

Procedures for the choice, use, checking, mounting and replacement of instrumentation used for temperature measurement in fire resistance tests

(revision of EGOLF TR2:2000)

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Foreword

This document has been prepared by EGOLF and adopted by all EGOLF member laboratories for the choice, use, mounting, checking and replacement of instrumentation used for temperature measurement in fire resistance tests.

It is recommended to other organisations and laboratories that it should be universally accepted for this purpose; in particular CEN Technical Committee TC127 for inclusion when the standards for fire resistance are revised.

1 Scope

This document details EGOLF procedures to be followed for the choice, use, checking and replacement of thermocouples used for temperature measurement in fire resistance tests undertaken to EN 1363-1 and specific downstream standards. It is intended to supplement to these European standards.

The document covers the following instruments:

- Plate thermometers for measurement of furnace temperature
- Thermocouples for measurement of unexposed surface, cavity and internal specimen temperatures
- Roving thermocouples
- Thermocouples for measuring gas temperature in service installation tests including fire resistant ducts and dampers, smoke extraction devices etc.

2 Specification of instrumentation for temperature measurement

2.1 Plate thermometers The design, construction and conditions of use of the plate thermometers used in fire resistance furnaces are specified in EN 1363-1. A specification of the materials to be used is given in Annex 1. Suggestions for the mounting of plate thermometers are given in Annex 2.

2.2 Instruments for measurement of other temperatures The instrumentation required for general temperature measurement in fire resistance tests is fully described in EN 1363-1. Further specific instrumentation required for general temperature measurement is given in the various downstream fire resistance test standards.

3 Thermocouple tolerance specifications

Use of type K (Nickel Chromium/Nickel Aluminium) thermocouples meeting the requirements of IEC 584-1 (now superseded by EN 60584-1) is allowed under EN 1363-1. However, there is no specification of the accuracy required. Tolerances for thermocouples are now given in EN 60584-2 shown in the table below.

Class	Temp range 375 - 1000°C	Tolerance	Temperature equivalent
1	-40 to 375°C		± 1.5°C
	375 to 1000°C	±0.4%	
2	-40 to 333°C		± 2.5°C
	333 to 1200°C	±0.75%	

EGOLF members shall use thermocouples of appropriate accuracy specified in EN 60584-2 i.e.:

- class 1 for temperatures up to 1000°C
- class 2 for thermocouples incorporated into plate thermometers for temperatures up to 1200°C .

All thermocouples (or thermocouple wire used to make thermocouples) shall be purchased from certificated production supplied with an accompanying certificate of conformity to the appropriate class of EN 60584-2.

4 Checks on instrumentation used for temperature measurement

Procedures for checking the accuracy of new and previously used instrumentation used for temperature measurement in fire resistance tests are not specified in EN 1363-1.

EGOLF members shall apply the checks given in 4.1 and 4.2 below on instrumentation used for temperature measurement in fire resistance tests:

4.1 Checks on ready made and laboratory made thermocouples before taken into service

Before the thermocouple is taken into service the following should be checked

- Correct welding of the wires at measuring point e.g. the copper disk
- Damage of the cable
- Correct connection of the wires to the connectors
- Verification of conformity to the appropriate class of EN 60584-2
- Verification of the functionality by making a temperature measurement before commencement of the fire test.

4.2 In-use checks on all thermocouples and thermocouple assemblies prior to each test

- All thermocouples and thermocouple assemblies, including plate thermometers, shall be checked by the laboratory for damage or corrosion by visual inspection and for malfunction or correct connection by an appropriate electrical continuity method.

5 Replacement of thermocouples

Instrumentation used for measuring temperature in fire testing may require replacement over time; thermocouples can age causing drift and can be damaged in a way that is not immediately obvious. Apart from plate thermometers which have to be replaced every 50 hours, the lifetime of instrumentation used for measuring temperature in fire resistance testing is not specified in EN 1363-1.

EGOLF members agree the following checks and replacement procedures:

- Fixed thermocouple assemblies such as unexposed face thermocouples may be re-used provided that they are not damaged on disconnection from the previous test specimen. Before re-use a visual check shall be made to ensure that there is no adhesive left on the disc, that the disc and thermocouple are not damaged or corroded, that the disc is flat and that there is no malfunction. If re-used for more than five (5) tests checks shall be made using the procedure of Annex 3. (to be deleted)
- Roving thermocouples need not be replaced unless they become damaged. A visual inspection shall be made every time before they are used in a test. Checks shall be made when they are used for more than 25 tests, using the procedure of Annex 3. (to be replaced with) The functionality of the roving thermocouple should be verified, ones every year, using the procedure of Annex 3.
- Thermocouples for measuring gas temperature in service installation tests e.g. fire resistant ducts and dampers, smoke extraction devices etc need not be replaced unless they become damaged. Checks on these thermocouples shall be made when they are used for more than 25 tests, using the procedure of Annex 3. (to be replaced with) The functionality of the thermocouples should be verified, ones every year, using the procedure of Annex 3.

ANNEX 1

PLATE THERMOMETERS - SPECIFICATION FOR MATERIALS OF CONSTRUCTION

Plate thermometer sheet metal

The folded metal sheet from which the plate thermometer is made shall comprise a nickel alloy, e.g. **Inconel 600**®, which has a composition:

0.05 %	Carbon	C
15.5 %	Chromium	Cr
75.0 %	Nickel	Ni
8.0 %	Iron	Fe

Insulation pad material

The insulation pad material of which the plate thermometer is made shall comprise an inorganic insulation material of density $280 \pm 30 \text{ kg/m}^3$, e.g. **EVAC EVS 121**® or **Keramab Insulfrax board**.

ANNEX 2 (INFORMATIVE)

ASSEMBLY/POSITIONING OF PLATE THERMOMETERS

The fixing of the thermocouple (using a single spot-welded or screw-fixed steel strip) and the assembly of the plate thermometer is specified in EN 1363-1. The inclusion of a second spot-welded or screw-fixed steel strip may provide additional support to the thermocouple provided that it is situated well away from the hot junction of the thermocouple.

Plate thermometers may be mounted within the furnace in the following manner:

- According to EN 1363-1 Figure 1, a mounting socket, through which the thermocouple passes, is fixed to the top edge of the plate thermometer. It is suggested that this mounting socket is made of stainless steel, of internal diameter of ~7mm and wall thickness of ~1mm. It may be threaded (R1/4) internally (or externally).
- To mount the plate thermometer within the furnace the mounting socket may be attached to a stainless steel mounting tube, the length of which depends upon the position of the plate thermometer in the furnace (see figure 2). The mounting tube may be in one or more sections and may enter the furnace from the top (as shown in figure 2), the side or the back of the furnace.
- Where this procedure is used, such mounting tubes should be of internal diameter sufficient to fit over the outside of the mounting socket (see figure 1 of this document, left hand drawing) or external diameter sufficient to fit inside the mounting socket (see figure 1 of this document, right hand drawing). The mounting tube may be fixed to the mounting socket by use of either "locking screws" or a screw thread.
- Where the mounting tube is to be attached to the plate thermometer via a screwed fitting, the mounting tube should be rotated during assembly, not the plate thermometer, to avoid twisting the thermocouple and any compensation cable used.
- Where compensation cable is used this must be in free air once outside the furnace.

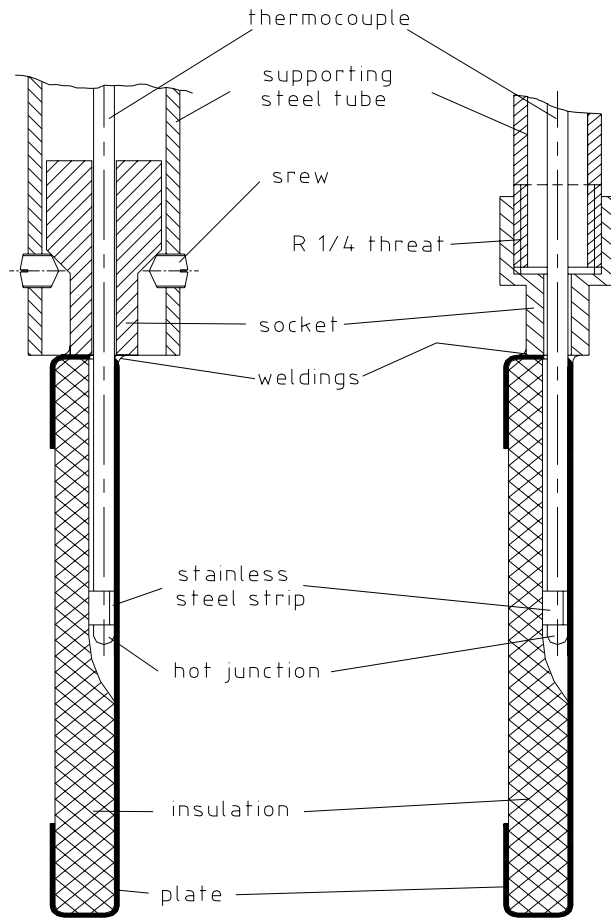


Figure 1

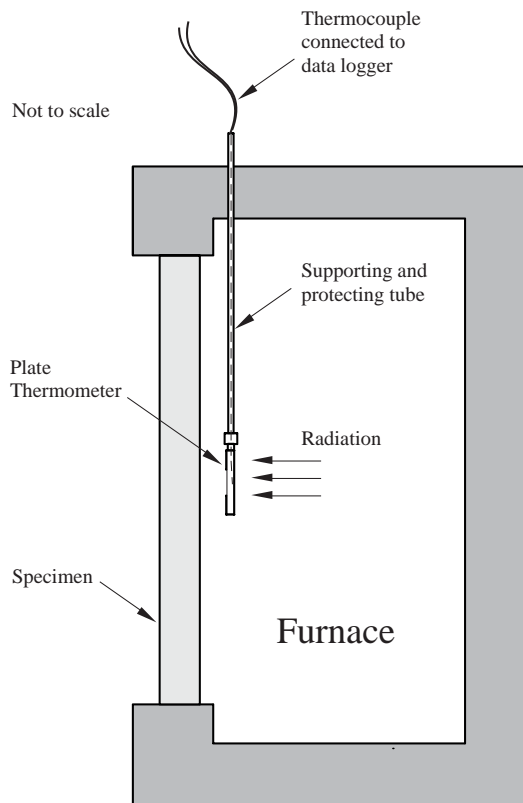


Figure 2

ANNEX 3

METHOD FOR VERIFYING THE PERFORMANCE OF LABORATORY MADE THERMOCOUPLES AND THERMOCOUPLE ASSEMBLIES (EXCLUDING PLATE THERMOMETERS)

The performance of laboratory made thermocouples and thermocouple assemblies (excluding plate thermometers) can be checked using the methods given within this annex.

Method 1

A selection to comprise 5% of each batch, or for small batches, the first, middle and last thermocouple made shall be checked in the following way:

The thermocouple or thermocouple assembly being checked shall be immersed in:

- Ice water made from distilled water
- Boiling distilled water.

The temperature recorded shall be compared to:

- The temperature of melting ice from distilled water; $t_{\text{melting}} = 0^{\circ}\text{C}$
- The temperature of boiling distilled water $t_{\text{boiling}} = 100^{\circ}\text{C} - 0,02857 \times (1013 - p_a)$ where p_a = atmospheric pressure (barometric pressure) in hPa.

ACCURACY: Laboratory made thermocouples and thermocouple assemblies (excluding plate thermometers) will almost exclusively be designed to measure temperatures of less than 1000°C and consequently, will be class 1 to EN 60583-2.

Accordingly, the maximum permissible error of the thermocouple is as follows:

- temperature of ice should be in the range -1.5 to $+1.5^{\circ}\text{C}$
- temperature of boiling water 98.5 to 101.5°C

If the error recorded on any of the tested selection is greater than this limit then all self made thermocouples and thermocouple assemblies within the batch shall be tested. Any failing to meet the criteria shall be rejected.

Method 2

A selection to comprise 5% of each batch, or for small batches, the first, middle and last thermocouple made shall be checked in the following way:

The thermocouple or thermocouple assembly is checked using an electrical medium temperature portable field calibrator. The temperature shall be recorded a minimum 2 temperatures, covering the intended measuring range of the thermocouple.

ACCURACY: Laboratory made thermocouples and thermocouple assemblies (excluding plate thermometers) will almost exclusively be designed to measure temperatures of less than 1000°C and consequently, will be class 1 to EN 60583-2.

Accordingly, the maximum permissible error of the thermocouple is as follows:

- temperature difference at any measuring point should be less than -1.5 to $+1.5^{\circ}\text{C}$

If the error recorded on any of the tested selection is greater than this limit then all self made thermocouples and thermocouple assemblies within the batch shall be tested. Any failing to meet the criteria shall be rejected.
