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Standards

Problems encountered in standards listed in ADR/RID/ADN

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Introduction

1. Since 2009, the use of standards has become mandatory in the ADR/RID/ADN so their importance has increased in recent years. For this reason, the ADR/RID/ADN Joint Meeting has a long standing partnership with CEN via the standards working group to revise, update and review standards listed in the context of the dangerous goods regulations. The following specific issues from the listed standards are presented for consideration. They were raised during a national exchange between the competent authority and its recognized bodies:

2. **EN 1251-2 (cryogenic receptacles, vacuum insulated, maximum capacity of 1000 L)**

(a) The German version differs from the French and the English versions: according to par. 4.2.6.2 at least 2 pressure relief valves are required (French and English versions) – at least 1 pressure relief valve is required (German version). After reading the rest of the paragraph it is clear that min. 2 pressure relief valves are required (German version is wrong).

Since ADR par. 6.2.4.1 refers to EN1251-2 for application of the conformity to ADR par. 6.2.3.1 and 6.2.3.4, and not for application of the conformity to ADR par. 6.2.3.3 (service equipment), 1 safety relief valve is sufficient (see ADR par. 6.2.1.3.6.4.1) if the blow-off capacity of the relief valve is large enough;

(b) In paragraph 4.3.7.2.5 of the standard, the formula (8) (calculation of the max. allowable external pressure, plastic deformation) is not correct : a safety factor of 1,5 is missing:

- The actual formula which is given is as follows:

$$p_p = \frac{20K}{S_p} \times \frac{s - c}{D_a} \times \frac{1}{1 + \frac{\nu(1 - 0{,}2\, D_a / l_b)\, D_a}{100\,(s - c)}}$$

- The correct formula (based on EN 13530-2, AD2000 Merkblatt B6) is:

$$p_p = \frac{20K}{S_p} \times \frac{s-c}{D_a} \times \frac{1}{1+\frac{1{,}5\mu(1-0{,}2D_a/l_b)D_a}{100(s-c)}}$$

(c) Paragraphs 4.3.7.4.1 and 4.3.7.4.2 consider 2 types of torispherical ends:

- 10% torispherical ends (R = Da and r = 0,1*Da)
- 2:1 torispherical ends (R = 0,8*Da and r = 0,154*Da)

The "2:1 torispherical ends" are generally known as "Korbbogen ends", which are ends having a spherical part (central part) and a torispherical part (knuckle region for the transition to the cylindrical shell).

The indication "2:1" is generally connected to semi-ellipsoidal ends which do not have a real spherical part or a torispherical part; they are ends with an elliptical shape for which the ratio of large axle / small axle equals 2. Such kind of ends are, for calculation purposes, transformed to equivalent torispherical ends (e.g. see EN 13445-3 par. 7.5.4, or EN 14025 par. 6.3.3.6).

It is proposed to correct the type "2:1 torispherical ends" to "torispherical ends with R = 0,8*Da and r = 0,154*Da", and to add a 3rd type of dished end, namely "ellipsoidal end", for which the equivalent torispherical end can be calculated as per EN 13445-3 par. 7.5.4 or EN 14025 par. 6.3.3.6.

In par. 6.2.2 of the standard, impact tests according to EN 10045-1 are required for austenitic stainless steel. Since the standard also accepts aluminium alloys (see par. 4.3.2.3), impact tests should also be carried out for aluminium alloys.

3. **EN 13094 (atmospheric road tanks)**

(a) In par. 6.9.2.2 a) (lateral protection for tanks with a circular or elliptical cross-section) a ring with associated shell having a min. bending modulus of 10 cm^3 is being considered as an effective reinforcement. The length of the associated shell to consider for the calculation of the min. section modulus however is not defined.

(b) In the German version of the standard, the text of par. 6.9.2.2 g) 3rd indent, differs from the English and French versions:

- According to the German version "the distance between adjacent partitions OR surge plates does not exceed 1,4 m"
- According to the English or French version "the distance between adjacent partitions AND surge plates does not exceed 1,4 m"

(c) In par. 6.9.2.2 i), 3rd and 4th indent differences between the German version on one side and English and French version on the other side occur in the use of the words "OR" and "AND".

(d) In Annex D, Fig. D.6 a typical swaged edge joint (also known as a "joggle joint") is shown. Other recognized pressure codes such as AD2000 Merkblätter, ASME VIII Division 1, CODAP do not allow this kind of joint for the longitudinal seams in cylindrical shells or for other joints if corrosive products are in contact with the inside of the joint. A note should be added that this kind of joint is not allowed

for longitudinal seams in cylindrical shells and for circumferential seams of vessels intended for the transport of corrosive products.

4. **EN 14025 (metallic pressure tanks)**

(a) In par. 6.3.5.2.9, formula (40) there is an error in the expression under the square root part of the formula:

- Actual formula is:

$$\ell_b = \sqrt{(d_e \oplus e_{a,b}) \times e_{a,b}}$$

in which :

de = outside diameter of the branch
ea,b = wall thickness of the branch

- The correct formula is (see also EN 12493, AD2000 Merkblatt B9):

$$l_b = \sqrt{(d_o \ominus e_b) e_b}$$

in which :

do = outside diameter of the branch
eb = wall thickness of the branch

5. **EN 14208 (welded pressure drums)**

(a) Paragraph 4.1.5 allows for all steel materials an increase of 15% above the min. value for the yield strength according to the material standard, provided the material manufacturer guarantees this higher value. In general (e.g. for tanks according to ADR par. 6.7 and par. 6.8) this 15% increase is allowed for austenitic stainless steel but not for carbon steel or ferro-austenitic steel (because in practice the real values for the yield strength, obtained by testing, is well above the min. value indicated in the material standard for austenitic stainless steel but not for other steels). An additional note should be added that the 15% increase is only allowed for austenitic stainless steel.

(b) Par. 5.4.1 indicates that, if the wall thickness of the pressure drum is less than 15 mm, the fittings (shut-off valves, …) should be fitted by means of an additional reinforcing plate (which is very rarely applied) or through a flange (socalled “block flange”). The standard does not prescribe any min. thickness for this kind of flange. Additional requirements for the flange mountings should be included in the standard (e.g. by means of referring to a flange pressure class according to EN 1092-1, or by means of referring to a calculation method as indicated in one of the European standards such as EN 13445-3.

(c) Par. 5.4.2.2 refers to the standards EN 629-1 and EN ISO 11116-1, concerning the threading of the standard valves. Both standards have been replaced through the standard EN ISO 11363-1.

(d) In par. 8.4 (hot pressed dished ends) indicates that no heat treatment after forming is required if the forming of the ends has taken place at min. 500°C:

- A heat treatment after forming is generally required only for ends in carbon steel;
- Carbon steel dished ends are being formed at a temperature of ca. 920°C (= hot formed) or are being formed at ambient temperature

and afterwards heat treated at ca. 920°C (= normalizing heat treatment after cold forming);

- If the forming of the ends is carried out at 500°C, resident stresses will remain in the dished end.

(e) In par. 9, joggle joints are allowed in certain cases. No additional technical requirements such as indicated in EN 12493 Annex E, EN 13530-2 Annex D or EN 14398-2 Annex D are given.

(f) Par. 11.3 refers to standards which have been replaced by new ones.

(g) The destructive testing of the material and of the pressure drum, described in par. 14.4, should be more transparent:

- According to par. 14.4.1, 2 transverse tensile tests (in the full material of the pressure drum) are required; according to Table 2 (par. 14.3) only 1 tensile test transverse over the weld of a production plate is required.
- According to par. 14.4.2, 2 transverse bending tests are required. According to table 2 (par. 14.3) 3 transverse bending tests are require (2 root bends and 1 face bend).
- According to par. 14.4.3, impact tests are required without specifying a min. thickness of 5 mm which is the min. thickness to obtain interpretable values. The min. impact values indicated in Table 3 of the standard are not in line with the min. impact values which are generally required (24 J/cm² for each individual result and min. 34 J/cm² as the average of 3 tests).

6. **EN 14398-2 (cryogenic non-vacuum tanks)**

(a) Par. 4.3.2.2 indicates that the tank should be able to resist at an external pressure of 0,4 bar and certain figures such as Fig. 2 give indications to external pressure requirements. However the standard does not give design formulas against external pressure; also no reference to another standard which could be used for the external pressure calculations is made;

(b) Par. 4.3.5.2 considers 2:1 torispherical dished ends. See remark 3 for standard EN 1251-2;

(c) Par. 6.2.1, 2nd indent mentions that no weld test plates are required for the external tank. This standard considers only non-vacuum tanks which do not have an external tank. So this information is useless;

(d) Par. 6.2.1, 3rd indent requires a weld test plate for the inner vessel. One of the required testing is a tensile test, transverse over the weld and the values for the obtained yield strength, tensile strength and percentual elongation should be evaluated. Since 3 different material zones (base material, heat affected transition zone and weld material) are being tested the results for the obtained yield strength and the percentual elongation cannot be correctly evaluated. The determination of the yield strength and of the percentual elongation makes only sense if a tensile test is carried out in the full weld; this test is only technically executable for thicknesses of 12 mm or more.

Proposal

7. The Standards Working Group is invited to consider and discuss the mentioned issues and formulate the appropriate corrections. Subsequently, the Standards Working Group is invited to task CEN with the implementation of the agreed corrections in the various standards.

Justification

8. Many practical problems and discussions arise from the mentioned issues in the various standards, which are all listed in the regulations in a mandatory way. Ensuring that these legally binding standards are correct, consistent and up to date eliminates these problems and enhances safety and uniformity in the application of the regulations.