# SVENSK STANDARD
# SS-ISO 7195:2020

**Kärnenergi – Transportbehållare för uranhexafluorid (UF6) (ISO 7195:2020, IDT)**

**Nuclear energy — Packagings for the transport of uranium hexafluoride (UF6) (ISO 7195:2020, IDT)**

Svenska Institutet för Standarder

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Svenska Institutet för Standarder

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Den internationella standarden ISO 7195:2020 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 7195:2020.

Denna standard ersätter SS-ISO 7195:2005, utgåva 2

The International Standard ISO 7195:2020 has the status of a Swedish Standard. This document contains the official English version of ISO 7195:2020.

This standard supersedes the SS-ISO 7195:2005, edition 2

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# LÄSANVISNINGAR FÖR STANDARDER

I dessa anvisningar behandlas huvudprinciperna för hur regler och yttre begränsningar anges i standardiseringsprodukter.

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Ett krav är ett uttryck i ett dokuments innehåll som anger objektivt verifierbara kriterier som ska uppfyllas och från vilka ingen avvikelse tillåts om efterlevnad av dokumentet ska kunna åberopas.
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These instructions cover the main principles for the use of provisions and external constraints in standardization deliverables.

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A requirement is an expression, in the content of a document, that conveys objectively verifiable criteria to be fulfilled, and from which no deviation is permitted if conformance with the document is to be claimed. Requirements are expressed by the auxiliary shall (or shall not for prohibition).

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A recommendation is an expression, in the content of a document, that conveys a suggested possible choice or course of action deemed to be particularly suitable, without necessarily mentioning or excluding others. Recommendations are expressed by the auxiliary should (or should not for dissuasion).

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An instruction is expressed in the imperative mood and is used in order to convey an action to be performed. It can be subordinated to another provision, such as a requirement or a recommendation. It can also be used independently and is then to be regarded as a requirement.

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A statement is an expression, in the content of a document, that conveys information. A statement can express permission, possibility or capability. Permission is expressed by the auxiliary may (its opposite being need not). Possibility and capability are expressed by the auxiliary can (its opposite being cannot).

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection,* Subcommittee SC 5, *Nuclear installations, processes and fuel technologies, WG4, Transport of radioactive material*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This third edition cancels and replaces the second edition (ISO 7195:2005), which has been technically revised. The main changes compared to the previous edition are:

— The title of the document has been slightly changed to better reflect its scope;

— The general structure of the document has been partly reorganized to enhance clarity and to ease comparison with ANSI N14.1;

— The cylinder model 48G has been removed and the cylinder model 30C added;

— The socket head plugs for 30 in and 48 in cylinders have been added (alternative to hex head plugs);

— The list of references and the list of terms and definitions used have been updated;

— "Quality assurance programme" has been replaced by "management system";

— Clauses related to manufacture, periodic inspection and recertification have been redrafted for better clarity;

— The possibility for 30B, 48X and 48Y cylinders to use non-destructive examinations as an alternative to hydrostatic testing during their periodic inspections, with the condition that additional examinations are carried out at the time of their manufacturing, has been introduced;

— The use of leak test methods other than the specified one is now permitted;

— The existing tie down requirements have been replaced by a reference to the new Appendix IV of IAEA SSG-26;

— The reuse of valves and plugs removed from cylinders is no longer permitted;

— All the figures have been revised to correct errors, increase clarity and add missing information.

# Introduction

The transport of uranium hexafluoride ($UF_6$) is an essential operation in the nuclear industry. The packaging and transport of $UF_6$ is subject to the relevant transport regulations for dangerous goods of each of the countries through or into which the material is transported. This document does not take precedence over applicable regulations, nor does it relieve the consignor and other parties from compliance with these regulations. For more detailed information, the user of this document is encouraged to consult the appropriate regulatory document.

According to IAEA Regulations for the Safe Transport of Radioactive Material (SSR-6), and all regulations based on, except as allowed in its para. 634, uranium hexafluoride in quantities of 0,1 kg or more is required to be packaged and transported in accordance with the provisions of this document.

ANSI N14.1 has been used internationally as an industry reference and the standard cylinders included in ANSI N14.1 have been used widely for international transport of $UF_6$. However, in some cases minor adaptations of the American standard were required to meet local conditions in a particular country. For example, equivalent materials may have been used instead of the materials specified. Moreover, the certification of cylinders as pressure vessels can have required equivalent authorization procedures appropriate in the countries concerned, rather than the US procedure specified.

This document presents primarily information on $UF_6$ packagings (including cylinders and valve protection). It is intended to provide for compatibility of $UF_6$ cylinders among different users within the nuclear industry. It has been developed from ANSI N14.1, but with incorporation of, and allowance for, other equivalent materials and national certification procedures.

Throughout this document and in conformity with standard ISO practice, SI metric units are used in preference to imperial units (which are given in parenthesis for information). However, generic cylinder designations are based on the diameter expressed in imperial units (48'' for instance).

If a common, commercially available component uses features that are defined in an appropriate non-SI metric-based Standard document, only the relevant base units are quoted.

# Nuclear energy — Packagings for the transport of uranium hexafluoride (UF6)

## 1 Scope

This document provides the following:

— specifications for cylinders for the transport of uranium hexafluoride ($UF_6$) to provide compatibility among different users,

— description of cylinder designs, but is not intended to develop new designs,

— fabrication requirements for the procurement of new cylinders designed for the transport of 0,1 kg or more of uranium hexafluoride,

— fabrication requirements for the procurement of new valve protections, valves and plugs, and

— requirements for cylinders and valve protections in service.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitute requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 263, *ISO inch screw threads — General plan and selection for screws, bolts and nuts — Diameter range 0,06 to 6 in*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 12807, *Safe transport of radioactive materials — Leakage testing on packages*

ANSI/ASME B1.1, *Unified Inch Screw Threads (UN and UNR Thread Form)*

ANSI/ASME B1.5, *Acme Screw Threads*

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ANSI/ASME B16.11, *Forged Steel Fittings, Socket-Welding and Threaded*

ANSI/AWS A5.8M/A5.8, *Specification for Filler Metals for Brazing and Braze Welding*

ANSI/AWS A5.14/A5.14M, *Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods*

ANSI/AWS D1.1/D1.1M, *Structural Welding Code — Steel*

ANSI/CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*

ASTM A20/A20M, *Standard Specification for General Requirements for Steel Plates for Pressure Vessels*

ASTM A36/A36M, *Standard Specification for Carbon Structural Steel*

ASTM A53/A53M, *Standard Specification for Pipe, Black and Hot-Dipped, Zinc–Coated, Welded and Seamless*

ASTM A105/A105M, *Standard Specification for Carbon Steel Forgings for Piping Applications*

ASTM A106/A106M, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*

ASTM A108, *Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*

ASTM A131/A131M, *Standard Specification for Structural Steel for Ships*

ASTM A193/A193M, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications*

ASTM A234/A234M, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*

ASTM A240/A240M, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

ASTM A285/A285M, *Standard Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate-Tensile Strength*

ASTM A354, *Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners*

ASTM A516/A516M, *Standard Specification for Pressure Vessel Plates, Carbon Steel for Moderate- and Lower-Temperature Service*

ASTM A574, *Standard Specification for Alloy Steel Socket-Head Cap Screws*

ASTM A575, *Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades*

ASTM B16/B16M, *Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines*

ASTM B32, *Standard Specification for Solder Metal*

ASTM B127, *Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip*

ASTM B150/B150M, *Standard Specification for Aluminum Bronze Rod, Bar, and Shapes*

ASTM B160, *Standard Specification for Nickel Rod and Bar*

ASTM B161, *Standard Specification for Nickel Seamless Pipe and Tube*

ASTM B162, *Standard Specification for Nickel Plate, Sheet, and Strip*

ASTM B164, *Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire*

ASTM B165, *Standard Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube*

ASTM B209, *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate*

ASTM B211, *Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire*

ASTM B249/B249M, *Standard Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings*

ASTM B366/B366M, *Standard Specification for Factory-Made Wrought Nickel and Nickel Alloy Fittings*

ASTM E2375, *Standard Practice for Ultrasonic Examination of Wrought Products*

IAEA SSR-6, *Regulations for the Safe Transport of Radioactive Material*

SAE J512, *Automotive Tube Fittings*

SAE J513, *Refrigeration Tube Fittings — General Specifications*

NUREG/CR-6407, *Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in the IAEA SSR-6 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

NOTE 1 Units are those of the International System, with other units shown in brackets for information.

NOTE 2 Throughout this document, the words *suggested* and *typical* denote an example for weld constructions, dimensions and/or layout, and means that other solutions may be used provided they comply with the requirements in the code and this document, as appropriate.

NOTE 3 Throughout this document, the words *nominal* and *Schedule* qualify a thickness of a material from stock (plate, bar, pipe, etc.), for which the tolerance is according to the standard specification for the relevant material.

**3.1**
**authorized inspector**
individual who is qualified by the jurisdictional authority/inspection authority as requested by the code

**3.2**
**clean and washed out cylinder**
cylinder that has been previously used and has been cleaned to remove residual quantities of uranium and other contaminants

**3.3**
**code**
pressure vessel code that is acceptable to the transport competent authority

EXAMPLE Section VIII of ANSI/ASME Boiler and Pressure Vessel Code is an example.

**3.4**
**competent authority**
national or international regulatory body or authority designated or otherwise recognized as such for any purpose in connection with the relevant transport regulations for dangerous goods

**3.5**
**competent inspector**
individual who is qualified according to the owner's requirements regarding inspection activities as detailed in its quality assurance program

**3.6**
**cylinder**
pressure vessel, equipped with its valves and plugs, as applicable

**3.7**
**fabricator**
manufacturer, repairer, or modifier of cylinders and valve protection

**3.8**
**heel**
residual amount of $UF_6$ and/or non-volatile reaction products of uranium

**3.9**
**heeled cylinder**
cylinder containing a heel in quantities equal to or less than those specified

Note 1 to entry: See Table 8.

**3.10**
**jurisdictional authority/inspection authority**
entity with the power, right, or authority to interpret and enforce laws, rules, or ordinances pertaining to the code

**3.11**
**maximum allowable working pressure**
**MAWP**
maximum allowable working pressure as defined by the code

**3.12**
**minimum design metal temperature**
**MDMT**
minimum design metal temperature as defined by the code

**3.13**
**new cylinder**
cylinder that has been cleaned to remove fabrication debris and contaminants that would react with $UF_6$ and that has never been filled with $UF_6$

**3.14**
**owner**
individual, agency, contractor, company, or corporation that carries or will carry title to the cylinder during its use

**3.15**
**outer protection**
mechanical and/or thermal protection during transport for cylinders containing $UF_6$

**3.16**
**package**
packaging containing $UF_6$ or heel prepared for transport in compliance with the relevant transport regulations for dangerous goods

**3.17**
**packaging**
cylinder equipped with all its outer protection necessary to ensure the containment and the other safety functions of the package in compliance with the relevant transport regulations for dangerous goods

**3.18**
**pressure vessel**
container designed, fabricated, examined, inspected, tested and certified in accordance with the code

**3.19**
**service life**
period of time from initial stamping at the end of manufacturing until the pressure vessel is no longer suitable for transport of $UF_6$ and is not repaired and returned to service and/or scrapped to prevent further use

**3.20**
**tare**
cylinder mass with valve(s), including cap(s), and plug(s) without valve protection with an internal air or nitrogen total absolute pressure corrected to 34,5 kPa (5 $lbf/in^2$)

**3.21**
**water capacity**
water mass in kilogram, corrected to a temperature of 15,6 °C (60 °F)

# 4 Management system

In alignment with the IAEA SSR-6, a management system based on international, national or other standards acceptable to the transport competent authority shall be established and implemented for all activities (including the manufacture, maintenance and repair of cylinder and outer protection) within the scope of this document, to ensure compliance with its relevant provisions. Certification that the design specification has been fully implemented shall be available to the transport competent authority. The manufacturer or owner shall be prepared:

a) To provide facilities for inspection during manufacture and use;

b) To demonstrate compliance with this document to the transport competent authority.

For guidance, see the IAEA SSG-26.

# 5 General requirements for cylinders and valve protection

## 5.1 Design of cylinders and valve protection

NOTE 1 Codes and standards listed in Clause 2 with corresponding versions using metric units can be used interchangeably.

NOTE 2 With respect to this document, American Society of Mechanical Engineers (ASME) material and filler metal specifications, identified by the prefix "S," are interchangeable with corresponding ASTM International (ASTM) and American Welding Society (AWS) specifications referenced herein and listed in Clause 2.

Cylinders shall

— be as shown in Figures 3 to 11 and in accordance with the requirements specified in 6.1 to 6.8, and

— comply with the code.

In order to minimize points of leakage, only one valve and one plug (where applicable) should be installed. However, if the purchaser deems additional valves or plugs necessary, they shall be installed in accordance with the requirements specified in 6.3 to 6.8.

Additional holes in skirts are permitted and shall be designed such that the fitness for purpose of the package is not impaired.

Details of pressure vessel (including skirts, stiffening rings, lifting lugs), valve, and plug are given in Figures 1 to 16.

Valve protection for specific cylinders shall be as shown in Figures 5 to 12.

Threads identified in this document shall conform to ISO 263 or ANSI/ASME B1.20.1, unless otherwise specified.

Metric units shown in this document may have been converted from Imperial units. Rounding of values is acceptable when not in conflict with the functional specification.

Annotations to dimensions used in figures: "typical" means "example" and "REF" means "indicative" only.

The parameters given in Table 1, along with the values for the minimum volume shown in Table 3, shall be the basis by which the pressure vessel parts of the various cylinders are designed.

**Table 1 — $UF_6$ cylinder design conditions**

| Cylinder model | Clause | Pressure vessel Design pressure/temperature | | | Minimum design transport temperature |
|---|---|---|---|---|---|
| | | MAWP External | MAWP Internal | MDMT | |
| 1S | 6.1 | 172 kPa gauge (25 lbf/in² gauge) | 1,38 MPa gauge at 121 °C (200 lbf/in² gauge at 250 °F) | −196 °C at 1,38 MPa gauge (−320 °F at 200 lbf/in² gauge) | −40 °C (−40 °F) |
| 2S | 6.2 | | | | |
| 5B | 6.3 | | | | |
| 8A | 6.4 | | | | |
| 12B | 6.5 | | | | |
| 30B | 6.6 | 172 kPa gauge (25 lbf/in² gauge) | 1,38 MPa gauge at 121 °C (200 lbf/in² gauge at 250 °F) | −29 °C at 1,38 MPa gauge (−20 °F at 200 lbf/in² gauge) | |
| 30C | 6.7 | | | | |
| 48X and 48Y | 6.8 | | | | |

## 5.2 Fabrication of new cylinders

### 5.2.1 General

Fabrication of valves and plugs are considered in 7.1.

Pressure vessels shall be fabricated and stamped in accordance with the code.

Longitudinal seam, head-to-shell girth seams, skirts, stiffening rings, lifting lugs, etc., shall be welded as shown in the relevant figures. Fillet welds shall be in accordance with ANSI/AWS D1.1/D1.1M and the code. All butt welds shall be full penetration unless otherwise specified. Longitudinal skirt welds shall be away from lifting holes, holes for valve protector alternate and weep holes. Circumferential pressure vessels seams should be welded without backing rings. Optionally, circumferential pressure vessel seams may be welded with backing rings, as shown in Figure 1.

All welders and welding procedures (brazing included) shall be qualified in accordance with the code.

Where the material of construction is steel per Table 3, at least one test weld representing each welding procedure to be used in the fabrication of the pressure vessel shall be Charpy V-notch impact tested. Test plates, including those for the appendages, shall have butt-type weld joints. The specimens shall be taken across the weld with the notch in the weld metal. Each specimen shall be oriented so that the notch is normal to the surface of the material, and one face of the specimen shall be within 1,6 mm (1/16 in) of the surface of the material. Each weld procedure shall be qualified with impact testing. This testing shall be as specified by the code utilized for the material being welded. Acceptance criteria shall be in accordance with the grade of steel to be used in fabrication of the pressure vessel. Procedures and qualifications shall be documented as required by the code. The fabricator shall receive the purchaser's formal acceptance of the test results prior to pressure vessel fabrication.

The minimum design transport temperature requirement is met when

— either the MDMT is lower than −40 °C, or

— the steel has been Charpy V-notch impact tested as specified in 6.6.2 a) or 6.8.2 a) for test temperatures of −40 °C or lower.

Where couplings are to be installed in pressure vessel, they should be installed by first screwing an appropriately sized National Pipe Thread (NPT) plug into the coupling prior to welding. Between welding passes and after welding is completed, the coupling should be allowed to cool. The coupling threads shall be inspected following removal of the plug. Tapped threads shall be free of all burrs, gouges, scratches, and the like. An appropriately sized NPT tap shall be used for a light chase. The coupling shall be gauged to assure compliance with ANSI/ASME B1.20.1.

### 5.2.2 Radiography and other non-destructive examinations (NDEs)

All NDE personnel shall be certified in accordance with ASNT SNT-TC-1A or ISO 9712 or other equivalent standard. All examinations shall be carried out using code-compliant procedures.

The weld imperfections indicated by NDEs shall not exceed the defects permitted by the code for pressure retaining parts and ANSI/AWS D1.1/D1.1M for non-pressure retaining parts (statically loaded non-tubular connection Table 6.1). Any weld defects not permitted shall be repaired.

Radiography is applicable for 5B, 8A, 12B, 30B, 30C, 48X and 48Y cylinders, in accordance with the appropriate section of the code.

For 5B, 8A, 12B, 30B, 48X and 48Y cylinders, the minimum number of spot-radiographic examinations for each cylinder shall be as required by the code. Unless otherwise directed by an authorized inspector, the locations of spots shall be as follows:

a) 5B cylinders: at the circumferential head-to-shell weldment, alternating ends for successive cylinders.

b) 8A, 12B, 30B, 48X, and 48Y cylinders: at the junctions of the longitudinal seam and the circumferential head weld, alternating ends for successive cylinders.

Alternatively (for the purpose of 5.3.4.2.3), for 30B, 48X and 48Y cylinders without backing bars, the following may be specified:

— complete (100 %) radiography of the longitudinal seam and the head-to-shell girth seams for each pressure vessel, and

— additional magnetic examination (MT) or penetrant examination (PT) on the external surface of the pressure vessel for: the shell longitudinal seam, the head-to-shell girth seams, the skirt-to-head girth seams, and the valve and plug coupling welds.

For 48X and 48Y cylinders, the stiffening ring butt welds shall be examined to ensure full weld penetration.

The welds of the lifting lugs shall be subjected to magnetic examination (MT) or penetrant examination (PT).

For 30C cylinders, the following shall be required:

— complete (100 %) radiography of the longitudinal seam and the head-to-shell girth seams for each pressure vessel, and

— additional magnetic examination (MT) or penetrant examination (PT) of other welds (as listed above for the 30B, 48X and 48Y cylinders) and valve protector cover (VPC) assembly welds.

### 5.2.3 Testing

a) Hydrostatic strength test: Pressure vessels shall be subjected to a hydrostatic strength test of the type set forth in the code. No leaks shall be permitted. The test pressure shall be twice the MAWP. Prior to inspection for leaks, the pressure may be lowered to 1,5 times the MAWP. Defects, if any, shall be repaired as permitted in the code, and a retest shall follow.

   An authorized inspector shall witness all hydrostatic strength tests for new construction.

b) Pneumatic leak test: cylinders shall be subjected to a pneumatic leak test at 690 kPa gauge (100 lbf/in$^2$ gauge) to be carried out on the tapered thread connection of valve and plug and on the valve seat, using an appropriate leak-testing fluid. A leak rate larger than $1 \times 10^{-4}$ Pa·m$^3$·s$^{-1}$ SLR (Standardized Leakage Rate) per threaded-connection/valve-seat shall not be permitted. Corresponding leak testing methods can be found in ISO 12807 or ANSI N14.5.