Designation: C1346 – 19

# Standard Practice for Dissolution of $UF_6$ from P-10 Tubes[1,2]

This standard is issued under the fixed designation C1346; 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 covers the dissolution of $UF_6$ from a P-10 tube to provide solutions for analysis.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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.* For specific safeguard and safety precaution statements, see Section 9.

1.4 *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:*[3]

C761 Test Methods for Chemical, Mass Spectrometric, Spectrochemical, Nuclear, and Radiochemical Analysis of Uranium Hexafluoride

C787 Specification for Uranium Hexafluoride for Enrichment

C859 Terminology Relating to Nuclear Materials

C996 Specification for Uranium Hexafluoride Enriched to Less Than 5 % $^{235}U$

D1193 Specification for Reagent Water

## 3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to the nuclear fuel cycle, refer to Terminology C859.

## 4. Summary of Practice

4.1 $UF_6$ samples intended for analysis are packaged in P-10 tubes to prevent sublimation and reaction with moisture in the air. The P-10 tube assembly (Fig. 1) consists of a Polychlorotrifluoroethylene (PCTFE) tube containing the $UF_6$, a PCTFE gasket to cover the tube's opening, and a nut and plug (Monel or SS) to seal the gasket to the tube.

4.2 The $UF_6$ tube is weighed, cooled in liquid nitrogen, and quickly opened and immersed in water for dissolution. The pieces of the tube's assembly are removed from the resulting solution, rinsed, dried, reassembled, and weighed. The solution is dried for gravimetric conversion to $U_3O_8$, or diluted to an appropriate concentration for dispensing into aliquots for subsequent analysis.

## 5. Significance and Use

5.1 Uranium hexafluoride is a basic material used to prepare nuclear reactor fuel. To be suitable for this purpose the material must meet criteria for uranium content, isotopic composition and metallic impurities in Specification C787 and C996. This practice results in the complete dissolution of the sample for uranium and impurities analysis, and determination of isotopic distribution by mass spectrometry as described in, for example, Test Methods C761.

## 6. Apparatus

6.1 *Steam bath,* in a hood, if optional step 10.2.13 is used.

6.2 *Vacuum oven,* if option 2 of 10.2.14 is used. The oven should be adjustable to 80°C at an absolute pressure of $3 \times 10^3$ Pa.

6.3 *Dewar flask,* wide-mouth.

6.4 *Vise,* small lab-bench model or similar type of holder.

6.5 *Wrench,* 15⁄16 in.

[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] Polychlorotrifluoroethylene P-10 tubes are widely accepted by the industry for subsample collection and subsequent $UF_6$ quality analyses or dispatch to the customer. The procedure for subsample collection and dissolution can also be used for other types of subsample tubes, for example, P-20, P-80 or P-100, in that case the amount of water has to be adjusted to ensure complete hydrolisation of $UF_6$ and avoid excessive heat evolution.

[3] 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.

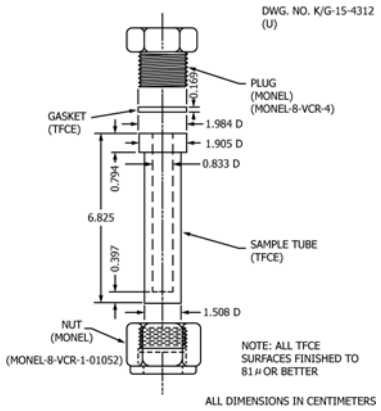


**FIG. 1 Example of a P-10 Sample Tube**

6.6 *Plastic clamping forceps,* 12 to 13 cm long, with a claw-like bent tip, to securely hold the cylindrical PCTFE tube.

NOTE 1—These forceps are not commercially available. Bend the ends of a straight-tip forceps by heating over a moderate flame, shaping, and maintaining the shape until cool.

6.7 *TFE-fluorocarbon-coated spatula,* 0.5- to 1-cm wide at its flat end, optional.

6.8 *Platinum or PCTFE rod,* optional.

6.9 *Platinum dishes or plastic beakers with compatible HF resistance (typically PolyEthylene; PE),* large enough to contain a completely submerged P-10 tube.

6.10 *Copper wires,* optional. The wires should be flexible and looped at one end to loosely fit around the PCTFE tube without allowing the flare nut to pass through.

6.11 *Desiccator,* optional.

6.12 *Balance,* ≥100-g capacity, readable to at least 0.1 mg, preferably 0.01 mg.

NOTE 2—Use of a balance with lower sensitivity will negatively impact on sampling error.

## 7. Interferences

7.1 The weight of the PCTFE tube is affected by atmospheric humidity. Keep the P-10 tube assembly in a desiccator between weighings until constant weight is attained.

7.2 The capacity of the $UF_6$ tube (a maximum of approximately 13.0 g $UF_6$) limits the number and size of the aliquots that can be obtained from each tube. See analytical procedures for their requirements.

## 8. Reagents

8.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[4] Other grades of reagents may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

8.2 Liquid nitrogen.

8.3 Deionized distilled water in accordance with Specification D1193, approximately 50 to 100 $cm^3$ per sample.

8.4 Ethanol or other suitable, volatile organic solvent.

## 9. Hazards

9.1 Uranium hexafluoride ($UF_6$) is radioactive, toxic, and highly reactive especially with reducing substances and moisture. Appropriate laboratory facilities, materials of construction, and techniques shall be utilized when handling $UF_6$.

9.2 Follow all safety procedures for handling uranium and $UF_6$ provided by the facility. Review the Safety Data Sheet (SDS) for $UF_6$ prior to performing the procedure.

9.3 Perform dissolutions in a laboratory hood. Hoods should be regularly inspected for proper air flow.

9.4 When released to the atmosphere, gaseous $UF_6$ reacts with moisture to produce HF gas and toxic $UO_2F_2$ particulates. Use sufficient ventilation or respiratory protection to avoid breathing fumes. Use appropriate personal protective equipment such as gloves, eye, and face protection.

9.5 Hydrofluoric acid is a highly corrosive acid that can severely burn skin, eyes, and mucous membranes. Hydrofluoric acid differs from other acids because the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers. Unlike other acids that are rapidly neutralized, hydrofluoric acid reactions with tissue may continue for days if left untreated. Familiarization and compliance with the Safety Data Sheet (SDS) is essential.

9.6 Use gloves designed for use with cryogenic substances, and wear goggles or a face shield when handling bulk quantities of liquid nitrogen.

## 10. Procedure

10.1 *Preparation:*

10.1.1 Wipe the outside of the tube with a lintless tissue moistened with a suitable, volatile organic solvent (for example, ethanol) and allow to air-dry. Allow the tube to stand overnight to equilibrate with room air, or place the P-10 tube in a dessicator for at least one hour.

[4] *Reagent Chemicals, American Chemical Society Specifications,* American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.