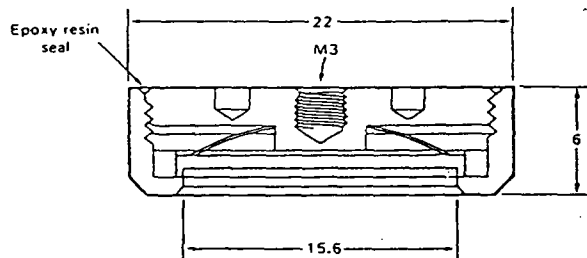
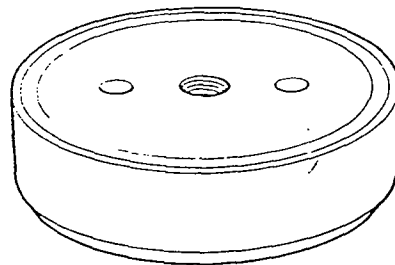
Only typical sources are listed.

Enquiries invited for sources to other specifications.

Recommended working life, see page 77

## Low energy, beta sources

### X.8095



### Safety performance testing

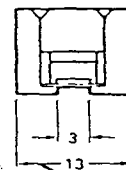
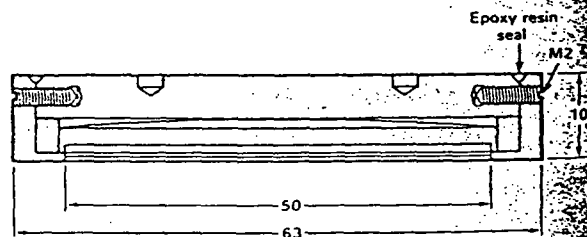
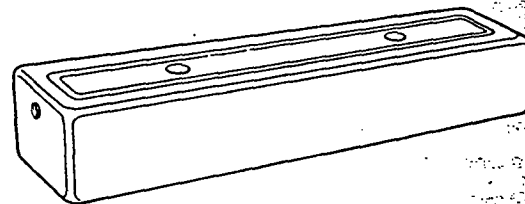
ANSI/ISO classification

77C33222

NRC model no.

PHC.C1

### X.8270



### Safety performance testing

ANSI/ISO classification

77C33222

### Quality control:

Leakage and Contamination tests, see page 71

A Test Report is supplied with each source or batch of sources.

Safety performance testing, see page 76

## ISO/ANSI classification

The International Organization for Standardization (ISO) has produced a system of classification of sealed radioactive sources based on safety requirements for typical uses (see ISO.2919, ANSI N542 1977).

"This system provides a manufacturer of sealed radioactive sources with a set of tests to evaluate the safety of his products under working conditions. It also assists a user of such sealed sources to select types which suit the application he has in mind, especially where protection against the release of radioactive material is concerned".

The suitability and safety of a source will depend on the intended application and environment of use, of which there is a wide range. It is the customer's responsibility to ensure that the source and its specification are suitable and safe for his particular application and environment of use. This applies especially to non-standard or custom made designs as well as standard products. The information on these pages is designed to help the customer in his evaluation.

The tests to which prototype sources are subjected are listed in table 1.

Each test can be applied in several degrees of severity. Test results are expressed as a five figure code to indicate the severity of the tests.

These figures are preceded by the letter C or E to show whether the source activity is less than or greater than certain limits. These limits depend upon the toxicity, solubility and reactivity of the active component of the source.

**C** indicates that the activity level of the source does not exceed the prescribed limit and

**E** that the limit is exceeded.

## Special safety performance tests on prototypes

A radiation source must provide highest possible integrity together with minimum attenuation of the required radiation by the encapsulation materials.

However, safety must always be the prime consideration.

Standards for the testing of sealed radioactive sources have been specified by the ISO/TR4826-1979(E) and ANSI N542-1977, Appendix A.

This classification system is modelled on USA standard ANSI N542 (1977) which also gives a number of comparable leak test methods.

Amersham International has facilities devoted solely to the testing of prototype sources according to ANSI/ISO recommendations.

The ANSI/ISO data given in this catalog are the latest available at time of preparation.

There is a continuous program of product improvement and testing and details of the current status of particular sources will be supplied on request.

**Table 1.** Classification of sealed source performance standards

Test	Class 1	2	3	4	5	6
<b>Temperature</b>	No test	-40°C (20 min) +180°C (1 h)	-40°C (20 min) +80°C (1 h)	-40°C (20 min) +400°C (1 h) and thermal shock 400°C to 20°C	-40°C (20 min) +600°C (1 h) and thermal shock 600°C to 20°C	-40°C (20 min) +800°C (1 h) and thermal shock 800°C to 20°C
<b>External pressure</b>	No test	25kPa absolute to atmospheric pressure	25kPa absolute to 2MPa absolute	25kPa absolute to 7MPa absolute	25kPa absolute to 70MPa absolute	25kPa absolute to 170MPa absolute
<b>Impact</b>	No test	50g from 1m	200g from 1m	2kg from 1m	5kg from 1m	20kg from 1m
<b>Vibrations</b>	No test	30min 25Hz to 500Hz at 5 g <sub>n</sub> peak amplitude	30min 25Hz to 50Hz at 5 g <sub>n</sub> peak amplitude and 50Hz to 90Hz at 0.635mm amplitude peak to peak and - 90Hz to 500Hz at 10 g <sub>n</sub>	90min 25Hz to 80Hz at 1.5mm amplitude peak to peak and 80Hz to 2000Hz at 20 g <sub>n</sub>		
<b>Puncture</b>	No test	1g from 1m	10g from 1m	50g from 1m	300g from 1m	1kg from 1m

### Notes to Table 1

1 Details of the testing procedures are given in ISO.2919 and ANSI N542-1977. A further class X can be used where a special test procedure has been adopted.

#### 2 External pressure

100kPa = 1 atmosphere (approximate)

#### 3 Impact test

The source, positioned on a steel anvil, is struck by a steel hammer of the required weight; the hammer has a flat striking surface, 25mm diameter, with the edges rounded.

#### 4 Puncture test

The source, positioned on a hardened steel anvil, is struck by a hardened pin, 6mm long, 3mm diameter, with hemispherical end, fixed to a hammer of the required weight.

# Source safety

## Performance requirements for typical uses

Minimum performance requirements are also given in ISO.2919 and ANSI N542-1977 for the use of sealed radiation sources (see table 2 below).

These recommendations take into account normal usage and reasonable accidental risks, but do not include exposure to the risk of fire, explosion or corrosion.

**Table 2.** Sealed source performance requirements.

Sealed source use		Sealed source test and class				
		Temperature	Pressure	Impact	Vibration	Puncture
Gamma gauges (medium and high energy)	Unprotected source	4	3	3	3	3
	Source in device	4	3	2	3	2
Beta gauges and sources for low energy gamma gauges or X-ray fluorescence analysis (excluding gas-filled sources)		3	3	2	2	2
Portable moisture and density gauges (including hand held or dolly transported)		4	3	3	3	3
General neutron source application (excluding reactor start-up)		4	3	3	2	3
Oil well logging		5	6	5	2	2

### If the sealed source has a 'C' classification

Table 2 can be used directly to assess the suitability of the source for the proposed application provided that there is no significant fire, explosion or corrosion hazard.

If such a hazard does exist, the user has to consider the following factors to determine whether additional testing is required:

- 1 consequences of loss of activity
- 2 quantity of active material contained in the source
- 3 radiotoxicity
- 4 chemical and physical form of the material and the geometrical shape
- 5 environment in which it is to be used
- 6 protection afforded to the source-device combination.

### If the sealed source has an 'E' classification

Table 2 cannot be used directly.

To determine whether any additional testing is necessary, an evaluation of the fire, explosion and corrosion hazards must first be made and a separate evaluation of the use and design of the source.

Some of our source designs exceed the recommendations of Table 2 and may therefore be acceptable for the applications listed despite the 'E' classification.

Amersham does not recommend use of its sealed source materials beyond the minimum performance requirements unless the proposed use is described to Amersham and Amersham in writing gives its recommendation with respect to the suitability of the sealed source for the proposed use.

## IAEA special form

'Special form' is a test specification for sealed sources given in the IAEA transport regulations. (IAEA Safety Series No. 6, 1973 revised edition as amended.)

It is used in determining the maximum acceptable activities for various types of transport containers.

The required test are:

- impact test
- percussion test
- bending test (only for long, slender sources)
- heat test.

After each test the source must be subjected to leaching assessment tests.

The certificate numbers given against approved items in the catalog listing are those issued by the Department of Transport, the competent authority in the UK for administering the IAEA regulations, or the U.S. Department of Transportation.

## Source working life

The 'recommended working life' (RWL) is our recommendation of the period within which the source should be replaced.

This information is given in the Test Report. The period has been assessed on the basis of such factors as, toxicity of nuclide, total initial activity, source construction (e.g. capsule design, source insert type, etc.), half-life of nuclide, typical application environments, operational experience, test performance data, etc.

The assessment of 'recommended working life' is based on the assumption that they are not used in adverse environments. It is the user's responsibility to inspect and test the source regularly in order to assess at what point during the 'recommended working life' the source should be replaced.

Advice should be sought regarding 'recommended working life' for sources that are used in adverse environments or for sources that having completed the 'recommended working life' appear satisfactory and may be suitable for an extended period.

### Other information

Other information on source safety is contained in the product specification sheets, test reports, handling and unpacking instructions where applicable.