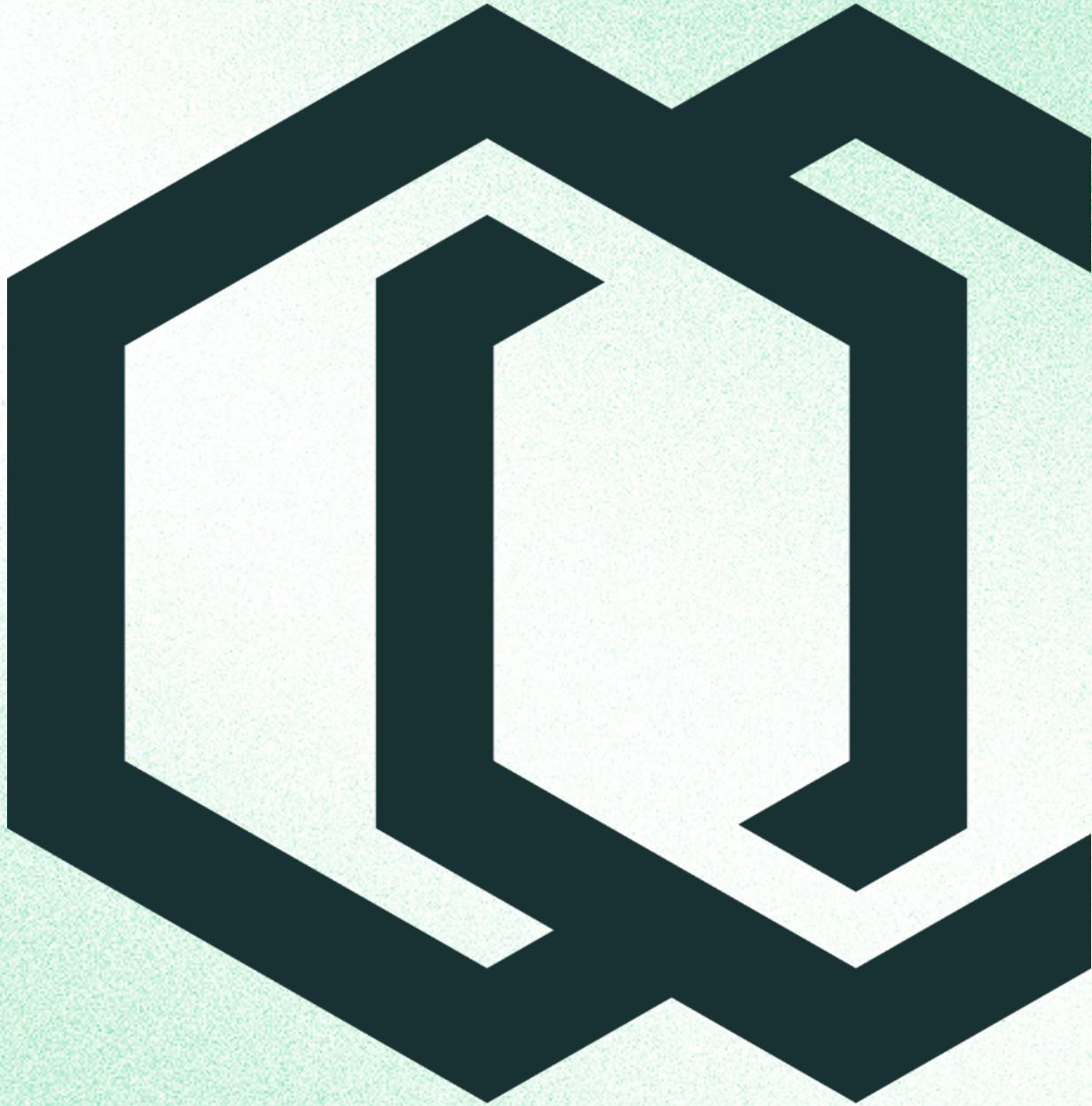




world nuclear
transport institute



Standard

Document Reference Number
WNTI/STAND/001

Revision Number
002

UF₆ Cylinder Numbering

Table of Contents

1. Objective and Scope.....	3
2. Regulatory Considerations.....	3
2.1. Current Standards for Cylinder Fabrication.....	3
2.2. Regulations for Certification of Cylinders.....	4
2.3. Material Accountability.....	4
2.4. International Safeguards for UF ₆	4
3. Identification Practices.....	5
4. Operational Practices.....	5
4.1. Cylinder Identification Activities.....	5
4.2. Transport Between Facilities.....	6
4.3. Compatibility with Existing Enterprise Reporting Systems.....	6
5. Preferred Global Identifier.....	7
5.1. Functional and Performance Requirements.....	7
6. Information Management.....	8
6.1. Assigning Cylinder Identification to New Cylinders.....	8
7. Implementation.....	8
8. References.....	9
Appendix A – Specifications for the Global Identifier.....	10
Appendix B – Assigned Prefixes for Global Identifier.....	15

Table of Images

Figure 1: Example global identifier containing 10-character global identification number with 2D barcode.....	7
Figure 2: Dimensions for global identifier for new cylinders.....	11
Figure 3: Global identifier for existing cylinders.....	12
Figure 4: 48Y with global identifier.....	13
Figure 5: 30B with global identifier shown with valve.....	13
Figure 6: Suggested layout for 30B cylinder nameplates.....	14
Figure 7: Suggested layout for 48Y cylinder nameplates.....	14

Table of Tables

Table 1: Assigned Prefixes for Global Identifier.....	15
---	----

1. Objective and Scope

This Standard is intended to provide a standardized format for a global identifier for the uranium hexafluoride (UF₆) cylinders most commonly used across the nuclear industry. Industry uses standardized cylinders (for example, Model 30B, as well as Model 48X, 48Y, and 48G cylinders) for storing UF₆ and transporting it among the many nuclear fuel cycle facilities (e.g. uranium conversion, uranium enrichment, fuel fabrication, and deconversion). Given the desire to ensure that all nuclear materials are safe and secure, stakeholders of the UF₆ industry have met to identify best practices and to explore opportunities to further improve the accounting for and control of cylinders containing UF₆. This document describes a preferred global identifier for industry use.

Current international transportation standards require cylinders to display a metal nameplate with identification information such as owner, serial number, and certifications. There is not an industry standard for the format of the assigned serial number global identifier to each cylinder.

The recommendations of this Standard are focused primarily on the larger diameter carbon steel cylinders (i.e., 30- or 48- inch diameter) containing nuclear materials subject to IAEA safeguards and used for transporting UF₆ between facilities and countries.

2. Regulatory Considerations

Uranium hexafluoride is shipped and stored in standardized cylinders for processing by the conversion, enrichment, fuel fabrication, and de- conversion facilities operating in the front end of the nuclear fuel cycle. These facilities report their inventory and transfers of UF₆ to national authorities and, when required, to international agencies such as IAEA and Euratom. This section describes the identification-related regulations associated with cylinder fabrication and the reporting of nuclear material to national, regional, and international organizations.

2.1. Current Standards for Cylinder Fabrication

Cylinder specification and use are regulated by the agencies that have authority over the transportation of radioactive materials. Cylinders used for commercial transport are fabricated from carbon steel in accordance with standards established by the International Organization for Standardization (ISO)¹ and the American National Standard Institute (ANSI)² to withstand the service conditions in the industry.

These standards provide criteria for packaging used for transporting UF₆ and define the requirements for in-service inspections, cleanliness, and maintenance for packaging in service.

The nameplates of cylinders that have been fabricated in accordance with the standards are stamped with the official code symbol and are registered with a national board. The nameplates also contain additional identification information provided by the purchaser (e.g., owner and serial number), the national board, and associated with the certification testing performed by the cylinder fabricator. This information is stamped or engraved on a nameplate that is welded to the valve end of the cylinder.

¹ ISO 7195, Nuclear Energy – Packaging's for the transport of uranium hexafluoride (UF₆), 2020-11

² American National Standard Institute (ANSI) N14.1, "Uranium Hexafluoride - Packaging's for Transport," 2023

2.2. Regulations for Certification of Cylinders

All cylinders are periodically inspected and tested throughout their service life which typically extends beyond 40 years. Cylinders cannot be filled with UF₆ unless they have been certified within the previous 5 years. The certification involves hydrotesting, internal and external examination of the pressure vessel, tare weighing and leak testing.

The cylinder identification is used for tracking and reporting the cylinder during the recertification process. The serial numbers are not changed during the certification process. Should the cleaning and certification process which, may involve sandblasting and painting change the tare weight, the new tare weight is engraved on the nameplate.

2.3. Material Accountability

Companies comply with national and regional regulations regarding the storage, handling, and shipping of cylinders containing UF₆. The cylinder identification or supplemental cylinder identifiers are used for recording and tracking the location of cylinders on-site and for transportation documentation.

For accountability purposes, a separate number (a batch number) is assigned to the nuclear material contained within the cylinder (the UF₆). A cylinder owner may apply an additional label to the cylinder containing the batch number.

Site accountability systems track material on shipment and receipt, and during processing and storage at the facility.

Different companies may assign different batch numbers for the same material (e.g., a receiver may assign a different batch number than the one assigned by the shipper to the same cylinder of material). Reports to national and regional safeguards systems will include the batch identification but will likely not contain the cylinder identification.

National regulations will require that the cylinders in storage be periodically inventoried, and the material verified. Typically, the cylinders are located using the cylinder identification, and the accountability information is reported using the batch numbers assigned to the UF₆. All inventory changes (shipments and receipts) are reported to the national authorities at a specified frequency

2.4. International Safeguards for UF₆

States with comprehensive safeguards agreements with the IAEA report on-site inventories of UF₆ contained within cylinders as well as inventory changes (shipments and receipts) to the site. The IAEA periodically sends inspectors to the sites to independently verify the material inventories that are present and to verify the content of cylinders that have been received or prepared for shipment.

During on-site inspections, the inspectors need to be able to quickly locate and identify all the cylinders provided on the physical inventory listing and in the inventory change reports. They must be able to match the cylinder identification and supplemental cylinder identifiers physically attached to the cylinders with the submitted batch information.

While some companies have automated their inventory practices by applying supplemental, machine-readable identifiers (e.g., barcodes), the inspectorates cannot readily use these because the identifiers vary between cylinder owners and are not permanently attached to the cylinders. Thus, their verification activities remain a manual process that is labour intensive and time consuming. The challenges in reading

the cylinder identification can lead to reading and transcription errors that require additional time to resolve.

3. Identification Practices

The cylinder fabrication standards require a nameplate that includes information for cylinder identification.

The cylinder identification is a string of alpha-numeric characters provided by the purchaser – typically a UF₆ conversion plant, enrichment plant, or fuel fabricator. Once stamped or engraved, the identification number typically remains unchanged over the entire service life of the cylinder which can extend 40 years or longer. Occasionally, an identification number may be changed if a cylinder is sold, and the new owner desires a new number with a different format.

While the combination of markings (names, dates, certifications) makes the entire nameplate unique, there is nothing that prevents multiple cylinders from having the same serial number.

The identification formats can vary widely across industry as each cylinder owner will establish its own specific format. Even within an organization, the format may change over time as cylinder owners change their names, revise their format, or change their practices. Some cylinder owners have reported that they are managing four or more ‘standard’ formats for their cylinders. Even if each cylinder owner establishes its own standardized format for identification of new UF₆ cylinders, its entire cylinder fleet might contain multiple formats due to the presence of legacy cylinders.

4. Operational Practices

4.1. Cylinder Identification Activities

The operational need exists to be able to correctly identify cylinders as they are stored on site, moved, and processed on-site, and transported between facilities. While the existing UF₆ cylinder numbering system has proven to be adequate for the logistics operations within the supply chain of UF₆, the following improvements may be achievable if a global identifier for UF₆ cylinders is implemented:

- all enterprise management systems within the supply chain using the same UF₆ cylinder identifier
- all transport documentation within the supply chain using of the same UF₆ cylinder identifier
- improved communication within the supply chain between consignor, consignee, transport agent, carriers, port authorities, customs, etc.
- improved tracking of UF₆ cylinders within the supply chain
- more efficient operation for the verification of UF₆ cylinders

The capability to correctly identify cylinders during their processing and storage at fuel cycle facilities is extremely important for:

- providing traceability for filling customer orders
- managing cylinder inventories and such cylinder transactions as sales or loans of cylinders to another operator or customer
- supporting databases that contain cylinder information and conditions to ensure that only compliant cylinders are placed in use

- facilitating compliance with national nuclear material control and international nuclear material safeguards requirements

To identify the cylinders, individual facility operators may use the serial number engraved on the nameplate or use their supplemental cylinder identifier.

4.2. Transport Between Facilities

In most cases, the cylinder identification used on the paperwork that accompanies and reports on the cylinders being transported is the cylinder serial number engraved on the nameplate. There are times, however, when the shipper may choose to use the supplemental cylinder identifier applied to the cylinder instead of the serial number on the nameplate.

There are also times during the transporting and processing of cylinders when the cylinder identification is not visible. This includes those periods when thermal protection or a protective shipping package is placed on the cylinder for shipment

The material accountability reports will list the batch number assigned to the material contained within the cylinder. Given that this batch number is not visible on the cylinder, the shipper and receiver use the cylinder identification to verify they are shipping and receiving the proper cylinder. Since the shipper and receiver might well use different batch numbers to refer to the same consignment of nuclear material, shipper and receiver use of the same cylinder identification would provide a common number that can be used to help match shipments and receipts.

4.3. Compatibility with Existing Enterprise Reporting Systems

Whether manually reading and recording the cylinder serial number engraved on the nameplate or reading the supplemental cylinder identifiers (manually or automatically), companies align the cylinder identification with other important information in the facility databases.

This information may include, but is not limited to:

- gross weight of the cylinder and its contents from
- accountability scales or process scales
- the isotopic enrichment of the uranium contained in the cylinder from destructive analysis, non-destructive assay measurements, or process measurements
- history of cylinder certification information such as last hydro-test date
- other pertinent information such as recertification date, tare weights, cylinder owner, cylinder inspection reports, etc

Companies maintain databases to allow them to coordinate the information contained on the supplemental cylinder identifier and the official identification information on the nameplate utilized for tracking the cylinder.

The three types of numbers typically seen on the nameplates are:

- the manufacturer's serial number
- the owner's serial number
- the national board registration number

In addition to the utilization of the nameplate information for regulatory reporting, the operators of the facility may utilize the information in their:

- Nuclear Material Control and Accountancy (NMC&A) system
- production planning/order management system
- cylinder management and compliant-cylinder monitoring system

Operators maintain enterprise reporting and management information systems that fulfil these functions and utilize cylinder information. An industry standard format for cylinder identification should be compatible with these existing enterprise management systems or require minimal modification of these systems.

5. Preferred Global Identifier

The global identifier consists of the following:

1. A 10-character, alpha-numeric identification number consisting of 4 capital letters followed by 6 numbers:
 - a. A 3-capital letter “prefix” assigned by the cylinder owner,
 - b. A fourth capital letter reserved for use by the cylinder own and
 - c. A 6-digit number assigned by the cylinder owner (not to be duplicated within the cylinder owner organisation).
2. A dot matrix (2D) barcode of the assigned 10-character identification number may also be applied.
3. No special characters (e.g. -, #, _) or spaces will be used, Figure 1 is an example design for the global identifier, design specifications are provided in Appendix A.



Figure 1: Example global identifier containing 10-character global identification number with 2D barcode

5.1. Functional and Performance Requirements

The global identifier meets the following functional and performance requirements:

- A numbering/lettering scheme that is not duplicated across industry
- an identification number that is large enough to be visually read from a reasonable distance (e.g., 1-3 meters)
- capability to withstand all the environment conditions associated with cylinder transport and processing
- capability to endure for the entire cylinder service life
- reasonable application and maintenance costs

An additional feature that enables the international inspectorates (e.g., IAEA, Euratom, etc.) to fully take

advantage of the global identifier for international safeguards purposes is the welding of the global identifier to the cylinder to enable the IAEA to verify its authenticity.

6. Information Management

Cylinder owners will be responsible for the assigning and managing the 10-character global identification numbers assigned to the cylinders.

6.1. Assigning Cylinder Identification to New Cylinders

- each cylinder owner will select a 3-letter prefix for its use³
- to prevent two or more owners from using the same prefix, cylinder owners will reserve their prefix(s) with WNTI⁴. A list of reserved prefixes is provided in Appendix B. Alternatively, should an owner desire not to designate a specific 3-letter prefix, they can use the prefix “WNT”
- the fourth character is a capital letter provided for use by the owner. For cylinder owners that decide to use the “WNT” prefix, WNTI will assign the 4th capital letter (A-Z) for the owner to use on all its cylinders with the “WNT” prefix.
- the cylinder owner will assign the remaining 6 numbers and will manage the assigned numbers to ensure that the same 6-digit sequence is not duplicated.

This 10-character format is compatible with the Bureau International des Containers et du Transport Intermodal (BIC) format, should an individual cylinder owner be registered with BIC.

The organisation purchasing a new cylinder will be responsible for assigning the 10-character global identification.

For newly fabricated cylinders, it is desirable that the 10-character global identification number also be used as the serial number marked on the nameplate so that these numbers agree.

The intent is that the global identification number assigned to an individual cylinder will remain unchanged. However, in the case of an ownership change the new cylinder owner may assign a new identification number and affix a new global identifier adhesive tag to the cylinder. The date of ownership change should be indicated on the adhesive tag. The cylinder owner information marked on the nameplate should be revised to reflect the new owner.

7. Implementation

1. New cylinders – beginning to assign the 10-character global identification number:
 - a. Using this number as the serial number engraved on the nameplate
 - b. Optionally a larger-sized number and a 2D barcode may be added to the valve end of the cylinder by either: enlarging the nameplate to add the information at the bottom or adding a separate global identifier below the nameplate.
2. Existing cylinders in circulation, a 10-character identification may be assigned to the cylinder and an adhesive tag with the global identifier may be affixed to the valve end cylinder below the nameplate.

³ A cylinder owner may select more than one prefix for its use

⁴ A cylinder owner does not have to be a member of WNTI to reserve a 3-letter prefix

8. References

ISO 7195, Nuclear Energy - Packaging's for transport of uranium hexafluoride (UF₆) - 2020

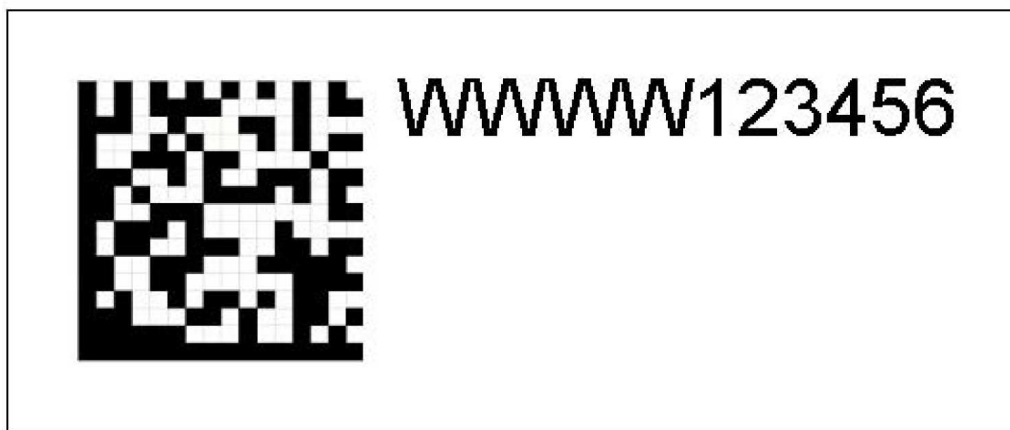
ANSI 14.1, Nuclear Materials - uranium hexafluoride packaging's for transport - 2023

ISO 6246, Freight Containers - Coding, Identification and marking, 1995-12-01

Appendix A – Specifications for the Global Identifier

Optional Global Identifier Nameplate for New Cylinders

The global identifier shall contain a 10-character, alpha-numeric global identification number and a two-dimensional (2D) Data Matrix representation of the identification number.



Dimensions of global identification number

Data Matrix (2D) Barcode:

- a 14 x 14 format should be used
- the data matrix barcode should use 2.54mm (0.1 inch) modules resulting in a 35.6mm (1.4 inch) square data matrix barcode
- a quiet zone of 1 module (2.54mm) shall be used around the barcode
- the top, side, and bottom of the data matrix barcode quiet zone shall be at least 6.35mm (0.25 inches) from the edges of the plate.

Alpha-numeric identification number: (see Figure 2)

- Arial font should be used
- the characters shall be at least 7mm (0.278 inches) tall (Arial size 28 font)
- the top of the characters shall be aligned with the top of the barcode. (8.9mm from the top edge of the plate)
- the letters should be capitalised.

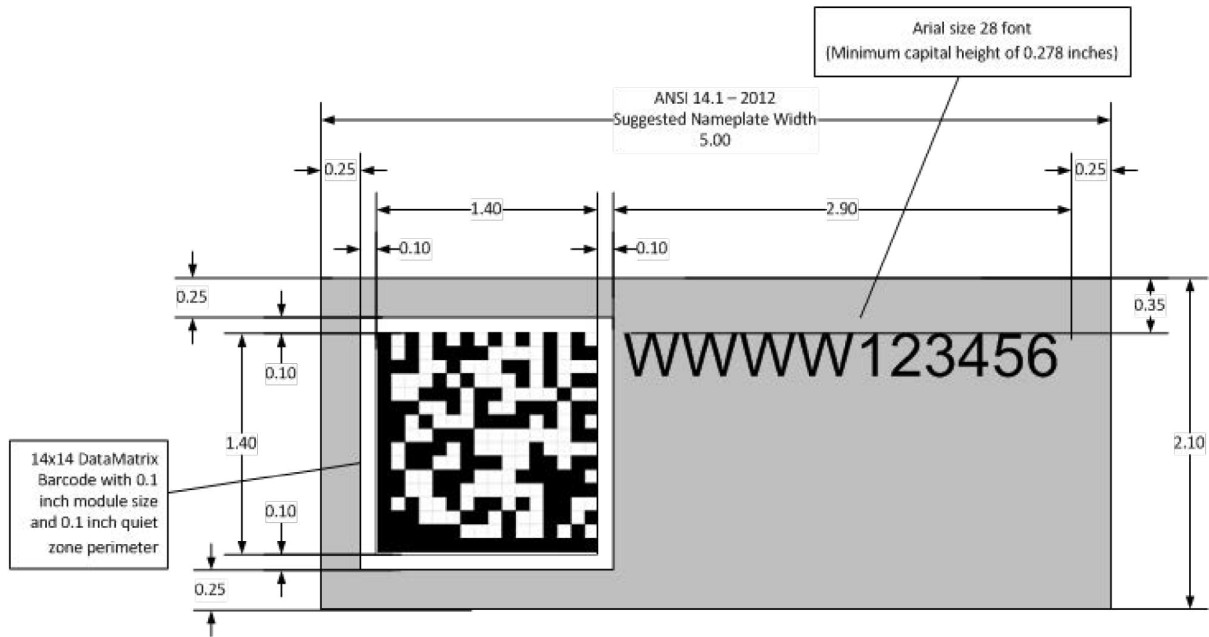


Figure 2: Dimensions for global identifier for new cylinders

Optional Global Identifier Nameplate for Existing Cylinders

Dimensions of global identification number

The dimensions are the same as provide above for the global identifier on the new cylinders

Application of global identification number (See Figure 3)

- the global identifier for existing cylinders shall have the alpha-numeric cylinder ID marked onto the surface
- the global identifier for existing cylinders shall have the 2D Data Matrix barcode marked onto the surface
- the global identifier for existing cylinders shall have the name of the owner marked onto the surface
- the date and MSN may be affixed onto the surface of the global identifier for existing cylinders. However, for ownership change the date shall be provided

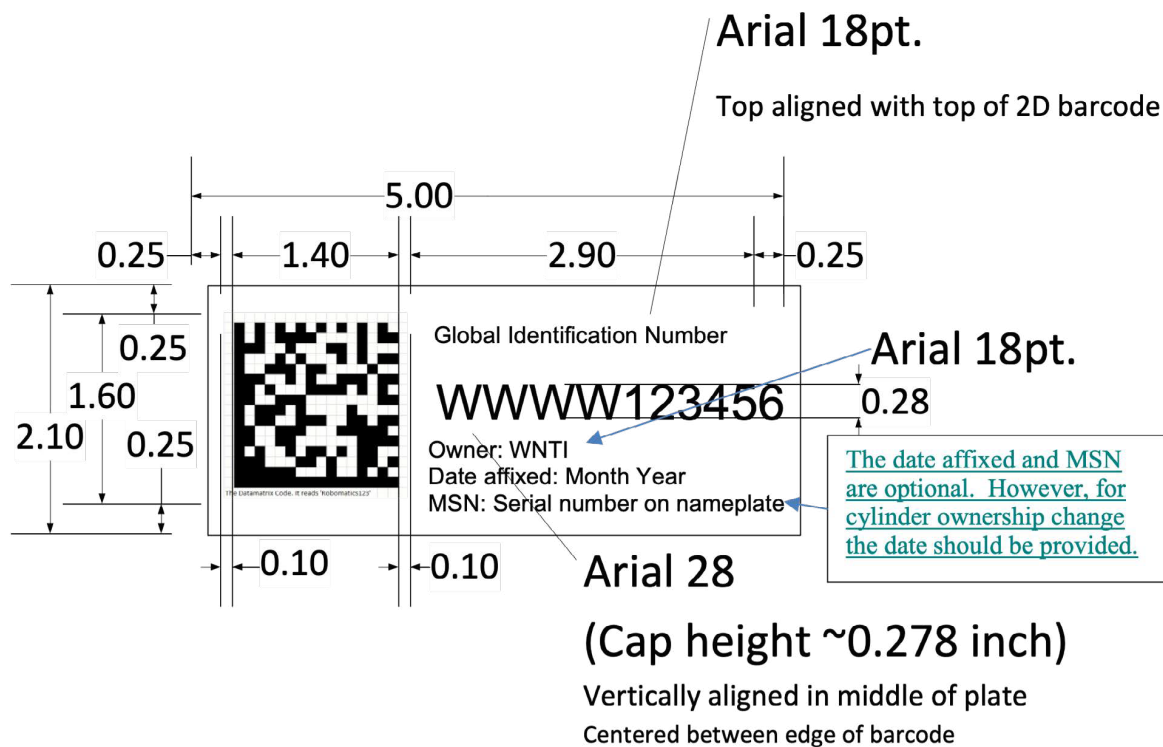


Figure 3: Global identifier for existing cylinders

Placement of Global Identifier

- the preferred location of the global identification is centred below the nameplate on the valve end of the cylinder
- for 30B cylinders, the top of the global identifier should be 7.62cm (3 inches) from the centre of the valve to not interfere with the valve cover and allow for the global identifier to be read with the valve cover in place (Figure 5)
- for 48Y cylinders, the top of the global identifier should be 14cm (5.5 inches) from the centre of the valve (Figure 4)

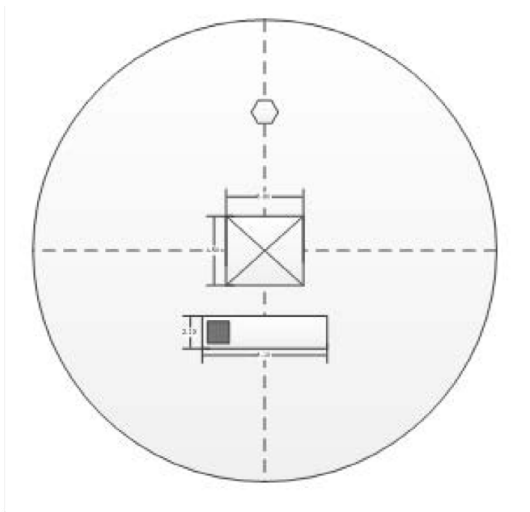


Figure 5: 30B with global identifier shown with valve

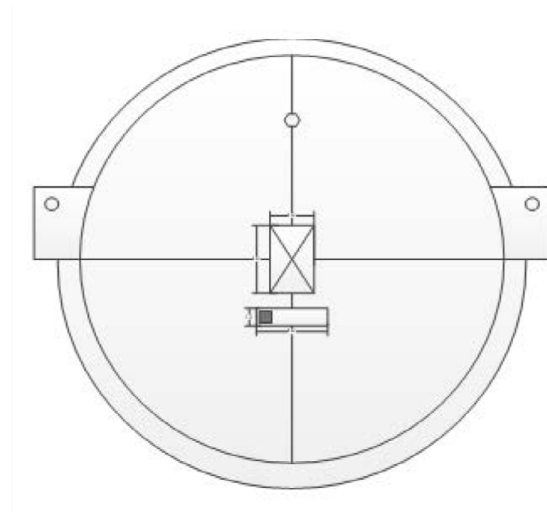
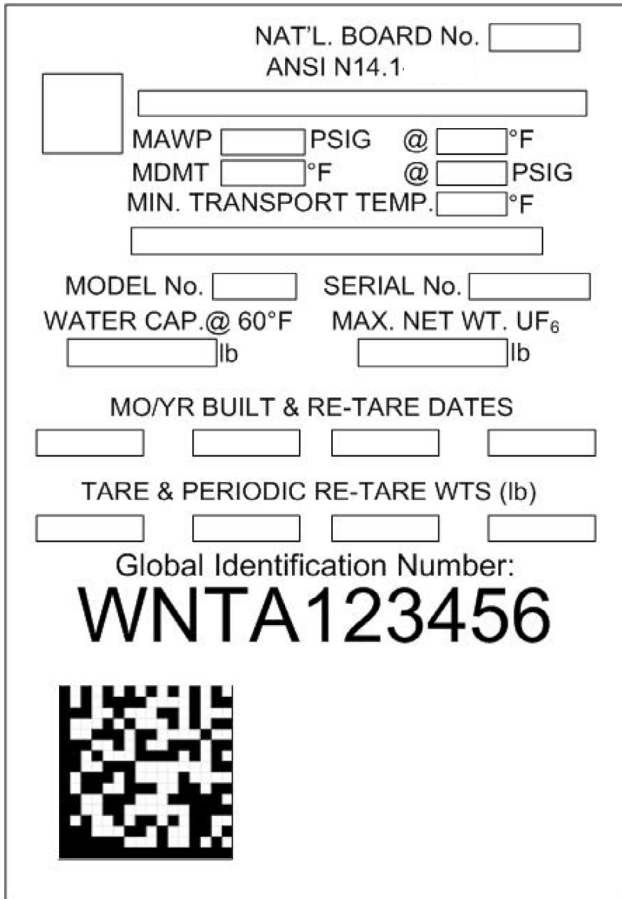


Figure 4: 48Y with global identifier

Alternate Specifications for Global Identifier for New Cylinders

For new cylinders, an alternative placement options is to extend the size of the nameplate to add the global identification number and 2D barcode at the bottom

A suggested layout for model 30B and 48Y cylinder nameplates is provided in Figure 6 and Figure 7, respectively.



NAT'L. BOARD No.
ANSI N14.1-

MAWP PSIG @ °F
MDMT °F @ PSIG
MIN. TRANSPORT TEMP. °F

MODEL No. SERIAL No.
WATER CAP. @ 60°F lb MAX. NET WT. UF₆ lb
MO/YR BUILT & RE-TARE DATES

TARE & PERIODIC RE-TARE WTS (lb)


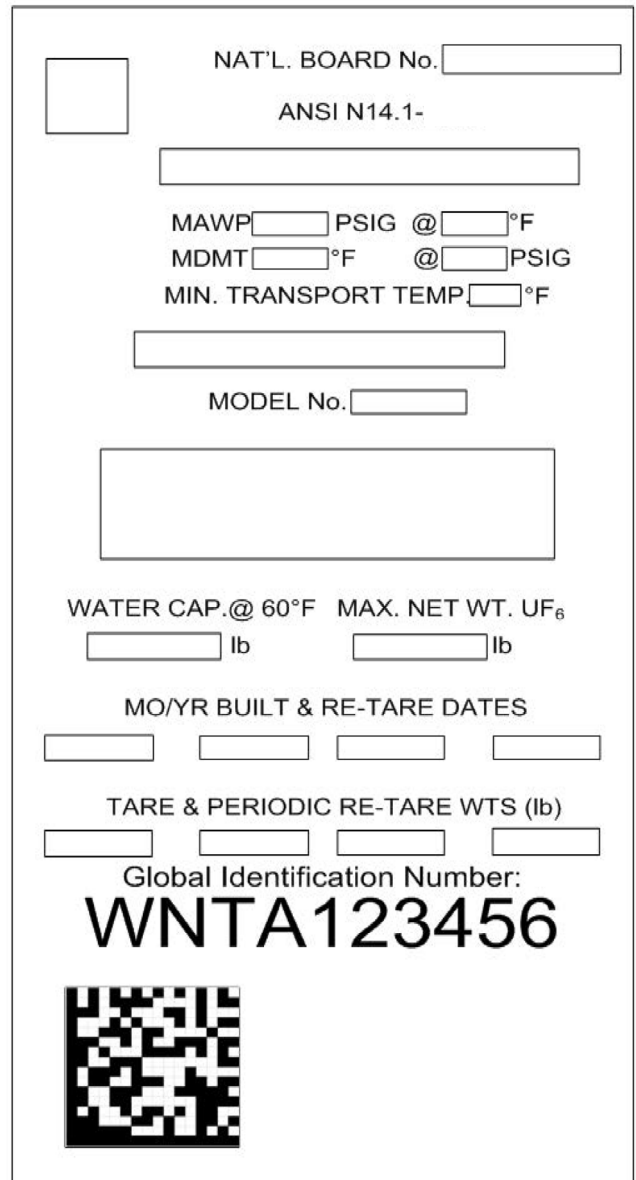
Global Identification Number:
WNTA123456


Figure 6: Suggested layout for 30B cylinder nameplates



NAT'L. BOARD No.
ANSI N14.1-

MAWP PSIG @ °F
MDMT °F @ PSIG
MIN. TRANSPORT TEMP °F

MODEL No.

WATER CAP. @ 60°F lb MAX. NET WT. UF₆ lb
MO/YR BUILT & RE-TARE DATES

TARE & PERIODIC RE-TARE WTS (lb)


Global Identification Number:
WNTA123456


Figure 7: Suggested layout for 48Y cylinder nameplates

Appendix B – Assigned Prefixes for Global Identifier

Table 1: Assigned Prefixes for Global Identifier

Prefix	CYLINDER OWNER/ORGANISATION
ACO	American Centrifuge Operating, LLC
CAM	Cameco
CXP	AREVA NC
DNT	Daher NT
DOE	U.S. Department of Energy
FAE	Electricite-de-France
GEW	Global Nuclear Fuel
HON	Honeywell/Converdyn
KAP	Kazatomprom
ORN	Orano
TAM	TAM
TNX	TENEX
URE	Urenco
USU	United States Enrichment Corporation
WEC	Westinghouse-Columbia USA
WUK	Westinghouse UK
WSE	Westinghouse Sweden
WNT	Assigned by World Nuclear Transport Institute*

Disclaimer

Whilst the WNTI will use all reasonable efforts to ensure that the information in this Standard is accurate, we cannot guarantee the accuracy of all information and we will accept no liability for any loss or damages incurred, howsoever caused and cannot be held liable for any use or reliance you may make of or put on it. The WNTI also cannot be held liable for your use or inability to use the fact sheet or the information or services that it contains. Errors and Omissions Accepted. This should not be relied upon in place of Legal Advice.

The WNTI offers the use of this Standard freely to members and non-members of the transport community. Where any interpretation of the information has been made, it has been done so with the interests of the wider transport community. Although the Standard has been extensively reviewed by industry experts, if you have any issues in use or content, please contact the WNTI so we can rectify the issues and conflicts in systems etc.

**The information presented is valid as per:
March 2026**

**4th Floor
York House
23 Kingsway
London WC2B 6UJ**

Tel: +44(0) 203 398 0637

**Web: www.wnti.co.uk
Email: wnti@wnti.co.uk**

**WNTI Standard
UF₆ Cylinder Numbering**

© World Nuclear Transport Institute Registered in England and Wales, Company Number 3557369