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THE NEXT GENERATION OF

COMPOSITE LPG CYLINDERS

USER MANUAL

Guide to the use, maintenance and periodic inspection of loW8 Composite LPG Cylinders

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1 Introduction

The loW8 technology combines the best of the conventional steel cylinders and conventional wet-wound composite cylinders.

A patented dry filament winding technique is used for the loW8 cylinders. This implies that for the fibres, for instance aramid or carbon, no resin is used for impregnation as is done for conventional composite materials. The fibres are loaded in tension only and therefore no resin is required to transfer shear loads. High production speeds can be obtained, and a clean production process is achieved with no need of post-curing resins.

A HDPE plastic liner is used which is made sufficiently gas tight and has the appropriate shape for filament winding the dry fibres. In house software "PresVes" is developed for design and analysis of the filament winding pattern and generation of the required machine control parameters.

The end boss or insert for mounting the valve is designed such that upon applying torque onto the valve, the torque is not introduced into the liner; instead, the insert starts rotating and prevents the liner from damaging. The closure design is such that gas tightness is still guaranteed during rotation. This is referred to as the Torque-Free™ design of the loW8 cylinder.

The design lifetime of loW8 cylinders is unlimited. Nevertheless, like all compressed gas equipment components, cylinders must be well maintained and properly used. This guide is intended to assist trained personnel in safely operating, valving, and inspecting loW8 cylinders.

It is fundamental to follow this manual before manipulation of the cylinders, but also is important to consider all applicable filling guidelines, regulations, requirements and laws of all appropriate local and/or national authorities and industry organizations.

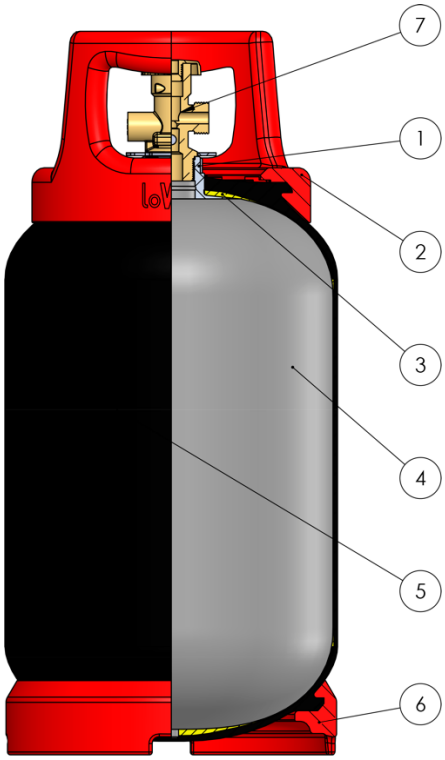
1.1 Distribution and proper use of the manual

This document must be provided to all parties involved in distributing, handling, inspecting and using loW8 cylinders. The manual may be reproduced to provide sufficient copies for this purpose, but its contents must not be altered in any way. loW8 accepts neither responsibility nor liability for consequences resulting from unauthorized alternations to this manual or for failure to follow the instructions herein.

1.2 Applicability

This manual applies to loW8 cylinders used in the storage of liquified petroleum gas (LPG).

2 Product description

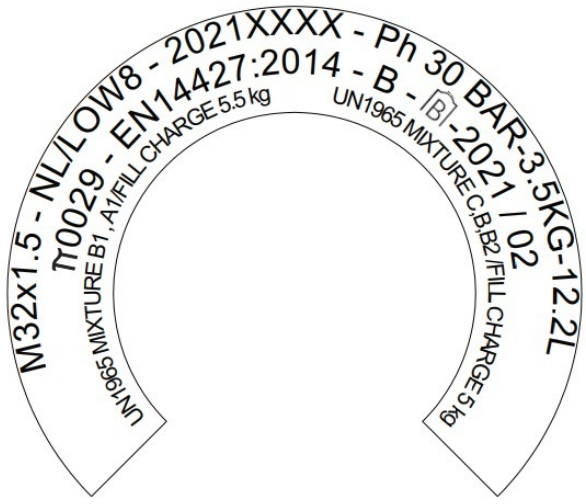


1	Insert
2	Handle
3	Fibers
4	Liner
5	Coating
6	Footring
7	Valve

3 Cylinder identification and labels

3.1 Label

The label with marking specific for the EN 14427:2014 is shown below:

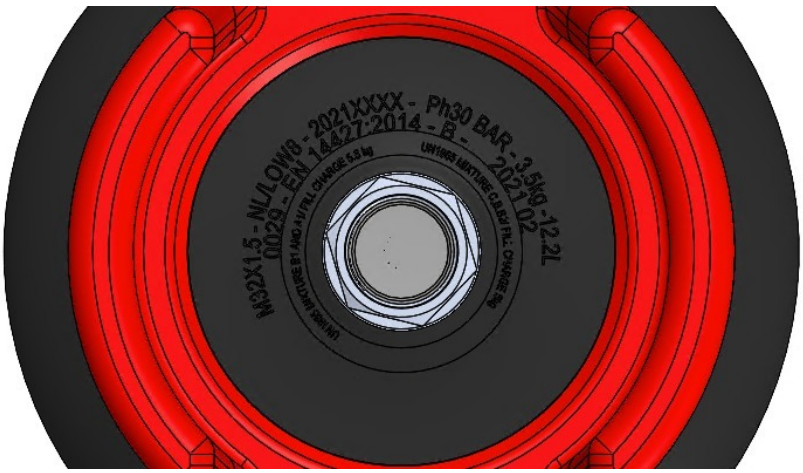


The explanation of the content:

- Row 1: thread – country of manufacturer – manufacturer – serial number - test pressure – tara mass cylinder – volume capacity.

- Row 2: Pi-mark notified body (NB)– standard – country NB – logo NB – production year and month.
- Row 3: Mixture- Fill charge.

The marking text is laser engraved on the top of the polyurethane coating as it is shown below:



3.2 Next periodic inspection

The date (year) of the next periodic inspection is required by ADR 2021 : §5.2.1.6

The label is manufactured in resistant plastic and placed between the valve and the insert avoiding any possible removal of it. An example of the label is shown below:

3.3 Vacuum condition and valve torque

The cylinder has a non-load bearing liner which deforms too much in case of an under pressure. According to the standard, the following text need to be marked clearly, legibly, and indelibly on the cylinder:

"WARNING – THIS CYLINDER MUST NOT BE SUBJECTED TO A VACUUM OR BE FILLED WITH BUTANE"

The restriction on the torque for mounting a valve is 110Nm.

"MAX. TORQUE 110Nm"

The Vacuum restriction text and the maximum torque text is located on the handle as it is shown below:

4 Operating conditions

Properties	Value	Unit
Test pressure	30	bar
Capacity	12.2	litre
Nominal height	500	mm
Nominal outside diameter	241	mm
Nominal liner diameter	224	mm
Average cylinder mass excluding valve	3.5	kg
Type of fibre	Aramid	-
Range of temperature	-40°C to 50°C	°C
Type of thread	M32x1.5	-
Max. Torque on valve	110	Nm
Design life	unlimited	-

The following relevant pressures for the cylinder are defined:

- p_w : working pressure
- p_h : test pressure
- $p_{b\ min}$: minimum design burst pressure

The relevant values for the pressures for the 5kg loW8 cylinder are listed in below.

The pressures are determined as follows:

- The test pressures is p_h = 30 bar.
- The working pressure p_w is defined as $½ \cdot p_h$.

- The minimum design burst pressure p_{bmin} is defined as $2.25 \cdot p_h$

Working pressure	p_w	15.0 bar
Test pressure ($2 \cdot p_w$)	p_h	30.0 bar
Minimum design burst pressure	$p_{b\ min}$	67.5 bar

4.1 Mixtures

The allowed mixtures and maximum fill grades according to the ADR 2021are given in table below. The other mixtures for UN1965, Mixture A (butane), Mixture A01, A02 and A0 are not allowed due to the risk of under pressure. Non-permanent deformation may occur in that case. The required labels to warn against the use of butane and mixtures are placed on the cylinder.

	Maximum [kg/litre] ADR 2021	Fill Grade [kg]
UN 1965 Propane C	0.42	5.1
UN 1965 Mixture B	0.43	5.2
UN 1965 Mixture B2	0.44	5.4
UN 1965 Mixture B1	0.45	5.5
UN 1965 Mixture A1	0.46	5.6

5 Cylinder handling and storage

5.1 Handling

To prevent cylinder damage, IoW8 recommends the following:

- Only handle IoW8 cylinders with appropriate lifting devices and equipment that will not cause damage.
- Do not drag, drop or roughly handle cylinders.
- Protect cylinder labels to ensure legibility.
- When transporting a valved cylinder, protect the valve and properly secure the cylinder. Never handle cylinders by their fittings, valves, pressure relief devices or piping.

5.2 Storage

IoW8 cylinders must be stored in a dry environment away from direct sunlight (UV radiation), chemicals, heat sources and corrosive environments. Protect cylinders from any contaminants and damage.
Install plugs and/or valves and O-rings intended for use according to the valve manufacturer's recommendations.

6 Valving

6.1 General

Only trained and qualified personnel shall be allowed to carry out valving or re-valving.

The valves that can be used for LoW8 cylinders are supplied by SCG from Thailand.

Please check if the valve is fitted with a so called Anti Static Device. This part should be made out of Brass (no plastic!)

Since the patented Rotating Coupling avoids over torqueing of the end boss, special care should be taken when valving or de-valving the LoW8 cylinder.

6.2 Clamping during (un-)valving

Clamping equipment to keep the cylinder in place during valving is NOT needed, since the torque applied shall be compensated by a special tool applied directly to the metal end boss.

6.3 Handling of Valves with LoW8 parallel threads an O-ring seal interface

Use only valves with LoW8 special parallel threads and O-ring seal interface

1) Remove (if applicable) the valve by first attaching the special wrench to the End Boss and only then rotate the valve counter clock wise as for traditional steel cylinders
2) Check the O-ring and threads on the valve for dirt and damage. See also "inspection of threads" below. Check O-ring groove for damage or dirt.
3) Check the thread and sealing area on the inside of the End Boss and plastic machined part for dirt and damage
4) Apply grease onto the O-ring all around the circumference. The grease should be compatible with propane and not contain silicon.
5) Insert the valve by hand and be sure the threads enter properly by screwing it a couple of turns
6) Tighten the valve by controlled torque to 40-55Nm
7) The operator might choose to apply a thread locking fluid/tape to assure semi-permanent fixation. If so LoW8 recommends Locite (242 or Quick Tape 249) or equivalent. Adding thread locker will not create a permanent seal, nor should it create a gas tight seal. Only the LoW8 O-ring solution will assure a permanent gas barrier.

6.4 Inspection of cylinder threads

This inspection is only relevant in the case of removing the valve due to other required inspections. In general, it should be avoided.

6.4.1 Threads

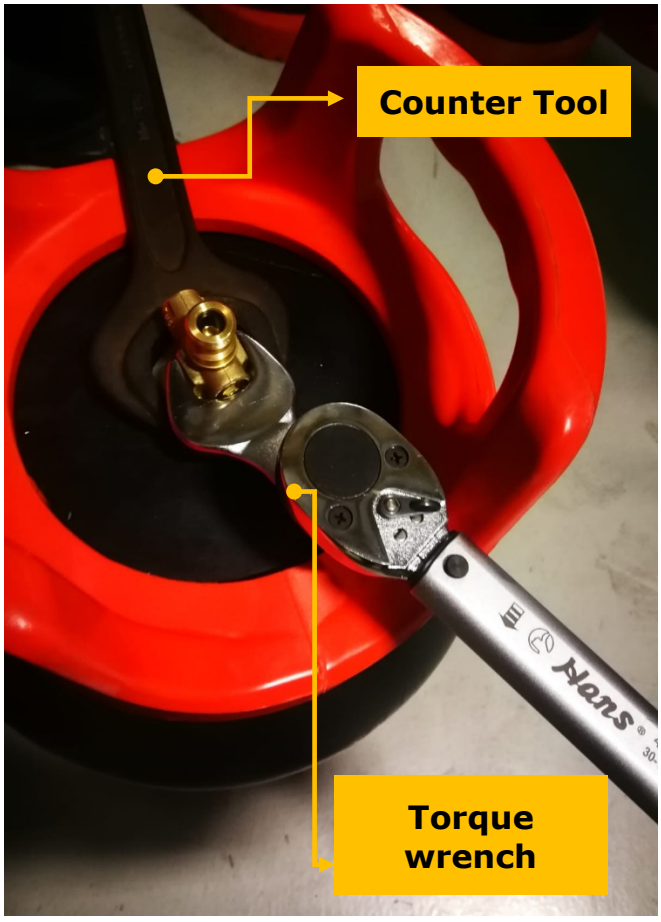
Where the valves (or any other fittings) are removed during requalification, the cylinder threads concerned shall be inspected

6.4.2 Internal threads

The internal threads of the cylinder shall be examined to ensure they are undamaged and clean. They shall be checked for burrs, cracks, and other damage. If applicable, check that thread locking fluids/tapes are completely removed. Check O-ring for damage or deformation

6.4.3 Damaged threads

Where necessary, and where the design permits, damaged threads may be rectified by a competent person. Alternatively, the cylinder shall be scrapped.



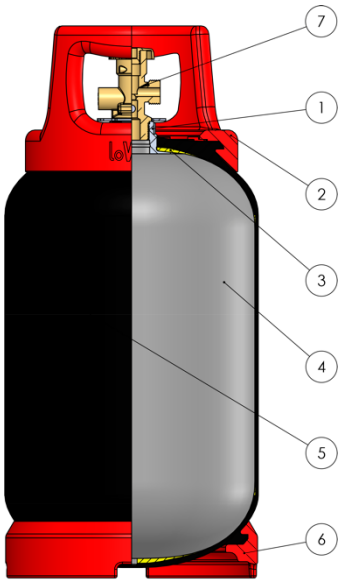
Torque wrench on valve when counter tool applied to End Boss.
Only then apply Torque!

7 Visual Inspection

7.1 Components to be visually inspected

The components of the loW8 cylinder which need to be inspected are:

- Handle (2)
- Foot ring (6)
- PU coating (5)
- Insert (1)



7.2 Potential defects

Potential defects in the handle:

- Tear(s)
- Permanent deformation
- Blisters
- Holes
- Disconnected regions

Potential defects in the foot ring:

- Tear(s)
- Permanent deformation
- Blisters
- Holes

Potential defects in the PU coating

- **Scratch**: defined by an irregularity which is clearly visible and has a certain depth. However, no material has disappeared. See Figure 1 and Figure 2.
- **Blister**: defined by an irregularity generally caused by heat. No material has disappeared. See Figure 3. Note: Any loose material should be removed. It can be the case that a blister becomes a hole.
- **Abrasion**: material thickness has been reduced due to an abrasive action; see

- Figure **4** and Figure 5. The severity must be determined prior to accepting / rejecting the cylinder.

In case the underlying Aramid fibers are visible for all defects, the Low8 cylinder body with the PU is rejected and cannot be repaired anymore.

Figure 1: Scratch (no visible fibres)

Figure 2: Scratch (with visible fibres)

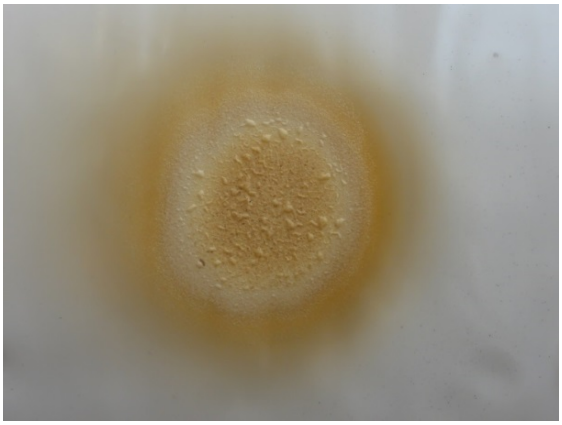


Figure 3: Blister (no visible fibres)

Figure 4: Abrasion damage (no visible fibres)

Figure 5: Abrasion damage (with visible fibres)

Figure 6: Cut damage (with visible fibres)

Potential defects in the end boss or insert:

- Corrosion
- Dents
- Holes

7.3 Visual inspection procedure

The visual inspection procedure for the components is given in the table below. The potential defects are mentioned and actions as a consequence of the observation are given. More than 2 errors in a single cylinder mean cylinder rejection immediately.

Step	Component	Defects	Observation	Action
1.	**Handle**	Tear(s)	-	-
		Permanent deformation	More than 15mm of the nominal contour	Replace
		Blisters	-	-
		Holes	Through material	Replace
			Larger than 15x15mm	Replace
		Disconnected regions	If exists	Replace
2.	**Foot ring**	Tear(s)	Through material	Replace
		Permanent deformation	More than 15mm of the nominal contour	Replace
			Deviation cylinder from vertical ≥5°	Replace
		Blisters	-	-
		Holes	Through material	Replace
3.	**PU coating**	Scratches	Visible fibres	Reject cylinder
			No visible fibres	Repair
		Blisters	Visible fibres	Reject cylinder
			Larger than 25x25mm	Reject cylinder
			No visible fibres	Repair
		Holes	Visible fibres	Reject cylinder
			No visible fibres	Repair
4.	**Insert**	Corrosion	-	-
		Dents	Affected thread	Reject cylinder
		Holes	Depth hole ≥5mm	Reject cylinder
			Larger than 5x5mm	Reject cylinder

8 Maintenance

8.1 Repair procedure for PU coating

The PU coating can be repaired according to the following procedure:

1. Remove any loose material
2. Degrease the surface
3. Use PU mixing unit to dispense the PU material in a plastic cup
4. Carefully poor the liquid PU into the cleaned damaged area
5. Cover up the liquid material with PE foil and fixate it with tape. Make sure to tightly stretch the foil to guarantee a smooth repair
6. Let the material cure for 1 hour
7. Remove PE foil and tape
8. Inspect the repair and accept / reject the cylinder
    a. Check bondage of new coating layer; the new layer should be impossible to remove. When the patched area is able to be removed. The repair strategy must be repeated.
    b. Check for newly occurred holes / blisters inside the repair. When holes / blisters are present, the repair strategy must be repeated.
    c. Check for surface smoothness. A smooth transition between the repair and the rest of the surface is required. If not, remove the patched area and the repair strategy must be repeated.

8.2 Replace procedure of Handle & Footring

The Handle& Footring can be replaced according to the following procedure:

1. Place the complete cylinder in the oven(@70ºC)
2. Wait until the material reach the desired temperature
3. Remove the handle or the footring
4. Place a new Handle and footring as done during production
    a. Preheat a new set of Handle and footring
    b. Place the footring in the floor (In the correct position)
    c. Place a coated body on top and push downwards
    d. Rotate the footring a couple of times for ensuring correct placement
    e. Place the handle on top of the theacte body and click on the click rings
    f. Rotate the handle a couple of times for ensuring correct placement
5. Reject and discard the damaged handle or footring.

9 Recommendations

ALWAYS:

- Always be alert for leaks with each fill. Always keep the threads and cylinder dry and free from oil, dirt and other contaminants.
- Always fill cylinders with the proper gas. Always follow inspection recommendations.
- Always follow the valve manufacturer’s installation procedures and recommendations.

NEVER:

- Never fill a cylinder if it leaks. Never fill a cylinder with a defect.
- Never fill or partially fill a cylinder with any gas not identified on the label.
- Never artificially heat your cylinder.
- Never fill a cylinder that is past its required periodic recertification inspection date.
- Never remove, obscure or alter a manufacturer's labels or stamped markings. Never use a cylinder after it has been exposed to an extremely corrosive atmosphere or environment, without having it pass the periodic recertification inspection.
- Never use a cylinder that has been involved in a traffic accident or a fire.