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Beilagenhinweis:

Der heutigen Ausgabe unserer Zeitschrift enthält eine Beilage des Verlages C. H. Beck oHG, München.
Wir bitten unsere Leser um freundliche Beachtung.



**Recognized technical code
(Anerkanntes Technisches Regelwerk, ATR)
for the construction, equipment, test, approval, and marking
as transportable pressure equipment of composite tubes with a seamless,
load sharing aluminium liner and a working pressure not exceeding 500 bar
and a water capacity not exceeding 450 L (ATR D 3/10)**

Based on Section 8 No. 10 of the Ordinance on the Transport of Dangerous Goods by Road, Rail and Inland Waterways (GGVSEB) of 17 June 2009 (Federal Law Gazette I p. 1389), the BAM Federal Institute for Materials Research and Testing in agreement with the Federal Ministry of Transport, Building and Urban Development promulgates, in accordance with section 6.2.5 of RID and ADR¹⁾, the recognized technical code for the construction, equipment, test, approval, and marking of transportable fully wrapped composite tubes with load sharing aluminium liners as set out below.

The present Code may be applied from the date of its publication in the Federal Ministry of Transport Gazette. The Federal Ministry of Transport, Building and Urban Development will submit this Code to the competent OTIF and UNECE²⁾ Secretariats in accordance with section 6.2.5 of RID/ADR.

The present ATR may be applied to the approval of composite tubes for transport by rail, road or inland waterways. It may only be applied to maritime or air transport if the competent authority in accordance with the Ordinance on the Transport of Dangerous Goods by Sea or air traffic provisions has given permission to do so in writing.

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¹⁾ RID = Regulations governing the International Carriage of Dangerous Goods by Rail
ADR = European Agreement concerning the international carriage of dangerous goods by road
ADN = European Agreement concerning the international carriage of dangerous goods by inland waterway

²⁾ OTIF = Intergovernmental Organisation for International Carriage by Rail (Bern)
ECE = United Nations Economic Commission for Europe (Geneva)

1 Introduction

This ATR concerns composite tubes with a working pressure not exceeding 50 MPa (500 bar) and a water capacity not exceeding 450 litres in accordance with section 6.2.5 of RID/ADR.

In accordance with the definition in section 1.2.1 of RID/ADR, the water capacity of cylinders is limited to a maximum of 150 litres. Pressure receptacles of the size envisaged in this Code of a water capacity not exceeding 450 litres shall be designated and approved as tubes in accordance with section 1.2.1 of RID/ADR.

As in the table in section 6.2.4 of RID/ADR 2009 there is no reference to a specific standard for composite tubes, a technical code to be recognized under section 6.2.5 of RID/ADR is required until the international standard ISO11515, which is currently being prepared, has been published and incorporated into the table in section 6.2.4 of RID/ADR.

This ATR ensures a high level of safety which is at least equivalent to the safety level of cylinders under the currently referenced standard EN 12245:2002 in the table in section 6.2.4 of RID/ADR. The present Code is based in particular on EN 12245:2009 „Transportable gas cylinders - Fully wrapped composite cylinders“; this updated version of the standard is to be proposed for inclusion in the table in section 6.2.4 of RID/ADR.

2 Scope

- 2.1 The present ATR applies to the construction, equipment, test, approval and marking of composite tubes up to a maximum working pressure of 50 MPa (500 bar) and a water capacity of not more than 450 litres which have a seamless aluminium liner which is reinforced by a wound composite consisting of carbon fibres embedded in a matrix.
- 2.2 The composite tubes shall be constructed, equipped, tested, approved and marked in accordance with the Ordinance on portable pressure equipment - OrtsDruckV - Article 1 of the Ordinance of 17 December 2004 (Federal Law Gazette I p. 371) in conjunction with section 6.2.5 of RID/ADR in conjunction with the present ATR.

2.3 Of the modules possible under OrtsDruckV in conjunction with Directive 1999/36/EC (TPED), only module B may be applied in conjunction with module D or F for as long as the provisions of section 1.8.7 of RID/ADR are not mandatory.

2.5 A conformity reassessment under OrtsDruckV in conjunction with TPED of composite tubes put on the market before the promulgation of the present ATR is not permitted.

2.6 For the use of composite tubes for the transport of gases by rail, road or inland waterways in accordance with this ATR, the provisions of GGVSEB, OrtsDruckV and RID/ADR/ADN¹⁾ are applicable.

3 Specification for the materials, design, manufacture and testing of composite tubes

3.1 Definitions

Within the framework of the present Code, the definitions and characters (symbols) of section 3 of EN 12245:2009 apply.

3.2 General requirements

Composite tubes shall comply with the requirements of sections 6.2.1, 6.2.3 and 6.2.5 of RID/ADR and the provisions of EN 12245:2009 "Transportable gas cylinders - Fully wrapped composite cylinders", unless variations are permitted or stipulated in the following.

3.3 Material requirements

3.3.1 In addition to the provisions of sub-section 6.2.5.1 of RID/ADR, the requirements and specifications in section 4 of EN 12245:2009 shall be complied with.

3.3.2 The seamless metal liner made of aluminium shall be manufactured in accordance with EN 1975:2004. The sections of the standard on materials, thermal treatments, neck design, construction and workmanship as well as mechanical tests shall be applied.

3.3.3 By derogation from EN 12245:2009, the manufacturer shall establish and document the requirements in accordance with the design of the composite tube.

3.3.4 The compatibility of the liner material with the gases intended for filling shall be demonstrated in accordance with EN ISO 11114-1.

3.4 Design of the pressure receptacles

The pressure receptacles shall be designed in accordance with EN 12245:2009.

3.5 Manufacture

The requirements and specifications of sections 4.4.3 (Autofrettage) and 4.4.4 (Manufacturing requirements) of EN 12245:2009 shall be complied with.

3.6 Tests

3.6.1 The following tests shall be carried out in accordance with section 5 of EN 12245:2009:

Test 1: Composite material tests in accordance with section 5.2.1.1;

Test 2: Tests on the liner material aluminium in accordance with section 5.2.2.1 d) as described in EN 1975:2004;

Test 3: Liner burst test at ambient temperature in accordance with section 5.2.3;

Test 4: Pressure test of finished tubes at ambient temperature in accordance with section 5.2.4;

Test 5: Burst test in accordance with section 5.2.5;

By derogation from the above provision, the test shall be carried out at ambient conditions and the temperature on the external surface of the tube shall be maintained at less than 35 °C. The rate of pressurisation during the test shall be recorded and shall not exceed 10 MPa/min (100 bar/min);

Test 6: Resistance to pressure cycles in accordance with section 5.2.6;

By derogation from the above provision, the pressure cycle tests shall be carried out at ambient conditions and on three test samples. The temperature of the external surface of the tube and of the medium shall not exceed 40 °C during the test. The cycle frequency shall only exceed 5 cycles per minute if it is ensured by means of pressure measurement at the second opening that the requirements as regards the maximum and the minimum values of the pressure (pressure extremes) in the sample are complied with. The test may be terminated after 50 000 cycles (pressure cycles to PH*) or in the event of failure. The criteria for non-limited

as well as limited life in accordance with section 5.2.6.1.2 of EN 12245:2009 or Table 1 in section 5.2.6.2.2 shall be applied.

Test 8: Exposure to elevated temperature at test pressure in accordance with section 5.2.8

By derogation from the above provision, cycle tests in accordance with Test 6 (see above) shall be carried out instead of the concluding burst tests (Test 5). The test shall be carried out on two test samples and may be terminated after 50 000 cycles (at PH^{*)} or in the event of failure. For the joint analysis of both samples the following criterion shall apply: The logarithmic - arithmetic mean of the number of cycles to failure shall be at least two thirds of the logarithmic - arithmetic mean of the three cycle results determined in Test 6. For the individual analysis of the two samples the following criterion shall apply: Each of the two samples shall withstand two thirds of the minimum number of cycles under Test 6 without failure by burst or leakage. Both criteria shall be complied with;

Test 9: Drop test as described „for cylinders over 80 litres water capacity“ in accordance with section 5.2.9.2;

Test 10: Flawed tube test in accordance with section 5.2.10

Test 11: Extreme temperature cycle test in accordance with sections 5.2.11.2 and 5.2.11.3;

By derogation from the above provisions, the test medium which flows into the sample during the test shall be tempered to the nominal temperature of the sample for the respective test stage and shall be maintained steady during the test with a $\pm 5^{\circ}\text{C}$ tolerance in relation to the starting temperature of the sample and of the medium contained in the sample. Alternatively, the tolerance requirement of $\pm 5^{\circ}\text{C}$ may also be complied with in a different way than by pre-tempering the test medium, e.g. by very slow pressure cycles. After the completion of the pressure

^{*)} *Footnote to tests 6, 8, 11 and batch test:*
*If Test 6 is based on the maximum developed pressure (P_{max}) *) in accordance with sub-section 5.2.6.1.1 of EN 12245:2009, the following shall apply:*

- *The P_{max} pressure shall be applied as pressure peak to all pressure cycle tests (tests 8, 11, and batch test).*
- *The minimum number of pressure cycles to be withstood is double the number required for tests to test pressure (PH).*
- *The test may only be terminated after 100 000 cycles.*

cycle test, the sample shall continue to be subjected to the point of failure to pressure cycles to $P_H^*)$, or of the maximum developed pressure ($P_{max}^*)$ in accordance with section 5.2.6.1.1 at room temperature. For the test result in the sum of all test stages on a sample, the following criterion shall apply: The sample shall withstand the minimum number of cycles under Test 6 without failure by burst or leakage;

Test 12: Fire resistance test in accordance with section 5.2.12;

Test 13: High velocity impact (bullet) test in accordance with section 5.2.13;

Test 16: Torque test in accordance with section 5.2.16;

Test 17: Neck strength in accordance with section 5.2.17;

Test 19: Neck ring (if fitted) in accordance with section 5.2.19;

3.6.2 The following tests in accordance with section 5 of EN 12245:2009 may be waived:

Test 7: Immersion in salt water in accordance with section 5.2.7

Test 14: Permeability test of cylinders with non-metallic or without liners in accordance with section 5.2.14

Test 15: Test of compatibility of thermoplastic liners with air or oxidising gases in accordance with section 5.2.15

Test 18: Cylinder stability in accordance with section 5.2.18

3.7 Testing of finished tubes

3.7.1 Batch tests

The tests shall be performed in accordance with annex A of the standard EN 12245:2009.

By derogation the test A.4.5.1 c) shall be carried out like Test 6 (see above).^{*)} For every year, the statistic analyses of the batch test results shall be presented together in the form of a comparison with the logarithmic-arithmetic mean determined within the framework of Test 6 of the type test. The test sample shall meet the criteria for Test 6 of the type test.

3.7.2 Provision of the test results for comparative analyses within the framework of concepts complementary to on-site tests.

In connection with periodic inspection and testing or lifetime monitoring, the manufacturer and the operator shall retain the statistics on Test 6 including the batch tests and

the results of Tests 8 and 11 and shall, on request, submit them to the authority competent for on-site tests.

4 Marking

4.1 The marking shall be affixed in accordance with chapter 6.2 of RID/ADR in conjunction with EN ISO 13769:2003 + A1:2005 and in accordance with OrtsDruckV/TPED. For the marking according to 6.2.3.9.1 in connection with 6.2.2.7.1 letter b) instead of the marking of a standard, this ATR has to be marked as follows: "ATR D 3/10".

4.2 In addition, the following specific additional information shall be indicated on a marking label which is permanently affixed to the composite tube and which may not be combined with the marking under No. 4.1:

- a) where a composite tube is approved with a specific pressure relief device intended to prevent failure in the case of fire (see section 5.2.12 of EN 12245:2009), this requirement shall be stated and the type of device shall be identified on the marking label;
- b) where the fitting torque for the valve does not correspond to the values given in EN ISO 13341:2005, the manufacturer's recommendation shall be shown on the marking label;
- c) where the composite tube is to be used for dedicated gas service and the developed pressure has been used in Test 6, the resistance to pressure cycles (see section 5.2.6 of EN 12245:2009), then the intended gas shall be stated;
- d) the aluminium alloy designation (e.g. "AA6061 LINER").

Berlin, 2010-05-03

BAM BUNDESANSTALT FÜR MATERIALFORSCHUNG UND -PRÜFUNG

Department III
Containment Systems
for Dangerous Goods

Working Group III.24
Pressure Equipment – Pressure Receptacles
and Fuel Gas Storage Systems

p.p.

p.p.

signed

signed

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This ATR consists of 7 pages.