DRAFT OF AN INTERNATIONAL STANDARD FOR LEAKAGE TESTING ON PACKAGES FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS

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I. INTRODUCTION

The recommendations expressed by the International Atomic Energy Agency (IAEA) for the Safe Transport of Radioactive Materials lay down, among other things, the limits for the release of radioactivity by the packages which transport radioactive materials, in terms of activity per unit of time, under both normal and accident conditions of transport. However, no advice is given on the methodology to be followed to demonstrate that the specified criteria have been met. The choice of methodology is left to the package designer, but the methodology must be agreed by the Competent Authority during the process of package approval.

In most cases it is impossible to demonstrate by direct measurement that activity release limits are not exceeded. The method which is usually used to prove that a package has adequate containment is based upon carrying out a gas leakage test.

In order to harmonise the approach of this problem worldwide, the INTERNATIONAL STANDARD ORGANIZATION (ISO) in 1986 asked a group of experts, representing about 15 countries, to write a standard concerning the leakage testing of packages for the safe transport of radioactive materials. This gave birth to the Working Group n°10 (WG 10) of the Sub Committee 5 "Nuclear Fuel Technology" (SC 5) whose activities are overviewed by Technical Committee 85 "Nuclear Energy" (TC 85).

The work of the WG 10 focused on the development of procedures to determine appropriate gas leakage rates and procedures for carrying out leaktightness tests. Such procedures are currently used but are often applied differently. The work was carried out with particular concern to provide for the future users of the standard (ie package designers, shippers of radioactive materials and Competent Authorities), a reference document which is accepted and used by the largest possible number of countries and provides the maximum help to all concerned.

II. SCOPE OF THE STANDARD

The standard pertains specifically to type B packages for which the regulatory containment requirements are specified explicitely. It specifies leaktightness definitions and test methods for demonstrating that packages comply with the regulatory requirements at the Design, Fabrication, Preshipment and Periodic stages.

This standard uses methodologies that are based on the detection and measurement of gas leakage rates under specified test conditions. It contains non-mandatory appendices that provide explanatory and advisory information as well as data on gas leakage test procedures and principles.

The standard is based on the following premises:

a) The radioactive material which could be released from the package could be in any one or any combination of the following forms: liquid, gas, solid, liquids with solids in suspension or particulate solids in a gas (aerosols).

The maximum permissible activity release rate can be expressed in terms of a maximum permissible leak diameter when the physical form and properties of the radioactive contents are taken into account.

b) Gas leakage test procedures can be used to measure gas flow rates. These rates can be related mathematically to the diameter of a single straight capillary which is considered to represent conservatively a leak or leaks.

c) Gas leakage test procedures can be used to demonstrate compliance with regulatory containment requirements when the maximum permissible leak diameter from a) above is equal or greater than the diameter of the single straight capillary from b) above.

The standard recognizes that the activity release, or the absence of activity release, can occur by one or more of the following ways:

a) Viscous flow, in which the releasable radioactive material is distributed uniformly in a radioactive or non-radioactive fluid in the containment system. This applies to gases, liquids and gases or liquids containing solid particles in suspension.

b) Molecular flow, in which radioactive gases escape from the containment system under the mechanism of their partial pressure differences.

c) Permeation, in which radioactive gases migrate through solid, but permeable materials.

d) Blockage of the leak(s) by solids, solid particles or some liquids may prevent an activity release.

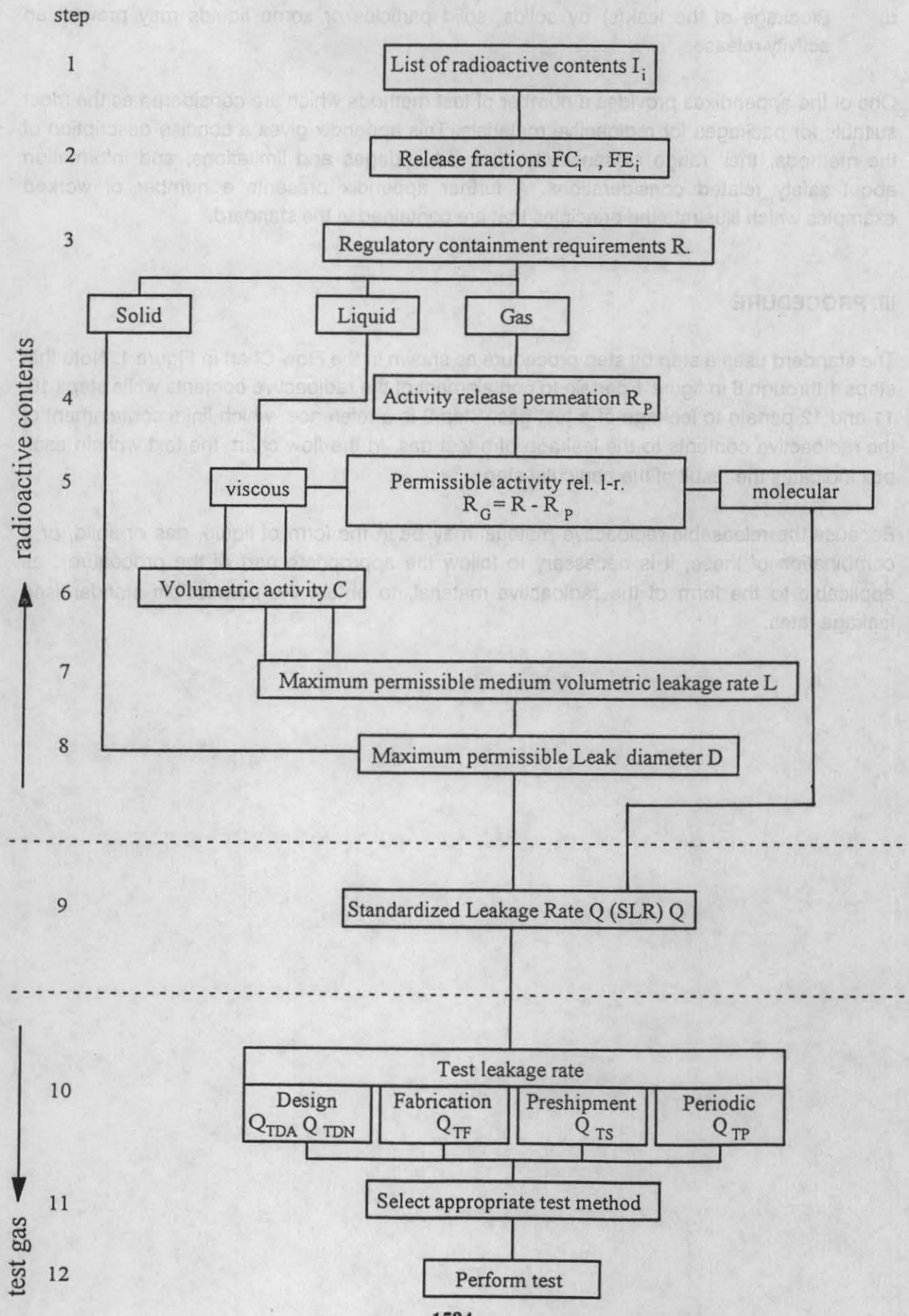
One of the appendixes provides a number of test methods which are considered as the most suitable for packages for radioactive materials. This appendix gives a concise description of the methods, their range of sensitivity, their advandages and limitations, and information about safety related considerations. A further appendix presents a number of worked examples which illustrate the principles that are contained in the standard.

III. PROCEDURE

The standard uses a step by step procedure as shown in the Flow Chart in Figure 1. Note that steps 1 through 8 in figure 1 pertain to containment of the radioactive contents while steps 10, 11 and 12 pertain to leakage of a test gas. Step 9 is a reference which links containment of the radioactive contents to the leakage of a test gas. In the flow chart, the text whithin each box indicates the result of the particular step.

Because the releasable radioactive material may be in the form of liquid, gas or solid, or a combination of these, it is necessary to follow the appropriate part of the procedure , as applicable to the form of the radioactive material, to obtain the permissible standardised leakage rates.

Fig.1 FLOW CHART



IV. PROGRESS OF THE WORK

At the end of our last working group meeting in Paris in April 1992, draft L of the ISO Standard was produced. This is the fourteenth draft which is approaching the final text and completion of this project. Draft L has the following structure:

Foreword

1 Scope and field of application

2 References

3 Definitions and symbols

4 Procedure for meeting the requirements of this standard

5 Regulatory requirements and permissible release rates

6 Determination of standardized leakage rates

7 Containment system verification requirements

8 Leakage test procedure requirements

Appendixes

A Preferred leakage test methods

B Calculation methods

C Conversion tables

D Worked examples

E Explanatory notes

As close agreement of the members of the working group was obtained for draft L, it was distributed to all the Competent Authorities concerned and to the main potential users of the countries represented in the ISO TC 85/SC5/WG 10, in order for them to be informed directly about the progress of our work. At the same time, draft L was given to the ISO TC 85/SC5 Secretary's office to be distributed to the ISO member countries as the FIRST COMMITTEE

DRAFT (CD). At this time, it is reasonnable to assume that this standard is in final draft form and could be submitted to the ISO member countries for a final vote within one year.

During the drafting of this standard , drafts of the document have been used, on an experimental basis, within some major organisations of different countries. This has confirmed the obvious benefit of an international document of reference in this field.

The IAEA has been kept informed about the progress of the work and has always shown a great interest in the development of this international standard which will greatly contribute to the objective of ensuring that IAEA's recommendations are correctly applied.

V. CONCLUSION

It is clear that this project of producing an ISO standard on Leakage Testing on Packages for the Safe Transport of Radioactive Materials has not reached its final form. In fact, it can be questioned whether a final form can really exist considering the permanent evolution of knowledge, technology and regulations. Yet the standard represents a summary of the most advanced knowledges available in this field at the moment. We consider that it is important to submit this document as soon as possible to real usage, that is to say, it must be tested within actual, real applications.

I would like to thank very sincerely all the members of the WG 10 who have shown constant openmindedness, a real eagerness to listen to the position of the others, and a strong desire to get to a concrete result in this team work. My thanks extend to all the Competent Authorities for the moral or financial support they have brought to this project. We trust that this joint work is a step forward in the development of Safety, which is the responsibility of us all.