

Temperature measurement —

Part 7: Guide to selection and use of temperature/time indicators

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- Department of Energy (Gas and Oil Measurement Branch)
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Foreword

This Part of BS 1041 has been prepared under the direction of the Industrial-process Measurement and Control Standards Committee. It is a revision of BS 1041-7:1964 which is withdrawn.

It is Part 7 of the standard and it differs somewhat from the other four specialist parts which deal with specific types of temperature measuring equipment, in that the devices considered herein are used primarily to indicate the effect of temperature and time by purely comparative means, as opposed to instruments which give a direct reading or recording of the temperature conditions. In the ceramic industry the effect of temperature-time treatment is generally referred to as “heat work”.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This Part of BS 1041 provides guidance on “change of state” devices used to indicate the amount of heat work which the subject being considered has undergone. The two groups of change of state devices which are included are those which change shape or size and those which change colour.

Included in the former are the following:

- a) pyrometric cones;
- b) thermoscope bars;
- c) Bullers rings.

Of the preceding, a) and b) change their shape during heating and c) change size.

The change of colour devices are:

- 1) temperature indicating paints;
- 2) reversible colour change indicators and paints;
- 3) temperature indicating labels.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 1041 the following definitions apply.

2.1

heat work

a qualitative indication of the effect of heat treatment, increasing with temperature and time spent at temperature

NOTE It is used especially in the firing of ceramics.

2.2

pyrometric cone

a slender truncated trihedral pyramid of pressed ceramic material that deforms under particular temperature/time treatment

2.3

touch-down temperature (end-point)

the temperature at which a pyrometric cone will bend so that the tip touches the stand or plaque when heated at a specified rate of temperature rise

2.4

signal cone

in a series of pyrometric cones, the cone that deforms after the least heat work

2.5

indicator cone

in a series of pyrometric cones, the cone whose tip touches the stand when the desired heat work has been applied

2.6

witness cone

in a series of pyrometric cones, the cone that begins to deform next after the indicator cone

2.7

thermoscope bar

a pressed ceramic bar that, when supported at each end in a horizontal position, deforms under its own weight under specified temperature/time treatment

2.8

bullers ring

an annular ring of pressed ceramic powder that contracts with heat work

2.9

temperature indicating paint

paint that undergoes a change in colour after exposure to a specified temperature for a specified time

2.10

single-change paint

a temperature indicating paint that undergoes only one principal colour change under temperature/time exposure

2.11

multi-change paint

a temperature indicating paint that undergoes several colour changes after various specified temperature/time exposures

2.12

signal colour

the colour which a temperature indicating paint turns after the specified temperature/time exposure

2.13

trigger temperature

the temperature at which a temperature indicating paint changes colour at a particular exposure time

2.14

cut-off temperature

the temperature below which a temperature indicating paint exhibits no colour change, no matter how long the exposure

2.15

reversible colour-change indicators

indicators that revert to the original colour on cooling below the colour-change temperature

2.16

temperature indicating label

an adhesive label containing a patch whose colour changes when the surface to which it is attached reaches a specified temperature

NOTE One label may contain several patches to indicate the attainment of a range of temperatures.

Section 2. Indicators that change shape or size

3 General

The temperature/time indicators that depend on the change of shape or size are largely used in the firing of ceramic wares such as grinding wheels, bricks, refractories, electrical porcelain, china, earthenware, sanitary ware, or tiles. These indicators can only be said to measure temperature/time treatment if they are used under the same conditions which existed when indicators of the same specification were compared with a temperature measuring instrument.

Such an indicator does not replace a temperature measuring instrument but is used in conjunction with it; the instrument will indicate the temperature-time treatment at a particular spot in a kiln during a firing cycle, whereas a number of suitably positioned indicators can give a measure of the variation in thermal conditions within a kiln setting.

Pyrometric cones and thermoscope bars are prepared from complex mixes containing various proportions of frits, fluxes, clays, calcium and magnesium compounds, silica, etc., designed to melt or soften within certain temperature ranges that depend on the rates of heating used. Cones deform and slump fairly sharply at a certain stage in the heating cycle. Bars, which are supported at their ends, bend in the middle.

Bullers rings are prepared from clays, fluxes, and inert materials, and do not melt or deform but shrink progressively during a heating cycle; the effect of temperature and time (heat work) is assessed by measuring the shrinkage of the indicator.

4 Pyrometric cones

4.1 General

Cones are manufactured in two sizes, the normal or standard cone with a height of about 60 mm, and the laboratory cone with a height of about 30 mm. Both can be used to monitor and control industrial kilns, but small cones are specified for determining the refractoriness of raw materials in accordance with BS 1902-5.2, ISO 528, and DIN 51063-1 and DIN 51063-2.

Cones from different sources vary in shape, manner of usage, and performance.

4.2 Characteristics

4.2.1 Construction. Pyrometric cones (see Figure 1) are typically slender truncated trihedral pyramids about 30 mm or 60 mm in height.

4.2.2 Cone numbers. Pyrometric cones are traditionally numbered from 022 to 20; this method of numbering has a historical basis, following original Seger practice, which is broadly accepted by other manufacturers. Temperature steps of 15 °C up to 30 °C exist between each cone number, and 42 cones cover the temperature range 600 °C to 1 535 °C (see Table 1).

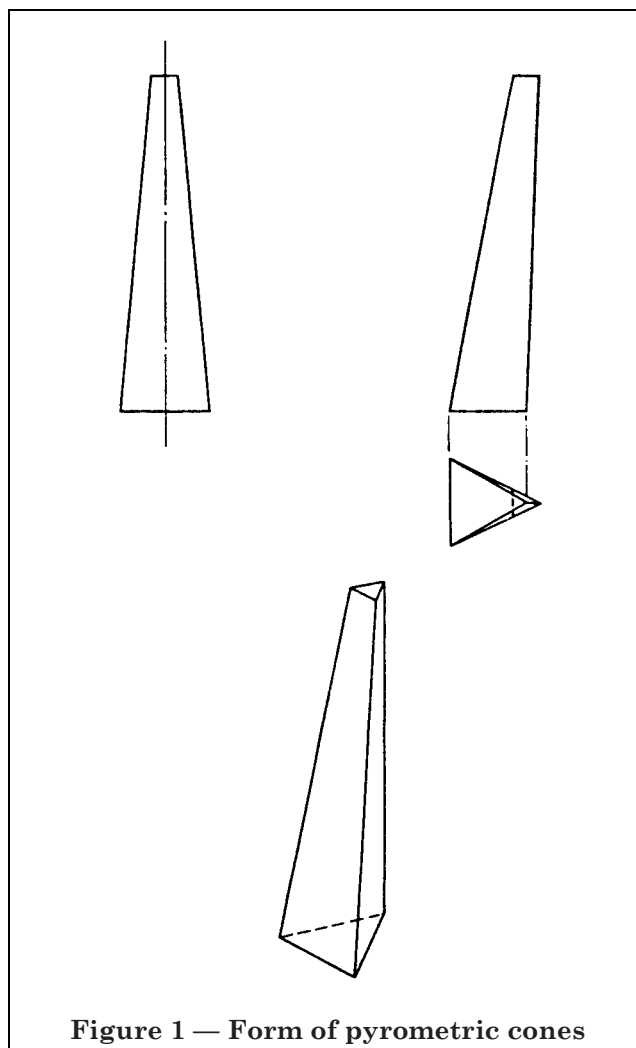


Figure 1 — Form of pyrometric cones

4.2.3 Touch-down temperature. This is the temperature at which a cone set up in the correct manner (see 4.3.1) will bend and touch the stand when heated in a kiln at a specified rate of rise of temperature.

A heating rate of 60 °C/h was used in preparing Table 1. Faster rates of heating will raise the touch-down temperature and vice-versa.

Laboratory cones, because of their lower mass, and because they are subjected to faster heating rates, usually fall at higher temperatures than normal cones of the same number and composition.

NOTE Though the temperatures in Table 1 may correspond approximately to those in tables provided by overseas cone manufacturers, cones of the same number from different producers should not be regarded as interchangeable.