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Standard Specification for Iodotrifluoromethane (CF_3I)[1]

This standard is issued under the fixed designation D8520/D8520M; 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 specification covers requirements for iodotrifluoromethane (CF_3I, CAS No. 2314-97-8) as an agent for fire suppression. This specification is not intended for large-scale commercial usage.

1.2 This specification does not address fire-fighting equipment or hardware that uses CF_3I or the conditions of using such equipment (for example, portable extinguishers, fixed fire suppression systems, explosion inerting systems, and so forth).

1.3 This specification does not address the storage or transportation of CF_3I. The storage, handling, and transportation issues may be addressed in future ASTM specifications.

1.4 CF_3I has been found to be a cardiac sensitizer with a no observed adverse effect level (NOAEL) of 0.2 %. Therefore, sampling and other procedures should be performed only in areas with effective mechanical ventilation. Long-term exposures should be avoided pending the development of appropriate exposure standards.

1.5 *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.

1.6 The following precautionary statement pertains only to the test method portion of this specification: *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 *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]

D5632/D5632M Specification for Halon 1301, Bromotrifluoromethane (CF_3Br)

2.2 *Federal Standards:*[3]

49 CFR 178.42 Specification 3E seamless steel cylinders (DOT-3E1800)

MIL-STD 1188 Commercial Packaging of Supplies and Equipment

2.3 *ISO Standards:*[4]

ISO 5789 Chlorinated Hydrocarbons for Industrial Use—Determination of Non-Volatile Residue

3. Material Requirements

3.1 Iodotrifluoromethane (CF_3I) shall conform to the requirements prescribed in Table 1 when tested by the appropriate method(s) listed in the Test Methods section.

3.2 By agreement between the purchaser and the supplier, further analysis may be required and limits established for elements or compounds not specified in Table 1.

4. Sampling

4.1 *Vessel:*

4.1.1 **Warning—**A liquid sample of CF3I should not be taken via typical National Exposure Research Laboratory (NERL) TO-15 Canisters. Traditional canisters such as Summa, Silonite™[5], and others typically used for TO-15 sampling are not rated for greater than 275 kPa [~39 PSI] and should not be used for taking liquid samples of CF_3I.

[1] This specification is under the jurisdiction of ASTM Committee D26 on Halogenated Organic Solvents and Fire Extinguishing Agents and is the direct responsibility of Subcommittee D26.09 on Fire Extinguishing Agents.

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[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 the U.S. Government Printing Office, Superintendent of Documents, 732 N. Capital St. NW, Washington, DC 20402-0001, www.access.gpo.gov

[4] Available from the American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

[5] Silonite™ is a registered trademark of Entech Instruments.

TABLE 1 Requirements

Property	CF_3I
Identity	Passes test
Purity, % by mass	99.6 min
Acidity, ppm by mass (as HI)	3.0 max
Water content, ppm by mass	10.0 max
Nonvolatile residue, % by mass	0.01 max
Fluoride ion, ppm by mass	0.5 max
Iodide ion, ppm by mass	0.5 max
Suspended matter or residue	Nonvisible
Color	Colorless to slightly pink

4.1.2 The sampling vessel may be a stainless steel cylinder with fittings on both ends or a simpler vessel with fittings only in one location and a volume between 100 mL and 500 mL is desirable. The SwageLok™[6], DOT-3E1800 compliant, 304L stainless steel, model configuration 304L-HDF product line is one example.

4.1.3 Non-rotating stem needle valves with rupture disk units are preferred as they allow for adaptation to various sizes of stainless tubing, storage tanks, capture devices, and analysis instruments. Having valves on both ends of a cylindrical vessel allows for choosing which end will deliver gas or liquid phase material depending on which end is up or down in the sampling setup. It also allows a variety of connection options depending on the instrument inlet configuration.

4.2 *Tubing Adapters:*

4.2.1 A ¼ in. tubing connection for filling the cylinder is advisable. A ⅛ in. or 1⁄16 in. tubing connection on the other end of the cylinder is advisable. In the case of a single port cylinder, having adapters of these types available is advisable. This allows adaptation to dispersal or instrument interfaces of various types.

4.3 *Vessel Cleaning:*

4.3.1 The vessel, valves, tubes, and connectors/adaptors should be rinsed with acetone, water, and alcohol in that order. The components may be initially air dried or blown dry with nitrogen, after which all components should be heated to 110 °C [230 °F] while pulling a vacuum, for example, in a vacuum oven for no less than 2 h.

4.3.2 Backflushing with high-purity argon or nitrogen gas and pulling a vacuum several times allows further rinsing of the sampling cylinder.

4.3.3 Other flushing protocols can also be implemented and consist of filling the cylinder with humidified nitrogen to just above atmospheric pressure and then heating it at 80 °C for an hour and then evacuating for an hour via a vacuum pump. This procedure is then repeated several times with evacuation of the cylinder after each filling with humidified nitrogen until the cylinder is left after the final cycle at vacuum.

4.3.4 A typical vacuum pump and manifold design include the ability to pull a vacuum to a measured value of approximately 0.04 Torr [40 μmHg]. After the final purge and pump down to vacuum, the cylinder can be left at a vacuum of approximately 0.04 Torr [40 μmHg] or lower with valve(s) closed.

[6] SwageLok™ is a trademark of Swagelok Company.

5. Liquefied Gas Sampling Process for CF_3I

5.1 Weigh the clean, dry cylinder assembly including any required adapters attached to the gas valve(s) of the sample cylinder, which is under vacuum. Record this value as "X". The cylinder will be weighed again to determine the amount of CF_3I delivered to the sample cylinder.

5.2 Attach the sample cylinder to the cylinder to be sampled. For the most efficient transfer, this connection should be made without a regulator on the cylinder to be sampled. Chill the sample cylinder in ice water for 30 min.

5.3 Invert the cylinder to be sampled if it only has a vapor outlet. If the cylinder to be sampled has both liquid delivery and vapor delivery valves, attach the sample cylinder to the liquid outlet of the cylinder to be sampled using appropriate fittings and ¼ in. [6.35 mm] stainless steel tubing.

5.4 There are several sample cylinder filling setups that can be considered depending on available equipment however the general concept is addressed in Fig. 1.

5.5 **Warning—**The following purging process should either be done in a chemical vapor hood or outdoors with adequate ventilation.

5.6 Open the liquid delivery valve on the cylinder to be sampled. Keeping the sample cylinder closed and the side arm valve open, allow the transfer line to be purged by CF_3I until liquid is released. Alternatively with the cylinder to be sampled valve closed, the side valve is opened and the sample cylinder valve closed, the transfer line can be evacuated through the side valve via vacuum pump and then the side arm valve closed.

5.7 This is then followed by opening the cylinder to be sampled and allowing it to fill the transfer line. Now that the sample transfer line has been either purged or filled after evacuation, open the evacuated sample cylinder valve and allow the CF_3I to be introduced into the sample cylinder until an estimated 140 g of have been delivered.

5.8 **Warning—**No more than 60 % of the liquid volume of the sample cylinder shall be occupied.

NOTE 1—Cooling the sample cylinder for CF_3I may not be necessary but it does speed up the transfer of material and allows for less variation in mass delivered.

5.9 When a sufficient sample has been taken, close the sample cylinder valve. Close the cylinder to be sampled valve. Open the side arm to release the pressure in the transfer line and disconnect the joint between the side arm valve and the sample cylinder valve. The sample cylinder is now ready to be weighed.

5.10 Weigh the cylinder assembly with the CF_3I and designate this value as "Y". The weight of the refrigerant is given by Y – X = grams of refrigerant sampled.

5.11 **Warning—**This is a good time to ensure that the sample cylinder does not contain more than 60 % of its volume in liquid.