



Designation: F3344 – 19

## Standard Guide for Storage, Use, and Handling of Liquid Rocket Propellants<sup>1</sup>

This standard is issued under the fixed designation F3344; 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.

The scope of this standard is limited to fuels and oxidizers which are not themselves monopropellants. While each propellant has its own unique hazards and handling practices, in general, the most important line of defense in storage and ground handling is to ensure that large quantities of fuels and oxidizer do not come into contact. As a monopropellant, by definition, can release chemical energy without mixture with another chemical, safety practices for monopropellants must assume the potential for that energy release, which differs from the approach for fuels and oxidizers. This standard provides no guidance for monopropellant storage and handling. Some common monopropellants include: Hydrogen Peroxide, Nitromethane, Nitrous Oxide, Ethylene Oxide, Hydrazine (including derivatives such as UDMH or MMH), and any chemical mixture where an oxidizer and a fuel have been premixed, such as various ammonium nitrate and fuel combinations.

### 1. Scope

1.1 *Purpose*—The purpose of this guide shall be to provide fundamental safeguards for the storage, use, and handling of liquid rocket propellants to ensure the safety of workers involved as well as the public.

1.2 *Goal*—The functional goal of this guide shall be to reduce the explosive hazard of liquid rocket propellants to hazard levels such that the use of quantity-distance criteria is not essential to assure public safety.

1.3 *Application*—The requirements of this guide shall apply to persons directly involved in the storage, use, or handling of liquid rocket propellants during nominal operations only.

1.4 *Retroactivity*—The provisions of this guide are not retroactive.

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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.*

1.7 *Environmental Concerns*—The scope of this standard encompasses the safety precautions for fuels and oxidizers used in commercial launch vehicles; it does not address the various precautions required to minimize risks of environmental contamination. Environmental regulation for chemical storage differs between different states and municipalities, and operators should consult the regulations of the authority having jurisdiction over their site for such matters.

1.8 *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 *CGA Standard:*<sup>2</sup>

CGA G-4 Oxygen

2.2 *NFPA Standards:*<sup>3</sup>

NFPA 30 Flammable and Combustible Liquids Code

NFPA 55 Compressed Gases and Cryogenic Fluids Code

NFPA 59A Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)

NFPA 407 Standard for Aircraft Fuel Servicing:

Section 5.8 Open Flames on Aircraft Fuel Servicing Ramps

Section 5.9 Lightning Precautions

Section 5.10 Aircraft Fuel Servicing Locations

NFPA 704 Standard System for the Identification of the Hazards of Materials for Emergency Response

2.3 *Federal Standards:*

29 CFR Part 1910.106 Flammable and Combustible Liquids<sup>4</sup>

40 CFR Part 355 Emergency Planning and Notification<sup>4</sup>

EPCRA Section 302 Emergency Response Planning<sup>5</sup>

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee F47 on Commercial Spaceflight and is the direct responsibility of Subcommittee F47.04 on Spaceports.

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<sup>2</sup> Available from Compressed Gas Association (CGA), 14501 George Carter Way, Suite 103, Chantilly, VA 20151, <http://www.cganet.com>.

<sup>3</sup> Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

<sup>4</sup> Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, <http://www.gpo.gov>.

<sup>5</sup> Available from U.S. Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.

**TABLE 1 Recommended Reference Standards**

| Propellants: | CGA G-4 | NFPA 30 | NFPA 55 | NFPA 59A | NFPA 407<br>(Sec. 5.8–5.10) | NFPA 704 | 29 CFR<br>Part 1910.106 |
|--------------|---------|---------|---------|----------|-----------------------------|----------|-------------------------|
| Methane      |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Ethane       |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Propane      |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Methanol     |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Ethanol      |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Isopropanol  |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Kerosene     |         | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |
| Oxygen       | ✓       | ✓       | ✓       | ✓        | ✓                           | ✓        | ✓                       |

### 3. Significance and Use

3.1 *Applicability*—This guide shall apply to the storage, use, and handling of liquid rocket propellants.

3.2 *Exemptions*—This guide shall not apply to the following:

- 3.2.1 Storage, use, or handling of solid rocket propellant;
- 3.2.2 Storage, use, or handling of pyrotechnics;
- 3.2.3 Storage, use, or handling of hypergolic liquid rocket propellants; and
- 3.2.4 Storage, use, or handling of extremely hazardous rocket propellants [those listed as an extremely hazardous substance in the Emergency Planning and Community Right-to-Know Act (EPCRA), Section 302 (40 CFR Part 355)].

3.3 *Equivalency*—Nothing in this guide is intended to discourage the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, debris protection, effectiveness, durability, or safety over those prescribed by this guide.

3.4 *General*—The standards or portions thereof listed in this guide are advisory. Compliance with referenced standards is an acceptable means, but not the only means, of compliance with this guide.

3.5 *Authority Having Jurisdiction (AHJ)*—If any provision of this guide conflicts with a requirement of the AHJ, the requirement of the AHJ shall take precedence over this guide.

### 4. Propellants

4.1 **Table 1** displays recommended standards to reference when handling and storing various propellants.

### 5. Keywords

5.1 handling; liquid rocket propellants; storage

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