



Designation: C 1689 – 08

Standard Practice for Subsampling of Uranium Hexafluoride¹

This standard is issued under the fixed designation C 1689; 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 practice is applicable to subsampling uranium hexafluoride (UF_6), using heat liquefaction techniques, from bulk containers, obtained in conformance with C 1052, into smaller sample containers, which are required for laboratory analyses.

1.2 It is assumed that the liquid UF_6 being sampled comprises a single quality and quantity of material. This practice does not address any special additional arrangement that might be required for taking proportional or composite samples.

1.3 The number of samples to be taken, their nominal sample weight, and their disposition shall be agreed upon between the parties.

1.4 The scope of this practice does not include provisions for preventing criticality incidents.

1.5 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

C 787 Specification for Uranium Hexafluoride for Enrichment

C 859 Terminology Relating to Nuclear Materials³

C 996 Specification for Uranium Hexafluoride Enriched to Less Than 5 % ^{235}U

C 761 Test Methods for Chemical, Mass Spectrometric, Spectrochemical, Nuclear, and Radiochemical Analysis of Uranium Hexafluoride

C 1052 Practice for Bulk Sampling of Liquid Uranium Hexafluoride

2.2 Other Documents:

ANSI N14.1 Uranium Hexafluoride: Packaging for Transport⁴

ISO/DIS 7195 Packaging of Uranium Hexafluoride (UF_6) for Transport⁵

USEC-651 The UF_6 Manual: Good Handling Practices for Uranium Hexafluoride, latest revision⁶

3. Terminology

3.1 Terms shall be defined in accordance with Terminology C 859 except for the following:

3.1.1 *sample bottle*—the vessel (typically a 1S or 2S bottle) into which the sample of UF_6 is withdrawn from the container for transfer to the laboratory, analysis or dispatch to the customer.

3.1.2 *subsample tube*—the small vessel (for example, a P10 tube⁷) into which a subsample of UF_6 is withdrawn from the sample bottle for analysis of UF_6 quality or dispatch to the customer.

3.1.3 *subsample rig*—the equipment to perform the transfer of liquid UF_6 from the sample bottle into the subsample tube, typically a vacuum manifold equipped with heating and a liquid nitrogen trap.

4. Summary of Practice

4.1 Two methods of withdrawing a subsample of UF_6 are described which differ based on safety requirements namely: (1) homogenizing of liquefied UF_6 by agitation before liquid transfer and (2) homogenizing of liquefied UF_6 by convection before liquid transfer. The first method involves homogenization of liquefied UF_6 in sample bottle by vigorous shaking. Subsequently the sample bottle is inverted and connected to the top of a heated vacuum-manifold system, and the subsample

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

⁵ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

⁶ Available from United States Enrichment Corp., 6903 Rockledge Dr., Bethesda, MD 20817, <http://www.usec.com>.

⁷ Polychlorotrifluoroethylene P10 tubes are widely accepted by the industry for subsample collection and subsequent UF_6 quality analyses or dispatch to the customer. Other types of subsample tubes, for example P-20, P-80 or P100, can be used for internal subsample collection and processing. Dispatch of these subsample tubes may be agreed upon by buyer and seller and subject to (local) transport regulations.

¹ This practice is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Methods of Test.

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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 Withdrawn.

tube is attached to the appropriate port of the system. The system is evacuated and the liquid UF_6 allowed to flow by gravity into the subsample tube. In the second method the sample bottle containing solid UF_6 is connected to the top of a manifold system, and a subsample tube is attached to the appropriate port of the system. The whole system is enclosed in secondary containment that can be heated (hot-box). After evacuation the complete system is heated for specific period (typically > 1.5 hr) to allow for complete homogenization of the liquid UF_6 by convection. Subsequently the liquid UF_6 is allowed to flow by gravity either directly or via graduated volume into the subsample tube.

4.2 For both methods of sampling, the presence of residues may have significant implications for the quality of UF_6 . For safety and quality reasons, sample bottles and an subsample tubes shall be clean, dry, and empty before filling.

4.3 Various types of sample bottles and tubes are in use and are described in detail in the applicable national and international standards, for example, **ANSI N14.1** and **ISO/DIS 7195**. For a given type of sample bottle, the detailed configuration, for example valve orientation, terminal fittings and the like, may vary. Hence the type and configuration of bottles used for the withdrawal of samples shall be agreed upon between the parties.

5. Significance and Use

5.1 Uranium hexafluoride is normally produced and handled in large (typically 1- to 14-ton) quantities and must, therefore be characterized by reference to representative samples. The quantities involved, physical properties, chemical reactivity, and hazardous nature of UF_6 are such that for representative

sampling, specially designated equipment must be used and operated in accordance with the most carefully controlled and stringent procedures. This practice indicates appropriate principles, equipment and procedures currently in use for subsampling of liquid UF_6 . It is used by UF_6 converters, enrichers and fuel fabricators to review the effectiveness of existing procedures or to design equipment and procedures for future use. Other subsampling procedures such as UF_6 vapor sampling are not directly representative of the chemical quality of liquid UF_6 .

5.2 It is emphasized that this test guide is not meant to address conventional or nuclear criticality safety issues.

6. Apparatus

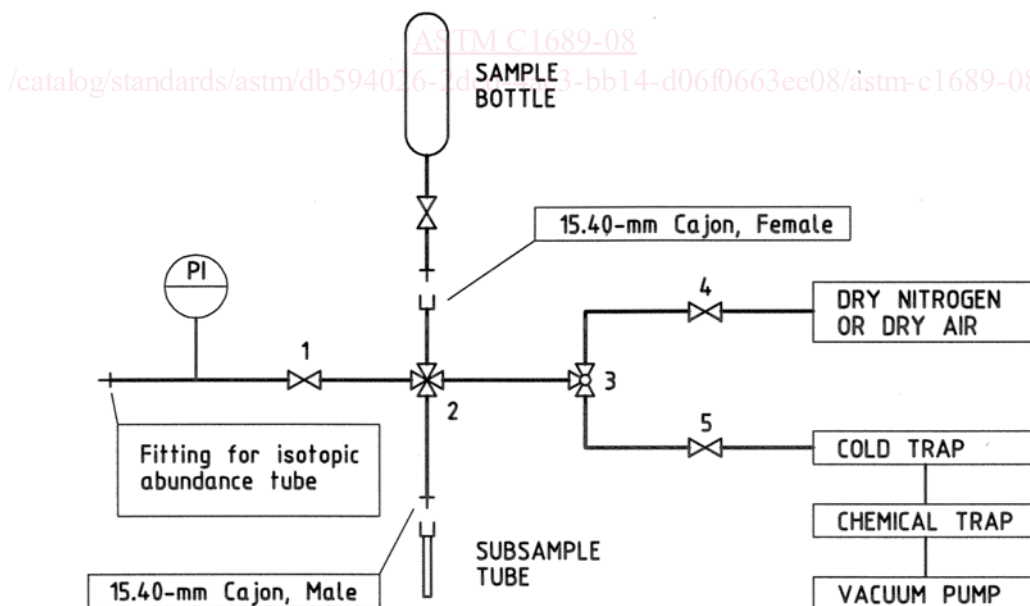
6.1 Hot Water Bath.

6.2 *Subsample Rig*—For Procedure 1 see **Fig. 1** and Procedure 2 see **Fig. 2**. Materials of construction in direct contact with liquid UF_6 are made from nickel, high nickel alloys, or materials having comparable resistance to UF_6 corrosion.

6.3 *Polychlorotrifluoroethylene Subsample Tube and Closing Disc* (**Fig. 3**)—The tube must be of uniform density, free from cracks or occlusions and able to withstand temperatures from -195°C to $+150^\circ\text{C}$. Materials of construction in direct contact with liquid UF_6 are made from polychlorotrifluoroethylene, PTFE/TFE (gaskets), or materials having comparable resistance to UF_6 corrosion.

6.4 *Flare Nut and Plug*—Flare nuts and plugs for subsample tube closure, storage and transport can be constructed from Monel, nickel, high nickel alloys or 316 SS.

6.5 *Gaseous Isotopic Abundance Sample Tube* (**Fig. 4**).



NOTE 1—All lines are $\frac{3}{8}$ in. (9.5 mm) Monel tubing.

NOTE 2—All valves are Monel diaphragm type valves.

NOTE 3—The valves and lines are wrapped with heating tape to maintain a system temperature of about 80°C .

NOTE 4—Valve 2 is a 3-way valve modified to make it a 4-way valve. When the valve is closed, the polychlorotrifluoroethylene tube is isolated from the system, but the lines from valve 1 to valve 3 and to the bulk container are open.

FIG. 1 Subsample Rig Used for Procedure 1