

Comments on draft recommendation OIML R35-2

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Conclusion: To approve the draft, with comments.

Comments:

Ref. 6.2.17 and 6.2.18.

The following standards sets the metrological requirements for flexible steel tape measures with tensioning weight or sinker, which are frequently referred to as “oil gauging tapes” or “dip tapes” and are used for gauging the level of liquids in tanks used as measuring containers:

- OIML R35-1:2007 Material measures of length for general use. Part 1: Metrological and technical requirements.
- ISO 7501-1: 2003 Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 1: Strapping method.
- ISO 12917-1: 2002 Petroleum and liquid petroleum products — Calibration of horizontal cylindrical tanks — Part 1: Manual methods.
- ISO 4512: 2000 Petroleum and liquid petroleum products. Equipment for measurement of liquid levels in storage tanks. Manual methods.
- OIML R71: 2008 Fixed storage tanks. General requirements.

International Standards ISO 4512: 2000, ISO 12917-1: 2002 and ISO 7507-1: 2003 were prepared by Technical Committee ISO/TC 28 Petroleum products and lubricants, Subcommittee SC 3 Statistic petroleum measurement, whereas standard OIML R 35-1: 2007 was developed by the OIML Technical Subcommittee TC 7 Measuring instruments for length and associated quantities.

Standard ISO 4512: 2000 specifies the metrological requirements of the equipment required to measure manually the liquid level of petroleum stored in tanks.

- the maximum permissible error up to 30 m is $\pm 1,5$ mm, for a new tape at its specified reference temperature and tension. For a tape in service shall not exceed $\pm 2,0$ mm in 30 m.
- if the nominal length exceeds 30 m, for each additional 30 m of tape length, an additional tolerance of 50 % of the maximum permissible error for the first 30 m shall be permitted.
- the certified traceable 95 % confidence limits uncertainty of the reference instrument(s) used to verify the error of the tape shall not exceed $\pm 0,5$ mm for any distance between 0 m and 30 m.
- the accuracy of dip-tapes should be verified before first use and thereafter at regular intervals (e.g. every six months)
- a reference tension of 10 N or 15 N is recommended.
- weights or sinkers shall be of cylindrical shape tapered at the lower end. The base shall be flat with a surface normal to the major axis.

However, standard ISO 7507-1: 2003, which specifies a method for calibration of vertical tanks for petroleum storage, predicts usage of a strapping tape with the following characteristics:

- coefficient of linear expansion: $(11 \pm 1) \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$
- applied tension of 50 N
- reference temperature (calibrated): 20 °C
- accuracy: 1,5 mm in each 30 m of length
- the tape shall be graduated at intervals of one meter, decimeter, centimeter and millimeter.
- the figures and graduations shall be raised between 0,01 mm and 0,03 mm and be brightly coloured on a black background.
- the graduations shall be of uniform width, between 0,20 mm and 0,55 mm.

For the dip-tape (with tensioning weight or sinker):

- coefficient of linear expansion: $(11 \pm 1) \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$
- applied tension: 15 N
- applied tension of 15 N or at a tension equivalent to the weight of the bob.
- reference temperature(calibrated): 20 °C
- accuracy: 1,5 mm in each 30 m of length
- the tape shall be graduated at intervals of one meter, decimeter, centimeter and millimeter.

For the dip-weight

- it shall be made of brass or another non-spark-producing material of similar density.
- the top section of the weight should preferably be flat and be approximately 13 mm in diameter.

The dip-weight is intended to be used in conjunction with, and form an integral part of the dip-tape.

However, standard OIML R 35-1, since its 1985 edition, establishes for the same instruments the accuracy classes and the maximum permissible error as follows:

- the material measures of length are designated by the numbers I, II and III. In the case of tapes used for gauging the level of liquids in tanks used as measuring containers, these shall conform to accuracy class I or II.
- the maximum permissible error on initial verification, positive or negative is defined:
 - a) for the nominal length, and
 - b) for any other distance between any two non-consecutive scale marks, is expressed by the formula: $(a + bL) \text{ mm}$,

where:

L= is the value of the length in question, rounded up to the nearest whole number of meters

a and b= are coefficients. Their values are given, for each accuracy class in Table 1:

Table 1. Values of coefficients a and b for each accuracy class

Accuracy class	a	b
I	0,1	0,1
II	0,3	0,2
III	0,6	0,4

- for end or composite measures, the maximum permissible error, positive or negative, for the length of the terminal scale interval bounded by an end surface, is increased by:

0,1 mm for measures of class I

0,2 mm for measures of class II

0,3 mm for measures of class III

- the maximum permissible error, positive or negative, equals twice the maximum permissible error on initial verification.

- reference temperature: 20 °C; tolerance ± 2 °C.

- in the case of dip-tapes with tensioning weight, the tension is approximately equal to the weight of the sinker in air, which tolerance shall be indicated to within ± 10 g.

- the properties of the materials used shall be such that: the expansion due to a temperature change of ± 8 °C from the reference temperature or the temperature indicated on the measure plus all other errors shall not exceed the maximum permissible error for the accuracy class to which the measure belongs. For measures which have to be used under a specified tension, a variation of ± 10 % of this tension does not produce a variation in length exceeding the maximum permissible error.

The comparison of the requirements of ISO 7507-1: 2003, ISO 4512: 2000 and OIML R 35-1: 2007, for tapes, leads to the following conclusion:

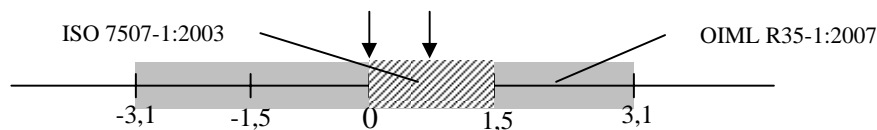
Although ISO 4512: 2000 and ISO 7507-1: 2003 establish that the tape used in strapping should have an accuracy of 1,5 mm in each 30 m, calibrated at 20 °C and a tension of 50 N, OIML R 35-1: 2007 establishes that a tape of 30 m, conform to accuracy class I, can have a maximum permissible error of $\pm (0,1 + 0,1 \times 30) = \pm 3,1$ mm, if new and on initial verification. For a periodic verification, in service, admits twice this value.

This means that a tape classified as accuracy class I by the OIML R35-1:2007 may actually have twice the error that the ISO standards can admit.

Because the value of 1,5 mm for the error of the tape of 30 m belongs to the maximum permissible error interval provided by the OIML R-35: 2007 for a tape accuracy class I of this nominal length, could be assumed that there is no contradiction between the standards. However, the assumption of the requirements of ISO 7507-1: 2003 represents a dramatic increase in the severity of the requirements.

Figure shows in gray color the maximum permissible error interval that approves OIML R 35-1: 2003 for a tape accuracy class I, 30 m nominal length, and shaded, the error interval that approves ISO 7507-1: 2003. The arrows indicate the interval where the error of the tape should keep on initial verification to keep the requirement when in use.

Figure. Comparison of permissible errors for measuring tapes according to OIML R 35-1: 2007 and ISO 7507-1: 2003.

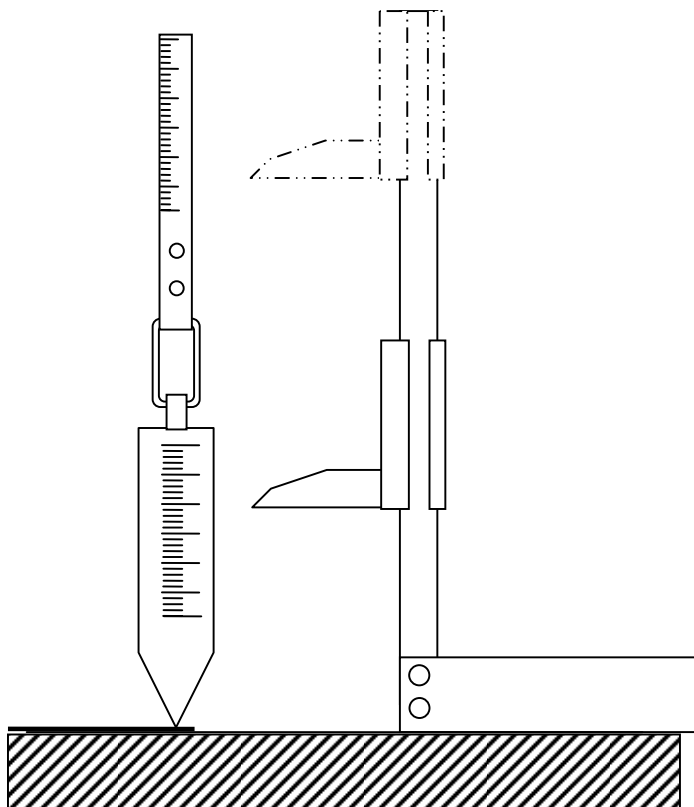


This case can serve as an example of insufficient harmonization of technical regulations in different standardization bodies, arguably as a result of a different representation of interest groups on the responsible technical committees.

Ref. 7.7.

- 1) Also, the test equipment may comprise weighing instrument for measure the mass of the sinkers.

2) In ref. 22.5 of OIML R35-1: 2007 states that “However, for any length between any two scale marks, one of which is on the sinker and the other on the tape, the maximum permissible error is ± 0.6 mm when application of the formula in 4.2.1 gives a value less than 0.6 mm”. This requirement must be checked as well, placing the tape with sinker in a suitable support, (as shown in the figure), and using a height calliper, making one measurement in the sinker and another on the tape.



Bibliography:

If comments are accepted, should be included in Bibliography the following ISO standards:

- ISO 7501-1: 2003 Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 1: Strapping method.
- ISO 12917-1: 2002 Petroleum and liquid petroleum products — Calibration of horizontal cylindrical tanks — Part 1: Manual methods.
- ISO 4512: 2000 Petroleum and liquid petroleum products. Equipment for measurement of liquid levels in storage tanks. Manual methods.

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