INTERNATIONAL

Designation: C1883 – 26

Standard Practice for Sampling of Gaseous Enriched Uranium Hexafluoride[1]

This standard is issued under the fixed designation C1883; 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 methods for withdrawing samples of enriched uranium hexafluoride (UF_6) during and after a transfer occurring in the gas phase in order to determine compliance with Specification C996. It is applicable to the filling of a transport UF_6 cylinder (30B cylinder or 1 m^3 russian vertical cylinder) at a centrifuge enrichment facility that has been fed with UF_6 that complies with Specification C787.

1.2 Since UF_6 sampling is taken during the filling process, this practice does not address any special additional arrangements that may be agreed upon between the buyer and the seller when the sampled bulk material is being added to residues already present in a cylinder ("heels recycle"). Such arrangements will be based on QA procedures such as traceability of cylinder origin (to prevent, for example, contamination with irradiated material).

1.3 This practice is only applicable when the transfer occurs in the gas phase. When the transfer is performed in the liquid phase, Practice C1052 should apply.

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

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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 *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]

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

C1052 Practice for Bulk Sampling of Liquid Uranium Hexafluoride

C1838 Practice for Cleaning for 1S and 2S Bottles

2.2 *ANSI Standards:*[3]

ANSI N14.1 Uranium Hexaflouride—Packagings for Transport

2.3 *ISO Standards:*[4]

ISO 7195 Nuclear Energy—Packagings for the Transport of Uranium Hexafluoride (UF_6)

3. Terminology

3.1 Terms shall be defined in accordance with Terminology C859, except for the following:

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *batch, n*—product cylinders processed and filled simultaneously to withdraw product UF_6 from a separation unit.

3.2.2 *cylinder, n*—a vessel either holding or receiving by transfer, the UF_6 to be sampled; it may consist of, for example, a fixed vessel in a UF_6 handling plant or a cylinder to be used for the transport of UF_6.

3.2.3 *HCH*—hydrocarbon, chlorocarbon, and partially substituted halohydrocarbon compounds.

3.2.4 *OC*—organic compounds

3.2.5 *sample vessel, n*—the small vessel into which the sample of UF_6 is withdrawn for analysis in the laboratory for characterization.

[1] This practice is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.02 on Fuel and Fertile Material Specifications.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 1180 Avenue of the Americas, 10th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

4. Summary of Practice

4.1 The method is based on three different steps for UF_6 characterization, namely: (*1*) continuous on-line analysis by mass spectrometry (MS) for isotopic measurement, (*2*) sequential withdrawals during filling to produce a representative composite sample, (*3*) gas sampling of cylinder after the filling is complete to determine volatile impurities.

4.2 The conformity of the cylinder is determined by three methods. First, sampling for isotopic composition using online mass spectrometry (1). The second composite sample (*2*) is analyzed for impurities, such as Pu, Np, fission products, ^{99}Tc, and additional uranium isotopes when these values are necessary. The composite sample can also be used for counter-analyses or supplied to the customer, and also may be used to determine UF_6 concentration. The third (*3*), post fill sample is analyzed for HF concentration to determine UF_6 concentration, and for very volatile impurities, such as BF_3, SiF_4, and HCH. Figs. 1-3 summarize the principle of the three sampling steps.

4.3 Determining concentration of ^{235}U and ^{234}U (^{236}U if necessary for instance if the separation unit is also used to produce reprocessed U) in a batch extracted is carried out according to the results of periodic mass-spectrometry isotope analysis. Weighted average value calculated over the entire control period is assigned to a batch.

4.4 Content of radioactive admixtures (^{99}Tc (and when necessary, ^{232}U, ^{237}Np, Pu isotopes, gamma-emitting uranium fission products (for instance if the separation unit is also used to produce reprocessed U))) shall be determined according to analysis results related to a composite sample collected from the process flow intermittently during the entire period UF_6 batch is extracted.

4.5 *Quality Control of UF_6*—The UF_6 concentration is carried out using an indirect method based on performed IR-spectrometry analysis for HF content in gas phase of cylinder once it is filled.

4.6 Compliance of UF_6 quality with Specification C996 by content of boron, silicon, and HCH is confirmed according to the results of IR-spectrometry analysis of samples collected from gas phase of cylinder once it is filled.

4.7 The intention of this practice is to avoid liquid UF_6 sampling once the cylinder has been filled. For safety reasons, manipulation of large quantities of liquid UF_6 should be avoided when possible. This practice is applicable only if the process of gas phase filling is sufficiently stable over time, ^{235}U concentration fluctuations in the process flow are characterized by the relative standard deviation equal to 0.2 %. This practice is not applicable for cylinders filled during transitional regime of the cascade.

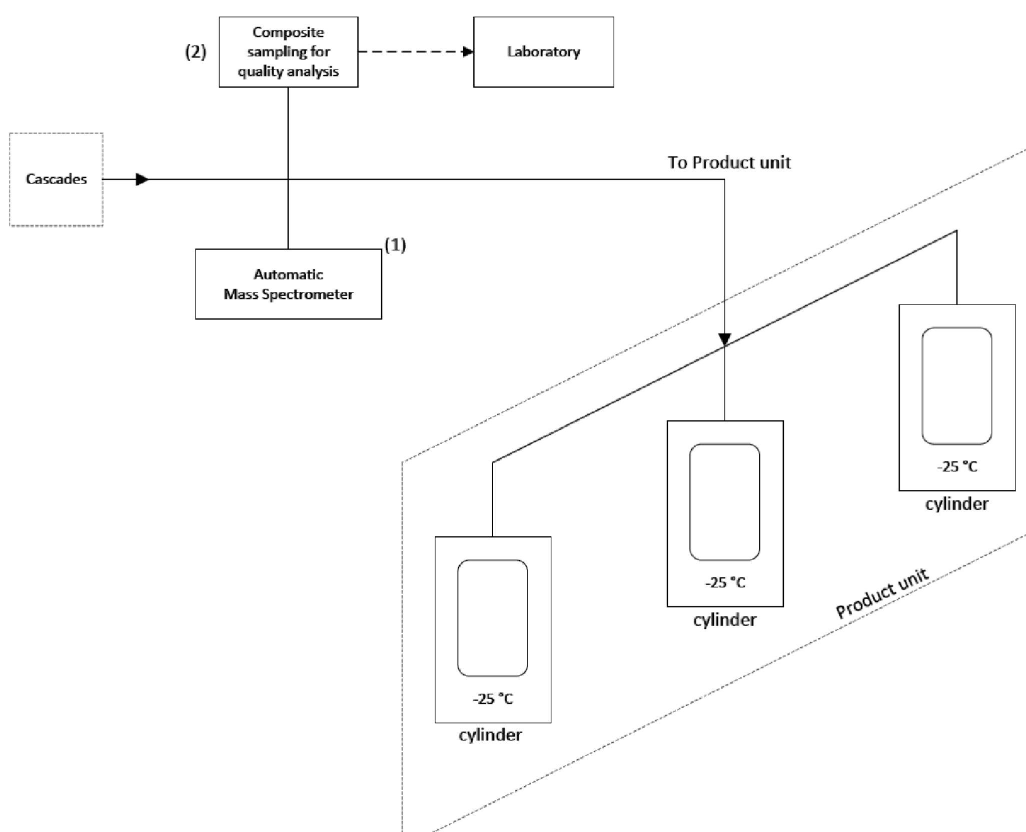

FIG. 1 Schematic Arrangement for Online Filling: Mass Spectrometer (*1*) Composite Sample (*2*)