SLOVENSKI STANDARD
SIST EN 2155-12:2001

01-junij-2001

Aerospace series - Test methods for transparent materials for aircraft glazing - Part 12: Determination of linear thermal expansion

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Luft- und Raumfahrt - Prüfverfahren für transparente Werkstoffe zur Verglasung von Luftfahrzeugen - Teil 12: Bestimmung der linearen Wärmeausdehnung

Série aérospatiale - Méthodes d'essais pour matériaux transparents pour vitrages aéronautiques - Partie 12: Détermination de la dilatation thermique linéaire

Ta slovenski standard je istoveten z: **EN 2155-12:1997**

ICS:

49.045	Konstrukcija in konstrukcijski elementi	Structure and structure elements

SIST EN 2155-12:2001 **en**

EUROPEAN STANDARD **EN 2155-12**

NORME EUROPÉENNE

EUROPÄISCHE NORM July 1997

ICS 49.025.40

Descriptors: aircraft industry, glazing, materials, transparency, plastics, tests, determination, thermal properties, thermal expansion

English version

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

After inquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 1998, and conflicting national standards shall be withdrawn at the latest by January 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies the method to determine the reversible linear thermal expansion of plastics with exclusion of changes in length due to accidental factors such as changes in moisture content, degree of polymerization and stress release. Since it will not be possible to exclude all these accidental factors, the method can be expected to give only approximate values.

2 Definition

For the purposes of this standard, the following definition applies :

Linear thermal expansion is defined as the change in length of a material in relation to unit length for a variation in temperature of 1 °C.

3 Apparatus

3.1 Dilatometer

A simple fused-quartz tube dilatometer is shown in figure 1. Any generally accepted method of measuring thermal expansion may be used which will be accurate to within ± 10 %. The accuracy of the device which measures the expansion shall be such that it measures the change in length over the temperature interval under consideration within ± 2 %.

This device shall not exert a stress of more than 50 kPa on this specimen which shall not be distorted or indented.

3.2 Scale or caliper

The scale or caliper shall be capable of measuring the test length of the specimen with an accuracy of ± 0,5 %.

3.3 Temperature bath

The temperature of the specimen shall preferably be controlled by the use of a liquid bath. The bath shall be arranged in such a way that uniform temperature throughout the specimen is secured. Means shall be provided for stirring the bath and for controlling its temperature within ± 0,2 °C of the temperatures used.

4 Specimens

4.1 Preparation

Specimens shall be cut or shaped, from sheet. The ends of the specimen shall be cut perpendicular to the axis of the specimen. They shall be protected by means of thin steel plates cemented to them.

4.2 Dimensions

For the apparatus shown in figure 1, specimens can be round or square and shall fit easily into the outer tube without excessive play. The length of the specimen may be 50 mm to 100 mm but its length is governed to some extent by the sensitivity of the dial gauge, the expected expansion and the desired accuracy.

5 Conditioning

The specimen shall be conditioned at (23 ± 2) °C, (50 ± 5) % relative humidity for at least 48 h prior to measurement of the test length of the specimen under these conditions.

6 Procedure

The temperature range over which the coefficient of thermal expansion is to be measured shall be chosen so that no transitional regions are included.

The limits of the range shall be agreed between purchaser and manufacturer.

6.1 Low temperature

Mount the specimen in the apparatus and maintain the temperature of the bath at the lowest temperature at which measurements are required until the temperature of the specimen reaches the temperature of the bath. The time necessary shall be determined by preliminary measurements of temperature inside a similar specimen. Record the reading of the dial gauge or other device indicating change in length.

6.2 High temperature

Repeat the foregoing operations at the highest temperature at which measurements are required.

6.3 Check determination

Repeat the operations described in 6.1 and 6.2. If the changes in length caused by heating and cooling do not agree within 10 % of their average, the cause of this discrepancy shall be investigated and if possible, eliminated (see 6.5). Otherwise the observations shall be reported, see 8.3.

6.4 Constant temperature bath

Where the construction of the apparatus permits, it may be more convenient to alternately use two baths at the required temperatures. Care shall be taken not to disturb the apparatus during exchange. The use of two baths is preferred because it will reduce the time required to bring the specimen to the desired temperature. The test in general shall be conducted in as short a time as possible to avoid changes in physical properties during long exposure to high and low temperatures.

6.5 Transition temperature

The coefficient of thermal expansion of some materials is known to change rather abruptly at a certain temperature. To find this temperature, it is necessary to measure the coefficient of thermal expansion in narrow temperature limits, or to observe the rate of expansion during a steady rise in temperature of the specimen. Once such a transition point has been found, a separate coefficient of expansion for a temperature range below and above the transition point shall be determined.

7 Expression of results

The average coefficient of thermal expansion shall be calculated from the formula :

$$\text{Coefficient of linear thermal expansion} = \frac{\Delta L}{L \; T}$$

where :

ΔL is the average of changes in length due to heating or cooling ;

L is the test length of specimens immediately after the conditioning stage (ΔL and L being in the same units) ;

T is the temperature difference in °C over which the change in length has been measured.

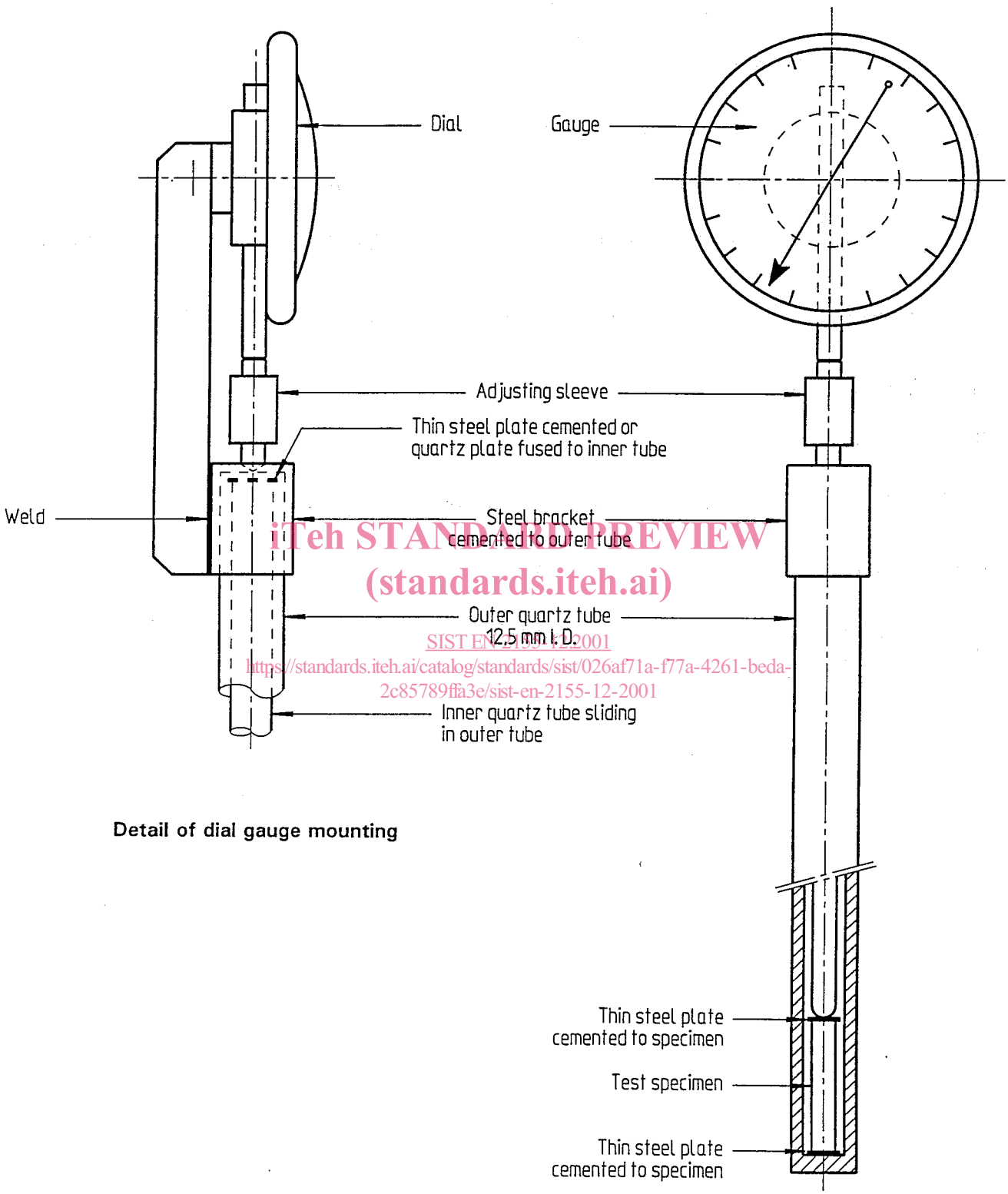
8 Test report

It shall include :

8.1 Temperatures between which the coefficient of thermal expansion has been computed.

8.2 Average coefficient of linear thermal expansion per °C

8.3 Complete description of any unusual behaviour such as, for instance, a difference of more than 10 % in measured values of expansion and contraction



Detail of dial gauge mounting

Figure 1 : Quartz-tube dilatometer