



DANGEROUS GOODS PANEL (DGP)

TWENTY-THIRD MEETING

Montréal, 11 to 21 October 2011

Agenda Item 2: Development of recommendations for amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284) for incorporation in the 2013-2014 Edition

REQUIREMENTS FOR NEUTRON RADIATION DETECTORS

(Presented by the Dangerous Goods Advisory Council)

摘要

这项建议将界定航空运输含有非加压2.3项气体的中子辐射探测器的条件。

危险物品专家组的行动：请危险物品专家组同意本工作文件附录中提出的建议，以便货运航空器能够运输中子辐射探测器。

1. INTRODUCTION

1.1 Neutron detection is key component in nuclear arms interdiction. For example, Radiation Portal Monitors (RPMs) for cargo screening (e.g. screening of freight containers being off loaded from a cargo vessel in port areas) use a combination of gamma radiation and neutron radiation detectors for the identification of highly enriched uranium and plutonium in warheads. In the words of one security expert, they are deemed “an essential aspect of interdiction of radiological threats for homeland security purposes since plutonium, a material used for nuclear weapons is a significant source of fission neutrons.” Additional applications for neutron radiation detectors include nuclear reactor monitoring, neutron-based cancer treatments, neutron spallation, non-destructive testing and health physics applications.

1.2 Neutron radiation detectors described in this proposal are hermetically sealed electron tube devices that contain a non-pressurized gas that functions as the detection medium. Neutrons are not directly ionizing and therefore cannot be detected directly; they must react with another medium to produce ionizing particles that can be detected. Boron trifluoride is used because the boron in the gas provides target nuclei for the neutron conversion reaction. When a boron atom in the gas captures a neutron emitted by an outside neutron source, the neutron radiation detector produces an electrical signal. Boron trifluoride filled neutron radiation detectors have been in use in industrial, medical and scientific applications for over seventy years. They have been shipped around the world without incident. With

more than 100,000 boron trifluoride sensors in service worldwide in the nuclear power and radiation protection industries, there has never been an incident of a boron trifluoride leak in transport.

1.3 To prevent nuclear terrorism, it is essential that neutron radiation detection systems and detector system components can be rapidly deployed worldwide. With boron trifluoride (UN 1008) classified as a Division 2.3 (8), air transport is currently only permitted under approvals by the State of Origin and State of the Operator in accordance with Special Provision A2. Such approvals have been issued by the United States and Canada. Clarifying the applicable requirements for their transport aboard cargo aircraft in the Technical Instructions would greatly facilitate deployment and in doing so would improve worldwide responsiveness to the security threat posed by certain radioactive materials.

1.4 A number of safety features are incorporated in the neutron radiation detectors, the component of radiation detection systems containing boron trifluoride, to provide for safe transport and use:

- a) the gas is non-pressurized with the pressure at the time of filling kept at 105kPa at 20°C or below (note that, while neutron radiation detectors are constructed differently and are subject to far more stringent construction requirements, Division 2.3 gas samples may be transported on cargo aircraft (Special Provision A1 for passenger) under UN 3169 at a pressure of 105 kPa or less);
- b) the neutron radiation detector is extremely rugged;
- c) the detection systems and neutron radiation detectors transported as components are packaged with an absorbent material that is capable of absorbing all of the gas contained in package. A study by a United States national laboratory shows the absorbent material to be highly effective in absorbing the gas should it leak from the electron tube under use or transport conditions; and
- d) the neutron radiation detectors are hermetically sealed. Each unit is helium mass spectrometer leak tested to 1×10^{-10} standard cc/sec leak tightness before filling. Note that the operation of the neutron radiation detectors is dependent on their absolute vacuum tightness.

1.5 An interpretation by the United States Department of Transportation authorizes neutron radiation detectors containing not more than 1 gram of gas to be treated as not subject to the regulations as dangerous goods. Approvals for transporting neutron radiation detectors and radiation detection systems by cargo aircraft have been issued by both the United States Department of Transportation and Transport Canada. Documents supporting these statements can be made available to the panel.

1.6 For purposes of the proposal:

- a) **Neutron radiation detector** is a hermetically sealed electron tube device. It is a transducer that turns neutron radiation into a measureable electric signal. It must be powered by an electrical circuit to function; and
 - b) **Radiation detection system** is an apparatus that contains neutron radiation detectors as components.
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附录

对《技术细则》的修订

建议 1:

第3部分第2章第7栏表3-1“危险物品表”三氟化硼（UN1008）条目中插入“AXX”：

名称	UN 编号	类别或项别	次要危险性	标签	国家差异条款	特殊规定	UN 包装等级	例外数量	客机		货机	
									包装说明	每个包装件最大净量	包装说明	每个包装件最大净量
1	2	3	4	5	6	7	8	9	10	11	12	13
Boron trifluoride 三氟化硼	1008	2.3	8		AU 1 CA 7 NL 1 US 3 IR 3	AXX			FORBIDDEN 禁运		FORBIDDEN 禁运	

建议 2:

加入下述特殊规定：

第 3 章

特殊规定

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表 3-2 特殊规定

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虽然表 3-1 第 12 栏和 13 栏有“禁运”标志，含有少量超过 1 克非加压三氟化硼气体的中子辐射探测器和含有中子辐射探测器组件的辐射探测系统，可以按照这些技术细则由货运航空器运输，条件是：

- a) 每个中子辐射探测器的压力不得超过 105 千帕/20℃；
- b) 每个中子辐射探测器的体积不得超过 4 升，每个探测器的气体容量不得超过 12.8 克。每件中子辐射探测器的外包装或每个辐射探测系统的总体积不得超过 16 L；

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- c) 每个中子辐射探测器必须是钎焊金属陶瓷馈通组件式的金属结构，最小爆破压力为 1800 千帕；

- d) 每个中子辐射探测器必须使用密封中间内衬塑料包装，具有足够的吸收材料以吸收整个气体含量。中子辐射探测器强必须使用坚固的外容器包装，能够承受 1.2 米跌落试验而无渗漏。含有中子辐射探测器的辐射探测系统，还必须包括足以吸收中子辐射探测器整个气体含量的吸收材料。吸收材料必须适当地有衬垫或内衬围绕。它们必须装在坚固的外包装之中，除非辐射探测系统能对中子辐射探测器提供同等的保护；

- e) 按照特殊规定运输必须在危险品运输凭证上注明。

虽然第 10 栏和 13 栏有“禁运”标志，但其所含三氟化硼不超过 1 克的中子辐射探测器，包括那些有焊料玻璃接缝的中子辐射探测器和满足并按照上述条件包装的含有中子辐射探测器的辐射探测系统，不受这些细则限制。

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