

Devices and procedures for measurement and control of pressure in fire resistance furnaces and their calibration

(previously available as EGOLF TR3:1998, revised in 2006)

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1 Scope

This document considers EGOLF procedures for the choice, use and calibration of pressure measurement devices used for measurement and control of pressure in fire resistance furnaces during fire resistance testing performed according to EN 1363-1. It is intended to be supplementary to EN 1363-1.

RESOLUTION EGOLF member laboratories shall adopt and implement the decisions given within this document, in respect of the purchase or manufacture, use and calibration of devices used for pressure measurement and control in fire resistance furnaces used for fire resistance testing according to EN 1363-1.

2 References

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|-----------------|--|
| EN 1363 | Fire resistance tests : Elements of building construction - Part 1 General requirements for fire resistance testing. |
| EN 10095 | Heat resisting steels and nickel alloys |
| CEN TC127/N1162 | Fire resistance furnace calibration proving test programme - Phase 2. [Report from CEN TC127 ad hoc 14 studies] |

3 Introduction

EN 1363-1 describes, in clauses 4.5.2, 4.6, 5.2, 9.2 and 10.4.2 and figure 4, requirements for the design, accuracy, installation and use of pressure measurement devices to be used for measurement and control of furnaces pressure in fire resistance testing.

This document aims to provide a completed harmonised furnace pressure measurement and control procedure to be used by all EGOLF members and thereby minimise performance differences between laboratories.

4 Choice of pressure sensor

The choice of pressure sensor to be used in fire resistance testing is dictated within EN 1363-1. According to this standard, pressure sensors may be "T" shaped sensors or "Tube" sensors.

Work reported in CEN TC127 N1161 shows no difference between the "T" shaped sensor defined in EN 1363-1 and "open pipe" sensors (which are not defined in EN1363-1) and recommends that either type may be used by fire test laboratories.

This document will address all 3 types of pressure sensor.

5 Pressure sensor specification

The type and dimensions of pressure sensors are only partially defined in EN 1363-1. Further definition is necessary for completeness.

5.1 'T' shaped pressure sensors

EN 1363-1 defines the internal diameter of stainless steel "T" shaped sensors in figure 4 as being 5-10 mm. It does not define the external diameter or dimensions of the "T" or the grade of stainless steel to be used (note: some grades will deteriorate with use).

EGOLF member laboratories propose that **'T' shaped pressure sensors** shall be of the following dimensions and properties :

- outside diameter of steel tube = 16 mm maximum
- length of arms of "T" (total) = (100 ± 2) mm
- length of leg within furnace = (50 ± 20) mm
- length of leg outside furnace = 100 mm minimum
- grades of stainless steel permitted = X10CrNiTi 18 10 * / X15CrNiSi 20 12 * / X15CrNiSi 25 20 *

5.2 Tube sensors

EN 1363-1 defines the internal and external dimensions of the tube and the positioning and size of holes. It does not define the length of the tube, within or outside the furnace, or indeed its overall length or the grade of stainless steel to be used (some grades will deteriorate with use).

EGOLF member laboratories propose that **Tube sensors** shall be of the following dimensions and properties :

- length within the furnace = (50 ± 20) mm [i.e. between holes & furnace wall]
- length outside the furnace = 100 mm minimum
- grades of stainless steel permitted = X15CrNiSi 20 12 / X15CrNiSi 25 20 *

5.3 Pipe sensors

EN 1363-1 does not define open pipe sensors or their use, however their performance has been shown to be acceptable (CEN TC127/N1161). EGOLF member laboratories propose that **open pipe sensors**, where used, shall be of the following dimensions and properties :

- internal dimensions of the tube = (5 ± 1) mm
- external dimensions of the tube = internal diameter + 2 mm
- length within the furnace = (50 ± 50) mm * *
- length outside the furnace = 100 mm minimum
- grades of stainless steel permitted = X15CrNiSi 20 12 / X15CrNiSi 25 20 *

* As specified in EN 10095

* * CEN TC127 ad hoc 14 reports that pipe length within the furnace is without effect from 0 - 100 mm.

DECISION EGOLF member laboratories agree that they shall only use "T" shaped pressure sensors (as specified in EN 1363-1), "Tube" sensors (as specified in EN 1363-1) or "open pipe" sensors. The specification for these shall be as given in EN 1363-1 and this document.

To prove conformity to these material or design specifications, new sensors or component materials shall be purchased against these specifications and be

provided be accompanied by Certificates of Conformity provided by the suppliers.

6 Mounting and positioning of pressure sensors

The mounting and positioning etc. of pressure sensing heads to be used for measurement and control of furnace pressure in fire resistance testing is specified in EN 1363-1. Any additional requirements particular to the fire resistance test standard in use will be defined therein.

DECISION EGOLF member laboratories agree that they shall only mount and position pressure sensors for fire resistance testing according to the methods given in EN 1363-1 or specific instructions within the test standard being followed.

7 Ageing and replacement of pressure sensors

The ageing and replacement of pressure sensing heads to be used for measurement and control of furnace pressure in fire resistance testing is not specified in EN 1363-1. EGOLF proposes that sensors shall be subjected to visual inspection for major damage or corrosion and rejected if this is found.

DECISION EGOLF instructs that member laboratories shall subject pressure sensors to visual inspection before every test and reject any found to be badly damaged or corroded.

8 Measuring equipment - type / specification

The measuring and recording equipment to be used for controlling pressure in fire resistance furnaces is not defined within EN 1363-1, other than giving the specifications for range, (0-20 Pa), precision, (± 2 Pa) and measurement frequency (continuous / at intervals less than 1 minute).

EGOLF members generally use for fire resistance testing, either, electronic micro-manometer transducer type pressure measurement devices, sloping tube (sometimes called inclined tube) manometers or U-tube type manometers (normally used for measuring under-pressure, e.g. in fire resistant duct tests and therefore not relevant to furnace control). Each type has its advantages and disadvantages.

EGOLF member laboratories propose that only electronic micro-manometer transducer type pressure measurement devices of the following specification shall be used in fire resistance testing for measuring and controlling furnace pressure:

- Response time (10 ± 5) seconds

DECISION EGOLF member laboratories shall only use the electronic micro-manometer transducer type pressure measurement devices for measuring and controlling furnace pressure. These devices shall meet the specification for range and accuracy given in EN 1363-1 and, if appropriate, given in any specific EN test method in use.

9 Connection of sensor tube to pressure measuring device

The means of connecting the sensor tube to the pressure measuring is not defined in detail within EN 1363-1.

EGOLF member laboratories propose that:

- the (+)ve and (-)ve pressure points should preferably be at the same height within and without the furnace and be joined via parallel tubes to the (+)ve and (-)ve connections of the measuring device [see figure 1]. If not, the individual (+)ve and (-)ve tubes shall not be exposed to different heating conditions.
- it is recommended that the (+)ve and (-)ve connections to the pressure measuring device be sealed and closed with a 2-way tap when not in use.
- the use of a condensation trap (as shown in figure 1) is optional.

DECISION EGOLF member laboratories agree that they shall only connect pressure sensors to pressure measuring devices using the procedures specified in EN 1363-1 together with those prescribed above, in this document.

10 Calibration of pressure measurement devices

10.1 General

The procedure for calibration of pressure measurement devices for use in fire resistance testing is not specified in EN 1363-1.

EGOLF member laboratories propose that the following **checks or calibration actions** shall be applied, at the given frequencies, to electronic micro-manometer transducer type pressure measurement devices used during fire resistance tests for furnace control :

- Adjustment according to manufacturers instruction : Every test
- Manual zero adjustment during test 2 times minimum : Every test (unless automatically made)
- Calibration and determination of response time : Initially when new and then once per year

10.2 New equipment

EGOLF member laboratories propose that all electronic micro-manometer transducer type pressure measurement devices shall be purchased with an initial calibration and response time certificate, stating the precision of the device over the required pressure range and proof of specification to the criteria of EN 1363-1.

DECISION : EGOLF member laboratories agree that they shall only purchase new pressure measurement devices which have been calibrated, the response time measured and are provided with appropriate certificates in respect of these determinations.

10.3 Existing equipment

A typical arrangement of equipment for calibration of electronic micro-manometer transducer type pressure measurement devices is shown in figure 2.

Re-calibration of response time of pressure measurement devices shall be done in one of two ways :

- by the laboratory, using its own "secondary standard calibration" device, pre-calibrated by the Accredited Calibration Service (ACS) - see figure 3.
- by an external Accredited Calibration Service (ACS) which holds a "secondary standard calibration" device against which the laboratory device is calibrated - see figure 4.

Pressure measurement devices used for furnace control shall be re-calibrated against the "secondary calibration manometer" at six different stepwise pressures covering the whole working pressure range of the instrument.

Simultaneous readings of pressure shall be taken for the electronic micro-manometer transducer type furnace pressure measurement device and the secondary calibration manometer when connected to the same pressure source on one side and to atmospheric pressure (or a constant pressure source at about atmospheric pressure) on the other side.

The results from the furnace manometer shall be compared with those from the "secondary calibration manometer" and assessed for being within the limits (± 2 Pa) given within EN 1363-1. Any instrument outside the calibration limits shall not be used for control of fire resistance furnaces.

The response time of electronic micro-manometer transducer type pressure measurement devices shall be determined according to EGOLF EA 5.

Notes:

- the "secondary calibration manometer" (whether ACS or fire test laboratory held) should be of uncertainty of not more than 0.6 Pa and have been calibrated against a "primary national standard manometer" (or against a manometer traceable to a "primary national standard manometer"). It should be any suitable electronic or mechanical instrument of higher precision than that to be calibrated.
- Electronic micro-manometer transducer type pressure measurement devices should be calibrated including the whole of the data measuring and recording system.
- The laboratory held "secondary calibration manometer", when also of the micropressure transducer type should be re-calibrated against a "primary calibration manometer", by an Accredited Calibration Service Laboratory, at least once every year. When of other types it should be re-calibrated against a "primary calibration manometer" at least once every 10 years. This re-calibration shall be confirmed by the issue of a Calibration Certificate.

DECISION EGOLF member laboratories agree that they shall calibrate pressure measurement devices, existing in laboratories and in use for measurement of furnace pressure in fire resistance testing, using the procedures and at the frequencies specified in this document.

In addition, EGOLF member laboratories agree that they shall determine the response time of pressure measurement devices, existing in laboratories and in use for measurement of furnace pressure in fire resistance testing, using the procedures and at the frequencies specified in this document.

11 Presentation of data

Unless otherwise stated, EGOLF member laboratories use immediate measured values at the end of each interval of measurement for plotting graphs and drawing tables. If a member laboratory performs any additional damping to the measured values, or uses values different from those measured directly, it shall be clearly stated in the test report.

Decision EGOLF member laboratories agree that they shall use data measured at each measuring interval in their test reports. If they use any other data (e.g. fixed or floating average values) the character of data presented will be clearly explained in the test report.

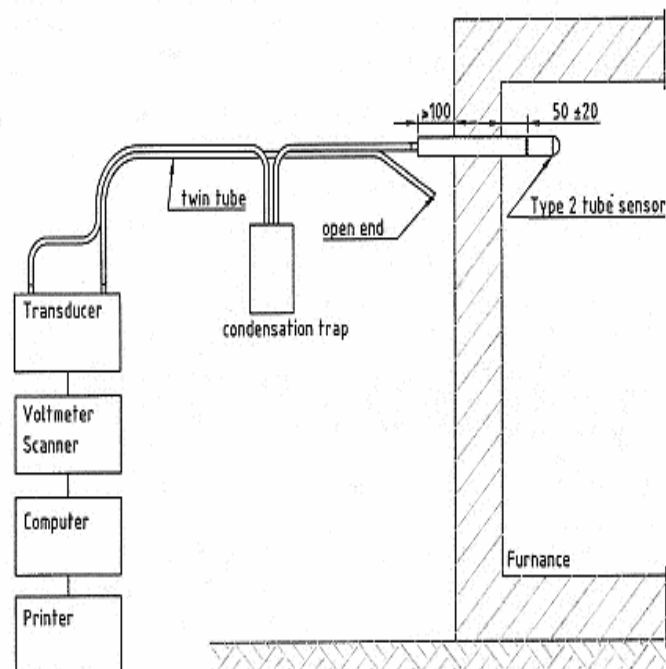


Figure 1 Arrangement of furnace pressure measurement

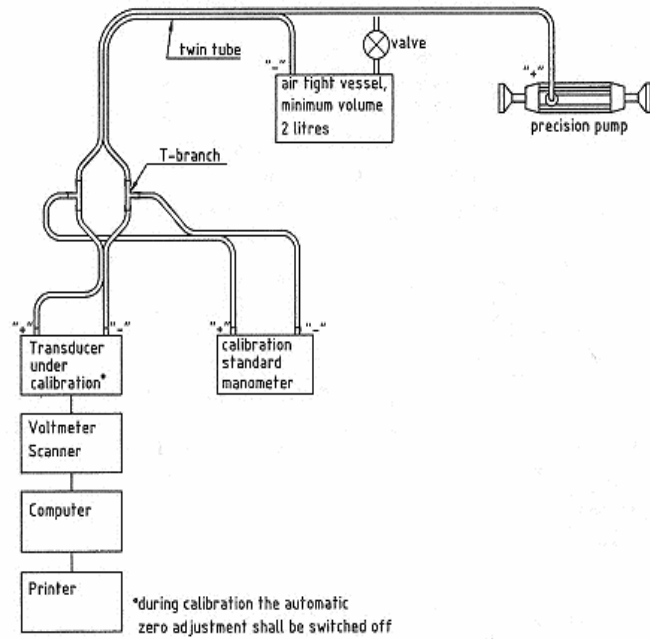


Figure 2 Arrangement of equipment for calibration of furnace pressure measurement devices

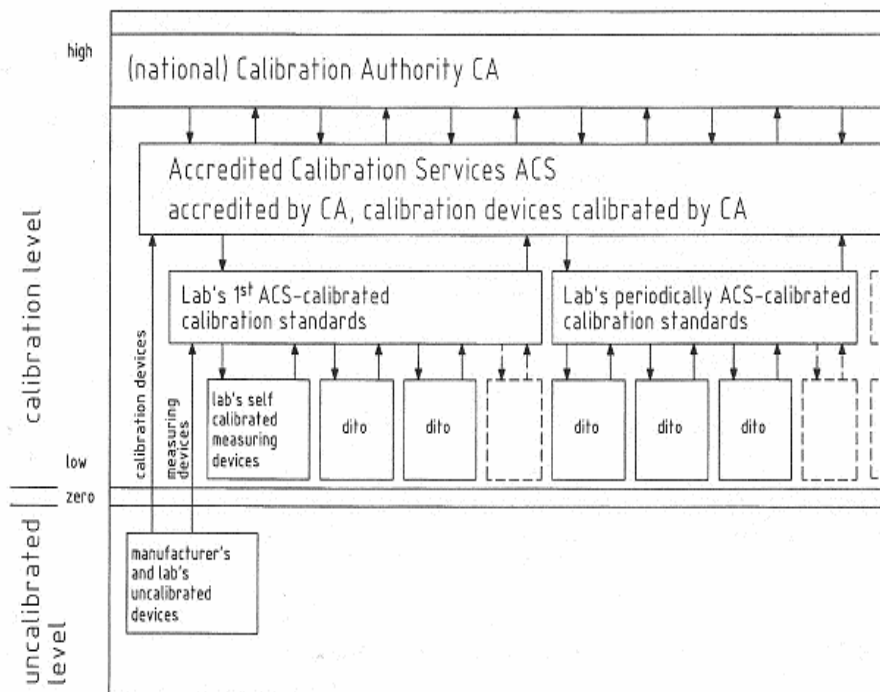


Figure 3 Structure of calibrating system including laboratories calibration

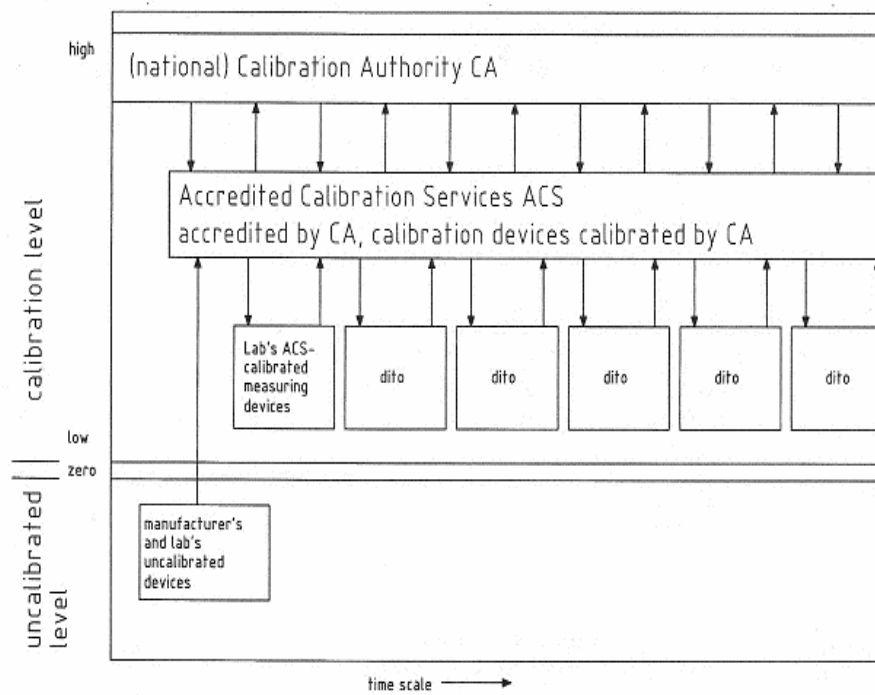


Figure 4 Structure of calibrating system excluding laboratories calibration