Designation: C852/C852M – 17 (Reapproved 2022)

Standard Guide for Design Criteria for Plutonium Gloveboxes[1]

This standard is issued under the fixed designation C852/C852M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide defines criteria for the design of glovebox systems to be used for the handling of plutonium in any chemical or physical form or isotopic composition or when mixed with other elements or compounds. Not included in the criteria are systems auxiliary to the glovebox systems such as utilities, ventilation, alarm, and waste disposal. Also not addressed are hot cells or open-face hoods.

1.2 The scope of this guide excludes specific license requirements relating to provisions for criticality prevention, hazards control, safeguards, packaging, and material handling. Observance of this guide does not relieve the user of the obligation to conform to all federal, state, and local regulations for design and construction of glovebox systems.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A193/A193M Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A269/A269M Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A376/A376M Specification for Seamless Austenitic Steel Pipe for High-Temperature Service

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A999/A999M Specification for General Requirements for Alloy and Stainless Steel Pipe

A1016/A1016M Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

F837 Specification for Stainless Steel Socket Head Cap Screws

2.2 *Other Standards, Codes, and Guidelines*

ANSI N13.1 Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities[3]

ANSI/ASME NQA-1 Quality Assurance Requirements for Nuclear Facility Applications[3]

ANSI/ASME AG-1 Code on Nuclear Air and Gas Treatment[3]

NFPA-70 National Electrical Code[4]

NFPA 72 National Fire Alarm Code[4]

NFPA 801 Standard for Fire Protection for Facilities Handling Radioactive Materials

DOE-HDBK-1081-94 DOE Handbook on Primer of Spontaneous Heating and Pyrophoricity[5]

[1] This guide is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.14 on Remote Systems.

Current edition approved July 1, 2022. Published July 2022. Originally approved in 1977. Last previous edition approved in 2017 as C852/C852M – 17. DOI: 10.1520/C0852_C0852M-17R22.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[5] Available to the public from the U.S. Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA 22161.

10 CFR 20 Standards for Protection Against Radiation[6]
10 CFR 50 Domestic Licensing of Production and Utilization Facilities[6]
40 CFR 260–279 Solid Waste Regulations—Resource Conservation and Recovery Act (RCRA)[6]
10 CFR 830 Subpart A Quality Assurance Requirements[6]
AGS-G001-2007 Guideline for Gloveboxes, Third Edition[7]
AGS-G004-2014 Standard of Practice for Leak Test Methodologies for Gloveboxes and Enclosures[7]
AGS-G005-2014 Standard of Practice for the Specification of Gloves for Gloveboxes[7]
AGS-G006-2005 Standard of Practice for the Design and Fabrication of Nuclear-Application Gloveboxes[7]
AGS-G010-2011 Standard of Practice for the Glovebox Fire Protection[7]
AGS-G013-2011 Guideline for Glovebox Ergonomics[7]

3. Significance and Use

3.1 The purpose of this guide is to establish criteria for the design of gloveboxes as primary confinement systems to ensure the safety of the workers and the protection of the environment when storing, handling, processing, and disposing of both combustible and non-combustible forms of plutonium. The use of this guide will provide the user with guidance to design a successfully performing glovebox system.

4. Quality Assurance

4.1 A quality assurance program should be established for the design, fabrication, construction, acceptance testing, and operation, including modifications, repairs, replacement and maintenance of structures, systems, and components important to safety. Quality assurance requirements should be specified in the purchase order or contract (see 10 CFR 50 Appendix B, 10 CFR 830 Subpart A, and ANSI/ASME NQA-1).

5. Design Considerations

5.1 Design considerations should include engineered safety features and redundant plant services to achieve confinement reliability. Reliability should be considered in the light of the risk associated with postulated accidents (for example, accidents resulting from pyrophoric behavior of metallic plutonium), the probability of occurrence of the accidents, and the severity of their consequences, as well as in the light of normal processing requirements. The design for the glovebox system should consider all of the following subjects:

5.1.1 Fire,
5.1.2 Explosions,
5.1.3 Seismic events,
5.1.4 Installation and removal from service,
5.1.5 Automated equipment,
5.1.6 Glovebox process operations,
5.1.7 Criticality,
5.1.8 Confinement system leaks,
5.1.9 Power failure,
5.1.10 Service water failure,
5.1.11 Other services failure,
5.1.12 Glovebox pressurization,
5.1.13 Glovebox evacuation,
5.1.14 Health physics,
5.1.15 Need for glovebox isolation or compartmentalization or both,
5.1.16 Maintenance,
5.1.17 Ergonomics,
5.1.18 Decontamination methods, and
5.1.19 Chemical compatibility and corrosion resistance.

6. Glovebox System Design Features

6.1 The glovebox system is defined as a series of physical barriers provided with glove ports and gloves, through which process and maintenance operations may be performed, together with an operating ventilation system. The glovebox system should minimize the potential for release of radioactive material to the environment under normal and abnormal conditions, protect the operators from contamination under normal operating conditions, and mitigate the consequences of abnormal conditions to the maximum extent practical. Where feasible and practical, the glovebox should incorporate passive safety controls rather than active safety controls. In the event that the glovebox is used to process and handle metallic plutonium, it should provide a dry inert atmosphere such as nitrogen or argon to prevent combustion or pyrophoric behavior of the plutonium. Compartmentalization within and between gloveboxes should be considered and installed as necessary to mitigate the potential seriousness of accidents involving fire, explosion, or criticality. The glovebox system design should consider interconnecting tunnels, conveyors, and passageways for transferring materials between adjacent gloveboxes. Provision for containment should be provided.

6.2 *Confinement:*

6.2.1 The glovebox shall be designed to operate at 50 to 500 Pa [0.2 to 2.0 in. H_2O gauge] pressure negative to the room in which it is located. The glovebox and its accessory equipment shall be designed to prevent liquid flooding or subjection of the box to excessive vacuum or pressure. Control devices, such as oil filtered U-tubes to relieve pressure, shall be positive-acting or automatic, or both. See USAEC Report TID 24236.[8] Passive features such as inlet filters, restricted orifices or both shall be considered and sized appropriately.

6.2.2 The glovebox, when assembled and blanked off (evacuated to a given negative pressure and sealed off from further evacuation source), should pass a leak-rate not to exceed 0.3 volume % air/h when tested at an initial pressure differential of one kPa [4 in. H_2O gauge] for 1 h. Penetrations in the glovebox (such as conduits, ports, ducts, pipes, and windows) shall be constructed to prevent the release of

[6] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

[7] Available from the American Glovebox Society, P.O. Box 9099, Santa Rosa, CA, 95405, http://www.gloveboxsociety.org.

[8] "Glovebox Window Materials: a Glovebox Fire Safety Application," TID-24896, United States Atomic Energy Commission, Factory Mutual Research Corporation, 1969, http://www.osti.gov/energycitations/servlets/purl/4822006-KYw7jb/.