TESTING TYPE-A PACKAGING FOR A SOLUTION CONTAINING MOLYBDENUM-99

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ABSTRACT

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The Center for Standardization and Radiation Safety Research - National Atomic Energy Agency (CSRSR-NAEA) of Indonesia has designed and contructed the equipment for testing type-A packaging for a solution containing Molybdenum-99 (Mo-99). According to the Indonesian and International Atomic Energy Agency (IAEA) regulations, type-A, which was designed and manufactured by Nuclear Equipment Development and Engineering Center (NEDEC-NAEA), should be tested under normal conditions. From the test result, it was confirmed that the packaging still maintained its integrity and characteristics in conformity with the regulation even after the normal condition test. There is no leakage of the solution and a dose rate increase of only 13.5 percent at the surface of the container after a nine meter free drop test.

1. INTRODUCTION

A packaging for type-A quantities of liquid solution of molybdenum-99 (Mo-99) has been designed, certified and used for transportation of radioactive solution. Mo-99 is produced by Radioisotope Production Center (RPC-NAEA). Its product is refined and distributed to the medical centers either for domestic use or for export in the future.

The design and construction of the equipment for testing type-A packaging is conducted according to the 1990 edition of the IAEA regulations (IAEA, 1990) and NAEA Safety Stipulations (NAEA, 1986).

2. DESIGN OF PACKAGING AND CONTAINMENT SYSTEM

Figure 1 shows the essential features of the gamma shielding and containment system packaging components which have a combined mass of 96 kg.

The drum is made from mild steel with thickness of 1.2 mm, diameter of 400 mm and height of 550 mm. The outer and the inner containers are made from stainless steel SS 304 with thickness of 6 mm and 60 mm of gamma shielding from lead (Pb). The containment systems (i.e. the product bottles) are made from stainless steel SS 304 and incorporate two enclosure plugs, each with a silicone elastomeric seal. New seals are used for each transportation.

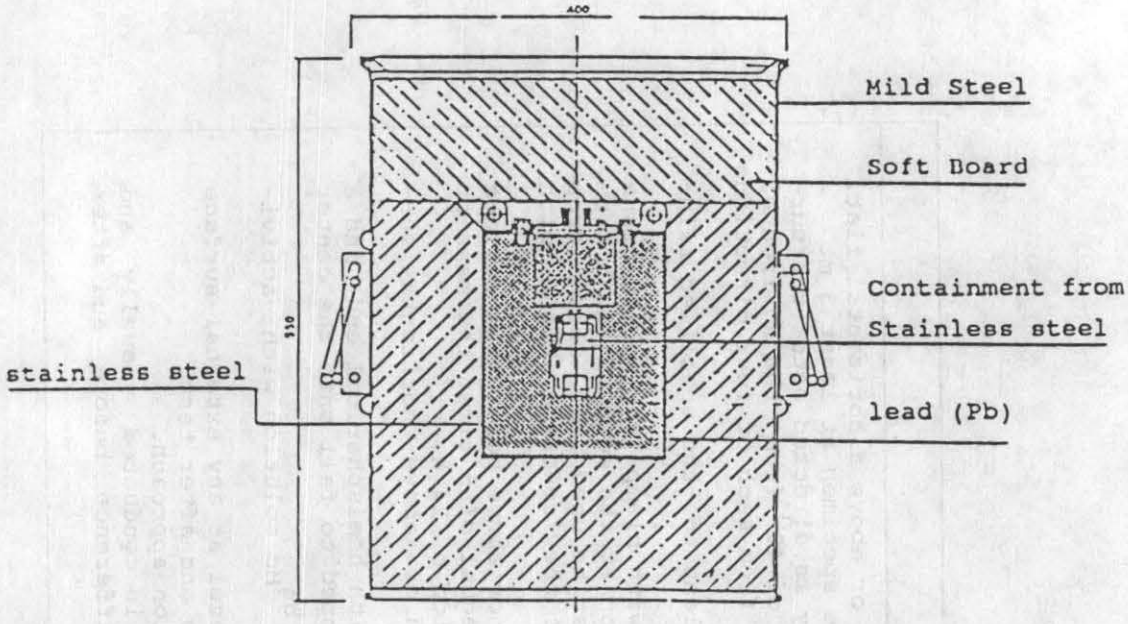

Fig.1. Type packaging for a solution containing Mo-99.

3. TESTING METHODS

The testing was conducted step by step as indicate in Table 1. Testing flow chart is shown in figure 2.

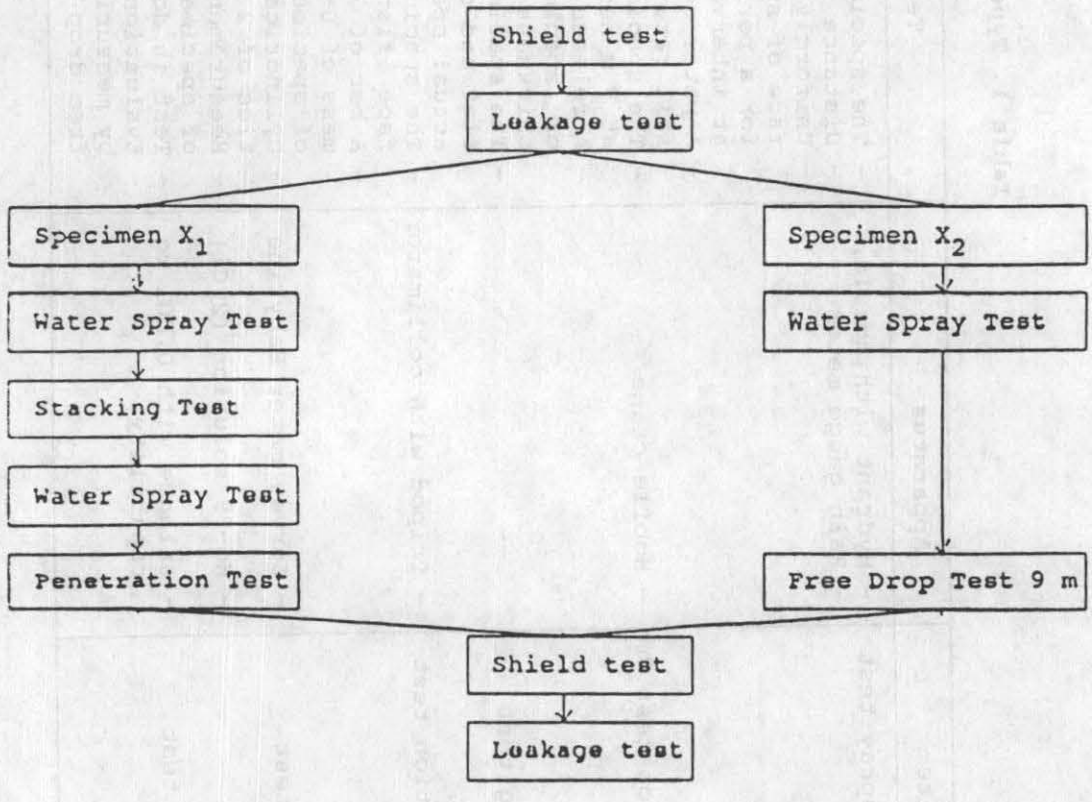

Fig. 2 Sequence of demonstration test

Table 1. Type of test method

No.	Test item	Apparatus	Test Method
1.	Water spray test	- Hydrant with nozzle, - Rain gauge meter	- The specimen is placed on or above a horizontal flat. - Distance from nozzle to the specimen at least 3 m. - Uniformly distributed spray is directed onto the surface of specimen at angle of 45^{o} from the horizontal for a period of 15 minutes from each of four directions at interval of 90^{o}. - A water consumption equivalent to the specified rainfall rate of 5 cm/h.
2.	Free drop test 9m	- Mobile crane	- The specimen easily held with clamp from mobile crane at 9 m height, with position at the edge of the bottom. - A release hook on crane must be used for easy drop of specimen on target of the concrete block with thickness of 20 cm.
3.	Stacking test	--	- The specimen is placed on or above horizontal surface flat and compressive load equal of 5 times the mass of actual specimen for a period of 24 h.
4.	Penetration test	- Tripod with collimator	- The specimen is placed on or above horizontal surface flat and rigid. - A bar of 3.2 cm diameter with hemispherical end and a mass of 6 kg shall be dropped to fall onto the center of specimen height of 1.7 m.
5.	Shield test	- Survey meter Babyline - Mo-99 solution (2 Ci)	- Cylindrical vial source of ^{99}Mo solution with activities of 2 Curie are used. - Measurement of radiation level at any external surface of specimen, applied before and after test.
6.	Leakage test	- Balance with 0.001 mg capability	- Test is done using simulation approach. - Evaluation of the leakage is conducted visually and by measuring the weight difference before and after free drop test of 9 m.

4. RESULTS

The water spray test did not cause any damage to the internal content of the package, because the drum has a rubber seal around the inside of the cover.

The 9 m free drop test caused some deformity especially at surface of the drum and the soft board, but with no leakage of the simulation solution (Rodamin-B) and increase in dose rate of only 13.5 percent at the maximum damage of the package.

The penetration test caused the most visible damage to the external portion of the package. The bar did not actually penetrate the soft board or the containment system. No damage was observed from the compression test of two sides of each package.

5. CONCLUSIONS

Test of packaging has been conducted completely according to IAEA Regulation. Test result shows that the packaging still maintains its integrity. It was mean that the packaging can be used for transportation of type A radioactive material.

REFERENCES

International Atomic Energy Agency, Regulation for the Safe Transport of Radioactive Materials. 1990 edition Safety Series No. 6, IAEA, Vienna (1990).

National Atomic Energy Agency, Safety Stipulation for Transport of Radioactive Materials. 1986 edition NAEA No. 07/DJ/5/II/74.