Australian Standard™

Preferred numbers and their use

STANDARDS AUSTRALIA

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The following are represented on Committee ME-071:

CSIRO Telecommunications and Industrial Physics
Department of Industry Science and Resources
National Association of Testing Authorities Australia
University of Melbourne

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PREFACE

This Standard was prepared by Standards Australia Committee ME-071, Quantities, Units and Conversions, to supersede AS 2752—1985.

The objective of this Standard is to rationalize and to reduce the number of sizes that have taken place since the introduction of SI units.

This Standard will be of use to those who wish to adopt the international system of preferred numbers when determining, for example, a series of sizes or ratings.

This Standard is based on the following documents:

ISO 3 Preferred numbers—Series of preferred numbers

ISO 17 Guide to the use of preferred numbers and of series of preferred numbers

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

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FOREWORD

Preferred numbers were first utilized in France at the end of the nineteenth century. From 1877 to 1879, Captain Charles Renard, an officer in the engineer corps, made a rational study of the elements necessary in the construction of lighter-than-air aircraft. He computed the specifications for cotton rope according to a grading system, so that the rope could be produced in advance without prejudice to the installations where such rope was subsequently to be utilized. Recognizing the advantage to be derived from the geometrical progression, he adopted, as a basis, a rope having a mass of a grams per metre, and as a grading system, a rule that would yield a tenth multiple of the value a after every fifth step of the series, i.e.—

$$a \times q^5 = 10a \text{ or } q = \sqrt[5]{10}$$

whence the following numerical series:

$$a \; a\sqrt[5]{10} \; a\left(\sqrt[5]{10}\right)^2 \; a\left(\sqrt[5]{10}\right)^3 \; a\left(\sqrt[5]{10}\right)^4 \; 10a$$

the values of which, to five significant figures, are—

$$a \; 1.5849a \; 2.5119a \; 3.9811a \; 6.3096a \; 10a$$

Renard's theory was to substitute more-rounded but more practical values for the above values, and he adopted as a a power of 10, positive, nil or negative. He thus obtained the following series:

10 16 25 40 63 100

which may be continued in both directions.

From this series, designated by the symbol R 5, the R 10, R 20, R 40 series were formed, each adopted ratio being the square root of the preceding one:

$$\sqrt[10]{10} \; \sqrt[20]{10} \; \sqrt[40]{10}$$

The first standardization drafts were drawn up on these bases in Germany by the Normenausschuss der Deutschen Industrie on 13 April 1920, and in France by the Commission Permanente de Standardisation in document X of 19 December 1921. These two documents offering few differences, the commission of standardization in the Netherlands proposed their unification. An agreement was reached in 1931, and in June 1932 the International Federation of the National Standardizing Associations (ISA) organized an international meeting in Milan, where the ISA Technical Committee 32, Preferred Numbers, was set up and its secretariat assigned to France.

Following a meeting of ISA Technical Committee 32 in September 1934, an international recommendation was laid down in ISA Bulletin 11 (December 1935).

After the Second World War, the work was resumed by ISO. Technical Committee ISO/TC 19, Preferred Numbers, was set up and France held the Secretariat. This committee at its first meeting, in Paris in July 1949, recommended the adoption by ISO of the series of preferred numbers defined by the table of ISA Bulletin 11, i.e., R 5, R 10, R 20, R 40. As a result of this and subsequent meetings, the series R 80 was added and slight alterations were made. The draft thus amended became ISO Recommendation ISO/R 3-1953.

ISO/TC 19 then recognized the need for some guidance on the use of preferred numbers, and ISO/R 17 was published in November 1955. This made brief reference to more-rounded values of preferred numbers.

In certain special applications, it may be found that the standard preferred numbers are unacceptable, e.g., because the precision that they imply cannot be achieved, or because the use of more than one or two significant figures is undesirable for other reasons, or because some section of industry or the general public is not yet ready to accept them. In such circumstances, it is better to use more-rounded numbers than non-preferred numbers, and this may, in some cases, lead to the adoption of preferred numbers in the future.

The members of ISO/TC 19 considered it desirable however to emphasize that such more-rounded values must be used with considerable care, and this consideration led in due course to the publication of ISO/R 497 in August 1966.

In 1973, ISO 3, ISO 17 and ISO 497 were published as International Standards.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard defines preferred numbers and a series of preferred numbers.

The Standard includes a guide to—

(a) the use of preferred numbers and a series of proposed numbers (see Section 3); and

(b) the choice of series of preferred numbers and of series containing more-rounded values of preferred numbers.

The precision of values and the regularity of the ratio used is discussed in Appendix A.

1.2 DEFINITIONS

For the purpose of this Standard, the following definitions apply:

1.2.1 Series of preferred numbers

The conventionally rounded-off term values of geometrical series, including the integral powers of 10 and having as ratios the following factors:

$$\sqrt[5]{10}\ \sqrt[10]{10}\ \left(\sqrt[20]{10}\right)\left(\sqrt[40]{10}\right)\left(\sqrt[80]{10}\right)$$

in accordance with Tables 2.1 and 2.2 set out for the 1 to 10 range.

NOTE: Because the series of preferred numbers is unlimited in both directions, the values of the terms in other decimal ranges are obtained by multiplying the values in the Tables by positive or negative integral powers of 10.

1.2.2 Theoretical value

The extended term value of $\left(\sqrt[5]{10}\right)^N$, $\left(\sqrt[10]{10}\right)^N$, etc., where the exponent N is the serial number of the preferred number.

1.2.3 Calculated values

Values approximating to the theoretical values, expressed to five significant figures (the relative error in comparison with the theoretical values is less than 1 in 20 000). (See Table 2.1, column 7.)

1.2.4 Preferred numbers

Values rounded off in accordance with columns R 5, R 10, R 20, R 40 and R 80. (See Table 2.1, columns 1 to 4, and Table 2.2.)

1.2.5 Serial numbers

An arithmetic series of consecutive numbers between 0 and 40 by which a preferred number is identified. (See Table 2.1.)