

**Committee of Experts on the Transport of Dangerous Goods  
and on the Globally Harmonized System of Classification  
and Labelling of Chemicals**

1 November 2023

**Sub-Committee of Experts on the  
Transport of Dangerous Goods**

**Sixty-third session**

Geneva, 27 November- 6 December 2023

Item 2 (c) of the provisional agenda

**Explosives and related matters:**

**Review of tests in parts I, II and III  
of the Manual of Tests and Criteria**

**Sub-Committee of Experts on the Globally Harmonized  
System of Classification and Labelling of Chemicals**

**Forty-fifth session**

Geneva, 6-8 December 2023

Item 2 (a) of the provisional agenda

**Work on the Globally Harmonized System  
of Classification and Labelling of Chemicals:  
Work of the Sub-Committee of Experts on the  
Transport of Dangerous Goods on matters of interest to  
the Sub-Committee of Experts on the Globally  
Harmonized System of Classification and Labelling of  
Chemicals**

**Bursting pressure test method for Koenen steel tubes**

**Transmitted by the expert from Germany**

**I. Introduction**

1. In the Koenen test (see *Manual of Tests and Criteria*), so-called Koenen steel tubes are used. For the manufactured steel tubes to be suitable within the meaning of the test method, it must be ensured that the manufactured steel tubes are of consistent quality. This is done by subjecting every production lot of steel tubes to quality control to verify compliance with various parameters specified in the test method.

2. An important quality control parameter is the bursting pressure of the steel tubes. A characteristic feature of the method for testing the bursting pressure developed by the Federal Institute for Materials Research and Testing (BAM) is that a continuous, rapidly rising pressure is built up in the steel tubes by means of a special hydraulic pump (electrically powered oil compressor (BAM pump)). The pressure at which the dynamically loaded steel tube ultimately bursts is called quasi-static bursting pressure. This pressure is then compared with the permissible parameter mentioned in the test method.

**II. Background**

3. The Koenen test was developed by BAM approximately 70 years ago. Since then, quality control and acceptance of steel tubes manufactured in Germany have been effected by means of the bursting pressure tests carried out at BAM, which are essentially still carried out with the same apparatuses. Over the years, it has thereby been possible to ensure that the steel tubes are of sufficiently high, consistent quality.

4. The quality test method used by BAM since then for the bursting pressure is currently to be classified as a reference method. In the case of changes to or modernizations of this quality test method, appropriate proof of equivalency must be furnished.

5. In the opinion of some countries, there seems to be the need to change the design of the steel tubes. Here, reference is made to informal document INF.15 submitted by the United Kingdom and the United States of America for consideration by the TDG Sub-Committee at its 60<sup>th</sup> session in 2022, to the presentation given and the comprehensive discussions at the IGUS EPP/CIE session in April 2022. Practical measures to that effect have also already been

initiated (round robin test in 2023). This initiative is based in particular on the results of the bursting pressure tests carried out by Safety Management Services, Inc. (SMS) (see INF.15, TDG 60<sup>th</sup> session).

6. However, it is to be noted that the bursting pressure test method used by SMS differs from the one used at BAM. In the SMS method, the pressure rise is not effected by means of a continuous, rapid increase in pressure, but the pressure is increased incrementally until the steel tube bursts. SMS refers to this method as “static incompressible bursting pressure tests on SMS”. Until then, results of equivalency tests of the BAM method and the method used by the company SMS had not been available.

### III. Exploratory examination as regards the equivalency of the different bursting pressure test methods

7. Due to the lack of an equivalency test, BAM conducted in the summer of 2023, an exploratory examination comparing the two different bursting pressure test methods (BAM vs. SMS bursting pressure test method). The examinations were carried out with five steel tubes each from three different production lots. The “static incompressible bursting pressure test” SMS method was simulated at BAM with the help of a manual hand pump in a way that the bursting pressure was achieved by means of manually effected strokes via several pressure stages.

8. The results of the comparison of the two bursting pressure test methods are shown in the following table:

Production lot of the steel tubes	Bursting pressure in acc. with the BAM method*	Bursting pressure in acc. with the SMS method**
	Mean value (standard deviation) [MPa]	Mean value (standard deviation) [MPa]
2019 lot	29.5 (0.3)	23.6 (0.8)
2018 lot***	25.5 (0.3)	22.7 (0.5)
2016 lot	28.3 (0.2)	26.1 (0.2)

\* dynamic-continuous rapid pressure rise

\*\* manually simulated discontinuous incremental pressure rise

\*\*\* 2018 lot was not accepted by BAM for UN Koenen test purposes

9. The results show significant differences between the two bursting pressure test methods. At a tolerated deviation of e.g. 10 %, it cannot generally be assumed that the bursting pressure test methods used by BAM and SMS are equivalent. Accordingly, the conclusions set out in INF.15 (TDG 60<sup>th</sup> session) cannot be confirmed in every case.

### IV. Proposal

10. The BAM bursting pressure test method, which has been used successfully and essentially without technical changes as part of quality control for more than 70 years, was the basis for determining the bursting pressure for quality control and thus the basis for a reliable classification of substances or mixtures in accordance with the Koenen test. Based on current knowledge, the results of the different methods to determine the bursting pressure are not equivalent.

11. The test carried out by SMS (see INF.15, TDG 60<sup>th</sup> session) shows that apparently there is now also a need in other countries to carry out their own bursting pressure tests of the steel tubes.

12. There have been no major changes so far to the method used by BAM. However, the ‘old’ test apparatuses used are no longer available on the market in their original form.

13. Germany asks that the following questions be discussed:
- (a) Is there a need for an additional description of the bursting pressure test method that has been used for quality control of the steel tubes since the 1950s until today?
  - (b) Is there a need to identify (and validate by means of equivalency tests) alternatives for the quality test for the bursting pressure test method that can be implemented using apparatuses available on the market today?
14. In the case that one or both of the above questions is/are answered in the affirmative, Germany is willing to assume the lead responsibility for further work.
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