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### Economic Commission for Europe

#### Inland Transport Committee

#### Working Party on the Transport of Dangerous Goods

#### Joint Meeting of the RID Committee of Experts and the Working Party on the Transport of Dangerous Goods

Geneva, 17-27 September 2013

Item 6 (b) of the provisional agenda

#### Proposals of amendments to RID/ADR/ADN: new proposals

### Periodic inspection and test of some transportable refillable LPG steel cylinders in RID/ADR

Transmitted by the European Liquefied Petroleum Gas Association  
(AEGPL)\*, †

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\* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106, ECE/TRANS/2010/8, programme activity 02.7 (c)).

† Circulated by the Intergovernmental Organisation for International Carriage by Rail (OTIF) under the symbol OTIF/RID/RC/2013/43.

*Summary*

<b>Executive summary:</b>	Introduce into RID/ADR the possibility of using a specific procedure for periodic inspection and testing of protected over-moulded liquefied petroleum gas (LPG) cylinders.
<b>Action to be taken:</b>	To add a definition in 1.2.1, a clause 6.2.3.5.3 and a new item in packing instruction P200 in 4.1.4.1.  To remove the exclusion of annex G for EN 1440:2008 + A1 :2012 in table in clause 6.2.4.2 and the exclusion of annex G for EN 1439 :2008 in the table in item 11) of P200.
<b>Related documents:</b>	Informal document INF.39 submitted at the spring 2013 session; ECE/TRANS/WP.15/AC.1/2013/16; Multilateral agreement M247; EN 1440:2008 + A1:2012, LPG equipment and accessories. Periodic inspection of transportable refillable LPG cylinders and prEN1440 EN 1439:2008, LPG equipment and accessories. Procedure for checking LPG cylinders before, during and after filling; prEN 14140 : 2012, LPG equipment and accessories. Transportable refillable welded steel cylinders for LPG — Alternative design and construction.

**General**

1. Protected over-moulded cylinders have a coated welded steel inner pressure receptacle over-moulded with a non porous material, which is full bonded to the pressure receptacle and whose integrity ensures the integrity of the metallic inner pressure receptacle. They are designed for carriage of LPG, UN1011, UN1965, UN1969 and UN1975
2. Protected over-moulded cylinders have been manufactured since 1997 and the quantity of cylinders manufactured is over 3.6 million. They are in commercial use in at least two European countries (France and Belgium). The steel pressure receptacle is manufactured in accordance with directive 84/527/EEC, directive 1999/36/EC or directive 2010/35/EU. Since 2003, the pressure receptacles have been manufactured according to the relevant parts of EN 1442 or EN 14140.
3. The cylinders capacity is 12.8lt so that the cylinders can be easily transported and handled. This capacity has been considered in the definition proposed in paragraph 13 of this document in order to be limited to cylinders of small capacity and be related to the concept of the note in ADR 6.2.3.5.1. This value is around 10% of the maximum capacity of a cylinder (as defined in chapter 1.2.1) and twice the capacity stated in the note of ADR 6.2.3.5.1 (which allows the replacement of the hydraulic pressure test by another test ensuring equivalent level of safety). This value can be discussed and increased if necessary.
4. Protected over-moulded cylinders have been introduced in the draft documents for revision of designing standards EN14140 and EN1442 in order to

clearly define the requirements for designing and manufacturing this type of cylinder as it leads to a specific procedure for periodic inspection.

5. The inner pressure receptacle is coated (painted), which is the first protection against external corrosion of the pressure receptacle; there is no possibility of water ingress between the receptacle and the layer of paint. The protective case in polyurethane material is over-moulded to the coated inner pressure receptacle, which is the second protection against external corrosion; it has adequate adhesion to the coating to prevent water ingress between the coating of the pressure receptacle and the over-moulded protective case during the cylinder life and it provides mechanical protection of the pressure receptacle.

6. All protected over-moulded cylinders are fitted with an individual resilient identification electronic tag. Their detailed characteristics are recorded in an information technology database. The record in the data base means that:

- the specific technical characteristics of the cylinders are easily available;
- cylinders can be safely filled/tested;
- cylinders can be monitored for mandatory tests;
- in case of an issue with a cylinder (detected at filling plant, at customer's, during periodic tests..), the electronic tag linked to the database allows cylinders from for the same batch to be automatically withdrawn to perform relevant tests and to assess if it is a batch issue or not. If necessary, the whole batch can be automatically withdrawn and disposed;
- a batch of cylinders can be automatically withdrawn to perform periodic tests;
- cylinders which have to be marked to indicate the successful completion of the periodic inspection can be identified and marked;
- the history of all the events in the life of a cylinder can be reviewed.

7. The design lifetime of the protected over-moulded cylinder is set at present to 30 years. However, this lifetime can then be extended every 5 years, as long as the tests undertaken at the periodic inspection demonstrate that the polyurethane adhesion to the inner receptacle has retained its properties.

The electronic tag linked to the database enables a batch of cylinders to be withdrawn when it has reached its lifetime.

This concept of lifetime is to be added in prEN1440 as it is related to periodic inspection test results (see annex 5).

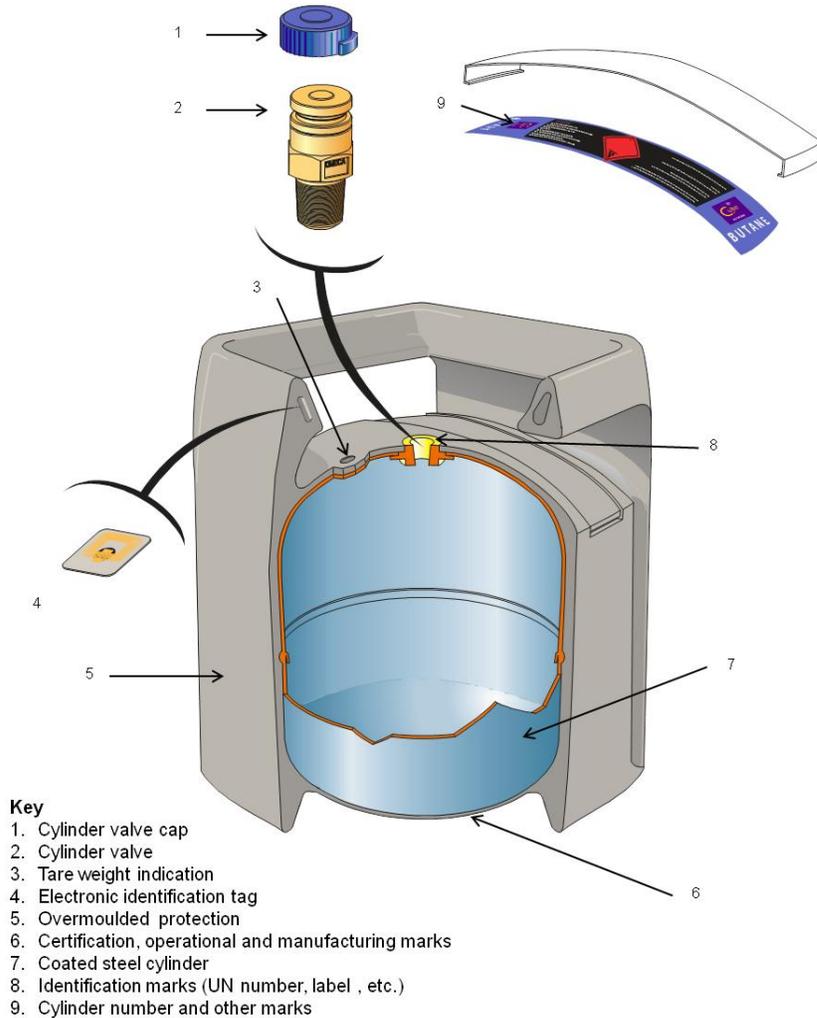
8. The overmoulding case does not cover the cylinder number. Other permanent markings which are covered are reproduced on the PU case. The date of the last periodic inspection is marked on each cylinder (of the same series) during the next filling process, subject to the successful completion of the periodic inspection.

9. The quality of LPG used to fill the cylinders has always complied with the corrosion contaminants level specified in ISO 9162:1989.

10. At manufacturing, before over-moulding of the polyurethane material, the steel receptacles are individually hydraulically tested. After over-moulding, the adherence of the polyurethane to the receptacle is tested on a sampling basis (destructive test).

11. At each fill, the protected over-moulded cylinders are externally visually inspected and leak tested according to EN1439.

12. A specific periodic inspection protocol has been developed step by step with an independent competent expert. It has been agreed with an external competent body and validated by the French authorities in 2002. A multilateral agreement (M247) has been signed in 2011 regarding this periodic inspection protocol.



Example of protected over-moulded cylinder

## Proposal

13. Add the following definition in 1.2:

“Protected over-moulded cylinder, means a cylinder of a water capacity not exceeding 13 litres made of a coated steel inner pressure receptacle with an over-moulded protective case

in polyurethane or material with equivalent properties, which is non removable and bonded to the inner receptacle wall giving mechanical protection against corrosion”.

14. Add a clause 6.2.3.5.3 and this paragraph:

For each batch of protected over-moulded cylinders intended for the carriage of gases of UN 1011, UN1075, UN1965, UN1969 and UN1978, the periodic inspection and test specified in 6.2.1.6.1 shall be completed by the application of annex G of EN 1440 :2008 + A1 :2012 by doing burst tests, peeling and corrosion tests and adhesion tests by sampling. The hydraulic pressure is optional.

The results of the burst tests shall consider the right unilateral statistical tolerance interval as per ISO 16269-6:2005.

The check of the external conditions of the pressure receptacle shall be understood as the check of the external conditions of the protected over-moulded cylinder.”

15. To add a new point in packing instruction P200 in 4.1.4.1:

“The competent authority shall verify that the cylinders are only filled in filling centres applying a documented quality system and that the requirements of EN1439:2008 are fulfilled.”

16. To remove the exclusion of clause 3.5. and of annex G for EN 1439:2008 in the table in point 11 in P200.

17. To remove the exclusion of annex G for EN 1440:2008 + A1:2012 in the periodic inspection and test standards table in 6.2.4.2.

## Justification

18. This type of cylinder complies with RID/ADR. The pressure test does not damage it but is not relevant due to the PU over-moulded case. Indeed the over-moulded case does not allow the detection of small leaks nor to visually check permanent volumetric expansion of the inner receptacle.

A check of the external conditions of the pressure receptacle is not possible as the steel external surface is not visible. Due to stringent requirements applied to this type of cylinder, visual inspection of the over-moulding ensures the integrity of the metallic inner receptacle wall. This inspection is done at each filling for every cylinder.

19. Instead of an individual check of the cylinder for periodic inspection, an alternative way has been developed. It is based on regular sampling and destructive testing. Some burst test, peeling and corrosion tests and adhesion tests are done after three years of service and every five years after the first tests on a sampling basis. It is important to point out that this type of cylinder is manufactured in batches.

The pressure test, the burst test can demonstrate that the mechanical and structural integrity of the inner receptacle is maintained.

In the same way with the external check of the pressure receptacle, the adhesion test and the peeling and corrosion test check that there is no external corrosion on the inner receptacle wall. The adhesion test demonstrates that the polyurethane material retains its adhesive properties with time and so continues to protect the anti-corrosion coating of the inner receptacle. The peeling test visually checks that there is no corrosion. It has been demonstrated (see the report in annex 2) that good adhesion of the PU foam (over-moulded case) means that there is no corrosion on the inner receptacle (external corrosion). An

adhesion test has been added in prEN14140 and prEN1442. The relevant extracts of prEN14140, which is currently at formal vote, are in annex 3.

It is important to note that the check of the external conditions of composite cylinders with a steel liner is also done through the check of the external coating.

So it can be considered that the level of safety of this alternative method is equivalent to the test pressure and the check of the external conditions of the pressure receptacle.

The details of these tests are described in the multilateral agreement M247 and in annex G of EN 1440:2008 + A1:2012.

EN1440 is currently under revision and annex G will be revised in order to be fully aligned with M247 (see annex 4). Currently annex G, contrary to M247, does not require a statistical analysis of the results but the tests to be done are the same: burst test, peeling and corrosion test and adhesion test.

20. Periodic inspection test procedure as described in RID/ADR in 6.2.1.6 is written for “traditional” steel cylinders but the evolution of new technologies and new designs have already led to add some notes in 6.2.1.6. Moreover there is already a note in 6.2.3.5.1 to authorize the replacement of the pressure test by another test with an equivalent level of safety for a type of LPG cylinders:

**NOTE:** *With the agreement of the competent authority of the country that issued the type approval, the hydraulic pressure test of each welded steel cylinder intended for the carriage of gases of UN No. 1965, hydrocarbon gas mixture liquefied, n.o.s., with a capacity below 6.5 l may be replaced by another test ensuring an equivalent level of safety.*

21. So far more than 10 000 burst tests, 5 200 peeling tests and 2 000 adhesion tests (5 tests per cylinder) have been performed. No trace of corrosion, no issues with the polyurethane material or degradation of the pressure receptacle have been detected.

22. In case of an unsuccessful periodic inspection, the batch can be easily withdrawn at the filling plant when the cylinders are returned by the customer’s using the electronic tag and database.



*Example of burst test*



*Example of adhesion test*

*Adhesion test blocks are glued to the over-moulded material. A tensile stress, increasing at a rate not greater than 1 MPa/s, perpendicular to the plane of the substrate is applied.*



*Example of blocks with polyurethane material layer extracted (adhesion test)*



*Example of peeling test: the over-moulded material is peeled and the steel surface is inspected.  
This test is done on a cylinder previously submitted to a burst test.*

## **Enforcement**

23. No difficulties with enforcement are foreseen. A multilateral agreement, M247, has been signed by several countries and is valid until the 31 December 2016.

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### Annexes\*:

- Annex 1: EN1439 :2008 annex G
- Annex 2: Document presented during ESOPE symposium in 2004
- Annex 3: Extracts of prEN14140
- Annex 4: Annex of EN1440
- Annex 5: Annex G of prEN1440

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\* The annexes are reproduced in informal document INF.6.