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Standards publications referred to

BS 1692 Gin blocks

BS 2045 Preferred numbers

BS 4318 Recommendations for preferred metric basic sizes for engineering

BS 4429 Rigging screws and turnbuckles

DD 29 Rules for and guide to the use of preferred numbers and preferred sizes

ISO 3 Preferred numbers — Series of preferred numbers

ISO 497 Guide to the choice of series of preferred numbers and series containing more rounded values of preferred numbers

NOTE. Further copies of the insert PD 6481C : 1977 'Preferred numbers and preferred sizes' are available in sets of 10, price group 4, from the BSI Sales Department, Newton House, 101 Pentonville Road, London N1 9ND.

Recommendations for the use of preferred numbers and preferred sizes

1. Introduction

Because of the absence of agreed rules for the application of preferred numbers and preferred sizes, confusion has arisen regarding their use. National (and international) standards show inconsistencies in the choice of values for characteristics or sizes, and these have grown to a significant extent from the lack of clear guidance on the circumstances where the theoretical *preferred numbers* should be used or where the rounded-off *preferred sizes* should be used. This document has therefore been produced to give general recommendations on this subject. It supersedes both BS 4318 and DD 29.

It is appreciated that designers and standards engineers may be compelled to make use of sizes outside the preferred ranges because of certain overriding considerations, such as the need to comply with established standards in specific fields of the kind listed in appendix A. Nevertheless, a considerable area of freedom exists and a disciplined approach to the selection of sizes would be beneficial locally, nationally and, finally, internationally.

2. Preferred numbers

The preferred number system is internationally standardized in ISO 3 (which is reproduced in BS 2045). It is also referred to as the Renard or R series.

The system provides a geometric series, i.e. one in which there is a constant ratio between each figure and the succeeding one, within a decimal framework. Thus the R5 series has five steps between 1 and 10, the R10 series ten steps between 1 and 10, the R20 series twenty steps and the R40 series forty steps, giving increases between steps of approximately 60 %, 25 %, 12 % and 6 % respectively. It is shown in figure 1 in diagrammatic form, which illustrates the geometric progression of the series.

The use of the preferred number series confers several important advantages, in particular those outlined below.

(a) The series can be extended in either direction by multiplying by the appropriate power of 10. Values can therefore be applied to any magnitude of a quantity.

(b) All the R5 series values are found in the R10 series, the R10 values in the R20 series, and so on. This makes it easy to insert additional values in chosen series.

(c) The products, quotients and powers of preferred numbers are also preferred numbers (allowing for slight differences in rounding). This means, for example, that the area of a square or rectangular figure whose sides are preferred numbers is also a preferred number, while the volume of a rectangular container whose sides are preferred numbers is also a preferred number.

(d) In the R10 and subsequent series the number 3.15 is found. Since this is very nearly equal to π, it follows that if the diameter of a circle is a preferred number the circumference is also a preferred number. Moreover, since 4 is a preferred number (see figure 1, first choice), the area of that circle is also a preferred number. This is useful when dealing with peripheral speeds, cylindrical and spherical areas, power transmission through cables, flow through pipes etc.

However, the preferred number series suffer from two disadvantages. First, the gaps between the steps become very large at the top end of the scale, and second, they contain values that are awkward and difficult to use in most design and production environments. It is for these reasons that they have not found universal acceptance for linear measurement.

3. Examples of the use of preferred numbers

Typical examples of the use of the preferred number series are given below.

(a) *Machine tools.* Belgian standard NBN 123 for machine tools adopts the R20 series (1; 1.12; 1.25; 1.40 etc.) for the range 1 r/min to 1000 r/min, but this series can of course be extended. The basis of this application is that cutting speed is a function of spindle speed, and that differences of cutting speed of less than 12 % are not significant. The preferred number spindle speeds provide, for any given workpiece diameter, a range of cutting speeds increasing by increments of 12 %.

(b) *Lifting equipment.* Norwegian Standard NS 2675 standardizes the lifting capacities of cranes, using a range comprising the R10 series (1; 1.25; 1.6 etc.). Again, in designing a series of sizes for cranes a significant increment between consecutive sizes is required, and a geometric series is ideal. An example from the UK in an allied field is BS 4429 for rigging screws and turnbuckles; here, the range of sizes is based on safe working loads (i.e. the principal characteristic of the articles), and the R10 series of preferred numbers is used. Similarly, the ranges of sizes of terminal fittings for wire rope and chain are based on safe working loads that increase in accordance with the R10 series. This is also illustrated by BS 1692 for gin blocks, which are classified by safe working loads in series of values according to the R10 series.

It should be noted that in each of these cases the preferred numbers are applied to the primary functional characteristic of the product, i.e. to the spindle speeds of machine tools, the lifting capacities of cranes, and so on.