FM Approvals®

Member of the FM Global Group

Examination Standard for Non-Flame-Propagating Containers Used in Top-Loading Automatic Storage and Retrieval Systems (TL-ASRS)

Class Number 4994

December 2023

Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for non-flame-propagating containers used in top-loading automatic storage and retrieval systems (TL-ASRS).

1.1.2 Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

1.2.1 TL-ASRS storage arrangements consist of open-top containers that are maintained in a tightly packed vertically aligned solid-piled arrangement. A metal grid track, located above the storage area, is traversed by remotely controlled robots for material handling purposes. Due to this, aisles are not required for the functionality of this ASRS arrangement thus making it inaccessible to fire service personnel who are relied upon for final extinguishment. As a result, this standard evaluates the storage container's ability to prevent flame propagation to other surrounding containers of similar construction without the use of automatic or manual fire-fighting intervention.

1.2.2 This standard sets the fire performance requirements of non-flame-propagating containers used in a TL-ASRS configuration only and does not apply to other storage systems. In addition, it only applies to the storage or containment of Class 1, 2, 3, 4, and plastic (cartoned and uncartoned) standard commodities.

1.2.3 The fire exposure test evaluates a storage container's ability to prevent flame propagation away from the container of fire ignition. This may reduce, but not eliminate the need for ceiling sprinkler protection. Other factors can impact the fire scenario, including but not limited to the presence robots above the fire area, that increase the potential for flame propagation or impede access for manual intervention.

1.3 Basis for Requirements

1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of non-flame-propagating containers used in TL-ASRS for the purpose of obtaining certification.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification;
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product which is examined

and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

1.6 Effective Date

The effective date of this examination standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is the date of publication.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Non-Flame-Propagating Containers – Containers that prevent flame propagation to adjacent containers if the products stored within the containers are ignited.

Top-Loading Automatic Storage and Retrieval Systems (TL-ASRS) – An automatic storage and retrieval system that consists of a metal grid structure under which open-top containers are stacked on-floor in vertically aligned columns. They are accessed from the top of the grid by service robots that have been programmed to either retrieve a specific container for commodity picking purposes or for replenishing the amount of commodity maintained within the storage container.

Ordinary combustibles – Standard commodities up to and including Class 1, 2, 3, 4, and plastic (cartoned and uncartoned) per FM Global Property Loss Prevention Data Sheet 8-1, *Commodity Classification*.

2 GENERAL INFORMATION

2.1 Product Information

Non-flame-propagating containers within this standard are containers used in a TL-ASRS configuration that prevent flame propagation beyond the container of fire origin.

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- General assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, piping and electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures.
- the number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing. Sample requirements will be determined by the certification agency following a review of the preliminary information.

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the non-flame-propagating containers used in TL-ASRS.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification examination results may further define the limits of the final certification.

3.2 Markings

3.2.1 Marking on the product or, if not possible due to size, on its packaging or label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, size, rating, capacity, etc., as appropriate;
- be permanently attached to the container.

When hazard warnings are needed, the markings should be universally recognizable.

3.2.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency’s mark of conformity.

3.2.3 The certification agency’s mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.2.4 All markings shall be legible and durable.

3.3 Manufacturer’s Installation and Operation Instructions

3.3.1 The manufacturer shall

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.4 Calibration

3.4.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A

copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.4.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

4 PERFORMANCE REQUIREMENTS

4.1 Fire Exposure Test for Non-Flame-Propagating Containers Used in TL-ASRS

4.1.1 Requirement

In order to qualify for certification, each container shall satisfy the below described test requirements.

Each test sample shall be subjected to intermediate-scale fire testing with a TL-ASRS grid configured with a 3 x 3 container footprint, with a propane sand burner centered within the grid as shown in Figure 1. The center row is two containers high (leaving the storage locations above empty), and the outside rows are the number of containers required to reach 10 ft (3.1 m) high. The propane sand burner will be placed in the center of the 3 x 3 grid above the container that is stacked (1) high. The storage grid is oriented in a way that aligns the most critical or vulnerable components of the containers to the fire source. This may require more than one test if a critical orientation cannot be determined.

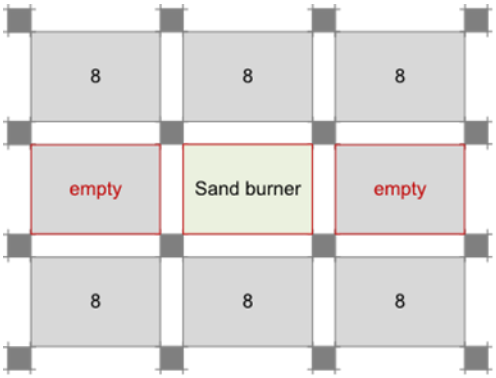

Figure 1: 3x3 Container Footprint with Centered Propane Sand Burner

4.1.2 Test/Verification

The containers within the storage grid are each filled with the same commodity made up of a corrugated carton with nominal dimensions of 12 in. x 19 in. x 8 in. (305 mm x 480 mm x 205 mm) tall. Inside the cartons are unexpanded rigid crystalline polystyrene cups (empty, 16 oz. [0.47 L]) nested together and arranged in a 15 x 3 x 2 tall grid (90 cups). These dimensions are subject to change depending on the size of the container to be tested. The containers storing the ordinary combustibles are set up in the representative storage configuration and exposed to a constant heat flux of 75 kW/m^2 (400 BTU/ft^2/min) for 15 minutes from the propane sand burner. The fire exposure test is conducted to determine if the containers meet the conditions of acceptance as stated in section 4.1.3.

4.1.3 Conditions of Acceptance of the Fire Exposure Test

The below criteria must be met in order to satisfy the minimum requirements during and after the representative fire exposure test to be considered non-flame-propagating:

1. No vertical flame spread* to involve the top level of containers, and
2. No horizontal flame spread* away from the ignition area to the backside of the containers in the 3 x 3 container footprint.

*Flame spread is based on the observed location of the flames and flame extensions; Not the point where the flame is attached to burning combustibles or burning containers.

4.2 Identification Tests - Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis, ASTM E1252

4.2.1 Requirement:

At the sole discretion of the certification agency, FTIR spectra may be determined and reported.

4.2.2 Test/Verification:

Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis, ASTM E1252

Note 1: These tests are conducted for identification purposes. No limits are placed on the values obtained.

4.3 Identification Test – FM Approvals Thermal Desorption Gas Chromatography Mass Spectrometry (TD/GC/MS)

4.3.1 Requirement:

At the sole discretion of the certification agency, TD/GC/MS may be conducted and reported.

4.3.2 Test/Verification:

Standard Practice for General Techniques of Gas Chromatography Infrared (GC/IR) Analysis. ASTM E1642

Note 1: These tests are conducted for identification purposes. No limits are placed on the values obtained.

5 OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility may be part of the certification agencies surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 Manufacturer's Responsibilities

5.3.1 The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation, or quality assurance procedures prior to implementation.

6 BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.