Working Party on the Transport of Dangerous Goods

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INFORMAL PAPER SUBMITTED BY THE UNITED KINGDOM

A. Tank Shell Equivalent Wall Thickness Formula
B. Alternative Arrangements for the Design of Tanks

Background Papers:
This UK INF paper refers to the following documents;
TRANS/WP15/2000/4
TRANS/WP15/2000/9
TRANS/WP15/2000/10
TRANS/WP15/AC.1/161/Add.1
Draft 2001 Edition of ADR
ST/SG/AC10/2000/9 (UN Committee of Experts)

A. Tank Shell Equivalent Wall Thickness Formula;

1. The equivalent thickness formula is used to calculate the thickness of alternative metallic tank shell materials based on the thickness of a mild steel tank shell. Chapter 6.8.2.1.18 of the draft ADR 2001 contains a modified equivalent wall thickness formula as follows;

$$e_1 = \frac{464\, e_0}{\sqrt[3]{(R_{m1}.A_1)^2}} \qquad \text{Formula (1)}$$

However, this modified formula was not agreed either at the 68th session of WP15 in May 2000, or in the informal Working Group which met on 11-12 January 2000 in Berlin. This formula is recorded in paper TRANS/WP15/AC.1/161/Add.1 but uses an incorrect value of R_{m0} in order to produce the constant value of 464 on the top line of the formula.

3. The value of 464 on the top line of Formula (1) is derived from the equation:

$$\sqrt[3]{(R_{m0}.A_0)^2} \qquad \text{Formula (2)}$$

where R_{m0} = tensile strength of 'Reference Steel' = 370N/mm^2 and

A$_0$ = elongation at fracture of the 'Reference Steel' = 27%

The definition of 'Reference Steel' has been introduce into the draft 2001 ADR, and given the value of 370N/mm^2, however, this term has not been agreed by the WP15 plenary committee.

4. The term 'Reference Steel' has also been introduced in the 11th Edition of the UN Recommendations (the 'Orange Book'), and is defined in Chapter 6.7.2.1 of those Recommendations. However, although the term 'Reference Steel' is defined, it is not used for calculating equivalent wall thickness.

5. The formula agreed during the informal Working Group meeting in January 2000, and by WP15 in May 2000 (paper TRANS/WP15/2000/10), was;

$$\mathbf{e_1} = \frac{\mathbf{456\ e_0}}{\mathbf{3}\ \sqrt{(R_{m1}.A_1)^2}} \qquad \text{Formula (3)}$$

where e_0 = minimum shell wall thickness for mild steel,

e_1 = minimum shell wall thickness for the metal chosen,

R_{m1} = guaranteed minimum tensile strength of the metal chosen and,

A_1 = guaranteed minimum elongation at fracture, of the metal chosen.

6. The figure 456 in Formula (3) is derived from Formula (2) but where;

R_{m0} = tensile strength of the 'mild steel of reference' = 360N/mm^2 and

A_0 = elongation at fracture of the 'mild steel of reference' = 27%

These values are the standard reference values for mild steel and have been in   use for many years.

7. The value of R_{m0} for 'Reference Steel' is 370N/mm^2, whereas the value for 'mild steel of reference' is 360N/mm^2. Mild steel has an accepted tensile strength between 360 and 440N/mm^2. The lowest figure of 360N/mm^2 has always been used for calculations such as this and is widely accepted and used internationally. It is included in many design codes world-wide. Any changes to these values must be agreed before any amendments are made to ADR.

8. The base equation from which all other formulae are derived is shown in Chapter 6.8.2.1.18 of the draft 2001 ADR (formerly M 211 127 and M212 127) as follows;

$$\mathbf{e_1} = \frac{\mathbf{21.4\ e_0}}{\mathbf{3}\ \sqrt{(R_{m1}.A_1)}} \qquad \text{Formula (4)}$$

The value of 21.4 on the top line of Formula (4) is derived from the equation;

$$\mathbf{3}\ \sqrt{(R_{m0}.A_0)} \qquad \text{Formula (5)}$$

where R_{m0} = 360N/mm2, and A_0 = 27%. This original formula is also included in the 11th Revised Edition of the UN Model Regulations Chapter 6.7.2.4.6.

9. The UK would like to make the following observations;

(a) Paper TRANS/WP15/AC.1/161/Add1 shows Formula (1) which was produced **after** agreement in WP15 by TRANS/WP15/2000/10. A proposal cannot be accepted in WP15 plenary session and then changed following agreement, without discussion. The proposal has not been agreed by WP15 or by members of the informal tank Working Group.

(b) Whilst the definition of 'Reference Steel' is contained in the 11th Revised Edition of the UN Model Regulations, it is not used in the calculation of the equivalent thickness. [This will be pointed out to the UN Committee of Experts at   the next biennium meeting in December 2000 (ref. paper ST/SG/AC10/2000/9)].

10. The UK would therefore like to make the following proposals;

(a) Formula (3) should be introduced into the 2001 Edition of ADR and not Formula (1).

(b) The definition of 'Reference Steel' should be deleted from Chapters 1.2.1 and 6.7.3.1 of the draft 2001 ADR proposals and all references to it removed.

(c) The value of R_{m0} should be 360N/mm^2, and defined as the 'guaranteed minimum tensile strength for mild steel of reference'.

B. 'Alternative Arrangements' for the design of tanks.

11. Paper TRANS/WP15/2000/4 is the report of an informal tank Working Group meeting held 11-12 January 2000 in Berlin. Paper TRANS/WP15/2000/9 is an amended proposal following that Working Group meeting. During that meeting, 'alternative arrangements' for the design of tanks were discussed. Paper TRANS/WP15/2000/9 was also discussed at an informal tank Working Group meeting held during the 68th session of WP15, (15-19 May 2000). However, in   the opinion of the UK, these papers do not completely reflect the decisions of that Working Group.

12. In the opinion of the UK, Working Group delegates were in favour of accepting   the **principle** of 'alternative arrangements'. However, all members expressed the need to develop the proposals further before they were included in ADR. All participating countries concluded that the principles and performance criteria should be developed in WP15 Technical Working Group meetings and submitted for inclusion in ADR, **before** being presented to CEN for detailed development in the technical standards.

13. All participating countries were prepared to adopt this principle, therefore the proposals in paper TRANS/WP15/2000/9 were **not adopted** for inclusion in the 2001 Edition of ADR without further development. However, they could be considered for inclusion into the 2003 Edition of ADR, provided they had been sufficiently developed by then.

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