



# **AGS-G010-2023 Standard of Practice for Glovebox Fire Protection**

## **2023 Edition Highlights**

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## AGS-G010-2023

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# ACKNOWLEDGEMENTS

The chair and members of the Standards Development Committee wish to acknowledge the dedication and support of the many individuals, including external reviewers, who helped to create, debate, and improve this standard of practice.

A document of this type is more difficult to write and publish than one might think. When you use the information presented herein, please be thankful for the efforts and dedication of the group of individuals, all working on a voluntary basis, with many attending working meetings at their own expense, who willingly devoted their valuable time, energy, and money to benefit others, most of whom they do not know.

Individuals participating in the preparation of this document have spent nearly seven years and hundreds of hours of effort. Some of these individuals sat through long hours of sometimes heated debate in committee meetings refining and revising the finer points of the document. Others gathered information and passed it on to the committee to help inform its debates and deliberations. A select group of individuals took the information gathered, conducted additional research on their own, drafted text or sections of the document, and presented it to the committee for review.

# Challenges with Implementation

## AGS-G010-2011

Glovebox fire suppression

Use and implementation of fixed inerting for GB fire protection

Implementation of 60 day requirement for glovebox covers, bungs, plugs

Implementation of an evaluation-based approach

# Goals for this revision

## AGS-G010-2023

Provide a prescriptive approach and judgement-based approach for compliance with the requirements of this SoP.

Expand the use of the FHE to allow for judgement-based alternative means of compliance with prescriptive requirements.

Clarify and expand on the use of fixed inerting system, and introduce the concept of an Inert Fire Protection System as alternative to GB fire suppression system.

# Summary of Changes

Section 1 - Expand the Scope to all use of Engineering Judgement with Authority Having Jurisdiction approval, (as allowed by NFPA); expanded definitions, ensuring the match other AGS Standards.

Section 2 - No Change

Section 3 - Adds 5 new definitions and modified 7 others.

Section 4 - No Change

Section 5 - Listed other standards that should be applicable per the local jurisdiction.

Section 6 - Significant FHE and Fire Modeling Changes



# Summary of Changes, Cont.

Section 7 - Significant Construction to make more consistent with other AGS Standards to include fixed inerting and fire suppression system designs

Section 8 - Strengthened combustible and glove controls in the Operations section.

Section 9 - Added Oxygen monitoring and fire system out of service compensatory measure requirements.

Section 10 - Added a 12 more references

Appendix A - Expanded to include more prescriptive criteria to consider

Appendix B & C - No Change; Minor change Appendix D

# Section 3 Definitions

**Fixed Inerting System:** A system that produces and maintains continuous atmospheric concentrations below levels that will support combustion or reactions of the materials at risk.

**Active Glovebox:** Gloveboxes approved for routine operations. Normal operations are permitted if the glovebox meets functional operational requirements and are subject to frequent habitability and routine inspections. Active only indicates that the glovebox is approved for use to conduct activities based on the authorizing documents. Active status typically allows for approved operations and the use of glovebox utilities (electric outlets), fluid services, and/or pressurized gases.

## Section 3, Definitions Cont.

**Inactive Glovebox:** Gloveboxes placed in maintenance mode where routine operations are not permitted. Normal Operations, ignition sources, combustible loading, and/or the introduction of pressurized gases into inactive gloveboxes are restricted to the minimum amount required to support maintenance activities. The habitability and routine inspections may be performed at reduced frequencies and usually does not include entry into the glovebox gloves and ports.

**Active Gloveport:** Gloveports that are required for access in support of maintenance and/or normal operations.



# Section 3, Definitions Cont.

**Inactive Gloveport:** Gloveports that are not required for access in support of maintenance activities and/or normal operations.

**Inert Atmosphere:** a glovebox environment used for mitigation of oxidation, corrosion, protection of product quality and/or fire prevention (Reference Fixed Inerting System).

**Inert Fire Protection System:** A system designed to prevent and/or suppress a fire primarily with inert gas.

# Section 3, Definitions Cont.

**Limited Combustible:** A material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 8141 kJ/kg (3500 Btu/lb) where tested in accordance with NFPA 259, Standard Test Method for Potential Heat of Building Materials, and complies with (1) or (2): (1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 3.2 mm (1/8 in.) that have a flame spread index not greater than 50; (2) materials, in the form and thickness used, other than described in (1), having neither a flame spread index greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion. (Materials subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition are considered combustible.) Source NFPA 101 (Reference: 10.3, 10.7)

# Section 3, Definitions Cont.

**Transient Combustible Materials:** Combustible materials that are not permanently installed within the glovebox.

## **Section 6.2 *Fire Hazards Evaluation***

Alternate means of compliance with the requirements of this SoP shall be documented in the FHE or as otherwise acceptable to the AHJ. (Added) *The FHE shall provide adequate technical justification for deviation from the prescriptive requirements of this SoP.*

### **Paragraph 3:**

*Consideration for all existing fire protection engineering evaluations associated with the facility and the cumulative effect of the use of exemptions, alternatives, or equivalencies against the safe operation of the facility and the specific FHE under development.*

## Section 6.2 *Fire Hazards Evaluation Cont.*

### **Paragraph 4:**

Summary of identified fire safety *prescriptive performance criteria*, including applicable codes and standards.

### **Paragraph 7:**

Identification of maximum expected and bounding fire consequences *including room exposure fires and fires originating within gloveboxes*. Consequences (personnel injuries, environmental impacts, radiological impacts, monetary losses, loss of production capability, cleanup costs, etc.) of the fire shall be quantified.



## Section 6.2 *Fire Hazards Evaluation Cont.*

### Paragraph 9

Fire protection actions and features necessary to achieve fire safety performance criteria *based on the identified fire hazards may* include, but are not limited to, the following:

#### 2<sup>nd</sup> Bullet...

*Unless otherwise determined by the FHE, inactive and out-of-service* gloveports not used within 60 days should have gloveport plugs, bungs or covers installed.....

#### 3<sup>rd</sup> Bullet....

*Administrative and engineered controls, such as* combustible material controls to limit....

## Section 6.3 *Fire Hazards Evaluation*

The software program used for fire modeling to support the FHE and/or FHA shall be verified and validated, applied within the limits of the associated models, and acceptable to the AHJ. The fire model shall simulate *maximum expected and bounding* fire scenarios and *should include* variations such as changes in the HVAC conditions, vent (damper) open/closed state, etc.

# Section 7.1 *Construction*

Gloveboxes shall be of noncombustible construction *unless approved by the AHJ and documented in the applicable FHE/FHA.*

## **Section 7.1.1**

Shell construction materials shall be noncombustible and compatible with the process and materials. When process and material compatibilities warrant the use of alternative shell materials, including linings or coating, the materials shall exhibit fire test response characteristics acceptable to the AHJ. In addition, the FHE shall evaluate potential combustibility and the need for *compensatory measures such as* a protective atmosphere or automatic fire suppression protection.

## Section 7.1.3 *Gloveports*

Gloveports shall be noncombustible, limited combustible, or otherwise protected as determined by the FHE *and acceptable to the AHJ.*

Gloveports shall include provisions for gloveport plugs, bungs, or covers for *inactive or* out-of-service gloveports, *or as otherwise determined by the FHE and acceptable to the AHJ.*

*The number of gloveports shall be minimized and the location of the gloveports shall be optimized to what is operationally necessary.*

## Section 7.1.4 *Bagports*

When provided, glovebox bagports shall be equipped with internal and/or external covers of noncombustible, limited combustible, or flame resistant material or protected as determined in the FHE. When not performing bag-out operations, the covers shall be installed. *External covers shall be held in place secured mechanically by a latch.* Internal covers shall remain in place.

Section 7.1.5 added an additional reference

## Section 7.3.2 *Fixed Inerting System Design*

Oxygen monitoring shall send a high oxygen alarm *locally and* in the form of a supervisory signal to a constantly attended location. Additional reporting requirements shall be identified in the FHE.

Oxygen monitoring equipment shall be inspected, tested and maintained in accordance with *Section 9.1 of this SoP*.

Implementing procedures, as required by the FHE, shall be in-place that provide *compensatory measures*, including operational and administrative controls when the inerting system is not in-service.....

## Section 7.3.2 *Fixed Inerting System Design, Cont.*

The *fixed inerting system* shall be incorporated into the System Impairment Program which shall evaluate the consequences and the required compensatory measures (e.g. impacts to product).

# *Fixed Inerting System Testing*

Department of Energy (DOE) National  
Nuclear Securities Administration (NNSA)  
Technical Bulletin March 2020 Vol. 2020-1

Testing of Nitrogen Atmospheres as a Fire  
Suppression System for Gloveboxes





*The FPSG Hybrid-Pac® and NMTech test glovebox*

# Section 7.6 *Fire Suppression Systems*

The following took a few extra break out sessions to resolve

## **Paragraph 7.6.1:**

*Fire Suppression system(s) provided internally or externally to the glovebox shall be provided in accordance with applicable NFPA and related (FM Global) standards and shall be automatic unless otherwise approved by the AHJ. Consideration shall be given to a room fire exposure to the glovebox from the room commodities. The fire suppression systems shall be designed and provided to minimize external fire exposures to gloveboxes when such potential exists. Automatic suppression shall be permitted to be excluded if evaluated in the FHE/FHA and approved by the AHJ.*

## Section 7.6.3 *Protection of Glovebox Contents*

Glovebox fire suppression systems shall be provided, unless otherwise determined in the FHE and as acceptable to the AHJ . *Fire suppression systems shall be designed and installed in accordance with applicable NFPA Codes and Standards, or as otherwise approved by the AHJ. The suppression system shall be automatic, or as determined in the FHE and approved by the AHJ .*

*If a fire suppression system is not provided, the FHE shall provide technical justification for not providing a glovebox fire suppression system.*

## Section 7.6.3 *Protection of Glovebox Contents, Cont.*

An inert fire protection system can be considered as an alternative to a conventional suppression system. See discussion in Appendix A for major considerations related to the selection and approval of an inert fire protection system.

*A means shall be provided to safely perform required inspection, testing and maintenance on the glovebox fire suppression system. A means for remote or external testing capabilities should be considered. Such means of testing shall not void the listing/approval.*



## Section 7.6.3.1 *Selecting Fire Suppression System*

*Glovebox fire suppression systems shall be selected based on the identified bounding fire scenarios and process hazards. Some considerations for selection and use of a suppression system for the protection of glovebox contents are chemical compatibility with glovebox contents, nuclear criticality, hazards associated with potential over-pressurization of the glovebox, potential impact of extinguishing agent on glovebox filters, potential containment/contamination concerns related to glovebox contents, challenges associated with cleanup and recovery after suppression system discharge, environmental impacts, and overall maintainability of suppression system.*

## Section 7.7.1 *Manual Fire Fighting*

*Provisions for manual suppression for fires inside the glovebox shall be provided, unless otherwise determined in the FHE.*

*Operator training shall be provided for the use of manual suppression.*

*Manual Suppression features shall be included in pre-incident plans.*

## Section 7.8 *Passive Fire Protection Features*

*[NOTE: Gloveboxes are not a common penetrating commodity and, therefore, will typically require engineering evaluations or judgments both in terms of installation of opening protectives, e.g., dampers, and firestops. For example, a conveyor line penetration opening protective through a fire barrier was evaluated to the ASTM E119 curve and failed. The opening protective was then tested to the actual fire curve based on the bounding fire modeled fire and then passed the test. For this case the opening protective was approved with the limitations well documented.]*

## Section 7.8.1 *Fire-rated Opening Protectives*

Fire barrier components *protecting facility fire barriers* such as rated doors, windows, shutters, firestops (sealing of through penetrations),.....

*A means to restrict* fire propagation between gloveboxes or within a long glovebox or between gloveboxes used in series *shall be provided, unless otherwise determined* by FHE and *acceptable to* the AHJ. (similar to the requirement in NFPA 801, Sec. 7.1.4.5.9) (Reference 10.3) . *Fire performance of separations between gloveboxes in series should be based on facility fire protection goals and requirements.*



## Section 8.1.2 *Controlling Combustibles*

*Combustibles accumulated inside a glovebox shall be kept as low as reasonably achievable, or shall be properly secured (e.g., stored in noncombustible containers), or separated into fuel packages acceptable to the AHJ, or shall be controlled by other means as otherwise analyzed in the FHE and approved by the AHJ.*

Accumulation of waste and combustible material *shall be minimized*; this includes both inside, adjacent to, *and in the same room as* the glovebox.

## Section 8.3 *Glovebox Operational Requirements*

Glovebox gloves that are not in use shall be positioned *and secured* outside the glovebox.

*During heat-generating or furnace operations, glovebox gloves shall be secured outside the glovebox.*

*Inactive gloveports not used within 60 days should have gloveport plugs or bungs or gloveport covers installed.*

## ***Section 9.1 Glovebox Operational Requirements***

***Oxygen monitoring equipment shall be inspected, tested and maintained in accordance with the manufacturer's criteria and in accordance with reference 10.26 (Reference 10.45). Accuracy of gas monitor can be independently determined by comparing reading against calibrated oxygen monitor, or by calibrating the oxygen monitor with traceable gas on a regular frequency.***

## **Section 9.2 *Glovebox Maintenance***

***Containment huts, tents, and glovebags shall be constructed of flame-retardant material, evaluated and installed in accordance with NFPA 701, NFPA 801, and AGS-G002 (References 10.3, 10.10, 10.44).***

## Section 10: *References*

Additional references 10.40 through 10.51 were added and included notables such as the following:

- *Factory Mutual – Global Data Sheet 7-61 Facilities Processing Radioactive Materials*
- *NFPA 750 Standard on Water Mist Systems*
- *NFPA 770 Standard on Hybrid Fire Extinguishing Systems.*

# Appendix A

***Provided more information related to a more prescriptive approach to Glovebox Fire Protection***

# **Appendix C & E**

## **Appendix C:**

**Added header to define type of system associated with the NFPA code referenced.**

## **Appendix E:**

**Added 9 more glovebox fire related losses for users to become familiar with fire loss potentials.**

# **AGS-G010-2023 Available for Purchase September 2023??**



# Questions



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**FIRE & PUMP  
SERVICE GROUP**

