

BS 2742:2009



BSI British Standards

Use of the Ringelmann and miniature smoke charts

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Contents

Foreword *ii*

Introduction 1

1 Scope 1

2 Normative references 2

3 Use of the Ringelmann chart and miniature smoke chart 2

Annexes

Annex A (informative) Format of Ringelmann charts 4

Annex B (informative) Chart holders and use of the chart BS 2742C 5

Bibliography 7

List of figures

Figure B.1 – Suitable holder for BS 2742C Ringelmann chart 5

Figure B.2 – Sketch showing method of use of British Standard Ringelmann chart 6

Figure B.3 – Suitable holder for BS 2742M miniature smoke chart 6

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 8, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 May 2009. It was prepared by Subcommittee EH/2/1, *Stationary source emission*, under the authority of Technical Committee EH/2, *Air quality*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 2742:1969, which is withdrawn.

Relationship with other publications

This British Standard is intended to be used with either of two charts: BS 2742C, *Ringelmann chart* or BS 2742M, *Miniature smoke chart*.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- the 1972 Addendum has been removed: when it was developed, it was subject to uncertainty and in practice only should have only been applied to a limited number of coal burning chain grate stoker appliances (which are now rare); the relationship was not truly applicable to other firing methods or fuels as the particles emitted are of a different particle size distribution and reflectance;
- added description of the manufacture/form of BS 2742C, *Ringelmann chart* and BS 2742M, *Miniature smoke chart*;
- this revision does not alter the technical requirements from those stated in the 1958 and 1969 editions; the values, however, are now expressed in metric terms.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

The method of visual assessment of smoke emission by comparison of the darkness of the smoke with standard shades of grey on a chart placed in a suitable position was devised by Professor Ringelmann of Paris in 1898. Professor Ringelmann obtained the shades of grey by cross-hatching in black on a white background so that a known percentage of the white was obscured. In use, the charts were placed at such a distance from the observer that the black lines merged into the white background and produced for each shade, apparently, a uniform grey. The numbers of the shades (the Ringelmann numbers) ranged from 0 (white) to 5 (black), the stages being by changes of 20% in obscuration of the background. The original charts were of large size so that the accuracy of reproduction could be obtained in a drawing office; since that time various other methods of reproduction have been tried and the size and details of the chart have been modified by various authorities from time to time.

Actually, Professor Ringelmann's original chart cannot have been drawn with 100% black ink on 100% white paper, since neither was obtainable. The commercially-printed charts in use for many years, including those issued by the U.S. Bureau of Mines, were printed on paper with a luminance factor of about 80%, with ink of luminance factor about 5%. Measurements on smoke which are accepted are derived from the use of commercially-printed Ringelmann charts, and therefore the British Standard Ringelmann chart, BS 2742C, which has been so printed as to reproduce with consistency shades of grey which are near the average of those to which users are accustomed. For convenience in size, the British Standard charts comprise the five shades corresponding to Nos. 0 to 4 Ringelmann; the black strip was included only for control during printing. A brief description of the construction of the British Standard Ringelmann chart, BS 2742C, is in Annex A. Annex B shows example chart holders and a sketch of the chart in use.

1 Scope

This British Standard provides guidance on the use of BS Ringelmann charts to assess smoke emissions from unregulated processes. It is not suitable for calibrating Continuous Emissions Monitoring Systems. It is not applicable to processes whose emissions are regulated by EU Directives with stated Uncertainty.

NOTE Most regulated processes have particulate emissions limits below Ringelmann 1.

This British Standard is intended for use with the related publications:

- BS 2742C, *Ringelmann chart*;
- BS 2742M, *Miniature smoke chart*.

Other measuring devices or charts are not suitable for use with this British Standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 2742C, *Ringelmann chart*

BS 2742M, *Miniature smoke chart*

3 Use of the Ringelmann chart and miniature smoke chart

3.1 Ringelmann chart, BS 2742C

3.1.1 Before use

The chart should be mounted so as to be held firmly without creases or bending. The portion of any holder adjoining the "viewing edge" of the chart should be neutral in colour: aluminium is a suitable material (a suitable form of holder is shown in Figure B.1). Protective coverings should not be applied to the chart in use. If the chart is attached to a board or other support, the fixing medium should not impair the luminance of the working surface of the chart.

3.1.2 Using the Ringelmann chart

The chart should be used under daylight conditions and held or fixed facing the observer in a vertical plane (e.g. as shown in Figure B.2). Where possible, the chart should be in line with the top of the chimney and placed so that the chart and the smoke have a similar sky background. The chart should be at a sufficient distance from the observer for the lines to appear to merge until each square forms a uniform shade. For most observers, this distance is in excess of 15 m.

Observations should be carried out as far as practicable under conditions of uniform general illumination from the sky, but if observations are made with the sun shining, or with the sky bright on one side, the bright source of illumination should be approximately at right-angles to the line of vision, and not in front of or behind the observer. The white (No. 0) square provides a useful indication of the illumination and will reveal any overshadowing or uneven illumination of the chart. It also facilitates the detection of rainspotting or other soiling of the chart. Under hazy conditions, readings should not be taken at extreme distances, as there is a tendency for the readings to be low.

The angle of view of the chart and smoke should be as low as possible: observations at a steep angle should be avoided.

The darkness of the smoke at the point where it leaves the chimney should be compared with the shades of the chart, the number of the shade which appears most closely to match the darkness of the smoke determined, and the time of duration of this darkness of smoke noted. The darkness of smoke which is intermediate between two shades may be estimated to the nearest quarter Ringelmann number in favourable conditions.

The chart will become soiled in use and the observed Ringelmann number of the smoke will be less than the true value. It is essential, therefore, that a used chart should be discarded as soon as it becomes appreciably soiled or discoloured.

3.2 The BS miniature smoke chart, BS 2742M

3.2.1 General

In practice, it has been found that there are many situations where a BS Ringelmann chart cannot conveniently be used. Use of the standard chart might, in many circumstances, require the services of an assistant to hold the chart for the observer, for example, where it is not possible to fix the chart on a building to meet the above recommendations in 3.1.2. Accordingly, the British Standard miniature smoke chart, BS 2742M, has been developed for use without assistance in such situations.

NOTE BSI requests all those users who are able to conduct, or have conducted, quantitative comparisons between the miniature chart and the standard Ringelmann chart to send their results to the committee via BSI.

The miniature chart has been prepared to the same precision as the BS Ringelmann chart; results obtained are similar (although not identical) to those from the BS Ringelmann chart and the miniature chart may conveniently be used for readings of a preliminary nature.

The grey shades painted on the miniature chart are arranged to correspond with the similar shades printed on the BS Ringelmann chart.

3.2.2 Before use

The chart is designed for use at a distance of less than 2 m from the observer's eye. It is to be used under the conditions of illumination in 3.1.2.

3.2.3 Using the miniature smoke chart

Preferably, the chart should be held at a distance of 1.5 m from the observer's eye. Figure B.3 shows a suitable holder which can be fixed to the end of a light rod. (A telescopic rod is convenient for carrying.) The chart may also be held at arm's length, but observers are likely to find that it is then less easy to obtain readings agreeing with those obtained with the British Standard Ringelmann chart, BS 2742C.

Annex A (informative) Format of Ringelmann charts

The BS Ringelmann charts are in two formats, standard and miniature.

The standard chart BS 2742C is a series of four sections, printed with approximately 5% luminance ink on approximately 80% luminance card, to appear identical to Professor Ringelmann's original charts when held at the recommended distance. There are also two control areas on the chart. The chart is printed on card to prevent creasing and present an even shade when in the holder. It is supplied trimmed to fit in the holder described in Figure B.1.

The rule given by Professor Ringelmann gave the following dimensions:

- 1: Black lines 1.06 mm thick, 10 mm apart, leaving white spaces 8.94 mm square.
- 2: Black lines 2.25 mm thick, spaces 7.75 mm square.
- 3: Black lines 3.68 mm thick, spaces 6.32 mm square.
- 4: Black lines 5.53 mm thick, spaces 4.47 mm square.

The paper and ink used by Professor Ringelmann was different from that used in BS 2742C, and that BS 2742C uses lines and spaces reduced to a 5 mm square rather than 10 mm square.

The miniature chart BS 2742M is a series of five paint swatches mounted on a card, the colours corresponding to those in BS 5252 and selected to appear identical to BS 2742C (when in use). The card is supplied with an instructional envelope and with additional protection for the paint swatches.

Users are reminded that this British Standard is only for use with the BS charts.

Annex B (informative) Chart holders and use of the chart BS 2742C

This Annex shows examples of suitable holders for the Ringelmann chart (see Figure B.1) and the miniature smoke chart (see Figure B.3) and an example of the use of the Ringelmann chart (see Figure B.2).

Figure B.1 Suitable holder for BS 2742C Ringelmann chart

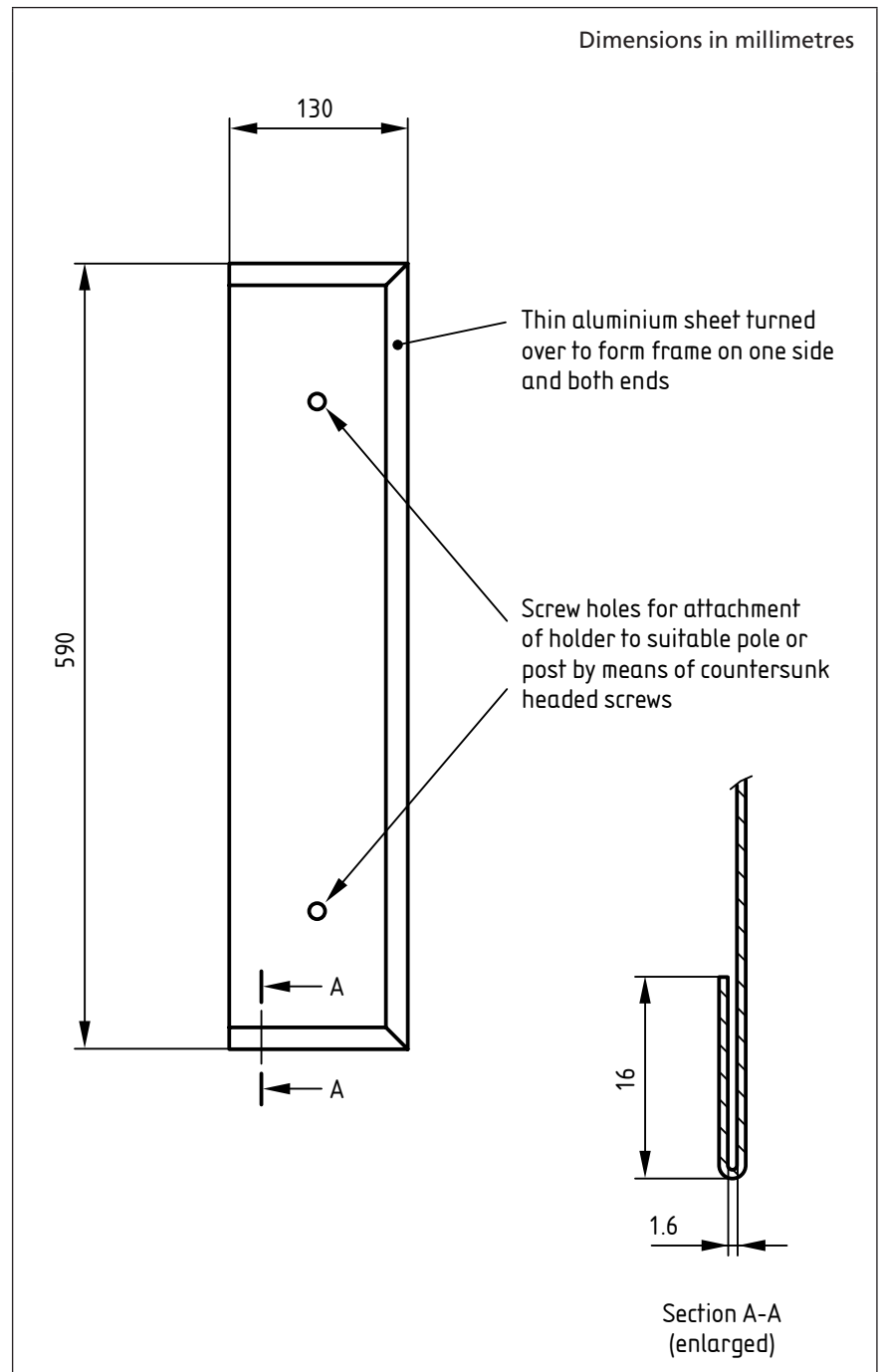


Figure B.2 Sketch showing method of use of British Standard Ringelmann chart

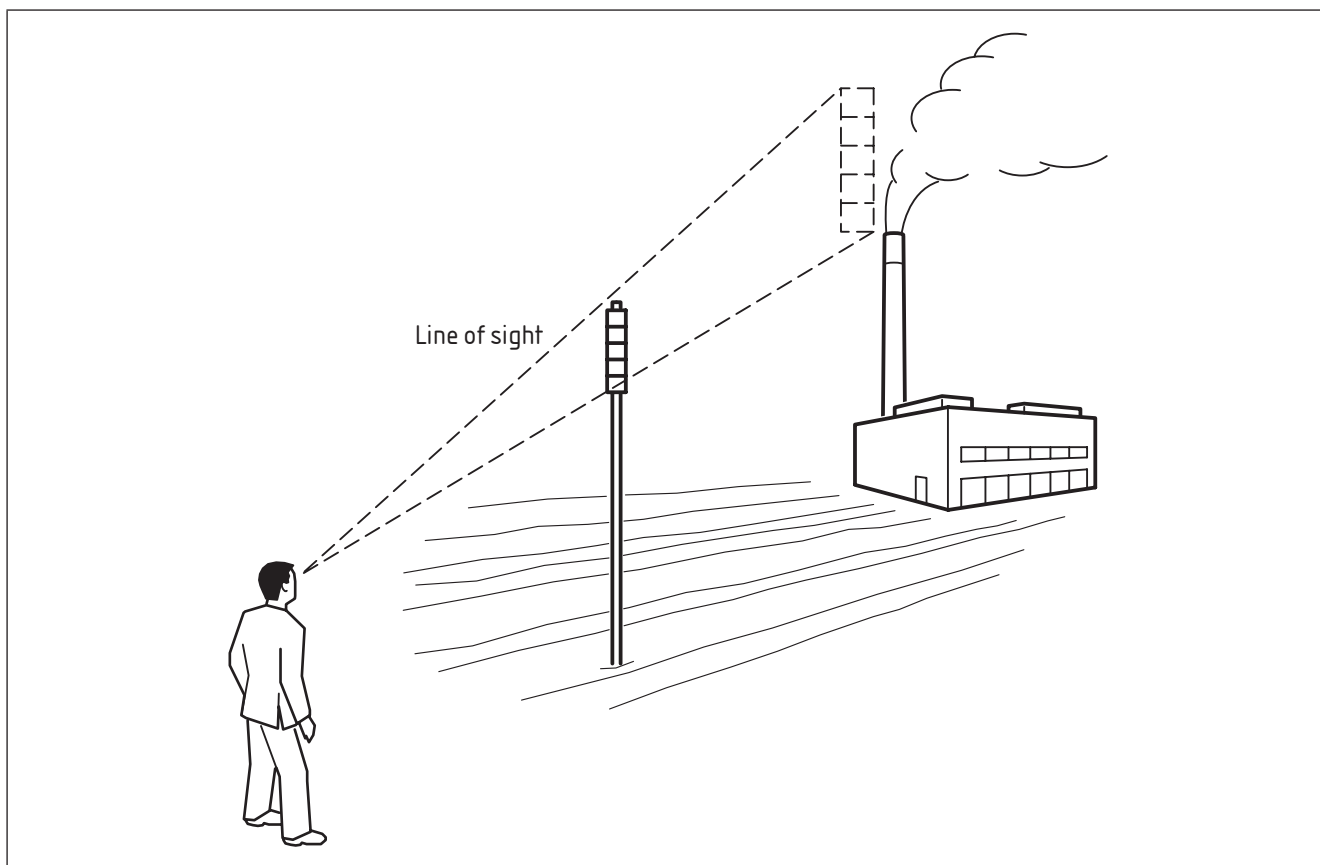
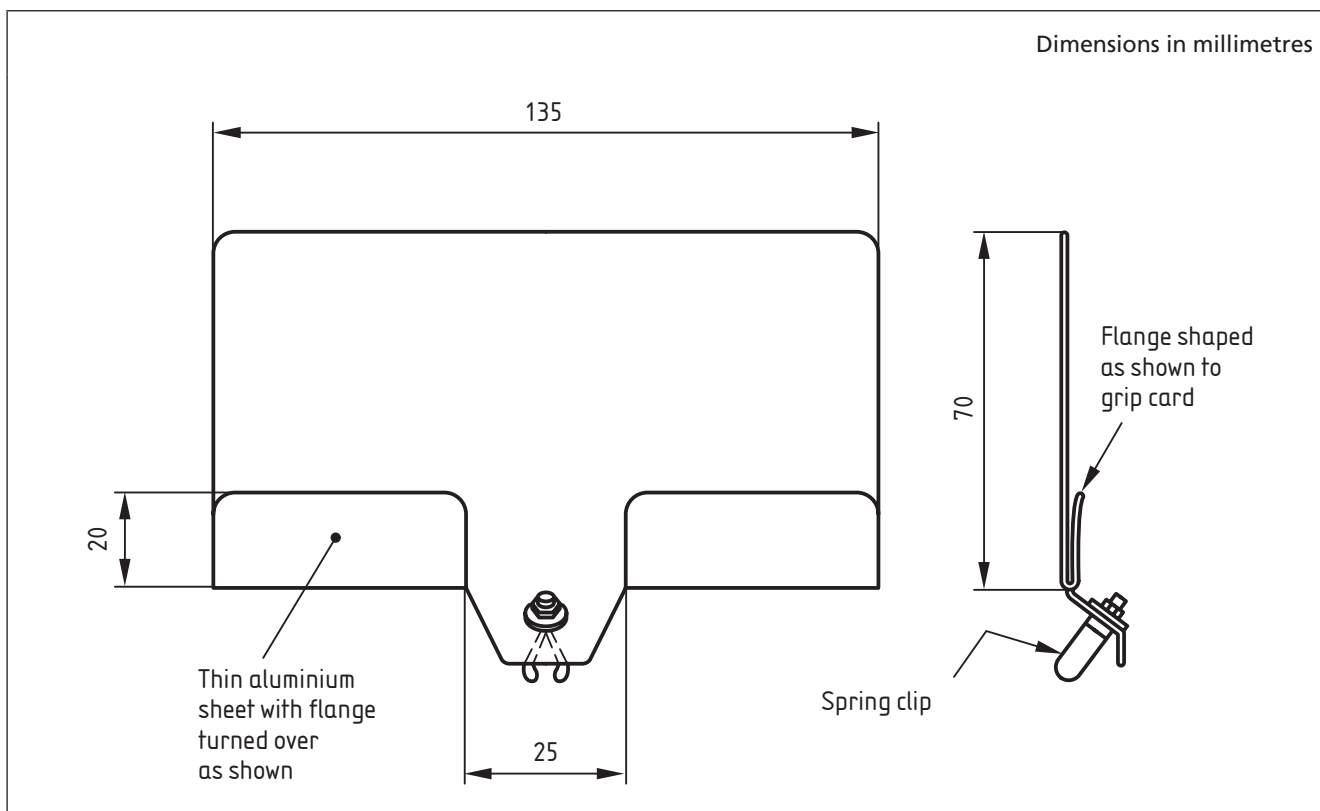


Figure B.3 Suitable holder for BS 2742M miniature smoke chart



Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 5252, *Framework for colour co-ordination for building purposes*

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389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001

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