COMPOSITE TECHNICAL SYSTEMS

SAFETY through LIGHTNESS

CTS CYLINDERS

INSTRUCTION MANUAL

Use, Maintenance and Inspection

USA MARKET

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Composite cylinders – Breathing Air

SCBA & SCUBA

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9
33048 - Chiopris Viscone (UD) - Italy
VAT 01155920323

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Revision status

REV	PAGES AFFECTED	DESCRIPTION OF CHANGE	DATE
00	ALL	INITIAL RELEASE	October 2023
01	ALL	General update of units of measurement and storage methods	February 2024
02	Pag 3	Label update	October 2024
03	Pag 5,13	Update chapter 4.4 and 7.2	November 2024
04	Pag 26	Addition of internal damage, section 7.4.2	March 2025
05	Pag 5,6,8,31	Addition of maximum recommended discharge rate	April 2025

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Table of contents

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

1. IDENTIFICATION DATA

1.1 INFORMATION ON THE MANUFACTURER

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9
33048 - Chiopris Viscone (UD) - Italy
VAT CODE 01155920323
Tel. +39 0432 991383
Fax. +39 0432 991323
E-mail: info@ctscyl.com
Web: www.ctscyl.com

1.2 COPYRIGHT

2. GENERAL INFORMATION

The current user and maintenance manual can be downloaded for free on the website www.ctscyl.com.

This manual is intended to provide to the customer, and in particular to the staff working in directly with the cylinder, all the information necessary for the proper use of it, as well as instructions for the maintenance in operational conditions, ensuring that is carried out in full respect of all safety conditions.
The instructions in this manual are a supplement to (not a replacement of) the health and safety standards in force.

Composite Technical Systems S.p.A. declines any responsibility in case of:

- use of the product in a way different from the provisions of the current legislation about health and safety;
- disregard or incorrect application of the instructions included in the manual;
- non-conforming uses;
- unauthorized changes or changes not carried out by technicians of Composite Technical Systems S.p.A.

Composite cylinders at high pressure, with non-structural plastic (PET) *liner*, wrapped with carbon fiber, are designed for durability in harsh conditions of use. However, like any other type of container that contains gas under pressure, even type 4 composite cylinders must be handled with care and properly maintained. **In particular, they should not be, under any circumstances, rolled, dragged on the ground, thrown to the ground or hit with objects of any type**.

3. TECHNICAL SPECIFICATIONS

CTS's composite cylinders for breathing air are designed and conceived to keep high-pressure breathing air. Their light, manageable and durable features make them innovative cylinders.
CTS cylinders are manufactured according to 49 CFR § 178.69, 178.70 and 178.71 and have been approved by Department of Transportation. They have passed all the tests required by the ISO11119-3 and are marked UN according to ADR regulation.

CTS's composite cylinders are made with a non-structural PET liner, wrapped with a composite material made of carbon fibers and epoxy resin, which confers the structural and mechanical properties. The plastic liner has the only function to contain the gas.
The cylinder comes with rubber protective caps (upper and bottom) which have the purpose of cushioning the impacts. These caps may also have holes for water drainage. It can also come with protective sleeves, which are intended to protect the composite surface and the label and also work as a flame retardant.
For the replacement of the sleeves, label and caps, ALWAYS ask for personnel authorized by CTS S.p.A.

1- Internal nozzle
2- Inner PET liner
3- Carbon fiber composite shell
4- Upper cap
5- Label
6- Optional protective finishing
7- Bottom cap

Figure 1. CTS cylinder composition diagram

3.1 DIFFERENCES BETWEEN SCBA AND SCUBA

This manual covers all C.T.S. breathable air cylinders, including SCUBA cylinders.
These cylinders differ from C.T.S. SCBA cylinders only in the nozzle material: SCUBA cylinders are indeed equipped with stainless steel nozzles to provide maximum corrosion protection.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

3.2 MARKING AND LABELLING OF THE CYLINDERS

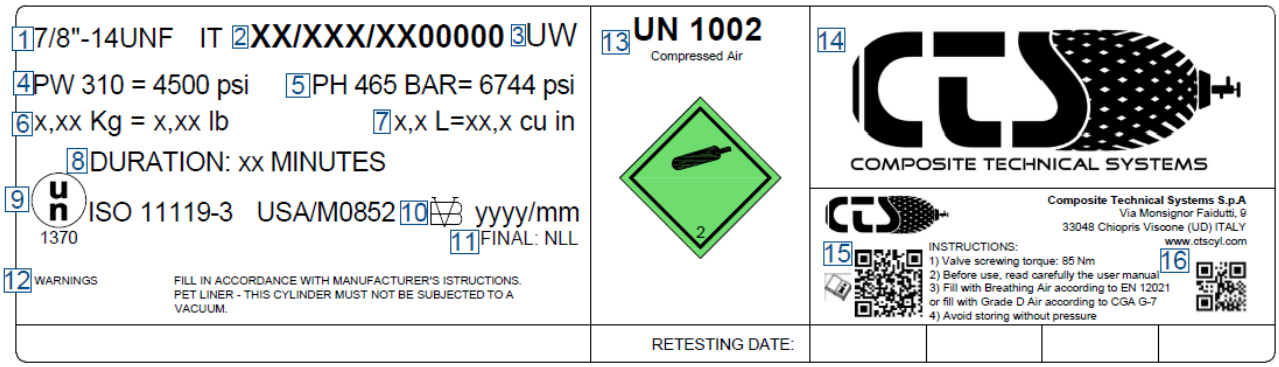


Figure 2: Label

Markings on labels are as example only.
1 Cylinder thread and country of manufacture ; **2** Serial number; **3** Underwater use (if SCUBA cylinder); **4** Working Pressure (PW); **5** Test Pressure (PH); **6** Weight of the cylinder; **7** Water capacity; **8** Duration; **9** UN Mark, Standard, DOT approval; **10** Inspection Stamp, Initial test date; **11** Non-Limited Life, no expiration date; **12** Warnings; **13** Gas approved; **14** Customizable logo area; **15** QR code for manual **16** Instructions and additional information.

*If the cylinder is approved according to EN 12245 (item 10 on the label), then the weight is the average weight of the bare cylinders in the batch, without finishes.
If the cylinder is approved according to ISO 11119-3 (item 10 on the label), then the weight is the average weight of the cylinders in the batch, in their final configuration (finishes and valve, if applicable).

The label specifies all the data prescribed by the regulations in force.
Carefully follow the relevant indications as specified on the label.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

4. USE OF THE CYLINDERS

CTS cylinders are designed to be used in the same way as other pressurized gas cylinders, with all the appropriate precautions.
However, there are some major differences, discussed in the following paragraphs.

4.1 NOTES ON HOW TO USE THE CYLINDER

We recommend to:

- Keep the threads and the cylinder interior dry, without grease, dirt or other contaminants
- Only fill the cylinders with breathable air complying with Compressed Gas Association (CGA) G-7 and G-7.1 standards.
- When installing the valve follow the installation procedures and the recommendations provided by the valve manufacturer

It is forbidden:

- Filling the cylinder with a pressure higher than 110% of the operating pressure (PW)
- Using the cylinder with a pressure higher than the operating pressure (PW)
- Exposing the cylinder to vacuum
- Fully or partially filling the cylinder with any gases other than breathable air and/or enrich with oxygen
- Filling a cylinder with an expired re-testing date (see section 7)
- Screwing a valve with a tightening torque outside the recommended values
- Tampering with the surface protections (end caps, protective sheathings, painting, changing the labels identifying the manufacturer), unless authorized by CTS S.p.A.
- **Using valves with sintered filter**
- Artificially heating the interior of the cylinder, especially to temperatures exceeding 150 °F (about 65°C).

We discourage the following behaviors:

- Filling the cylinder if it presents a leak
- Filling a cylinder showing defects
- Fully discharging a cylinder, unless when planning to remove the valve (see section 6.1.1)
- Using a cylinder that has been exposed to a highly corrosive atmosphere or environment, without subjecting it to strict checks of inspection and testing
- Using a cylinder showing signs of shocks, hits, abrasions or falls of considerable entity
- Storing the cylinder without any internal pressure
- Discharge regularly the cylinder at speed exceeding 69 gpm (260 liters per minute) (see section 4.3).

In the above-mentioned cases we recommend that you have the cylinder examined by personnel authorized by CTS S.p.A.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

4.2 FILLING

The cylinder must be filled using a breathable air compressor, properly serviced and equipped with an appropriate filtering system to ensure a breathing air quality level according to CGA G-7 and G-7.1.

GENERAL CAUTIONS:
When recharging the cylinder, its temperature rises due to the increase in pressure. As a consequence, pay attention to the following:

- The cylinder body temperature must never exceed 150 °F (about 65°C)
- The cylinder must be charged to the maximum pressure specified on the label, at a temperature of 59°F (15°C).
- Compression is an exothermal process; for this reason, we recommend that you charge the cylinder at no more than 300÷435 psi/min (about 20 ÷ 30bar/min) up to 4650 psi (about 320 bar), to minimize the pressure drop that will occur when the cylinder cools down to room temperature
- **DO NOT** dip the cylinder into water (or other coolants), in order to dissipate the heat generated during the filling process. For cylinders made of composite material this process is useless and counterproductive
- The sealing O-RING between the inner nozzle and the outer one sometimes requires a few cylinder pressurization cycles to settle and operate properly
- TO PROPERLY CHECK THE SEALING FOLLOW THE PROCEDURE DESCRIBED in section 7.2

During the filling and discharge procedure, the cylinder may emit some noises, often described as a crunch, which is not cause for concern.

4.2.1 SLOW FILLING

Filling the cylinders slowly will reduce the heat generated by the filling process.
If you opt for slow filling (which is the recommended method) the filling rate should be equal or lower to 435 psi/minute (about 30 bar per minute).

4.2.2 FAST FILLING

The CTS composite gas cylinders allow the operation known as "quick filling" to be carried out, provided that the bottle is properly handled and maintained by the filling staff according to the CTS-regulations or according to the CTS-operating instructions and that the CTS bottle is therefore in perfect condition.

4.2.3 HIGHER FILLING PRESSURE

CTS cylinders can be filled with a higher pressure up to a maximum of 10% above the operating pressure, provided that the pressure at rest corresponds to the operating pressure.

4.3 DISHARGING

To improve the lifespan of the cylinder CTS recommends, when possible, to maintain a discharge rate of 69 gpm (260 liters per minute) maximum. To ensure a stable discharge rate it is advisable to use an EFV, as it already reduces the discharge rate to approximately 69 gpm (260 l/min) maximux, resulting in a healthy liner. However, it is possible to discharge the cylinder at higher speeds whenever necessary.

In the case of SCUBA cylinders:
The cylinder should never be fully emptied to prevent water from entering inside unless you intend to remove the valve.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

4.4 MOISTURE CONTENT OF THE AIR INSIDE THE CYLINDER

The following procedure, if done correctly, helps reduce moisture inside the cylinder air. It is advisable to perform these steps if the cylinder has been retested, if it has been internally cleaned, if it has been stored without a cap or valve, or if it contained air contaminated with moisture.
In order to decrease the humidity level in the cylinder, follow these steps:

1. The filling compressor should be able to fill the cylinder with breathing air according to CGA G-7 and G-7.1 standards
2. Fill the cylinder up to 725psi (about 50 bar) with breathing air with humidity level according to CGA G-7 and G-7.1 standards
3. Empty the cylinder with a recommended discharge rate of 69 gpm (260 l/m) maximum
4. Repeat steps 2 and 3 at least two more times
5. Fill the cylinder with at least 2900 psi (about 200 bar) of breathing air with a humidity level according to CGA G-7 and G-7.1 standards before carrying out the humidity level test

The CGA G-7.1 standard gives the following [Table 1] values for air humidity, based on the final use of the cylinder. Grade L air is used for self-contained breathing apparatus (SCBA), while grade E air is used for self-contained underwater breathing apparatus (SCUBA).
It is important to ensure that your compressor delivers breathing air with the correct composition.

Table 1

Table 1—Directory of limiting characteristics

QVLs (grades)						
	Maxima for gaseous air					
Limiting characteristics	A	L	D	E	J	N [1), 2)]
Carbon dioxide		1000 [3)]	1000 [3)]	1000	0.5	500 [3)]
Carbon monoxide		10 [3), 4)]	10 [3), 4)]	10	1	10 [3), 4)]
Halogenated solvents					0.1	
Nitric oxide						2.5
Nitrogen dioxide					0.1	2.5
Nitrous oxide					0.1	
Odor		None	None	None	None	None See 6.6
Oil (condensed) (mg/m^3 at NTP)		5 [5)]	5 [5)]	5 [5)]		None [6)]
Percent oxygen, balance is predominantly nitrogen	19.5-23.5	19.5-23.5	19.5-23.5	20-22	19.5-23.5	19.5-23.5
Sulfur dioxide					0.1	5
Total hydrocarbon content (as methane)				25	0.5	
Water [7)] Dew point °F °C		24 –65 –53.9	67 –50 –45.6		1 –105 –76.1	

NOTES

1 Units in ppm (v/v) unless shown otherwise.

[1)] For Canadian requirements, see 7.4.2.

[2)] CGA proposed changes to the specifications for medical air USP; however, USP has not been officially revised as of the date of this publication. Therefore, the reader is advised to consult the current USP to determine the tests to be performed.

[3)] Not required for synthesized air when oxygen component was produced by air liquefaction and meets the United States Pharmacopeia (USP) specification [4].

[4)] Not required for synthesized air when nitrogen component was previously analyzed and meets the National Formulary (NF) specification [4].

[5)] Not required for synthesized air whose oxygen and nitrogen components are produced by air liquefaction.

[6)] Includes water.

[7)] The water content of compressed air required for any particular QVL can vary with the intended use from saturated to very dry. For breathing air used in conjunction with a self-contained breathing apparatus (SCBA) in extreme cold where moisture can condense and freeze causing the breathing apparatus to malfunction, a dew point less than –65 °F (24 ppm v/v) or 10 °F less than the coldest temperature expected in the area is required. If a specific water limit is required, it should be specified as a limiting concentration in ppm (v/v) or dew point. Dew point is expressed in °F at 1 atm, abs (101 kPa, abs).[2] To convert to other units, see Section 8.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

When performing the humidity test CTS does not recommend using salt vial-based instruments, as they are too sensitive to environmental conditions. CTS recommends to use digital electronic instruments instead, as they provide greater precision, and are easier and faster to use.

5. HANDLING

Every type of cylinder must not under any circumstances be dragged, dropped, manipulated, left without custody, or roughly handled. When transporting cylinders, ensure that they are properly secured and cannot roll, swing or fall. The cylinders must be handled only with equipment that will not cause any damage to them.

6. MAINTENANCE

After using a cylinder in an emergency situation or in a rescue operation, remove it from the harness and check its conditions. Thoroughly clean the cylinder and its components. For cleaning procedures, see to section 6.2. When using water for cleaning, allow all necessary time for the components to dry. Make sure all components are dry before reassembling the cylinder.

In the case of SCUBA cylinders:
After use, especially in a marine environment, it is essential to thoroughly clean the cylinder with tap water to remove salt residue and accumulated dirt. The corrosive effect of seawater should never be underestimated. Failure to take appropriate cleaning precautions after use can lead to significant damage to the cylinder, especially the valve and nozzle, during periods of inactivity. Even in freshwater dives, there may be corrosive substances in solution (such as chemical residues or oils) that may not be visible directly, and these can trigger corrosion if left untreated for an extended period.
After diving, it is advisable to release a small amount of air from the valve connections to expel any residual water from the nozzle.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

6.1 VALVE INSTALLATION/REMOVAL

The valve installation/removal must be carried out by qualified personnel or authorized service centers, following the relevant instructions provided by this manual and any instructions provided by the valve manufacturer.

WARNING:
BEFORE removing the valve MAKE SURE THE CYLINDER IS COMPLETELY EMPTY.
Anyone handling a cylinder with a valve, which they believe to be empty, must take the same precautions as they would if the cylinder were considered pressurized/full.
Pay attention during the removal of the valve. If the valve is difficult to remove, stop immediately. It is possible that the valve is damaged or not functioning properly. CTS is not responsible for malfunctions or incorrect use of valves on CTS cylinders. In case of suspected valve malfunction, contact the manufacturer immediately.

Always follow the following steps to install/remove the valve

- PLACING THE CYLINDER: place and fix the cylinder in a horizontal or vertical position. If using jaws or forks, cover the forks with a rubbery material in order to prevent any damage to the surface of the cylinder. The force exercised on the cylinder must not compromise the mechanical characteristics of the composite; the maximum force applied to the jaws must not exceed 85 psi (about 6 Kg/cm^2).
  NOTE: If the cylinder is clamped in a clamp equipped with jaws, do not place the jaws on the label but on area of the cylindrical wall where there are no labels and/or stickers.
- USE A COUNTER WRENCH: For the valve removal, place a wrench complying with the indications provided in Table 2 on the (milled) notches of the nozzle as shown in Figure 3. The threads on the CTS cylinders are all right-handed so to unscrew the valve you will need to turn counter clockwise.
- USE A TORQUE WRENCH: For the valve installation, use a torque wrench calibrated to the values provided by the standard ISO 13341 **(CTS S.p.A. recommends, as stated by the directive ISO 13341 regarding cylinders made out of composite materials with a plastic liner, 63 ft.lbs (about 85Nm)).** The threads on the CTS cylinders are all right-handed so to screw the valve you will need to turn clockwise.

Table 2. Counter wrench size

Cylinder Model	Wrench [mm]
All models	46

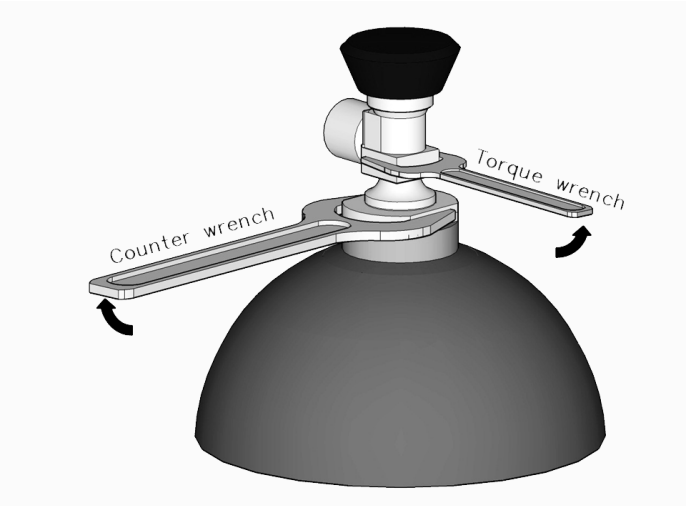


Figure 3. Use of the counter wrench to disassemble the valve.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

6.1.1 VALVE REMOVAL:

1. The pressurized gas must be removed from the cylinder.
   The cylinder should be emptied using the valve fitted with a recommended emptying speed of 69 gpm (260 liter per minute) maximum and following any recommendations provided by the valve manufacturer.
2. Once the cylinder is empty, remove the valve, following the instructions above, locking the cylinder as to prevent any damage to the nozzle thread and the valve.
3. To check the valve operation, add a small amount of air into the cylinder, to verify that the valve is not stuck, then release pressure again. If this operation is successfully completed, the valve works as intended.
   Fully release pressure, then try to remove the troubling or possibly malfunctioning valve. For each request or in case of problems with the valve, contact the valve manufacturer.

If, for any reason, it is difficult to remove the valve, do not persist. In case of alleged defects of the valve, avoid disassembling it. Refer to the manufacturer and/or dealers authorized by the manufacturer.
If any defect resulting in the non-acceptance of the cylinder is detected during the inspection, do not proceed further with the check and contact CTS S.p.A. or an authorized center.

6.1.2 VALVE INSTALLATION:

1. Verify that the valve designed service pressure is compatible with the cylinder designed service pressure before the valve is inserted into the cylinder. The valve's thread and the boss' thread should be carefully inspected and repaired as necessary, in accordance with the valve manufacturers or cylinder manufacturer's recommendations, to ensure satisfactory performance in-service.
2. Insert the valve into the cylinder neck and tighten first by hand, then finish tightening the valve with a torque wrench calibrated to the above-mentioned value.
   Do not install any valve that has not passed inspection. The valve threads should be free from damage and also checked for compliance to the thread specification by using the appropriate gauges. The surface of contact with the valve must be smooth and in good condition. Damaged or distorted valve threads can damage the cylinder's boss threads. Damage to the contact surface can prevent sealing and damage the cylinder's boss.
   Use valves that allow tightening torques corresponding or higher than those indicated by the manufacturer of the cylinder.

6.2 DRYING AND CLEANING

The following cleaning procedures are recommended for **external** cleaning of polyester liner composite cylinders:

- Dirt and soot: Wash with a water solution containing a non-aggressive detergent, thoroughly rinse with clean water.
- Oli and grease: Degrease with soap and water. Do not use substances listed in chapter "Chemical exposure or attack" and do not expose to temperatures above 150°F (65°C).
- Moisture: wipe with a soft cloth.
- Boss Corrosion: contact Customer Service. The inner collar of the boss can be removed to reach the areas exposed to corrosion. Ensure that this operation is carried out only by qualified personnel who will also be responsible for replacing the O-ring seal.
  After each removal of the nozzle, it is advisable to replace the O-RING.
- To dry the cylinder turn it upside down and wait for the water to flow out of it. Do not expose it to heat sources to speed up the drying time. It is possible to use a clean air jet (max temperature 150 °F (65°C)).

In the case of SCUBA cylinders:
It is advisable to perform cleaning after each use.
Cleaning after a diving activity can be done by thoroughly rinsing the cylinder with tap water and using a mild soap. It is crucial to conduct a thorough cleaning to remove any traces of salt or dirt. Pay particular attention to ensuring that the threads are completely free of salt and any foreign particles. Afterward, allow the cylinder and valve to dry.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

The following cleaning procedures are recommended for **internal** cleaning of polyester liner composite cylinders:

- Light soil: Remove any existing solid contaminants from the interior of the cylinder by rinsing. Follow the above-mentioned drying procedure. The interior of the cylinder must be cleaned and dried before reinstalling the valve.
- Oduor: Rinse with a solution of baking soda, then rinse with a highly diluted solution of vinegar, then follow the above-mentioned drying procedure.
- Oil and grease: Clean gently with mild soap and water. If it is not enough, contact CTS S.p.A. for assistance. Avoid the use of organic solvents or acid/caustic substances that might corrode the inner liner made out of polyester.
- Under no circumstances shall the cylinder interior be cleaned by rolling inside chips, balls or other solid materials mixed with water.
- For any problems other than the above, please contact CTS S.p.A. for assistance.

7. INSPECTION AND PERIODIC RETEST

Title 49 of CFR §180.207 specify that composite UN cylinders shall be periodically inspected and tested in accordance with ISO 11623. UN composite cylinders must undergo periodic inspection and qualification every five years in USA. The inspection consists in internal and external examination for damage and degradation and hydrostatic pressure test to design test pressure. If the results are positive the cylinder can return to service, otherwise be rejected and rendered unserviceable (see section 10).

Note that during the external examination the finishes and the caps must not be tampered, in fact they are integral part of the cylinder design. The rubber caps have the purpose of cushioning the impacts, while the sleeves are intended to protect the composite surface and the label and work as a flame retardant.
If the finishes or the caps are damaged, it is possible that the composite surface have been damaged too, in this case we suggest to let an authorized center or CTS S.p.A. itself carry out a survey on the damages.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

7.1 HYDRAULIC TEST

Each cylinder must be subjected to a proof testing using a suitable fluid – water is commonly used as a test medium. In any case, the test medium shall not reduce the integrity of the cylinder.
The test pressure is marked on the cylinder label. Adequate safety precautions shall be taken during the test.
For Type 4 cylinders the test method is the hydraulic test, this test should be conducted following the guidelines outlined in Test 8.5.1 of the ISO 11119-3 standard:

8.5.1 Proof pressure test

8.5.1.1 Procedure

When carrying out the pressure test, a suitable fluid (e.g. normally water) shall be used as the test medium. This test requires that the pressure in the cylinder be increased gradually and regularly until the test pressure, p_h, is reached. The cylinder test pressure shall be held for at least 30 s with the cylinder isolated from the pressure source, during which time there shall be no decrease in the recorded pressure or evidence of any leakage. Adequate safety precautions shall be taken during the test.

If leakage occurs in the piping or fittings, the cylinders shall be re-tested after repairing such leakages.

The limit deviation on attaining test pressure shall be test pressure +3 % / -0 or +10 bar whichever is the lower. Pressure gauges with the appropriate accuracy shall be used.

All internal surfaces of cylinders shall be dried (to ensure no free water) immediately after testing.

Alternatively a pneumatic pressure test can be used provided that appropriate measures are taken to ensure safe operation and to contain any energy that can be released, which is considerably more than in the hydraulic test.

8.5.1.2 Criteria

The cylinder shall be rejected if there are leaks, failure to hold pressure or visible permanent deformation after the cylinder is depressurised.

NOTE Cracking of resin is not necessarily a sign of permanent deformation.

NOTE: Type 4 cylinders are not subjected to autofrettage.

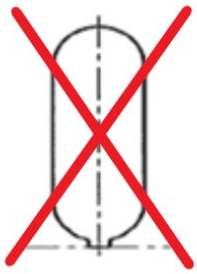
To dry the cylinder turn it upside down and wait for the water to flow out of it. Do not expose it to heat sources to speed up the drying time. It is possible to use a clean air jet (max temperature 140 °F (60°C)). Avoid the use of organic solvents or acid/caustic substances that might corrode the inner liner made out of polyester. The interior of the cylinder must be cleaned and dried before reinstalling the valve.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

With regards to Type 4 cylinders pressure test, it is important to know that:

- Type 4 cylinders must not be subjected to vacuum; therefore, it is imperative to not create vacuum during the filling procedure and, above all, during the emptying procedure.

  For this reason, do **NOT** empty the cylinder in a vertical position.

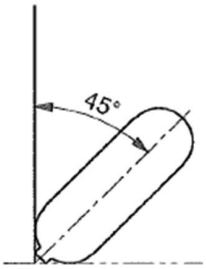


NO!

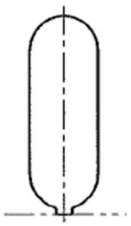
Instead, the following method **must be USED**:

Step 1: empty the first water half the in a horizontal position

Step 2: carefully tilt the cylinder to approx. 45°



Step 3: carefully tilt the cylinder to the vertical position and end the emptying



- Type 4-cylinder hydraulic test does not include water jacket test or any other kind of test that records the water capacity increasing. Checking the water capacity increasing during the hydraulic test is not useful and sometimes even misleading, given the high mechanical elasticity of Type 4 cylinders.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

7.2 LEAK TEST

The ISO 11623 standard recommends the following procedure to test the cylinder for leak tightness:

1. Pressurize the cylinder to its operating pressure.
2. Allow the cylinder and the O-RING to stabilize at room temperature for 3 hours (settling period).
3. Immerse the cylinder in water for at least 10 minutes to check for the presence of leaks. The release of air bubbles from the end caps, the connection area between fibers, or from the composite material, even after the settling period, is not considered a leak. These bubbles are trapped air between the different layers that make up the cylinder and are pushed out during filling.
   A leakage rate greater than 1 bubble per minute (equivalent to 6 ml/h) in the leak test constitutes a leak.

The settling period serves the following purposes:

- Allowing the cylinder to reach room temperature.
- Ensuring the proper settling of the sealing O-RING.
- Allowing trapped air between the various layers that make up the cylinder's coating (sheaths and end caps) to escape.

If the cylinder is not allowed the settling period after filling, the described phenomena may simulate leaks. It should be emphasized that these are not actual leaks.

Adequate safety precautions must be taken to contain any released energy.

7.3 O-RING REPLACEMENT

If during the leak test a leak is found between the internal and the external nozzle, this leak is due to a damaged internal O-Ring.

It is possible to replace the internal O-Ring in CTS S.p.A. Type 4 cylinders thanks to the CTS patented nozzle. The operative instructions and all the spare parts can be requested via email at info@ctscyl.com. They can be also found in the eLearning section of Interspiro website.

7.4 DAMAGE EVALUATION

According to ISO 11623 damages can be classified as follows:

Level 1: minor entity damages that can happen during normal exercise, they do not require compulsory repair.

Level 2: damages more severe than level 1, requiring additional inspections or repair. Following manufacturer's inspection, they may be deemed damages of level 1 or level 3. Please ask for assistance at your authorized dealer or at info@ctscyl.com for authorization and recommendations cited above.

Level 3: severe damages, to an extent where the cylinder repair is not viable. The cylinder must be discarded and made unusable.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

7.4.1 EXTERNAL DAMAGE EVALUATION

To perform an effective external inspection the cylinder should be clean. The cleaning should be gentle, do not use harsh soaps, chemical agents or solvents. Let the cylinder dry naturally.
Once the cylinder is clean, proceed with the evaluation following the criteria described below.

Damages that could arise on the cylinder during its lifetime while using a composite cylinder, can be classified in three categories:

- Damages to the finishing
- Damages to the composite material
- Damages to the threads

Not all damages declare the cylinder's end of life. This brief guide analyses the most common ones. In case of any doubt, please seek assistance at your authorized dealer or directly at info@ctscyl.com

Damages to the finishings (protective sleeves and caps)

The finishing includes the caps (top and bottom), the exterior sleeves and the stickers.
The finishing materials are not a structural part of the cylinder, for this reason even if damaged they don't compromise the cylinder functionality and safety. If they have been damaged, please ensure that the composite material underneath has not been damaged as well.
In case of any damages, such as tears and cuts, all these components can be replaced with a simple procedure from an authorized dealer. Please seek assistance at your authorized dealer or directly at info@ctscyl.com.

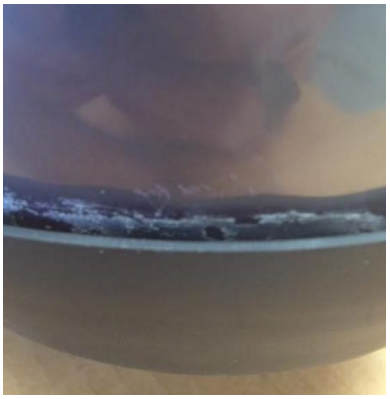
Damages to the label, especially to the serial number or other identification markings, require the action from an authorized dealer or CTS S.p.A. to wholly substitute the label, thus maintain its traceability.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 1

Damages to the sleeves and protective caps that do not involve the composite surface (level 1) do not affect the cylinder's safety. In case these damages are such that their protective function is compromised, they should be replaced.

Some examples of level 1 damages on finishings:

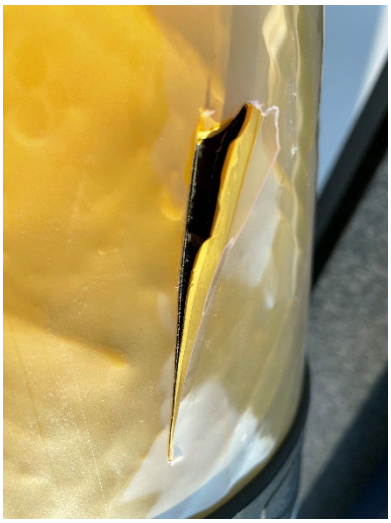


Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 2

In level 2 damages, the colored polyolefin sleeve is torn. The user must ensure that no damages have been transmitted to the reinforcement composite material below. If the composite material is involved in the damage, then the cylinder must undergo the Level 2 of *Damages to the composite material*, otherwise it can be treated as a Level 1 of *Damages to the finishing*. In case of any doubt or to request any assistance, always contact the authorized dealer.

Some examples of level 2 damages on finishings:



Level 3

Level 3 damages are to be considered so that their extent undermines the cylinder's safety, finishing with this kind of damage firmly indicates damage to the cylinder structure.

Some examples of level 3 damages on finishings:

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Damages to the composite material

If the composite material underneath the exterior finishes shows any kind of damage, please proceed as following:

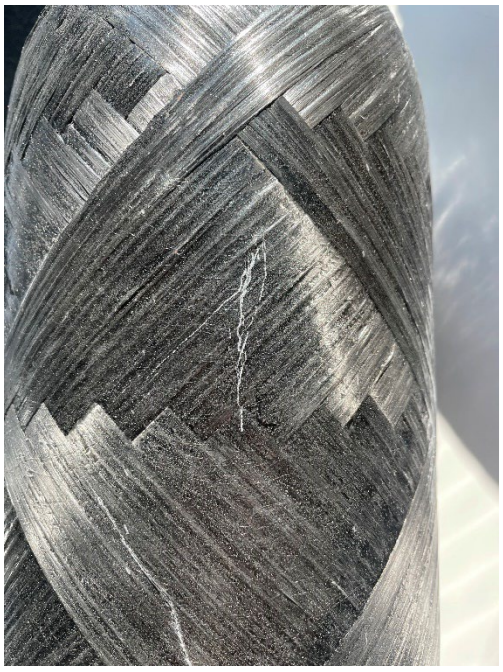
In case of scratches, the correct cylinder functionality and safety are not compromised. The epoxy resin can get scratches but this does not create any structural problem for the cylinder nor for its safety.

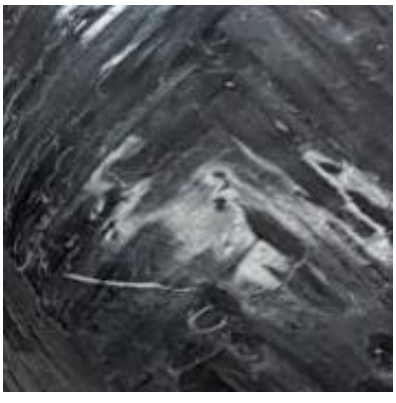
In case of dents, lack of material or cracks, the cylinder must be inspected by authorized personnel.
DO NOT USE THE CYLINDER. DO NOT ATTEMPT TO REFILL THE CYLINDER.
Please seek for assistance at your authorized dealer or directly at info@ctscyl.com.

Damages to the composite layer can be subdivided in: abrasion damages, impact damages, delamination, damages caused by exposure to high temperatures, chemical attack damages. According to the kind/level of damage, it is necessary to perform the appropriate actions described in the introduction.

Level 1

Low entity damages, mostly aesthetic, that have not affected the composite material.
Some examples of level 1 damages on composite surface:



Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 2

This kind of damages, with prior permission, can be repaired by CTS S.p.A. or by authorized dealers. Please note that this is not always possible and Level 2 damages can be subsequently categorized as Level 1 damages (where no repair is necessary) or Level 3 damages (where the cylinder is deemed unusable and must be discarded). The main difference between the Levels resides in the damage depth and/or width and whether or not it affected the carbon fiber.

CTS S.p.A. works constantly with the aim to improve the accuracy at which these defects are recognized, so that discarded cylinders are kept to a minimum without compromising the user safety.

Some examples of level 2 damages on composite surface:




Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 3

Damages to be considered of Level 3 are damages that have reached the carbon fiber. These are structural damages; hence the cylinder must be made unusable.

Some examples of level 3 damages on composite surface:

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Chemical exposure or attack

Composite materials can be attacked by chemicals and in some cases, by treated water.
If a cylinder has been exposed to chemicals or aggressive fluids, check the external composite surfaces for any visible signs of damage. Chemicals may dissolve, corrode, soften, remove or ruin cylinder materials.
They may also cause bubbling, pitting or extreme dulling of the resin, deterioration of the resin or protective layer (sacrificial envelopment or protection sleeves) or create multiple fractures to the structure.
Cylinders with evidence of such damage shall be REJECTED.
If a carbon cylinder has been damaged by chemicals, it must be REJECTED.

SET ASIDE for further inspection if the cylinders are known to have come into contact with any chemicals other than those listed below and which may have damaged the composite material. Contact C.T.S. S p.A. for further information.
Any cylinder coming into prolonged contact (e.g., soaking) with these types of chemicals and materials must be REJECTED:

- *Strong bases*: Materials that contain medium-to-high concentrations of sodium hydroxide, potassium hydroxide (and / or others) substances containing strong soapy solutions and substances containing surfactants used in removing stubborn dirt, etc.
- *Acids*: Materials that are or contain any concentration of acids, including hydrochloric, sulphuric, nitric and phosphoric acids
- *Corrosives*: Corrosive materials or those containing corrosive components, including chemicals mentioned above, as well as harsh all-purpose cleaners, glass cleaners, metal cleaners, resin cleaners/removers, drain openers/cleaners, glues, rubber cement and other chemical cements; also, atmospheres containing corrosive gases
- *Solvents that can make the structure or the liner swell*: acetone, benzene, chlorinated solvents, mineral turpentine solvent, etc.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

High-temperature exposure

When dealing with cylinders exposed to high temperatures, it is important to distinguish between the environmental temperature and the effective temperature reached inside the cylinder. Since the composite layer has thermal insulation properties, even if the cylinder is exposed to a high temperature environment, it takes time to reach the same temperature inside the cylinder. For this reason, not only temperature, but also time of exposure is to be taken in consideration.

The exposure to high temperature, even 580°F (about 300°C), in a brief period of time (10-15 seconds) cannot alter neither the external composite layer nor the chemical-physical properties of the internal liner. This is relevant in the case of SCBA cylinders used by firefighters: firefighters can place full trust in CTS composite cylinders even in the presence of high temperatures, as a firefighter's exposure to flames is typically not prolonged enough to impact the cylinder. Anyway, we suggest to let an authorized center or CTS S.p.A. itself carry out an inspection on the fire exposed cylinder.

Any cylinder abandoned during a fire or exposed to high temperatures for an extended period must be REJECTED.

Some examples of fire exposed composite cylinders:




Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Damages to thread/nozzle

The valve removal must be carried out by qualified personnel or authorized service centers, following the relevant instructions provided by this manual and any instructions provided by the valve manufacturer.

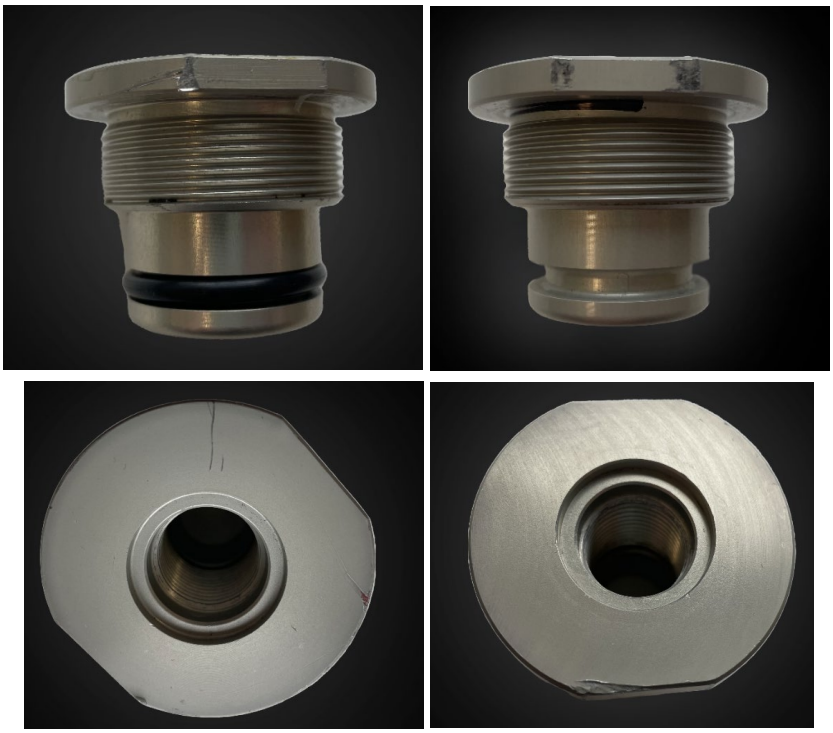
WARNING:
BEFORE removing the valve MAKE SURE THE CYLINDER IS COMPLETELY EMPTY.
Anyone handling a cylinder with a valve that he believes to be empty should take the same precautions that he would take if the cylinder were assumed to be pressurized / full.
Pay attention during the removal of the valve. If the valve is difficult to remove, stop immediately. It is possible that the valve is damaged or not functioning properly. CTS is not responsible for malfunctions or incorrect use of valves on CTS cylinders. In case of suspected valve malfunction, contact the manufacturer immediately.

Damages on the threads shall be evaluated to assess if these damages affect or not the cylinder safety (Level 2 and Level 3 damage according to ISO 11623), the classification distinction is explained in the introduction.

Level 1

These kinds of damages do not compromise the part functionality, although care is required because these imperfections can lead, especially on Aluminum alloy nozzles, to a loss in the corrosion resistance.

Some examples of level 1 damages on nozzles:



In the case of SCUBA cylinders:
SCUBA cylinders are designed for use in both fresh and saltwater environments, but they can also be used for diving in environments with diluted chlorine, albeit with some additional precautions. The stainless steel used in the nozzle can withstand the corrosive effects of chlorine in the short term but begins to lose its mechanical properties after 3 weeks. Therefore, it is advisable to thoroughly wash the cylinder even after a dive in chlorinated water and store it in a dry environment free from such contaminants. If there has been prolonged exposure to chlorine, even in diluted form, we recommend having the cylinder inspected by an authorized center or directly by CTS S.p.A.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 2

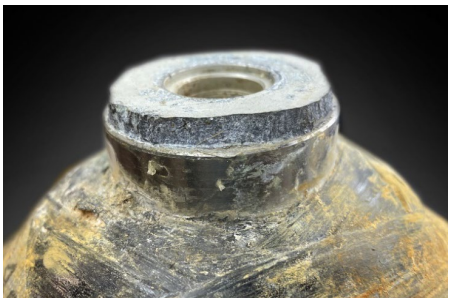
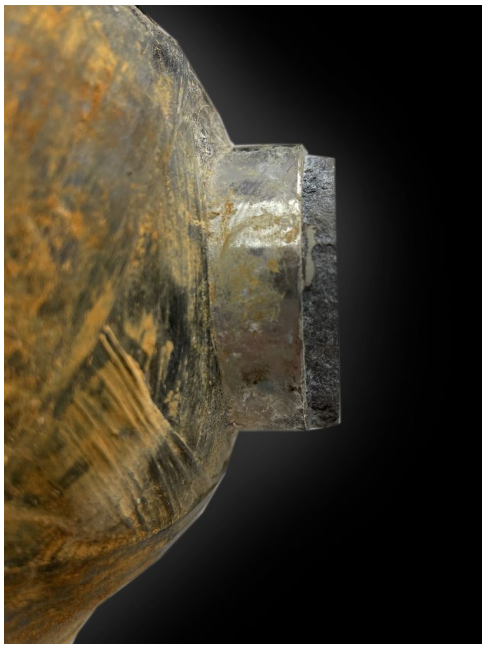
Damages on the nozzle thread and/or body could be caused by an incorrect valve installation or uninstallation.
In case of these kind of damages, it is possible to contact CTS S.p.A. or the authorized dealer to replace the internal nozzle following a thorough cylinder's safety inspection.

Some examples of level 2 damages on thread/nozzle:


Level 3

Damages caused by corrosion are to be considered harmful to the cylinder. Cylinders showing signs of corrosion must be decommissioned.

Some examples of level 3 damages on nozzle:

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

7.4.2 INTERNAL DAMAGE EVALUATION

The internal inspection should be carried out using a sufficient illumination or a video endoscope to detect any damage. The cylinder interior should be clean. If not, it can be cleaned gently using a mild soap and water, rinse abundantly with clear water. To dry the cylinder turn it upside down and wait for the water to flow out of it. It is possible to use a clean air jet (max temperature 150 °F (65°C)).

Type 4 cylinders are made out of an internal PET liner and of an outer shell in composite material. The internal PET liner has the only purpose of containing the gas, it has no structural property.
In fact, all the mechanical properties of the pressure vessel are given by the outer shell.

The internal PET liner can be damaged only because of an incorrect use of the cylinder, such as filling or washing it with hot water or with hot gases or with corrosive substances. The internal PET liner can be also damaged because of an extended exposure to very high temperatures or to an aggressive environment, especially when the cylinder is empty.

The internal liner, being made out of plastic material, is the most elastic material of the entire cylinder, therefore an improper use of the cylinder not specified for in the manual may create blisters. The blistering phenomenon is merely aesthetical and does not affect in any case the safety nor the correct functioning of the cylinder.

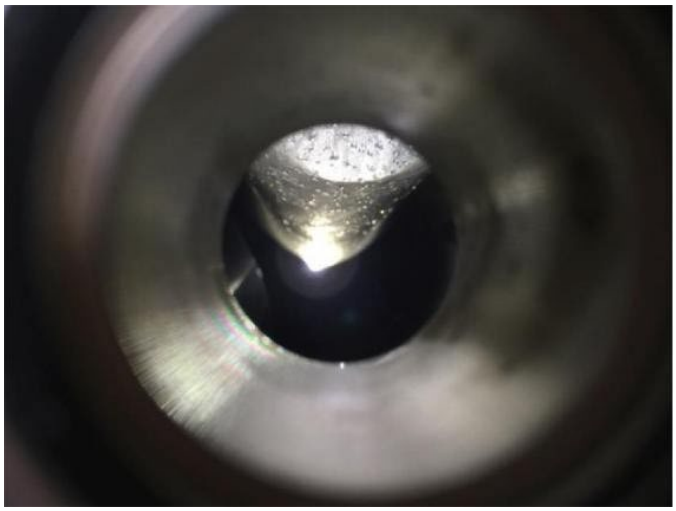
The blistering phenomenon may be of two kinds: macro and micro blistering.

Level 1

Macro Blistering

Macro blistering consists in one or more big blisters oriented towards the inside of the cylinder.
The blisters are caused by a depressurization inside of the cylinder (for example during a flight with no pressure in the cargo). This phenomenon, purely aesthetical, does not impair the correct functioning of the cylinder nor to any of its mechanical or sealing properties and, in any case, it does not affect the safety of the product.

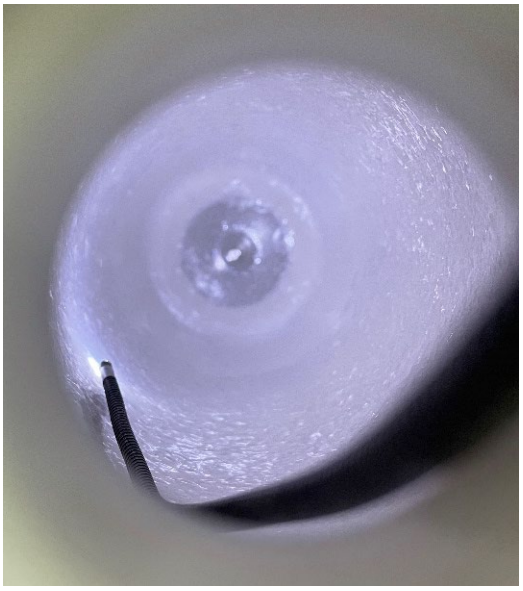
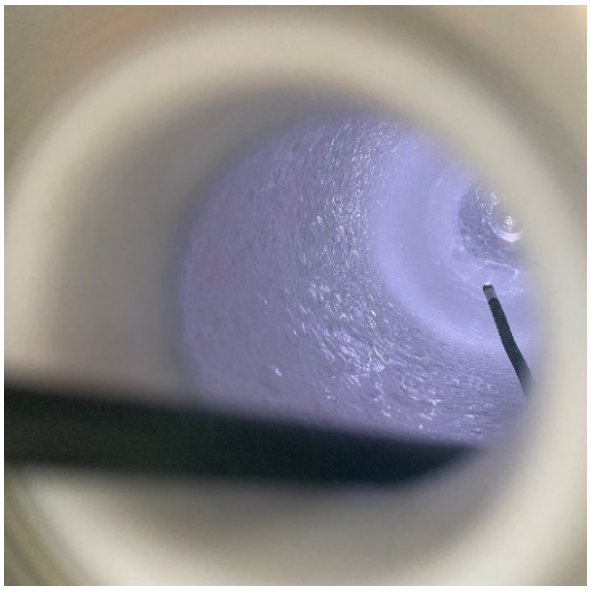
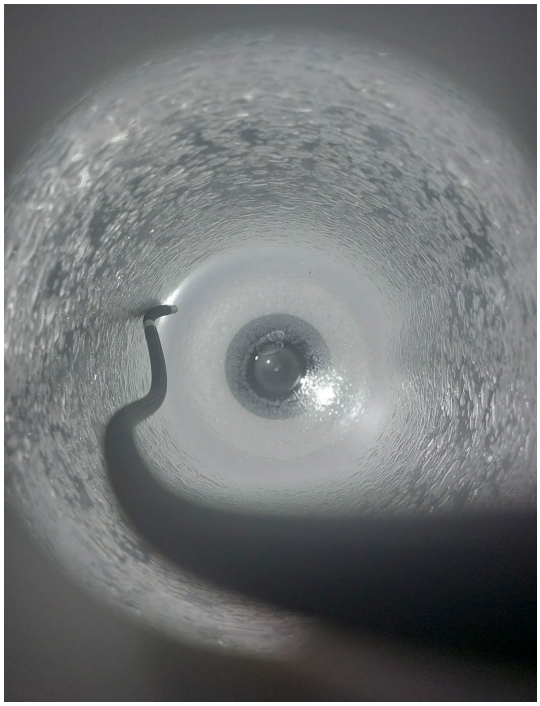
In fact, thanks to the high level of elasticity of the plastic material, in order to restore the correct shape of the internal liner, it is sufficient to fill the cylinder with breathing air at 3,2 - 4 gpm (about 12-15 l/min). Usually, it is sufficient to fill the cylinder at 725 psi (50 bar) but, in some cases, it is necessary to fill the cylinder up to the working pressure.



Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Micro Blistering

Micro blistering consists in micro blisters on the liner internal side.
This type of blistering is due to the permeation phenomenon: if a cylinder is kept charged for a long time and then is completely emptied, the air molecules, that were permeating from the inside of the cylinder to the outside through the plastic material, experience a molecular expansion creating the micro blisters on the internal surface of the plastic liner. This phenomenon, purely aesthetical, does not cause any problem to the correct functioning of the cylinder nor to any of its mechanical or sealing properties and, in any case, it does not affect the safety of the product.


CTS S.p.A. states once again that both macro and micro blistering are merely aesthetical phenomena that, in any case, do not affect or compromise the safety, the sealing and the correct functioning of the cylinders. The internal plastic liner has the only purpose of being gas-proof. All the mechanical properties of the cylinder are demanded to the outer composite shell.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

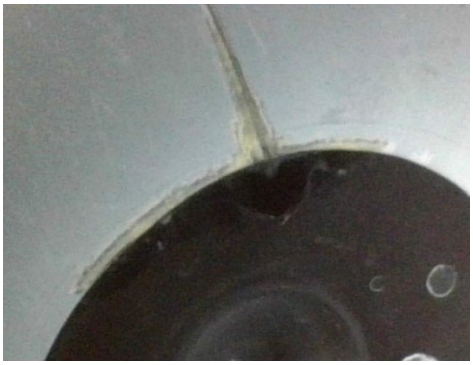
Blemishes

To facilitate internal inspection, the inner liner has a white cover, which covers the black background of the carbon. It is possible for this cover to become damaged over time, due to the movement of the liner during air charging and discharging.
This defect should only be regarded as cosmetic, as it does not affect the functionality of the cylinder.

Below are examples of a ruined white liner, revealing the carbon underneath:



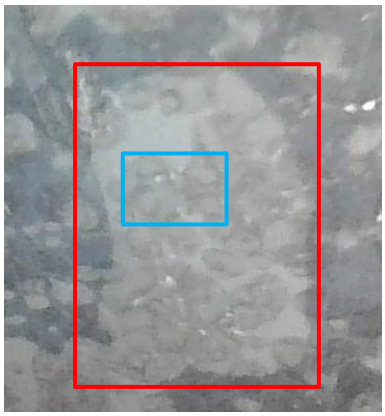
Small imperfections may already be present in the white liner cover. These do not constitute a problem and should be regarded as imperfections rather than defects, as they are only for internal inspection and do not affect the function of the cylinder.


It is also possible to detect another type of defect in the white cover, which can be mistaken for blistering. This is actually air bubbles between the white cover and the liner, not an air blister within the PET layers.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

It is important to note that this defect should not be confused with imperfections resulting from the production process, as illustrated above.



In red: white air bubble between white cover and liner
In blue: blistering

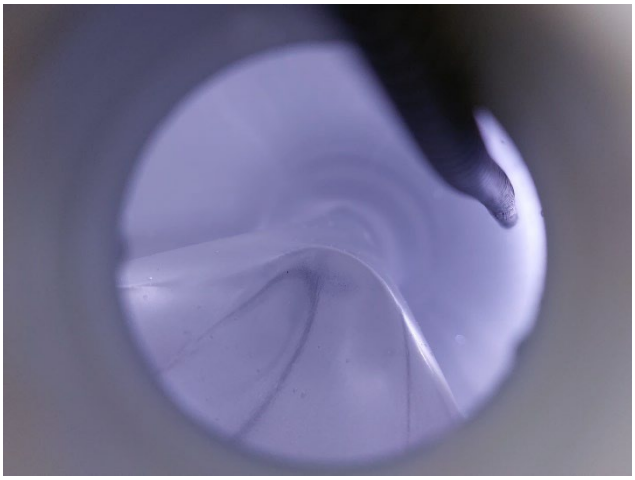
Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 2

Level 2 liner damage usually consists in one bulge towards the inside of the cylinder. It differs from the macro blistering by the fact that the bulge is not a blister, but a deformation of the liner itself.
These kinds of damages occur after the cylinder is subjected to a negative pressure (vacuum), please note that also an excessively fast cylinder emptying rate can cause local vacuum with subsequent liner damage.

This type of damage can be repaired by CTS S.p.A. or by authorized dealers.
Generally, this doesn't create issues to the cylinder, after filling it to 70-145 psi (5 - 10 bar) the PET liner reacquires its original shape. The intervention of CTS S.p.A. is necessary to assess if the liner has been damaged, performing hydrostatic and air leakage tests.



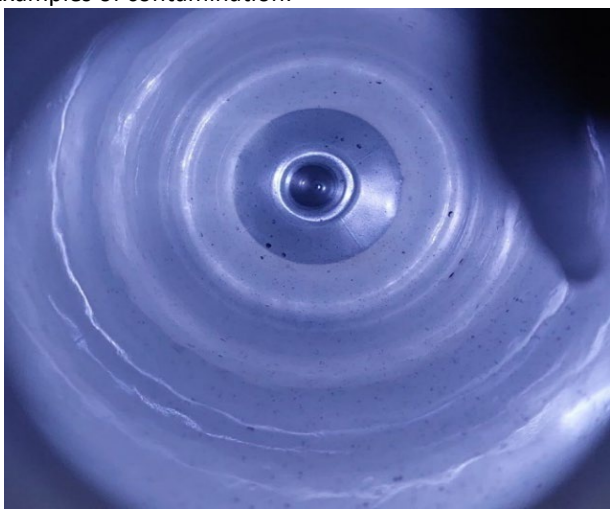
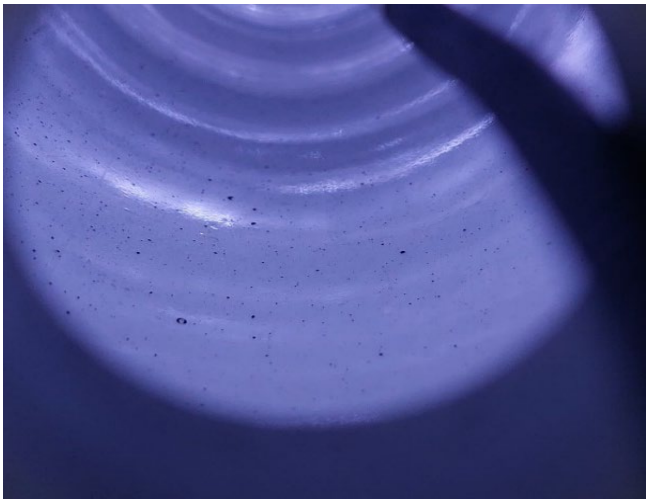



Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Contamination

The contamination of the liner falls into level 2 or 3, as it is not acceptable the presence of foreign matter or substances inside the cylinder.
Depending on the substance (and how it affects the material of the liner) and the severity of the contamination, the liner can be cleaned by CTS S.p.A. or be rejected, resulting in the decommissioning of the cylinder.

NOTE: Type IV cylinders need more precautions than cylinders with metal liners when cleaning. In fact, the internal liner cannot be exposed to a direct temperature higher than 140°F (60°C). The use of jets of hot water or hot air is strongly forbidden. Anyway, we suggest to let an authorized center or CTS S.p.A. itself carry out a survey on the contaminated liner.
Examples of contamination:

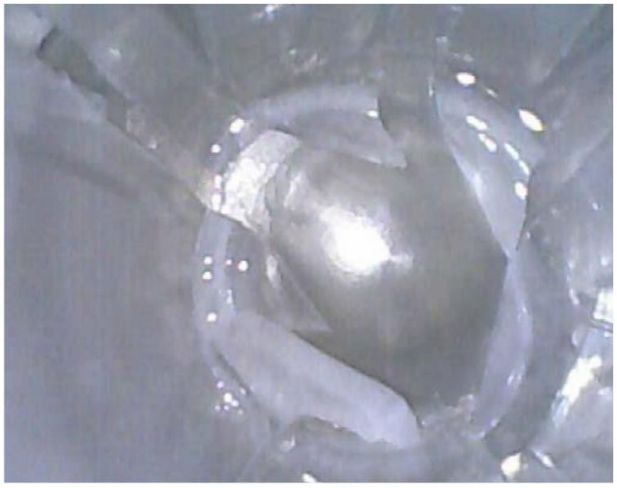



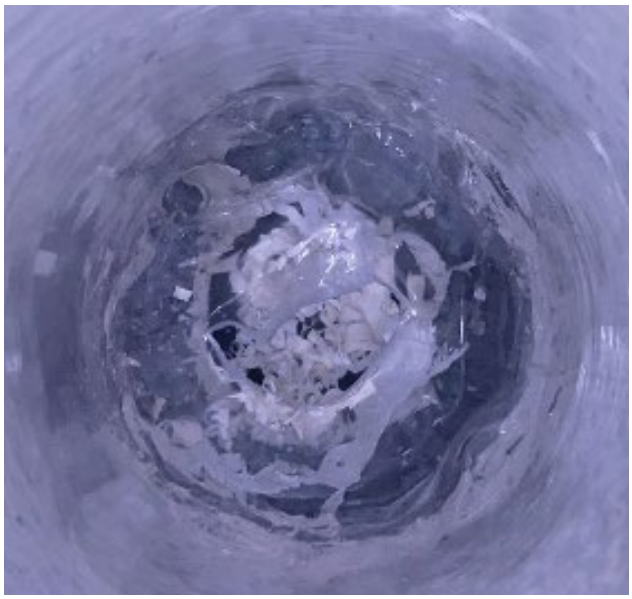
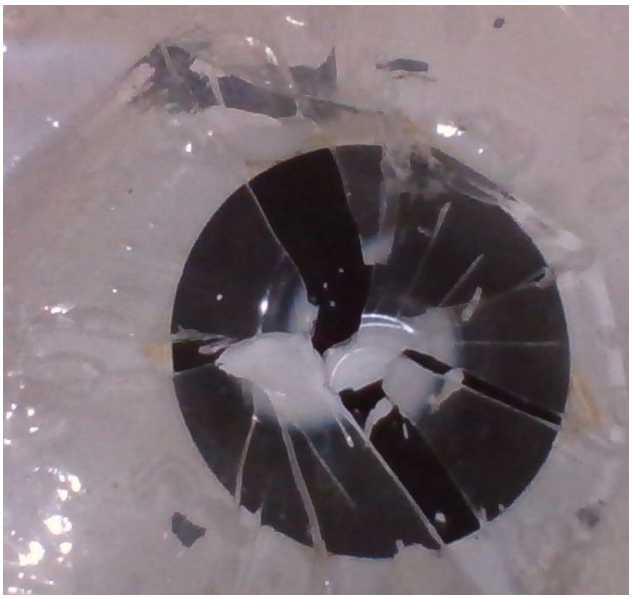
Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Level 3

The internal PET liner can be damaged after an incorrect use of the cylinder, i.e., filling or washing the internal surface with hot water, hot gases or with corrosive substances. The internal PET liner can be also damaged after a long exposure to very high temperature or to an aggressive environment, mainly when the cylinder is empty. This incorrect use leads to a leaking cylinder that cannot be used anymore.

Crystallization of the PET liner, result of a prolonged or internal exposure to high temperature, cracks on the liner or the collapse of the liner itself are most common level 3 damages.



Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

7.5 RMA PROCEDURE

CTS S.p.A. established a return merchandise authorization (RMA) procedure.

This procedure is issued once CTS S.p.A. receives a copy of the RMA form duly filled and signed. It is compulsory to send the filled in and signed form before sending the cylinders to CTS S.p.A.

Filling out and sending the RMA form via email are essential actions in order to be authorized for the delivery of the cylinders to CTS S.p.A. so that they can be repaired, substituted or analyzed. This is applicable whether the cylinders are still inside the warranty period or not.

It is possible to download the RMA form from CTS S.p.A. website www.ctscyl.com or request it via email at info@ctscyl.com

Cylinders sent without a filled and signed RMA will be rejected by CTS S.p.A.

8. STORAGE

Store the cylinder with the valve at room temperature in a dry place, away from chemical products, heat sources, and corrosive environments. The cylinder must be secured in a vertical or horizontal position to prevent rolling, swaying or tipping. Particular attention must be paid to the proper protection of the valve to avoid damage.

To prevent external contamination and/or damage to the inner plastic liner, all Type IV bottles should not be stored without any pressure.

9. SHIPMENTS

Title 49 of CFR §173.301 provides all of the general requirements for transporting compressed gas cylinders. Empty compressed gas cylinders are not considered hazardous if they meet the following criteria:

- The cylinders only have residue of division 2.2 gasses (including compressed air)
- The division 2.2 gas is neither ammonia and anhydrous (Not applicable in CTS breathing air cylinders)
- No subsidiary hazards regarding the gas (Not applicable in CTS breathing air cylinders)
- The pressure gauge indicates a pressure of <29.0 psi (about 2 bar) at 68 °F (about 20°C)
- The packaging material is not a hazardous substance, waste or marine pollutant

Empty cylinders that carry division 2.2 gas that meet these criteria can be shipped without having to follow hazardous material regulations (HMR) of DOT.

Also note that type 4 cylinders should always have a minimum internal pressure of 29 psi (2 bar). This is required for keeping the cleanliness and internal hygiene of the cylinder.

The additional international Standards or Codes that classify the goods as dangerous or not dangerous, and that regulate their transport, are:
ADR for land transport, *ADN* and *IMDG* for ship transport, *RID* for railway transport and *IATA* for air transport.
The *ADR, ADN, IMDG* and *RID* regulations allow the carrying of breathing air cylinders (and other gases that are part of the same group) with an internal pressure of maximum 29 psi (2 bar) without that transport being classified as dangerous and therefore transportable without special care.
The *IATA* regulation states that the gas compressed air transport is always to be considered, and must always be handled, as a dangerous material transport, even if the cylinders are stored at a pressure of only 29 psi (2 bar). It is for this reason that CTS S.p.A. recommends its customers to follow the instructions given below, so that the cylinders are not to be shipped as dangerous goods, but at the same time use the cylinders in the best possible way.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

Table 2. Method of transport allowed by the regulations

	Type of transport			
Method	**Trucking**	**Ship**	**Train**	**Air**
Figure 4	X	X	X	-
Figure 5	X	X	X	-
Figure 6	-	-	-	X
Figure 7	-	-	-	X

Fig.4: Cylinder with valve and internal pressure of 29 psi

Fig.5: Cylinder with valve and internal pressure of 29 psi

Fig.6: Cylinder with cap and without internal pressure

Fig.7: Cylinder with open valve and anti-tampering tape

CTS S.p.A. recommends, where allowed, to always keep an internal pressure of 29 psi (2 bar).
In the case where transport in pressure would not be allowed (e.g., air transport), it is recommended to carry out the following operation in the first three/four hours after receiving the cylinder:

1. Fill the cylinder with at least 725 psi (50 bar) of breathable air according to Standard CGA G-7 and G7.1
2. Empty the cylinder with a recommended emptying speed of 69 gpm (260 litre per minute) maximum
3. Fill the cylinder with a small amount (14,5 – 29 psi or 1 – 2 bar) breathable air according to Standard CGA G-7 and G7.1 to store it, otherwise load it at working pressure to have the cylinder ready for use.

10. SCRAPPING AND DISPOSAL

Cylinders that may be dangerous or which identity label cannot be easily read must be immediately REJECTED.
To SCRAP SAFELY a cylinder and make it UNUSABLE, drill a hole through the cylinder structural wrapping and liner. Proceed as follows:

- Ensure the proper functioning of the valve
- Make sure that the cylinder is COMPLETELY EMPTY: slowly open the valve to release all the air contained in the cylinder and leave the valve open.
- Remove the valve only if it proves necessary to the operations of disposal of waste by type, otherwise leave it installed
- Lock the cylinder body on a suitable locking device (workbench with bench-vice), wear personal protective equipment suitable for drilling such as gloves, goggles, safety shoes, etc.
- Drill a small diameter hole (e.g., 0.3 in (6mm)) on the cylindrical part of the cylinder
- Properly dispose according to the applicable regulation

CTS cylinders are made of: carbon fibers and/or glass fibers and/or aramid fibers, aluminum and/or steel, rubber and/or polyester. They can be recycled. DO NOT DISPOSE INTO THE NATURAL ENVIRONMENT.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com

11. USE AND MAINTENANCE SUMMARY

DO'S:

- **Do** keep the threads and cylinder interior dry and clean
- **Do** fill the cylinders only with breathable air complying with Compressed Gas Association (CGA) G-7 and G-7.1 standards.
- **Do** always comply with the testing terms
- **Do** inspect cylinders exposed to fire or high temperature environment for prolonged time
- **Do** follow both valve manufacturer's and CTS' installation and disassembly procedures
- **Do** always discharge slowly the cylinder to limit the onset of blistering and to maintain the plastic liner healthy
- **Do** use clear water to perform hydrostatic tests

DON'TS:

- **Don't** use valves with sintered filter
- **Don't** discharge the cylinder until it reaches 0 psi (0 bar) or less
- **Don't** store the cylinder without any pressure, to keep the plastic liner healthy
- **Don't** fill the cylinder with a pressure higher than 110% of the operating pressure (PW)
- **Don't** use the cylinder with a pressure higher than the operating pressure (PW)
- **Don't** discharge the cylinder quickly or create vacuum inside the cylinder
- **Don't** directly expose the inner liner to temperatures above 145°F (65°C)
- **Don't** clean the interior of the cylinder by rolling inside chips, balls or other solid materials mixed with water.
- **Don't** use chemicals that are not compatible with PET to clean the inside of the cylinder
- **Don't** tamper with the surface protections (end caps, protective sheathings, painting, changing the labels identifying the manufacturer)
- **Don't** use a cylinder that has been exposed to flames and has not been retested
- **Don't** use a cylinder that has been attacked by chemicals.

Composite Technical Systems S.p.A.
Via Monsignor Faidutti, 9 - 33048 Chiopris-Viscone UD, Italy
Phone: +39 0432 991383 | info@ctscyl.com | www.ctscyl.com
VAT No 01155920323 | R.E.A. UD 273252 | Share Capital: € 1.000.000,00 | PEC: cts@pec.ctscyl.com