BRITISH STANDARD

BS 2045:1965

Preferred numbers

Confirmed
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Co-operating organizations

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee
Association of Consulting Engineers
Association of Mining Electrical and Mechanical Engineers
Board of Trade
British Chemical Plant Manufacturers' Association
British Compressed Air Society
British Electrical and Allied Manufacturers' Association*
British Gear Manufacturers' Association
British Internal Combustion Engine Manufacturers' Association
British Iron and Steel Federation
British Mechanical Engineering Federation
British Railways Board
Crown Agents for Oversea Governments and Administrations
Electricity Council, the Generating Board and the Area Boards in England and Wales
Engineering Equipment Users' Association*
Gas Council
Institute of Marine Engineers
Institution of Civil Engineers
Institution of Gas Engineers
Institution of Heating and Ventilating Engineers
Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
Institution of Production Engineers
Locomotive and Allied Manufacturers' Association of Great Britain
London Transport Board
Machine Tool Trades Association
Ministry of Defence, Army Department
Ministry of Defence, Navy Department
Ministry of Labour (H.M. Factory Inspectorate)
Ministry of Power
Ministry of Public Building and Works
Ministry of Technology — National Engineering Laboratory
Ministry of Transport
National Coal Board
National Physical Laboratory (Ministry of Technology)
Radio Industry Council
Royal Institute of British Architects

The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Electronic Engineering Association
National Federation of Engineers' Tool Manufacturers
Radio and Electronic Component Manufacturers' Federation
Woven Wire Association

This British Standard, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 10 August 1965

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Contents

Foreword

When BS 2045 was first published in 1953 it was stated that its objects were a) to give authoritative status to preferred numbers for application, where appropriate, in British practice, and b) to provide readily accessible information on the numbers themselves for those who have occasion to use them. The numbers were those agreed internationally by the International Organization for Standardization (Technical Committee ISO/TC.19, Preferred Numbers) and published as ISO Recommendation R3.

Since that date, United Kingdom participation in the work of ISO Committees has brought increasing awareness of the extent to which preferred numbers may be used for a variety of products. The more numerous the applications for which these series of numbers may be used, however, the more necessary it is to ensure that they are selected to the best advantage from a practical as well as from a theoretical point of view. To this end, ISO Recommendation R17, "Guide to the use of preferred numbers and of series of preferred numbers" was published in 1956 and the present revision of the British Standard takes account of that Recommendation.

Mention should also be made of BS 1638, "*Report on the selection of ranges of types and sizes (Preferred Numbers)*", published in 1950, in which the late Mr. J. E. Sears, C.B.E., discussed the technical advantages and practical applications of preferred numbers. In dealing with the subject, Mr. Sears referred to other series of preferred numbers which were in use at the time; since then, the countries concerned have accepted ISO Recommendation R3 and it is felt that in general future consideration of preferred numbers should be confined to the Renard series given in that Recommendation. Mention should, however, be made of the fact that series known as the "E" series are still in wide use in the electrical industry and appear in some of the publications issued by the International Electrotechnical Commission (IEC).

BS 1638 has now been withdrawn, but it is thought that much of Mr Sears's general explanatory matter would still be helpful to potential users of preferred numbers and part of it has therefore been incorporated in the Introduction to this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 11 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.

Introduction

When planning the production of any commodity, there are a number of factors which must be taken into account in deciding the number of different sizes for which provision must be made. The demand of consumers for a very wide range of choice has to be balanced against any increase in the costs of production, stocking and distribution, which may result from the production of many sizes and types.

Experience has shown that the consumer's requirements are frequently found to be satisfied when the range of sizes follows more or less closely a geometrical progression, even though the selection has been made without any dictation from theory.

When a standard is in course of preparation and the subject calls for a range of sizes, an appropriate procedure would be, first to determine what are the smallest and the largest sizes required and how many intermediate sizes are needed, and then by a simple calculation to set out a table of sizes, each being approximately a uniform percentage larger than its predecessor.

In order to secure some measure of uniformity of practice in the choice of sizes, a number of countries has adopted as standard the use of one or other of the following ranges, all of which include the numbers one, ten, one hundred, etc.:

a) Five steps in each decade.

b) Ten steps in each decade.

c) Twenty steps in each decade.

d) Forty steps in each decade.

a) Largest 10 times the smallest in 5 steps.

b) Largest 10 times the smallest in 10 steps.

c) Largest 10 times the smallest in 20 steps.

d) Largest 10 times the smallest in 40 steps.

An explanation of the derivation of these series is given in Clause **2** below, but it may be mentioned here that they are intended for application in all those fields where a scale of numbers is necessary and are designed to present certain characteristics which it is considered essential that such numbers should possess; namely that they should:

i) be simple and easily remembered,

ii) be unlimited both towards the lower and higher numbers,

iii) include all the decimal multiples and sub-multiples of any term,

iv) provide a rational grading system.

The theoretical numbers, suitably rounded off for practical convenience, as explained in Clause **2**, are known as "preferred numbers"; alternatively, they are often referred to as "Renard numbers" as a tribute to the French engineer, Col. Charles Renard, who first proposed their use and the various series include "R" in their designations, e.g. R5, R10, etc.

The field of use for preferred numbers is of the broadest kind, and they can be applied with advantage either to the grading of complete articles by length, area, volume, weight, power rating, and so on, or to the individual dimensions of component parts in engineering designs. Some specific applications are described in Appendix A.

It must be emphasized that the object of formulating an agreed series of preferred numbers is to provide the designer with a guide which, while not operating to restrict his liberty of choice for the essential purposes of his design, will serve to minimize unnecessary variations of sizes. The mere suggestion of any such limitation of choice is bound to give rise to misgivings as to its possible reaction on the freedom of the designer to meet the conditions of any particular problem in the most effective manner. But without the guidance afforded by a series of preferred numbers, individual designers will tend to vary widely, though often without real necessity, in their choice of many features of design, whereas the general adoption of preferred numbers, where applicable, tends to foster uniformity of practice in respect of those factors of design where it is likely in the long run to be advantageous.

In the great majority of cases the designer, having calculated or otherwise selected a preliminary value for a particular size, for example, would not prejudice his final design in any way by adopting instead the nearest larger or smaller size in a pre-selected list. The manufacturer should then be in a position, provided that sufficient demand arises from all sources for these particular sizes, to purchase suitable standard stock material, or tools such as drills and reamers, for producing the work, with evident economy in its ultimate cost.

The adoption of preferred numbers in grading a series of articles saves unnecessary variations in the articles marketed, and enables the requisite range to be covered by a minimum number of different sizes, with resulting economy to both maker and user. Should subsequent demand indicate that sizes with closer increments are needed at either end or in the middle of a range, these can readily be interpolated, provided a satisfactory basic series has been chosen in the first place. Even if a range of sizes is not contemplated in the first instance, the adoption of a preferred number for the initial design will facilitate the addition of a suitable range of sizes should these be required by later developments. Further, if a number of different designers exercise free choice in assigning sizes to some new range of products, the result, almost inevitably, will be that in the aggregate an indiscriminate collection of sizes will come into being, and if later the desirability of standardization arises, there may be considerable difficulties to overcome on account of the divergent interests of different makers and the capital invested in special tools. If, however, from the beginning, the various designers select their sizes from a generally recognized schedule, then obviously there is a considerable probability of common sizes being adopted, and even if this is not the case, the sizes actually adopted are much more likely to fall on appropriate points of a suitably graded scale which greatly facilitates the choice of a series of sizes for eventual standardization.

Products of quite different types and origins may, further, have certain factors in common which it is desirable should be correlated. For example, the designer of a series of power-driven pumps might conceivably assign capacities to these which did not conform to the horse-powers of motors commercially available. It is hardly likely that he would do so now, but in the case of two newly developing industries it is quite possible that such divergencies might arise, and involve wasteful use of one or other product. If both designers work to the same schedule of preferred numbers it is at least probable that such difficulties will be in large measure overcome in advance.

Many standards now in existence already represent, in one form or another, series of preferred sizes for special applications. Typical examples include sheet and wire gauges, nut and bolt series, electric lamp ratings and so on, and even if these are not at present strictly in agreement with preferred numbers as defined in this standard, the fact that experience has led to the establishment of standard series by empirical selection gives confidence in the validity of the general principle involved in the formulation of the preferred number series.

1 Scope

Part 1 of this British Standard lists the preferred numbers in the four principal series, R5, R10, R20 and R40, as well as the additional R80 series intended for special applications, and gives information regarding their derivation, together with definitions of the terms used.

These numbers are those agreed internationally by the International Organization for Standardization in New York, June 1952, and published as ISO Recommendation No. 3.

Part 2 gives guidance in the use of preferred numbers and is based on ISO Recommendation No. 17, "Guide to the use of preferred numbers and of series of preferred numbers".

Examples of the use of preferred numbers and recommendations for calculating with preferred numbers are given in appendices.

2 Derivation

Preferred numbers are derived from geometric series having one of the following common ratios:

$$\sqrt[5]{10}, \quad \sqrt[10]{10}, \quad \sqrt[20]{10}, \quad \sqrt[40]{10}, \quad \text{or} \quad \sqrt[80]{10}$$

These ratios are approximately equal to:

1.58, 1.26, 1.12, 1.06 and 1.03 respectively. Thus, successive terms in the respective series increase by approximately 58 per cent, 26 per cent, 12 per cent, 6 per cent or 3 per cent.

The calculated values of these progressions are arbitrarily rounded off to give terms which are in general doubled every 3 terms in the R10 series, every 6 terms in the R20 series and every 12 terms in the R40 series. The maximum roundings off are + 1.26 per cent and – 1.01 per cent.

It will be noted that any series can be extended indefinitely upwards or downwards by multiplying or dividing repeatedly by 10.

3 Nomenclature and definitions

The terms used in this standard and defined below are in accordance with ISO Recommendations Nos. 3 and 17.

3.1
theoretical values

the values of the terms of $(\sqrt[5]{10})^N$, $(\sqrt[10]{10})^N$ etc. These values have an infinite number of decimal places and are not suitable for practical use

3.2
calculated values

values approximating to the theoretical values, expressed to 5 significant figures and having a relative error in comparison with the theoretical values of less than 1/20 000

these values are not generally used

3.3
preferred numbers

values rounded off as explained in Clause **2** and given in Table 1 and Table 3

3.4
serial numbers

an arithmetic series of consecutive numbers indicating the preferred numbers starting with 0 for the preferred number 1.00

4 Designation

The series of preferred numbers are designated respectively R5, R10, R20, R40 and R80, in which the "R" stands for Renard and the number indicates the particular root of 10 on which the series is based.

5 Series of preferred numbers

a) *Basic series*. The basic series of preferred numbers, R5, R10, R20 and R40 are given in Table 1; their relation to the calculated values in the corresponding geometric series is shown in Table 2.

Wherever possible, the values of the R5 series are to be given preference over those of the R10 series, and these latter over the values of the R20 series and finally these last over those of the R40 series.

b) *R80 series*. The values of the R80 series, which is intended for use only in exceptional cases, are given in Table 3.

The terms of the basic series should be given preference over the terms of the R80 series.

c) *Derived series*. Additional series which can be obtained by taking the terms at every second, every third, every fourth step, etc. of the basic series. These series are designated R5/2, R10/3, R20/3, etc. (See also Clause **6**.)

d) *Shifted series*. A series having the same grading as the basic series, but beginning with a term not belonging to that series. (See also Clause **6**.)

Table 1 — Basic series of preferred numbers

1	2	3	4	5
Serial number	Basic series			
	R5	R10	R20	R40
0	**1.00**	**1.00**	1.00	1.00
1				1.06
2			1.12	1.12
3				1.18
4		**1.25**	1.25	1.25
5				1.32
6			1.40	1.40
7				1.50
8	**1.60**	**1.60**	1.60	1.60
9				1.70
10			1.80	1.80
11				1.90
12		**2.00**	2.00	2.00
13				2.12
14			2.24	2.24
15				2.36
16	**2.50**	**2.50**	2.50	2.50
17				2.65
18			2.80	2.80
19				3.00
20		**3.15**	3.15	3.15
21				3.35
22			3.55	3.55
23				3.75
24	**4.00**	**4.00**	4.00	4.00
25				4.25
26			4.50	4.50
27				4.75
28		**5.00**	5.00	5.00
29				5.30
30			5.60	5.60
31				6.00
32	**6.30**	**6.30**	6.30	6.30
33				6.70
34			7.10	7.10
35				7.50
36		**8.00**	8.00	8.00
37				8.50
38			9.00	9.00
39				9.50
40	**10.00**	**10.00**	10.00	10.00

Table 2 — Derivation of basic series

1	2	3	4
Serial number	Theoretical values		Percentage differences between basic series and calculated values
	Calculated values	Mantissae of logarithms	
0	1.0000	000	0
1	1.0593	025	+ 0.07
2	1.1220	050	– 0.18
3	1.1885	075	– 0.71
4	1.2589	100	– 0.71
5	1.3335	125	– 1.01
6	1.4125	150	– 0.88
7	1.4962	175	+ 0.25
8	1.5849	200	+ 0.95
9	1.6788	225	+ 1.26
10	1.7783	250	+ 1.22
11	1.8836	275	+ 0.87
12	1.9953	300	+ 0.24
13	2.1135	325	+ 0.31
14	2.2387	350	+ 0.06
15	2.3714	375	– 0.48
16	2.5119	400	– 0.47
17	2.6607	425	– 0.40
18	2.8184	450	– 0.65
19	2.9854	475	+ 0.49
20	3.1623	500	– 0.39
21	3.3497	525	+ 0.01
22	3.5481	550	+ 0.05
23	3.7584	575	– 0.22
24	3.9811	600	+ 0.47
25	4.2170	625	+ 0.78
26	4.4668	650	+ 0.74
27	4.7315	675	+ 0.39
28	5.0119	700	– 0.24
29	5.3088	725	– 0.17
30	5.6254	750	– 0.42
31	5.9566	775	+ 0.73
32	6.3096	800	– 0.15
33	6.6834	825	+ 0.25
34	7.0795	850	+ 0.29
35	7.4989	875	+ 0.01
36	7.9433	900	+ 0.71
37	8.4140	925	+ 1.02
38	8.9125	950	+ 0.98
39	9.4406	975	+ 0.63
40	10.0000	000	0

Table 3 — R80 series of preferred numbers for exceptional use

1	2	3	4
1.00	1.80	3.15	5.60
1.03	1.85	3.25	5.80
1.06	1.90	3.35	6.00
1.09	1.95	3.45	6.15
1.12	2.00	3.55	6.30
1.15	2.06	3.65	6.50
1.18	2.12	3.75	6.70
1.22	2.18	3.87	6.90
1.25	2.24	4.00	7.10
1.28	2.30	4.12	7.30
1.32	2.36	4.25	7.50
1.36	2.43	4.37	7.75
1.40	2.50	4.50	8.00
1.45	2.58	4.62	8.25
1.50	2.65	4.75	8.50
1.55	2.72	4.87	8.75
1.60	2.80	5.00	9.00
1.65	2.90	5.15	9.25
1.70	3.00	5.30	9.50
1.75	3.07	5.45	9.75

6 Choice of series

a) *Basic series*. In the preparation of a project involving numerical values of characteristics, whatever their nature, for which no particular standard exists, preferred numbers, as given in Table 1, should be selected for these values. No deviation should be made, except for imperative reasons (see Clause **7**).

It cannot be too strongly emphasized that the uncontrolled use of alternative approximations, even to the same theoretical series, will not only lead to the perpetuation of such divergencies as it is the object of preferred numbers to avoid, but may also render difficult the interpolation of suitable intermediate values, should this subsequently be required.

In selecting a scale of numerical values, the first choice should be that series having the highest ratio consistent with the technical, economic or other considerations to be satisfied, in the order: R5, R10, etc.

The best scale will be determined by taking into account, in particular, the two following contradictory tendencies: a scale with too wide steps involves a waste of materials and an increase in the cost of manufacture, whereas a too closely spaced scale leads to an increase in the cost of tooling and also in the value of stock inventories.

When the needs are not of the same relative importance in all the ranges under consideration, the most suitable basic series for each range should be selected so that the sequences of numerical values adopted provide a succession of series of different ratios permitting new interpolations in each range where necessary.

b) *Derived series*. Derived, or supplementary series, should only be used when none of the scales of the basic series is satisfactory and preference should be given to such of those series as, whether extended upwards or downwards, include the number 1. Further, as in the case of the basic series, derived series should be selected in the same order of preference, e.g. R5, R10, etc.

As stated in Clause **5**, these series are obtained by taking every third step, every fourth step, etc. of a basic series. For example, convenient series with a step ratio of 2 can be derived from every third step in the R10 series, or with a ratio of 1.4 from every third step in the R20 series.

It will be noted that there is always more than one supplementary series with a given ratio, other than the normal series containing the number 1, the additional series being based on one or other of the numbers in the primary series which are omitted from the normal supplementary series. Thus there are three supplementary series (R10/3), derived from the R10 series, as follows:

Normal series:	1	, 2	, 4	, 8	, 16,	31.5 . . . .
Other series:	1.25,	2.5	, 5	, 10	, 20,	40 . . . . .
	1.6	, 3.15,	6.3,	12.5,	25,	50 . . . . .

each with an increment step of approximately 100 per cent.

It will be apparent that a supplementary series with any desired step ratio can be derived provided the ratio required corresponds to a preferred number. For example, if a ratio of 1.25 (25 per cent) is required, this will be seen to correspond to every second term in the R20 series.

c) *Shifted series*. Shifted series should be used only for characteristics which are functions of other characteristics, themselves scaled in a basic series.

d) *Single numerical value*. In the selection of a single value, irrespective of any idea of scaling, one of the terms of the R5, R10, R20, R40 basic series should be chosen or else a term of the exceptional R80 series.

Whilst preference should be given to the terms of the series of the highest step ratio, choosing R5 rather than R10, R10 rather than R20, etc., it should also be borne in mind when selecting a single value, for example for the establishment of a prototype, that it may subsequently be desired to insert it in a series, the ratio of which will have to be assumed.

e) *Grading by means of preferred numbers*. Since preferred numbers may differ from the calculated values by + 1.26 per cent to – 1.01 per cent, it follows that sizes, graded according to preferred numbers, are not exactly proportional to one another.

7 More rounded values of preferred numbers

In certain special applications it may be found that the standard preferred numbers are unacceptable; for example, they, may appear to imply a precision regarded as unnecessary or impossible to achieve, such as 1/31.5 seconds instead of 1/30 second for photographic time exposures, or it may be impossible to retain all the significant figures where a whole number is necessary, e.g. 32 instead of 31.5 for the number of teeth in a gear. There may also be reasons of an economic or psychological nature which make some section of industry or of the general public unready to accept them at the present time. 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) and every, effort should be made to use only the more rounded values given in Table 4.

When these more rounded values are used in series of numbers, those which yield the most rational grading should be chosen.

When there is a possibility that intermediate values may subsequently have to be introduced in the series, the use of these more rounded values should be avoided.

NOTE An ISO Recommendation giving guidance in the use of more rounded values and setting out the dangers and disadvantages of using them as compared with the advantages of using the preferred numbers themselves is now in course of preparation by Committee ISO/TC 19.

Table 4 — More rounded values of preferred numbers

Column	1		2			3			4		5
Number of terms or index	5		10			20			40		Serial number
Approximate ratio	1.6		1.25			1.12			1.06		
Series	R5	R″5	R10	R′10	R″10	R20	R′20	R″20	R40	R′40	
	1		1			1.0			1.0		0
									1.06	1.05	1
						1.12	1.1		1.12	1.1	2
					(1.2)			(1.2)	1.18	1.2	3
			1.25			1.25			1.25		4
									1.32	1.3	5
						1.4			1.4		6
		(1.5)			(1.5)				1.5		7
	1.6		1.6			1.6			1.6		8
									1.7		9
						1.8			1.8		10
									1.9		11
			2			2.0			2.0		12
									2.12	2.1	13
						2.24	2.2		2.24	2.2	14
									2.36	2.4	15
	2.5		2.5			2.5			2.5		16
									2.65	2.6	17
						2.8			2.8		18
					(3)			(3.0)	3.0		19
			3.15	3.2		3.15	3.2		3.15	3.2	20
									3.35	3.4	21
						3.55	3.6	(3.5)	3.55	3.6	22
									3.75	3.8	23
	4		4			4.0			4.0		24
									4.25	4.2	25
						4.5			4.5		26
									4.75	4.8	27
			5			5.0			5.0		28
									5.3		29
						5.6		(5.5)	5.6		30
		(6)			(6)			(6.0)	6.0		31
	6.3		6.3			6.3			6.3		32
									6.7		33
						7.1		(7.0)	7.1		34
									7.5		35
			8			8.0			8.0		36
									8.5		37
						9.0			9.0		38
									9.5		39
	10		10			10.0			10.0		40

Preferred numbers | *More rounded values :* 1st rounding | 2nd rounding ¦

Values in brackets to be avoided wherever possible.

Appendix A International examples of the use of preferred numbers

A.1 Standard currents

Publication 59 of the International Electrotechnical Commission gives, for standard currents, the following ratings in amperes:

1	1.25	1.6	2	2.5	3.15	4	5	6.3	8
10	12.5	16	20	25	31.5	40	50	63	80
100	125	160	200	250	315	400	500	630	800
1 000	1 250	1 600	2 000	2 500	3 150	4 000	5 000	6 300	8 000
10 000									

A.2 Rotating speeds of machine tool spindles

The Belgian standard NBN.123:1950 has adopted the R20 series (and the R20/2, R20/3, R20/4, R20/6 derived series) for the rotating speeds of machine tool spindles, expressed in revolutions per minute:

1	1.12	1.25	1.4	1.6	1.8	2	2.24	2.5	2.8
10	11.2	12.5	14	16	18	20	22.4	25	28
100	112	125	140	160	180	200	224	250	280
1 000									
3.15	3.55	4	4.5	5	5.6	6.3	7.1	8	9
31.5	35.5	40	45	50	56	63	71	80	90
315	355	400	450	500	560	630	710	800	900

A.3 Tanks for water under pressure

The German standard DIN.2760 has adopted for the nominal capacities the following values, expressed in litres:

4		6.3		10		16		25	
40		63		100	125	160	200	250	315
400	500	630	800	1 000	1 250	1 600	2 000	2 500	3 150
4 000	5 000	6 300	8 000	10 000	12 500	16 000	20 000	25 000	

A.4 Lifting capacity of cranes

The Norwegian standard NS.300 has adopted the following values for the lifting capacity of cranes, expressed in tons:

1	1.25	1.6	2	2.5	3.15	4	5	6.3	8
10	12.5	16	20	25	31.5	40	50	63	

A.5 Diameters of cylinders for hydraulic equipment

A British firm manufacturing hydraulic equipment has standardized cylinder diameters in the R40 series in order to enable a limited range of grinding, honing and gauging equipment to be stocked, to facilitate raw material supply and to enable many internal components, pistons, seals, etc. to be standardized. The comparatively small steps of the R40 series are necessary because the hydraulic lead or force involved is a function of the incremental step of the area or of the square of the diameter (the incremental step in the R40 series = 6 per cent, or about 12 per cent in area).

The firm uses these diameters in all hydraulic designs, an interesting example being in hydraulic accumulators (piston type). The main technical requirement here is displaced volume and the component parts are standardized in the R5 series (40, 63, 100, 160, etc. cubic inches).

A.6 Small tools

In ISO Recommendations for small tools such as drills, reamers and milling cutters which have now been published basic and derived series of preferred numbers have been used for the standard diameters listed in the principal tables.

Appendix B Recommendations for calculating with preferred numbers

B.1 Serial numbers

It may be noted that, for computing with preferred numbers, the terms of the arithmetical progression of the serial numbers (Column 1, in Table 1 and Table 2) are exactly the logarithms to base $\sqrt[40]{10}$ of the terms of the geometrical progression corresponding to the preferred numbers of the R40 series (Column 5 of Table 1).

The series of the serial numbers can be continued in both directions, so that if N_n is the serial number of the preferred number n, it follows:

$N_{1.00} = 0$

$N_{1.06} = 1$ $\qquad N_{0.95} = -1$

$N_{10} = 40$ $\qquad N_{0.10} = -40$

$N_{100} = 80$ $\qquad N_{0.01} = -80$

B.2 Products and quotients

The preferred number n'' which is the product or quotient of two preferred numbers n and n' is calculated by adding or subtracting the serial numbers N_n and $N_{n'}$ and finding the preferred number $_n''$ corresponding to the new serial number thus obtained.

Example 1: $3.15 \times 1.6 = 5$

$N_{3.15} + N_{1.6} = 20 + 8 = 28 = N_5$

Example 2: $6.3 \times 0.2 = 1.25$

$N_{6.3} + N_{0.2} = 32 + (-28) = 4 = N_{1.25}$

Example 3: $1 : 0.06 = 17$

$N_1 - N_{0.06} = 0 - (-49) = 49 = N_{17}$

B.3 Powers and roots

The preferred number which is the integral positive or negative power of a preferred number is computed by multiplying the serial number of the preferred number by the exponent and by finding the preferred number corresponding to the serial number obtained.

The preferred number corresponding to the root or fractional positive or negative power of a preferred number is computed in the same way, provided that the product of the serial number and the fractional exponent be an integer.

Example 1: $(3.15)^2 = 10$

$2\, N_{3.15} = 2 \times 20 = 40 = N_{10}$

Example 2: $\sqrt[5]{3{\cdot}15} = 3{\cdot}15^{1/5} = 1{\cdot}25$

$\frac{1}{5}\, \mathrm{N}_{3.15} = \frac{20}{5} = 4$ (integer) $= \mathrm{N}_{1.25}$

Example 3: $\sqrt{0.16} = 0.16^{1/2} = 0.4$

$\frac{1}{2}\, N_{0.16} = \frac{-32}{2} = -16$ (integer) $= N_{0.4}$

Example 4: On the other hand, $\sqrt[4]{3} = 3^{1/4}$ is not a preferred number because the product of the exponent $\frac{1}{4}$ and the serial number of 3 is not an integer.

Example 5: $0.25^{-1/3} = 1.6$

$-\frac{1}{3}\, N_{0\,25} = -\frac{1}{3}\,(-24) = +8 = N_{1.6}$

NOTE The mode of calculation with the serial numbers may introduce slight errors which are caused by the deviation between the theoretical preferred numbers and the corresponding rounded off numbers of the basic series.

B.4 Decimal logarithms

The mantissae of the decimal logarithms of the theoretical values are given in Column 3 of Table 2.

Example 1: $\log_{10} 4.5 = 0.650$

Example 2: $\log_{10} 0.063 = 0.800 - 2 = 2.800$

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