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EXPLOSIVES, SELF-REACTIVE SUBSTANCES AND ORGANIC PEROXIDES

Amendments to the Manual of Tests and Criteria

Transmitted by the expert from Germany

Working document ST/SG/AC.10/2004/14 was submitted to the 25th session of the Sub-Committee by the expert from Germany, and an informal document UN/SCETDG/25/INF.92 dealing with the same issue was submitted in addition. Both papers were aimed at clarifying the specifications for the Koenen-test which is found in the Manual of Test and Criteria as 1(b)-, 2(b)-, 8(c)-, and E.1-test. During the 25th session, however, more questions were asked by the experts from other countries, and due to a lack of detailed data the proposal was withdrawn during the meeting. This working document contains now the requested additional information and the expert from Germany proposes the amendment to the Manual of Tests and Criteria as given below.

1. Background

The Koenen-test can be found within the Manual of Tests and Criteria at four places with the same description:

> as 1(b)-test in chapter 11.5,
> as 2(b)-test in chapter 12.5,
> as 8(c)-test in chapter 18.6,
> and as E.1-test in chapter 25.4.

Within the chapters listed above a description of the steel tubes for the Koenen-test is given in a sub-chapter #.#.1.2.1. The second sentence reads: "*The tube is deep drawn from sheet steel of suitable quality.*" Experts from various countries felt that this description was not sufficiently precise. The only other information given was a mass range for the tubes and dimensions without tolerances as shown in Figures #.#.1.1 of the Manual of Tests and Criteria.

During a past meeting an amendment was proposed. However, sufficient test data was not available as background information.

The German Federal Institute for Materials Research and Testing (BAM) is involved in quality control of the Koenen test-tubes since more than two decades. For this working document a number of current test data has been compiled. Furthermore, information set out in national testing standards in relation to the Koenen-test are reproduced, and finally a proposal for the amendment of the text in sections 11.5.1.2.1, 12.5.1.2.1, 18.6.1.2.1, and 25.4.1.2.1 is made.

2. Detailed information

In the original German description of the Koenen test the steel quality for the tubes was given through a material number valid at that times. The material number "1.0336.5 05 g" with a trade name "USt 14 05 g" was given, and chemical constituents of at maximum 0.1% carbon, only traces of silicon, manganese from 0.2 to 0.45 %, no chromium and no nickel were listed. The yield point shall be 235 N/mm^2 and the tensile strength shall be 275 - 375 N/mm^2.

These values are met by cold rolled sheet steel of the quality "DC04" which is a code according to EN 10027-1, but which is also known as "material number 1.0338" according to EN 10027-2. Other equivalent names are "USt 4" and "USt 14" according to DIN 1623, or "A620 (1008)" according to standard ASTM in the USA, or "SPCEN" according to standard JIS G 3141 in Japan. A study on the internet revealed a consistent picture regarding these designations, and further names are in principle available. With respect to the UN recommendations it is suggested to mention only three different codes as used in Europe, USA, and Japan.

The original test description also contained some information on tolerances. To suplement this information, steel tubes from current testing have been checked on dimensions and mass, giving the following results with average value and standard deviation ?: length l = 75.1 mm, ? = 0.1, outer diameter measured 20 mm from bottom of tube is d = 25.2 mm, ? = 0.02, inner diameter measured 20 mm from bottom of tube is e = 24.1 mm, ? = 0.05. It is, of course, necessary to use the above data as indications and not to use the standard deviations as tolerance. Tolerances have to be chosen realistically in terms of reproducible production and range of values. It is suggested to apply the following tolerances: length ± 0.5 mm, wall thickness ± 0.05 mm. Please note that, although inner and outer diameter have been measured, it is technically more reasonable to define the wall thickness as relevant parameter.
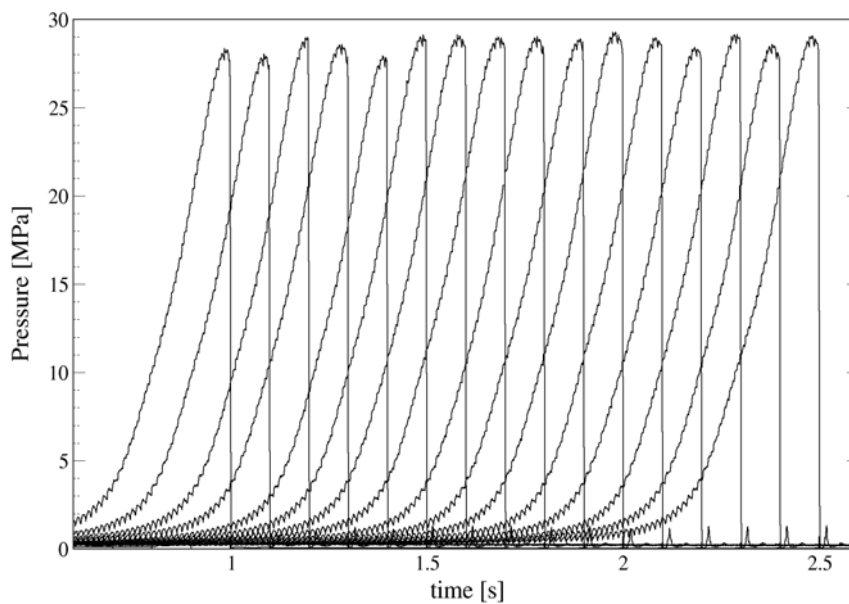

Fig. 1: Pressure curves from the bursting of 16 steel tubes, curves horizontally shifted

As another feature of the first original test description there has been a limitation on the mass range of tubes to be used in one test sequence. It was required that tubes do not differ by more than 1 g, obviously to ensure some degree of consistency from test to test within a sequence. The overall mass interval for tubes was set out higher since the mass of tubes during production apparently can only be controlled to a limited degree.

The diagrams shown in Fig. 1 and 2 are pressure traces and peak values from the quasi-static bursting of Koenen test-tubes under oil pressure. The data has been analysed to form Fig. 2 with the peak values from the curves, i. e. the highest pressure recorded before the bursting occurred.
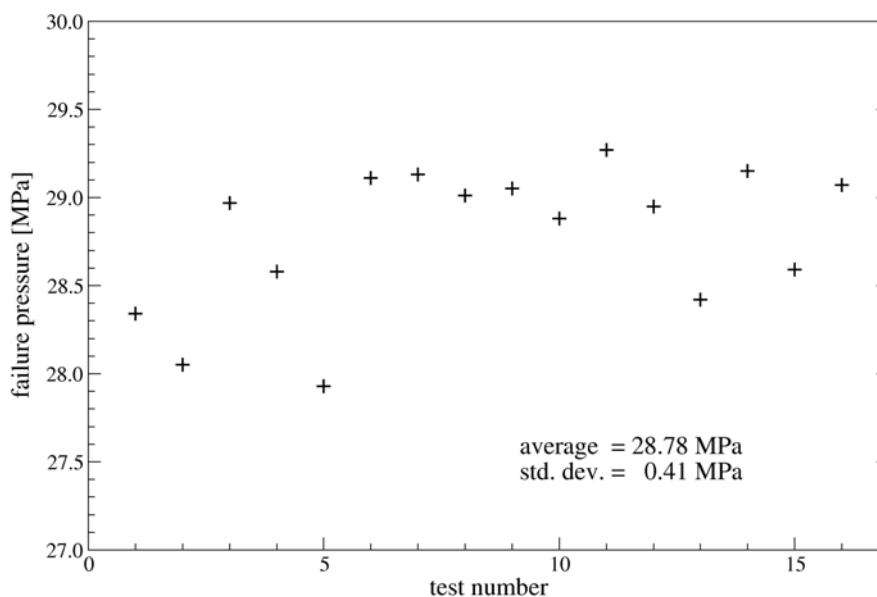
Fig. 2: Bursting pressures for 16 steel tubes tested, statistical analysis

The data from Fig. 2 fit into the earlier given interval for the bursting pressure of 300 bar ± 30 bar. Regarding more or less accurate definition of testing conditions, it is a matter of considerations to which detail this description shall go. The more limiting the parameters are set out, the more difficult it will be to comply with the requirements. There has to be a reasonable balance of defining parameters not as accurate as possible, but as accurate as appropriate. While the former description was in fact not very accurate, the proposal made here is already fairly restrictive.

3. Proposal

It is proposed to delete in the second sentence of 11.5.1.2.1, 12.5.1.2.1, 18.6.1.2.1, and 25.4.1.2.1 the words *"of suitable quality"* and to insert instead *"with the specification DC04 (EN 10027-1, Europe), or equivalent A620 (AISI/SAE/ASTM, USA), or equivalent SPCEN (JIS G 3141, Japan)."*

It is further proposed to move the third sentence to the end of the paragraph and to combine this sentence with further information on properties of the steel tubes. It may be a matter of editorial considerations to make the following an individual paragraph:

> *For quality control of the steel tubes 1% of the tubes from each production lot shall be subjected to quality control and the following data shall be verified: (a) the mass of the tubes shall be 26.5 ± 1.5 g, tubes to be used in one test sequence shall not differ in weight by more than 1 g; (b) the length of the tubes shall be 75 ± 0.5 mm; (c) the wall thickness of the tubes measured 20 mm from the bottom of the tube shall be 0.5 ± 0.05 mm. (d) the bursting pressure as determined by quasi-static load through an incompressible fluid shall be 30 ± 3 MPa.*