

247951

RSPA-2001-9731-5

Please docket
Add'l Info



Document No.: 0147230-812
Dokument Nr.:

Page 1 of 15
Side

12706

Registered copies / Registrerte kopier :

YES / JA

NO / NEI

Title / Tittel:

**RAC 5kg and 10kg LPG Composite Cylinder
Instruction for retesting
versions 110002-000, 147230-900, and similar**

2003-03-19
DEPT OF TRANSPORTATION
LITHIUM

Distribution / Distribusjon :

Internal / Internt :
Archive

External / Eksternt :
Different customers, filling stations, companies performing retest and authorities

Key words / Nøkkelord :

Revision :	Date :	Prepared by :	Approved by :	Released by:	Ref.
Revision :	Dato :	Utarbeidet av :	Godkjent av :	Frigitt av :	EM - ECO :
	2001-03-20	Ola Johnsrud	Rune Ulekleiv	Ola Johnsrud	
A	2001-04-04	Ola Johnsrud		Rune Ulekleiv	NA
B	2002-05-03	Ola Johnsrud		Rune Ulekleiv	NA
C	2002-10-14	Ola Johnsrud		Rune Ulekleiv	NA
D	2003-05-15	Ola Johnsrud		Rune Ulekleiv	

The document is revised due to splitting the "inspection before, during, after filling" and "Retesting" into to separate documents. The "Inspection before, during, after filling" document is called 1300-813 "RAC 5kg and 10kg LPG Composite Cylinder, Refilling of versions 110002-000, 147230-900, and similar".

This document is RAGASCO specific guidelines for handling this particular product. The content is totally based on the work done by CEN TC286 WG7 (Operations), documents used as input to the meeting 2003-03-19 and -20. This document will be updated iaw the progress in WG7.

RA 724.05

95.01.01

1 Content

1	Content	2
2	Summary and background	3
3	General information	3
3.1	The company.....	3
3.2	The product.....	3
3.3	Material and assembly details:.....	3
4	Inspection for retesting RAC 10kg LPG composite cylinder	4
4.1	General	4
4.2	Special consideration.....	4
5	Definitions	4
5.1	Competent body.....	4
5.2	Competent person.....	4
5.3	Periodic inspection:.....	4
5.4	Periodic inspection test station:.....	4
6	Written scheme of inspection	4
7	Procedures for Periodic Inspection	4
7.1	General	4
7.2	External Visual Inspection	4
7.2.1	Preparation.....	5
7.2.2	Inspection procedure.....	5
7.2.3	Visible defects.....	5
7.3	Additional Inspection /Test Procedures.....	6
7.3.1	Hydraulic Proof and Leakage Test.....	6
7.3.2	Pneumatic test.....	7
7.3.3	Leakage test	7
7.4	Internal visual inspection	7
7.4.1	Preparation of cylinders	7
7.4.2	Procedure.....	7
7.5	Additional test procedures.....	7
7.5.1	Hydraulic proof and leakage test.....	7
7.5.2	Pneumatic proof and leakage test.....	8
7.5.3	Leakage test	8
8	Inspection of cylinder threads	9
8.1	Threads.....	9
8.2	Internal threads	9
8.3	External threads	9
8.4	Damaged threads.....	9
9	Final operations	9
9.1	Drying and cleaning	9
9.2	Purging.....	9
9.3	Retaring	9
9.4	Revalving	9
9.5	Marking	9
9.6	Reference to next requalification date.....	9
9.7	Identification of contents.....	9
10	Rejection and scrapping of cylinders	10
11	Annex A - Types of damage of cylinders and casing	11
12	Annex B - Requirements for 10-year periodic inspection interval	15

2 Summary and background

This document is a guideline for retesting the RAC 10kg LPG Composite Cylinder, versions 0147210-900, 147230-900, 110002-000 and all RAC cylinders similar to those baselines. The instructions are based on experience from the type approval test program (iaw CEN 12245, ISO 1119-3.2 and drop testing iaw prEN 14427:2002Apr), on experience from manufacturing approximately 500.000 cylinders and experience from use in the marked.

This document focuses on the topics that are special for the composite cylinder testing. The main difference will be at visual inspection inside and outside the cylinder. All other tests are to be performed as for normal steel cylinders.

3 General information

3.1 The company

RAGASCO AS is located in Raufoss industrial park, about 100km north of Oslo, together with Norsk Hydro, SAPA, Nammo and other companies within the Raufoss Group.

The company has more than 15 years of experience with developing and manufacturing fibre reinforced pressure cylinders for markets that acknowledge the special characteristics of composite materials - lightweight, high strength, especially good behaviour in fire, corrosion resistance to mention some.

The main activities today are

- Developing and manufacturing tubes for rocket motors and small high pressure bottles for use in various NATO defence systems
- Manufacturing cylinders for cars, trucks and busses.
- Raufoss Composites is the main contractor for development of prototype risers – that is tubes for transporting oil from the seabed to platforms or production ships.
- The company manufactures the new LPG composite cylinders (COMPLET).

3.2 The product

Compleat is an innovative LPG composite cylinder targeted mainly toward the leisure market. It can be used for cooking and heating, in caravans and cottages, barbecues, kitchens aso. Main advantages are

- Light weight
- Translucent wall.
- Very good behaviour in fire
- Corrosion resistant
- Easy to handle and stackable
- The valve is very well protected from impact
- It's easy to clean
- And the material is UV-stable with a tough surface to withstand the environmental effects from sun, rain, temperature variations and handling.

3.3 Material and assembly details:

- RAGASCO type 4 (all composites) cylinder for 5kg/10kg LPG.
- Inner liner: HDPE. Blow moulded. 12.2/ 23.8L. Typical burst pressure: 4, 10 litres expansion.
- Boss (interface between liner and valve): HDPE with 20-30% glass fibre, hotplate welded to the liner.
- Composite: 75% glass fibre (two types). Resin based on vinyl ester.
- Standard valves used in very large numbers. Threads modified to cylindrical.
- Outer casing: HDPE. Injection moulded. Covering 80% of the composite cylinder. Protects the valve.
- All production is highly automated and controlled by PLC's and PC's. A suitable number of manufacturing- and test parameters will be collected for each individual cylinder.

4 Inspection for retesting RAC 10kg LPG composite cylinder

4.1 General

Acceptance criteria's given in this document shall not replace official rules/standards. They are to be regarded as RAGASCO recommendations directly related to the properties of the actual product.

Authorised personnel only are allowed to carry out the testing.

4.2 Special consideration

- As a rule of thumb, always handle the cylinder carefully, both due to safety and visual appearance.
- Impact from drop higher than 1,5 m shall lead to the cylinder being inspected by authorised personnel.
- Do not expose the cylinder to temperatures higher than 65°C.
- Do not wash the cylinder with solvents or strong acids.
- Due to low electrical conductivity, we recommend the filling operator to evaluate the need of special caution during the filling procedure, f.ex. adding water to the cylinder surface. Do not use it as a part of the filling equipment earthing system.

5 Definitions

For the purpose of this standard the following definitions shall apply:

5.1 Competent body

person or corporate body defined by the national authority, which by a combination of appropriate qualification, training, experience and resources is able to make objective judgements on the subject.

5.2 Competent person

person who by a combination of training, experience and supervision is able to make objective judgements on the subject.

5.3 Periodic inspection:

Activities carried out at defined intervals, such as examining, measuring, testing or gauging the characteristics of a cylinder and comparing these with specified requirements as defined in WI59 and marking to attest conformity.

5.4 Periodic inspection test station:

A place where cylinders are tested and requalified .

6 Written scheme of inspection

Cylinders shall be periodically inspected in accordance with a written scheme of inspection approved by a competent body. The scheme shall specify the interval between inspections and the procedures to be employed.

The interval between periodic inspections shall be 10 years providing conditions of Annex B are fully met. A 5 year interval shall apply if any of the conditions are not met as specified in Annex B.

The inspection procedures to be applied shall be selected from the alternatives given in 5.

7 Procedures for Periodic Inspection

7.1 General

In all cases, procedures for periodic inspection shall consist of an external visual inspection as described in 5.2 and additionally at least one of the procedures listed in 5.3

7.2 External Visual Inspection

The acceptance of the container during retesting is to be based mainly upon visible investigation of the outer casing and the parts of the pressure cylinder without protection. The container including outer casing is to be regarded as one total system where every product part is necessary to retain all safety properties. While the outer casing is made of a material softer than the composite cylinder, all "life-time history", as for example damage from drop, will be shown on the outer casing. Investigation of the outer casing and the composite material in the open

slots of the casing should be the base for visual inspection. If changing the casing due to maintenance, both the casing and the inner cylinder must be inspected.

7.2.1 Preparation

If required the cylinder shall be cleaned and have labels, tar oil or other foreign matter removed from its external surface e.g. by water jet cleaning, chemical cleaning or other suitable methods. The outer casing shall be kept on during inspection. Care shall be taken to avoid damaging the cylinder.

7.2.2 Inspection procedure

The entire surface of the cylinder shall be inspected for:

- a) Cuts, gouges, bulges, cracks or delaminations applying the guidelines for acceptance/rejection criteria in table 1.
- b) Other defects e.g. depressed bung or fire damage applying to the guidelines for acceptance/rejection criteria in table 1.
- c) Integrity of all permanent attachments.

Any cylinder rejected by the competent person shall be segregated for reconditioning or scrapping.

7.2.3 Visible defects

Rejection criteria guidelines for physical and material defects on the cylinder shell/casing are contained in the acceptance/rejection criteria in Table 1.

Table 1 —Acceptance/Rejection criteria

Type of damage	Description	Rejection limits
Abrasion damage or damage from cuts	Abrasion damage is caused by wearing, grinding or rubbing material away by friction, see figure 1, Annex A. Cuts or gouges are caused by contact with sharp objects in such a way as to cut into the composite, reducing its thickness at that point, see figure 2, Annex A.	<ul style="list-style-type: none"> — Depth: more than 10 % of composite overwrap thickness or — Total length of cut(s): more than 50 % of diameter of cylinder or — Damaged area: maximum diameter more than 50 % of the diameter of the cylinder. <p>Note 1: the maximum diameter of the damage area is the diameter of the smallest circle that includes the damaged area.</p> <p>Note 2: Intra-laminar hairline cracks (between fibres, typically on the circumference after proof testing) is allowed if not in combination with impact damage.</p> <p>Note 3: Scratches that do not sever a fibre are not included in the above.</p>

Instruction for retesting RAGASCO 5kg and 10 kg LPG composite cylinder

Delamination and impact damage	<p>An Inter-laminar delamination is a separation of layers of strands^a. An intra-laminar delamination is a separation between strands within the same layer^b. Impact damage may appear as hairline cracks in the resin or delamination or cuts of the composite^c.</p>	<p>Impact damage that has caused surface damage including delamination, is not acceptable. Impact damage made by a pointed object that has caused delamination and surface damage is not acceptable. A delamination that runs through more than one layer is not acceptable. For a bulge (cavity) internally in the composite overwrap, the maximum diameter of the bulge shall not exceed 10% of the composite thickness. Any bulge in combination with outer damage is not acceptable. A delamination that is not in combination with outer damage and not covering more than 30 % of the cylinder is acceptable. No fibre strands shall be cut. Areas with no adhesion between liner and overwrap are not to be regarded as delaminated.</p>
Chemical damage	<p>Chemical attack would appear as the dissolution of the resin matrix surrounding the fibres, the cylinder surface feeling sticky when touched. The cylinder shall be rendered unserviceable.</p>	<p>Chemical attack resulting in damage to the resin matrix surrounding the fibres is not acceptable.</p>
Damage of casing		<p>Minor damage that does not affect the protecting function of the casing is acceptable. Acceptable damage can be, for example, small cracks, see fig 5. If it cannot be established that the cylinder is unaffected, the cylinder shall be put aside for further investigation. Unacceptable damage is, for example, a broken casing. The casing is then to be removed and the cylinder inspected underneath. A damaged cylinder is unacceptable. If the cylinder is not damaged, a new casing can be assembled. See fig 6.</p>
Heat/fire damage of casing or cylinder	<p>Heat or fire damage may be evident by discolouration, scarring or burning of the composite overwrap, casing, labels and non-metallic components of the valve. Cylinders with this type of damage shall be rendered unserviceable^e.</p>	<p>Visible damage from heat and/or fire is unacceptable. See fig. 7.</p>
<p>^a see annex A, figure 4. ^b It may also appear as a whitish patch like a blister or an air bubble beneath the surface. See annex A, figure 4. ^c see figure 3, Annex A. ^d see figure 5, Annex A. ^e see figure 6, Annex A.</p>		

7.2.3.1 Delamination

Delamination: Inter-laminar delamination is a separation of layers of strands, while intra-laminar delamination is separation between strands within the same layer. It may also appear as a whitish patch like a blister or air bubble beneath the surface. See fig 5, 6 and 7, Annex A for examples. An area with no adhesion between liner and composite is not to be regarded as delamination.

7.3 Additional Inspection /Test Procedures

7.3.1 Hydraulic Proof and Leakage Test

Hydraulic test and leakage test see 5.5.1.

7.3.2 Pneumatic test

Pneumatic proof and leakage test, see 5.5.2.

7.3.3 Leakage test

- Leakage test using LPG as test media, see 5.5.3
- Ultrasonic or another equivalent non destructive testing method.
- For transparent cylinders visual inspection can replace the ultrasonic test.

A minimum of 30 cylinders shall be subjected to internal inspection during retesting to verify general internal integrity. If no internal defects decreasing the internal surface integrity (e.g. cracks, chemical attack and significant foreign materials) are detected, the notified body shall define internal inspection as not required during retesting.

7.4 Internal visual inspection

7.4.1 Preparation of cylinders

- The cylinders shall be emptied of LPG and depressurised in a safe and controlled manner before proceeding.
- Cylinders with inoperative or blocked valves shall be brought to a place for safe valve removal.
- Valves shall be removed from cylinders for inspection and maintenance.

7.4.2 Procedure

- After removing, where necessary, residual LPG and any other foreign matter from the interior, cylinders shall be inspected internally for any signs of internal corrosion or other defects that may affect its integrity, using a safe inspection lighting system with appropriate internal illumination.
- Cylinders showing signs of internal defects, e.g. cracks, damaged liner, internal corrosion or chemical attack, shall be scrapped. If cleaning is required, care shall be taken to avoid damaging the cylinder walls. Cylinders shall be reinspected after cleaning.

7.5 Additional test procedures

7.5.1 Hydraulic proof and leakage test

Water or another suitable fluid shall be used as test medium.

7.5.1.1 Preparation of cylinders

- The cylinders shall be emptied of LPG and depressurised in a safe and controlled manner before proceeding.
- Cylinders with inoperative or blocked valves shall be brought to a place for safe valve removal.
- Valves shall be removed from cylinders for inspection and maintenance. (Note: the external surface of the cylinder can already have been subjected to cleaning.)
- If the cleaning method involves the wetting of the outside surface, the outside surface shall be completely dried before commencing the hydraulic test procedure.

7.5.1.2 Test equipment

All rigid pipe work, flexible tubing, valves, fittings, and components forming the pressure system of the test equipment shall be designed to withstand a pressure of 1,5 times the maximum test pressure of any cylinders to be tested. Flexible tubing shall have characteristics to prevent kinking.

Pressure gauges shall be used to read the cylinder test pressure with an accuracy of at least 2 %. They shall be checked at regular intervals and in any case not less frequently than once a month. The design and installation of the equipment and the cylinders connected to it shall ensure that no air is trapped in the system.

All joints within the system shall be leak tight. A device shall be fitted to the test equipment to ensure that no cylinder is subjected to pressure in excess of its test pressure by more than the tolerance given in 5.5.1.3.

7.5.1.3 Procedure

- The test pressure shall be established from the marking on the cylinder.

Instruction for retesting RAGASCO 5kg and 10 kg LPG composite cylinder

- More than one cylinder may be tested at a time provided that they will have the same test pressure.
- Before applying pressure, the external surface of the cylinder shall be in such condition that any leak can be detected.
- The pressure shall be increased gradually in the cylinder until the test pressure is reached.
- The test pressure shall not be exceeded by more than 10 % or 2 bar, whichever is the lesser.
- The test pressure shall be held for the time necessary to carry out the test and minimum 30 s.
- If there is a leakage in the pressure system, it shall be corrected and the cylinders retested.
- Cylinders, which do not leak or show any permanent distortion, shall be deemed to have satisfied the requirements of this test.
- Any cylinders that fail shall be rejected and rendered unserviceable.

7.5.2 Pneumatic proof and leakage test.

Air or another suitable gas shall be used as a test medium.

7.5.2.1 Preparation of cylinders

- The cylinders shall be emptied of LPG and depressurised in a safe and controlled manner before proceeding.
- Cylinders with inoperative or blocked valves shall be brought to a safe place for valve removal.

NOTE The external surface of the cylinder can already have been subjected to cleaning, see 5.2.1.

7.5.2.2 Procedure

- The pneumatic proof test pressure shall be the same as for an equivalent hydraulic proof test.
- Cylinders shall be charged with the pneumatic test medium to the test pressure and held at that pressure for 5 s to 7 s.
- Where a pressure relief valve is fitted, an adequate margin of safety shall be maintained between the pneumatic proof test pressure and the pressure setting of the pressure relief valve, or the safety valve shall be blocked during the pneumatic proof test.
- The pressure may then be reduced to that required for the leakage check. The reduced pressure shall not be less than the operating pressure at the reference temperature.
- The leakage check shall be for the whole of the cylinder and shall be by full water immersion or an equivalent.
- Any cylinder that fails the test shall be reconditioned or scrapped.

7.5.3 Leakage test

LPG is used as test medium.

7.5.3.1 Test equipment

To detect leakage, soap water is sprayed onto the cylinder.

7.5.3.2 Procedure

- More than one cylinder may be tested at the same time.
- The external surface of the cylinder shall be in such condition that any leak can be detected.
- Cylinders, which do not leak or show any permanent distortion, shall be deemed to have satisfied the requirements of this test.
- Any cylinders that fail shall be rejected and rendered unserviceable.

8 Inspection of cylinder threads

8.1 Threads

Where the valves (or any other fitments) are removed during requalification, the cylinder threads concerned shall be inspected in accordance with 6.2 to 6.4.

8.2 Internal threads

The internal threads of the cylinder shall be examined to ensure that they are of full form and clean. They shall be checked for burrs, cracks, and other thread damage. Locking fluid and similar is OK.

8.3 External threads

External neck threads, which are required for operational reasons, shall be examined for integrity and for thread damage.

8.4 Damaged threads

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

9 Final operations

9.1 Drying and cleaning

Following hydraulic test with water, effective drying of the inside of the cylinder using e.g. dry, compressed air shall be made.

Alternatively, a small amount of IPA (isopropyl alcohol) can be added to the cylinder before revalving.

9.2 Purging

Any air can be removed from the cylinder, e.g. by evacuation or by displacement with LPG. Cylinders shall not be left open without valves for any period other than that required for essential maintenance.

9.3 Retareing

NA

9.4 Revalving

Depending on the type of threads (straight or tapered) one of the following methods should be used:

Tapered: This procedure shall be as for steel cylinders. The valve shall be fitted to the cylinder using a sealing material/system and the optimum torque necessary to ensure a seal between the valve and the cylinder. The torque applied shall be according to the cylinder manufacturers recommendations.

Straight:

1. Check the O-ring and threads.
2. Add Holdtite Optolok 211 (medium strength locking fluid) or equivalent onto 1-2 threads
3. Put grease onto the o-ring all around the circumstances. The grease must be compatible to propane and not contain silicon. If in doubt, please contact RAGASCO.
4. Insert the valve by hand and be sure the threads enter properly by screwing it in a couple of turns.
5. Tighten the valve by controlled torque to 80-120Nm.
6. Tightness test is recommended

9.5 Marking

After successful completion of the requalification, each cylinder shall be legibly and durably marked with the following information:

- The symbol of the requalification test station and the identification number of the inspection body;
- The year (minimum) of next requalification: the marking heights shall be at least 4 mm.

Where cylinders are not under the full control of any marketing organizations, test results may be kept on record by the organization responsible for requalification.

9.6 Reference to next requalification date

The next requalification date shall be indicated.

9.7 Identification of contents

The cylinder content shall be identified, e.g. commercial propane.

10 Rejection and scrapping of cylinders

The decision to reject a cylinder may be taken at any stage during the requalification procedure. With the agreement of the owner, a rejected cylinder shall be rendered unserviceable so that it cannot be re-issued into service as a pressure vessel.

Rendering cylinders unserviceable is performed by drilling minimum two holes of diameter minimum 4 mm in the cylinder or equivalent.

11 Annex A - Types of damage of cylinders and casing

Examples of types of damages of cylinders and casing are represented in Figure 1 to 7 (see Table 1).



Figure 1 — Damage from abrasion

Depth of abrasion damage: maximum 10 % of composite thickness. Length of damage: not exceeding 50 % of diameter of cylinder. Acceptable damage.

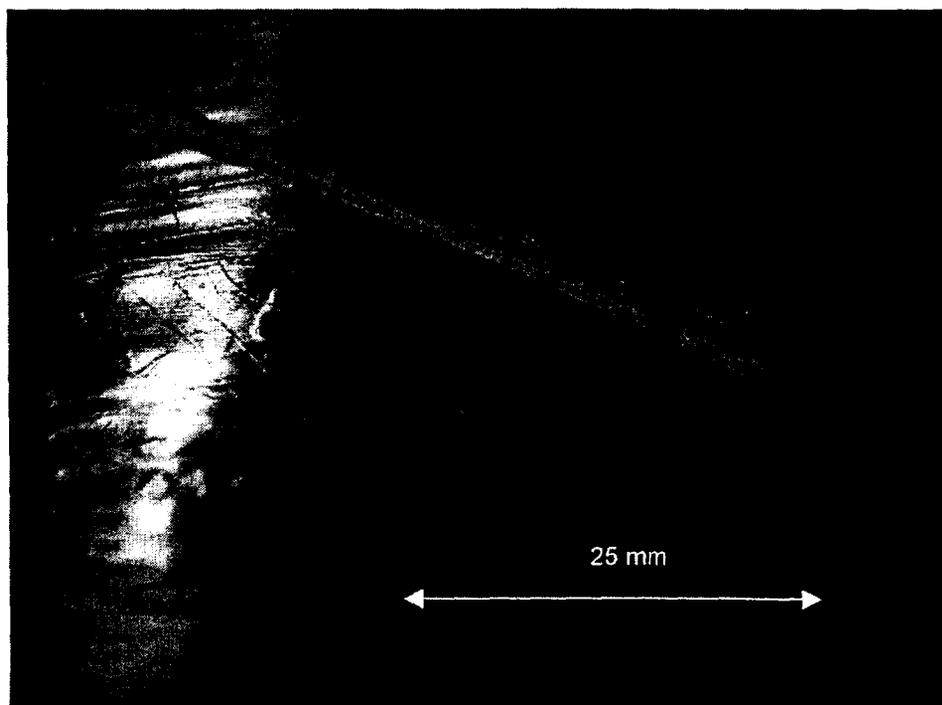


Figure 2 — Damage from cuts

Depth of damage from cuts: maximum 10 % of composite thickness. Acceptable damage.

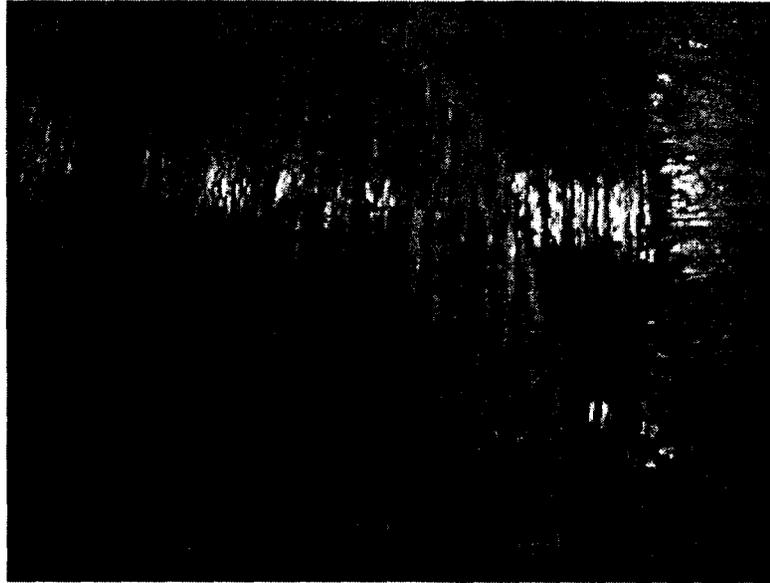


Figure 3 — Impact damage in combination with delamination and surface defects

Not acceptable damage.

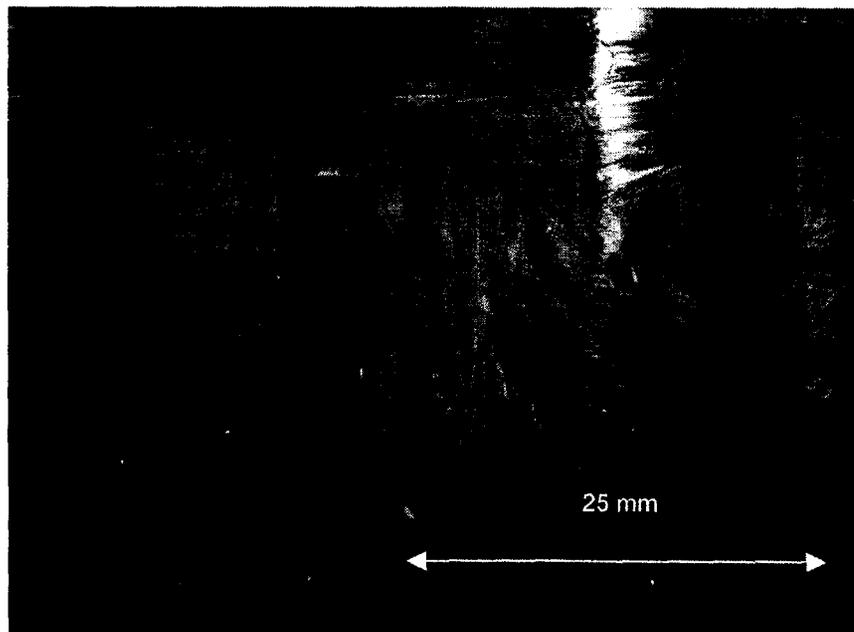


Figure 4 — Delamination, level 1.

The delamination appears as a whitish patch beneath the surface. There are no signs of external impact or surface damage.



Figure 5 — Casing, level 1, acceptable damage

Cylinders with large damages that lead to partial or full separation of the casing, destroyed handle or in other way makes the casing unable to protect the cylinder.



Figure 6 — Defect casing, level 3



Figure 9 — Heat damage, level 3. This type of damage is not acceptable in any form

12 Annex B - Requirements for 10-year periodic inspection interval

For a cylinder to qualify for a 10 year time interval, all of the following specific requirements shall apply:

- 1) Cylinders of the same design approval and manufacture where the following tests, witnessed by a notified body, have been satisfied:-
 - 100 cylinders older than 5 years shall be picked at random
 - 80 cylinders shall be subjected to and pass a burst test in accordance with ISO 1119-3.2 burst test.
 - 20 cylinders shall be subjected to and pass a fatigue test in accordance with ISO 11119-3.2 Ambient pressure cycle test.
- 2) The cylinder shall be filled in accordance with the criteria contained in WI1439 or an equivalent standard as approved by a competent authority.

Some key parameters that shall be controlled include the following:

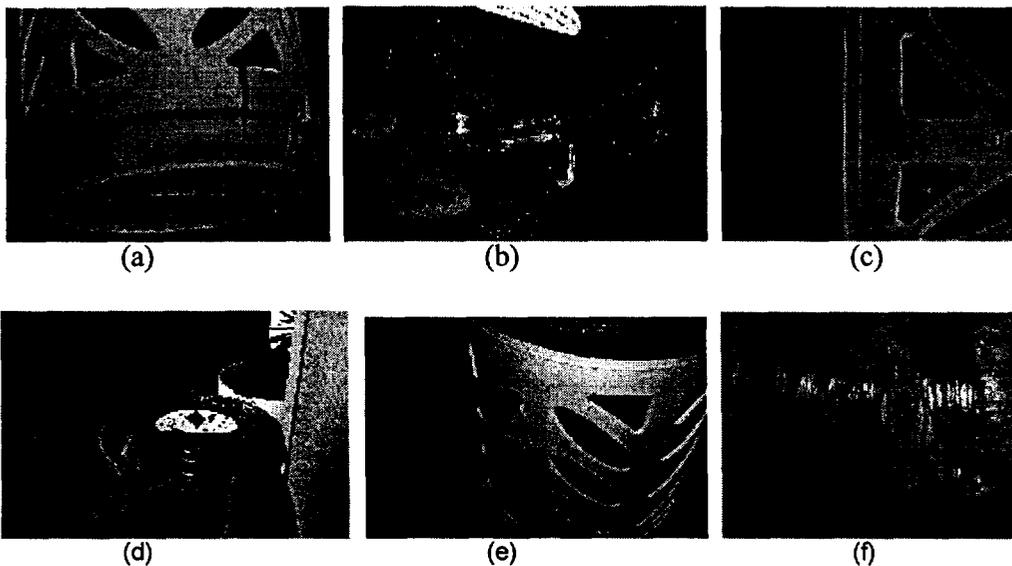
- cylinder identification (e.g. design code, tare weight, mark of the competent body);
 - external cylinder condition (see 5.2);
 - the cylinder is within the test date.
- 3) The LPG quality shall comply with ISO 9162 or similar

This document covers the recommendations from RAGASCO AS, manufacturer of Complet, for Inspection before, during and after filling of Complet. Official laws, regulations and instructions / regulations / guidelines at the filling establishment are superior to the content of this document, and must be followed. The document is not valid for other types of composite cylinders.

Before filling

the RAGASCO LPG composite cylinder, please check that the

- Valve has no dents, deformation or damage to rubber sealing, and it's correctly fitted / torqued
- The outer casing has no cracks, major abbreviation, heat marks or deformation (eg fig.1 a-e)
- Composite vessel has no marks from impact or abbreviation going into the wall, and no cut fibres (f)



Damage described or more severe, shall lead to investigation in accordance with RAGASCO doc. "147230-812 Instructions for retesting..."- performed by authorized personnel, alternatively the cylinder must be scrapped.

During filling

... the instructions / regulations / guidelines at the filling establishment must be followed.

After filling, check that

- There is no leakage – eg. check by smelling, looking for icing, listen for whistling sound, spray connections with soapy water, using other equipment on the filling establishment.
- The quantity LPG filled is correct, by weighing and by leaning it to the side to see the level just above the upper open spots in the casing