USA STANDARD

Preferred Limits and Fits for Cylindrical Parts

USAS B4.1-1967 (R1974)

Note

For soft conversion of nominal dimensions and limits given in this standard, 1 inch = 25.4 mm.

For explanation of conversion techniques see American National Standard Z210.1-1972, Metric Practice Guide.

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Foreword

THIS standard represents the latest result of vork which began with the organization of Sectional Committee B4 in June 1920 under the name "Sectional Committee on the Standardization of Plain Limit Gages for General Engineering Work." This original committee produced American Standard ASA B4a-1925, "Tolerances, Allowances and Gages for Metal Fits," which was used in varying degree for many years.

In December 1930, Sectional Committee B4 was reorganized and the name changed to the present form, "Sectional Committee on the Standardization of Allowances and Tolerances for Cylindrical Parts and Limit Gages." The change in name indicated a significant shift to a more definite and somewhat more restricted mission for the committee.

During the years of World War II an ASA War Committee formed in 1943 worked on the project but produced no completed results, and the activity was turned back to Sectional Committee B4. After the war the subject was discussed at the Canadian Conference on the Unification of Engineering Standards held in Ottawa in 1945, attended by delegates from Great Britain, Canada, and the United States, and again at another joint meeting in New York later in the same year. These meetings are significant because since 1945 work in this project has been strongly influenced by these and similar ABC conferences. Proper evaluation of the present standard will depend upon an appreciation of the important effects of progress towards agreement on unification of standards between the ABC countries.

The result of the activities immediately following World War II was American Standard "Limits and Fits for Engineering and Manufacturing (Part I), ASA B4.1-1947." In the preface to that document it was stated that the ABC meetings resulted in agreement on five basic principles, and since the first four of these principles, with certain minor and obvious variations, apply to this present standard, it is considered worth while to repeat them here. First, there must be a common language (definitions) through which analyses may be recorded and conveyed. Second, a table of preferred basic sizes helps in reducing the number of different diameters commonly used in a given size range. Third, preferred tolerances and allowances are a logical complement to preferred sizes and should aid the designer in selecting standard tolerances. Fourth, uniformity of method of applying tolerances is essential.

Additional ABC conferences were held in New York in June 1952 and February 1953. Delegations from Sectional Committee B4 were active in these conferences, which resulted in a draft proposal for an ABC system of Limits and Fits, published as ASA B4/30. The Sectional Committee B4 delegates to these conferences voted to recommend approval of the ABC proposals as the basis for an American standard if and when such a standard were developed.

Since the publication of this standard there has been additional discussions at ABC conferences held in Ottawa in June 1960 and at Arden House, New York, in September 1962. There has been an expansion of definitions under ASA B1.7, and they are reflected in the revision.

The revised proposal was submitted to the sponsor organization and to the USA Standards Institute (formerly American Standards Association) for final approval as a USA Standard. This approval was granted on August 3, 1966.

This revision, however, was never published as it was noted that other changes, agreed to at the Arden House ABC Conference, had not been incorporated in the standard.

A new revision was issued, and following approval by the USA Standards Committee B4, it was approved by the sponsor and on September 18, 1967 by the USA Standards Institute.

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This USA Standard is one of nearly 3000 standards approved as American Standards by the American Standards Association. On August 24, 1966, the ASA was reconstituted as the United States of America Standards Institute. Standards approved as American Standards are now designated USA Standards. There is no change in their index identification or technical content.

UDC 621.753.1.3

USA Standards Committee B4, Standardization of Allowances and Tolerances for Cylindrical Parts and Limit Gages

USA Standard

Preferred Limits and Fits for Cylindrical Parts

1. Scope and Application

1.1 This standard presents definitions of terms applying to fits between plain (non-threaded) cylindrical parts and makes recommendations on preferred sizes, allowances, tolerances, and fits for use wherever they are applicable. The standard through 20 in. diameter is in accord with the recommendations of American-British-Canadian Conferences. Experimental work is being carried on and when results are available, agreement in the range above 20 in. will be sought. It represents the combined thinking and experience of groups who have been interested in standards in this field, and it should have application for a wide range of products. The recommendations, therefore, are presented for guidance and for use where they might serve to improve and simplify products, practices, and facilities.

Many factors, such as length of engagement, bearing load, speed, lubrication, temperature, humidity, surface texture, and materials, must be taken into consideration in the selection of fits for a particular application, and modifications in these recommendations might be required to satisfy extreme conditions. Subsequent adjustments might also be desired as the result of experience in a particular application to suit critical functional requirements or to permit optimum manufacturing economy. Selection of departure from these recommendations will depend upon consideration of the engineering and economic factors that might be involved.

2. Definitions

2.1 Terms relating to the size and fit of parts which are generally applicable to mechanical parts, are defined as follows:

2.2 **Dimension.** A dimension is a geometrical characteristic such as diameter, length, angle, or center distance. The term "dimension" is also used for convenience to indicate the size or numerical value of a dimension as specified on the drawing.

2.3 **Size.** Size is a designation of magnitude. When a value is assigned to a dimension it is referred to hereinafter as the size of that dimension.

NOTE: It is recognized that the words "dimension" and "size" are both used at times to convey the meaning of magnitude.

2.4 **Nominal Size.** The nominal size is the designation which is used for the purpose of general identification.

2.5 **Basic Size.** The basic size is that size from which the limits of size are derived by the application of allowances and tolerances.

2.6 **Reference Size.** A reference size is a size without tolerance used only for information purposes and does not govern machining or inspection operations.

2.7 **Design Size.** The design size is the basic size with allowance applied, from which the limits of size are derived by the application of tolerances. If there is no allowance the design size is the same as the basic size.

2.8 **Actual Size.** An actual size is a measured size.

2.9 **Limits of Size.** The limits of size are the applicable maximum and minimum sizes. (See 2.14, Tolerance Limit)

2.10 **Maximum Material Limit.** A maximum material limit is that limit of size that provides the maximum amount of material for the part. Normally it is the maximum limit of size of an external dimension or the minimum limit of size of an internal dimension.

2.11 **Minimum Material Limit.** A minimum material limit is that limit of size that provides the minimum amount of material for the part. Normally it is the minimum limit of size of an external dimension or the maximum limit of size of an internal dimension.

NOTE: An example of exceptions: an exterior corner radius where the maximum radius is the minimum material limit and the minimum radius is the maximum material limit.

2.12 **Allowance.** An allowance is a prescribed difference between the maximum-material-limits of mating parts. It is the minimum clearance (positive allowance) or maximum interference (negative allowance) between such parts. (See 2.17 Fit.)

2.13 **Tolerance.** A tolerance is the total permissible variation of a size. The tolerance is the difference between the limits of size.

NOTE: The plural term "tolerances" is sometimes used to denote the permissible variations from the specified or design size, when the tolerance is expressed bilaterally. In this sense the term is identical to "Tolerance limit."

2.14 **Tolerance Limit.** A tolerance limit is the variation, positive or negative, by which a size is permitted to depart from the design size. (See 2.9, Limits of Size)

2.15 **Unilateral Tolerance.** A unilateral tolerance is a tolerance in which variation is permitted only in one direction from the design size.

2.16 **Bilateral Tolerance.** A bilateral tolerance is a tolerance in which variation is permitted in both directions from the design size.

2.17 **Fit.** Fit is the general term used to signify the range of tightness or looseness which may result from the application of a specific combination of allowances and tolerances in the design of mating parts.

2.18 **Actual Fit.** The actual fit between two mating parts is the relation existing between them with respect to the amount of clearance or interference that is present when they are assembled.

NOTE: Fits are of three general types: clearance, transition, and interference.

2.19 **Clearance Fit.** A clearance fit is one having limits of size so prescribed that a clearance always results when mating parts are assembled.

2.20 **Interference Fit.** An interference fit is one having limits of size so prescribed that an interference always results when mating parts are assembled.

2.21 **Transition Fit.** A transition fit is one having limits of size so prescribed that either a clearance or an interference may result when mating parts are assembled.

2.22 **Unilateral Tolerance System.** A design plan which uses only unilateral tolerances is known as a unilateral tolerance system.

2.23 **Bilateral Tolerance System.** A design plan which uses only bilateral tolerances is known as a bilateral tolerance system.

2.24 **Basic Hole System.** A basic hole system is a system of fits in which the design size of the hole is the basic size and the allowance, if any, is applied to the shaft.

2.25 **Basic Shaft System.** A basic shaft system is a system of fits in which the design size of the shaft is the basic size and the allowance, if any, is applied to the hole.

3. Preferred Basic Sizes

In specifying fits, the basic size of mating parts shall be chosen from the following tables (one for fractional and one for decimal sizes) whenever possible. All dimensions are given in inches.

TABLE 1

Preferred Basic Sizes

Fractional

1/64	0.015625	5	5.0000
1/32	0.03125	5 1/4	5.2500
1/16	0.0625	5 1/2	5.5000
3/32	0.09375	5 3/4	5.7500
1/8	0.1250	6	6.0000
5/32	0.15625	6 1/2	6.5000
3/16	0.1875	7	7.0000
1/4	0.2500	7 1/2	7.5000
5/16	0.3125	8	8.0000
3/8	0.3750	8 1/2	8.5000
7/16	0.4375	9	9.0000
1/2	0.5000	9 1/2	9.5000
9/16	0.5625	10	10.0000
5/8	0.6250	10 1/2	10.5000
11/16	0.6875	11	11.0000
3/4	0.7500	11 1/2	11.5000
7/8	0.8750	12	12.0000
1	1.0000	12 1/2	12.5000
1 1/4	1.2500	13	13.0000
1 1/2	1.5000	13 1/2	13.5000
1 3/4	1.7500	14	14.0000
2	2.0000	14 1/2	14.5000
2 1/4	2.2500	15	15.0000
2 1/2	2.5000	15 1/2	15.5000
2 3/4	2.7500	16	16.0000
3	3.0000	16 1/2	16.5000
3 1/4	3.2500	17	17.0000
3 1/2	3.5000	17 1/2	17.5000
3 3/4	3.7500	18	18.0000
4	4.0000	18 1/2	18.5000
4 1/4	4.2500	19	19.0000
4 1/2	4.5000	19 1/2	19.5000
4 3/4	4.7500	20	20.0000

TABLE 2

Preferred Basic Sizes

Decimal		
0.010	2.00	8.50
0.012	2.20	9.00
0.016	2.40	9.50
0.020	2.60	10.00
0.025	2.80	10.50
0.032	3.00	11.00
0.040	3.20	11.50
0.05	3.40	12.00
0.06	3.60	12.50
0.08	3.80	13.00
0.10	4.00	13.50
0.12	4.20	14.00
0.16	4.40	14.50
0.20	4.60	15.00
0.24	4.80	15.50
0.30	5.00	16.00
0.40	5.20	16.50
0.50	5.40	17.00
0.60	5.60	17.50
0.80	5.80	18.00
1.00	6.00	18.50
1.20	6.50	19.00
1.40	7.00	19.50
1.60	7.50	20.00
1.80	8.00	

4. Preferred Series for Tolerances and Allowances.

All fundamental tolerances and allowances of all shafts and holes have been taken from the series given in the following table. All dimensions are given in thousandths of an inch.

TABLE 3

0.1	1	10	100
...	1.2	12	125
0.15	1.4	14	...
...	1.6	16	160
...	1.8	18	...
0.2	2	20	200
...	2.2	22	...
0.25	2.5	25	250
...	2.8	28	...
0.3	3	30	...
...	3.5	35	...
0.4	4	40	...
...	4.5	45	...
0.5	5	50	...
0.6	6	60	...
0.7	7	70	...
0.8	8	80	...
0.9	9	...	...

5. Acceptance of Parts

5.1 **Acceptability.** A part shall be dimensionally acceptable if its actual size does not exceed the limits of size specified in numerical values on the drawing or in writing. It does not meet dimensional specification if its actual size exceeds those limits.

5.2 **Reference Temperature.** Limits of size as derived from the tolerances shown herein are the extreme values, within which the actual size of the dimension shall lie, at the standard temperature of 20C or 68F.

For Length deviations per inch (or per centimeter) for temperatures other than 68F, and for various coefficients of thermal expansion, reference should be made to the tables in Appendix II.

5.3 Limits and tolerances are considered to be absolute regardless of the number of decimal places. Limits and tolerances are to be used as if they were continued with zeros beyond the last significant figure.

NOTE: This means that all inaccuracies of size, due to errors, wear, or change in tools, gages, machines, processes or measurement, shall be included within these limits.

5.4 **Effect of Surface Texture.** Parts of necessity are measured over the crests of surface irregularities, yet for moving parts such irregularities soon wear off and clearances are increased. For this reason surface finish is quite critical, especially for the finer grades, and should be specified when considered necessary. For further detail on this subject refer to USA Standard Surface Texture, USAS B46.1.

6. Standard Tolerances

The series of standard tolerances shown in Table 4 are so arranged that for any one grade they represent approximately similar production considerations throughout the range of sizes. The table provides a suitable range from which appropriate tolerances for holes and shafts can be selected. This enables the use of standard gages. These tolerances have been used in arranging the fits given in Tables 5 to 9.

TABLE 4

Tolerance values are in thousandths of an inch. Data in bold face are in accordance with ABC agreements.

Nominal Size Range Inches Over – To	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12	Grade 13
0 – 0.12	**0.12**	**0.15**	**0.25**	**0.4**	**0.6**	**1.0**	**1.6**	**2.5**	**4**	**6**
0.12 – 0.24	**0.15**	**0.20**	**0.3**	**0.5**	**0.7**	**1.2**	**1.8**	**3.0**	**5**	**7**
0.24 – 0.40	**0.15**	**0.25**	**0.4**	**0.6**	**0.9**	**1.4**	**2.2**	**3.5**	**6**	**9**
0.40 – 0.71	**0.2**	**0.3**	**0.4**	**0.7**	**1.0**	**1.6**	**2.8**	**4.0**	**7**	**10**
0.71 – 1.19	**0.25**	**0.4**	**0.5**	**0.8**	**1.2**	**2.0**	**3.5**	**5.0**	**8**	**12**
1.19 – 1.97	**0.3**	**0.4**	**0.6**	**1.0**	**1.6**	**2.5**	**4.0**	**6**	**10**	**16**
1.97 – 3.15	**0.3**	**0.5**	**0.7**	**1.2**	**1.8**	**3.0**	**4.5**	**7**	**12**	**18**
3.15 – 4.73	**0.4**	**0.6**	**0.9**	**1.4**	**2.2**	**3.5**	**5**	**9**	**14**	**22**
4.73 – 7.09	**0.5**	**0.7**	**1.0**	**1.6**	**2.5**	**4.0**	**6**	**10**	**16**	**25**
7.09 – 9.85	**0.6**	**0.8**	**1.2**	**1.8**	**2.8**	**4.5**	**7**	**12**	**18**	**28**
9.85 – 12.41	**0.6**	**0.9**	**1.2**	**2.0**	**3.0**	**5.0**	**8**	**12**	**20**	**30**
12.41 – 15.75	**0.7**	**1.0**	**1.4**	**2.2**	**3.5**	**6**	**9**	**14**	**22**	**35**
15.75 – 19.69	**0.8**	**1.0**	**1.6**	**2.5**	**4**	**6**	**10**	**16**	**25**	**40**
19.69 – 30.09	0.9	1.2	2.0	3	5	8	12	20	30	50
30.09 – 41.49	1.0	1.6	2.5	4	6	10	16	25	40	60
41.49 – 56.19	1.2	2.0	3	5	8	12	20	30	50	80
56.19 – 76.39	1.6	2.5	4	6	10	16	25	40	60	100
76.39 –100.9	2.0	3	5	8	12	20	30	50	80	125
100.9 –131.9	2.5	4	6	10	16	25	40	60	100	160
131.9 –171.9	3	5	8	12	20	30	50	80	125	200
171.9 –200	4	6	10	16	25	40	60	100	160	250

7. Selection of Fits

In selecting limits of size for any application, the type of fit is determined first, based on the use or service required from the equipment being designed; then the limits of size of the mating parts are established, to assure that the desired fit will be produced.

Theoretically an infinite number of fits could be chosen, but the small number of standard fits shown herein should cover most applications.

8. Standard Fits

8.1 Tables 5 to 9 have been developed to give a series of standard types and classes of fit on a unilateral hole basis, such that the fit produced by mating parts in any one class will produce approximately similar conditions throughout the range of sizes. These tables prescribe the fit for any given size, or type of fit; they also prescribe the standard limits for the mating parts which will produce the fit.

In developing Tables 5 to 9 it has been recognized that any fit will usually be required to perform one of three functions, as indicated by the three general types of fits: running fits, locational fits, and force fits.

The fits listed in Tables 5 to 9 contain all those in the approved ABC proposal but have been extended to include a wider range of sizes. Standard fits are represented graphically by Figures 1 to 5.

8.2 Designation of Standard Fits. Standard fits are designated by means of the symbols given below to facilitate reference to classes of fit for educational purposes. These symbols are not intended to be shown on manufacturing drawings; instead, sizes should be specified on drawings.

The letter symbols used are as follows:

- RC Running or Sliding Clearance Fit
- LC Locational Clearance Fit
- LT Transition Clearance or Interference Fit
- LN Locational Interference Fit
- FN Force or Shrink Fit

These letter symbols are used in conjunction with numbers representing the class of fit; thus "FN 4" represents a class 4, force fit.

Each of these symbols (two letters and a number) represents a complete fit, for which the minimum and maximum clearance or interference, and the limits of size for the mating parts, are given directly in the tables.

8.3 Description of Fits.

8.3.1 *Running and Sliding Fits.* Running and sliding fits, for which limits of clearance are given in Table 5, are intended to provide a similar running performance, with suitable lubrication allowance, throughout the range of sizes. The clearances for the first two classes, used chiefly as slide fits, increase more slowly with diameter than the other classes, so that accurate location is maintained even at the expense of free relative motion.

These fits may be described briefly as follows:

RC 1 *Close sliding fits* are intended for the accurate location of parts which must assemble without perceptible play.

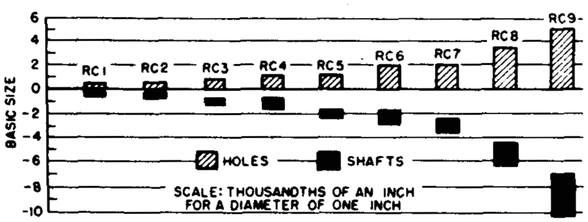

FIG. 1 GRAPHICAL REPRESENTATION OF STANDARD RUNNING OR SLIDING CLEARANCE FITS (SHOWN IN TABLE 5)

RC 2 *Sliding fits* are intended for accurate location but with greater maximum clearance than class RC 1. Parts made to this fit move and turn easily but are not intended to run freely, and in the larger sizes may seize with small temperature changes.

RC 3 *Precision running fits* are about the closest fits which can be expected to run freely, and are intended for precision work at slow speeds and light journal pressures, but are not suitable where appreciable temperature differences are likely to be encountered

RC 4 *Close running fits* are intended chiefly for running fits on accurate machinery with moderate surface speeds and journal pressures, where accurate location and minimum play is desired.

RC 5, RC 6 *Medium running fits* are intended for higher running speeds, or heavy journal pressures, or both.

RC 7 *Free running fits* are intended for use where accuracy is not essential, or where large temperature variations are likely to be encountered, or under both of these conditions.

RC 8, RC 9 *Loose running fits* are intended for use where wide commercial tolerances may be necessary, together with an allowance, on the external member.

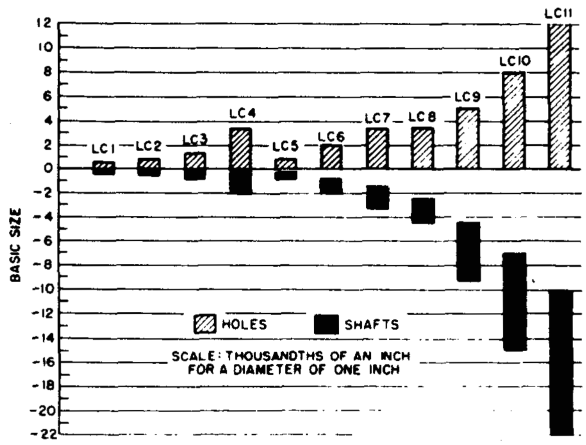

FIG. 2 GRAPHICAL REPRESENTATION OF STANDARD LOCATIONAL CLEARANCE FITS (SHOWN IN TABLE 6)

8.3.2 *Locational Fits.* Locational fits are fits intended to determine only the location of the mating parts; they may provide rigid or accurate location, as with interference fits, or provide some freedom of location, as with clearance fits. Accordingly they are divided into three groups: clearance fits, transition fits, and interference fits.

These are more fully described as follows:

LC *Locational clearance fits* are intended for parts which are normally stationary, but which can be freely assembled or disassembled. They run from snug fits for parts requiring accuracy of location, through the medium clearance fits for parts such as ball, race and housing, to the looser fastener fits where freedom of assembly is of prime importance.

LT *Locational transition fits* are a compromise between clearance and interference fits, for application where accuracy of location is important, but either a small amount of clearance or interference is permissible.

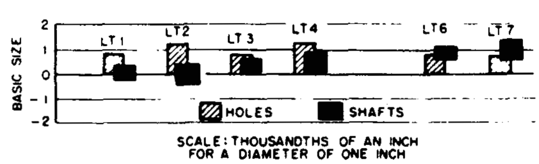

FIG. 3 GRAPHICAL REPRESENTATION OF STANDARD LOCATIONAL TRANSITION FITS (SHOWN IN TABLE 7)

Continued on page 12

TABLE 5 RUNNING AND SLIDING FITS

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts.

Data in bold face are in accordance with ABC agreements.

Symbols H5, g5, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Nominal Size Range Inches		Class RC 1			Class RC 2			Class RC 3			Class RC 4		
		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits	
Over	To		Hole H5	Shaft g4		Hole H6	Shaft g5		Hole H7	Shaft f6		Hole H8	Shaft f7
0	– 0.12	**0.1** **0.45**	**+ 0.2** **0**	**– 0.1** **– 0.25**	**0.1** **0.55**	**+ 0.25** **0**	**– 0.1** **– 0.3**	**0.3** **0.95**	**+ 0.4** **0**	**– 0.3** **– 0.55**	**0.3** **1.3**	**+ 0.6** **0**	**– 0.3** **– 0.7**
0.12	– 0.24	**0.15** **0.5**	**+ 0.2** **0**	**– 0.15** **– 0.3**	**0.15** **0.65**	**+ 0.3** **0**	**– 0.15** **– 0.35**	**0.4** **1.2**	**+ 0.5** **0**	**– 0.4** **– 0.7**	**0.4** **1.6**	**+ 0.7** **0**	**– 0.4** **– 0.9**
0.24	– 0.40	**0.2** **0.6**	**+ 0.25** **0**	**– 0.2** **– 0.35**	**0.2** **0.85**	**+ 0.4** **0**	**– 0.2** **– 0.45**	**0.5** **1.5**	**+ 0.6** **0**	**– 0.5** **– 0.9**	**0.5** **2.0**	**+ 0.9** **0**	**– 0.5** **– 1.1**
0.40	– 0.71	**0.25** **0.75**	**+ 0.3** **0**	**– 0.25** **– 0.45**	**0.25** **0.95**	**+ 0.4** **0**	**– 0.25** **– 0.55**	**0.6** **1.7**	**+ 0.7** **0**	**– 0.6** **– 1.0**	**0.6** **2.3**	**+ 1.0** **0**	**– 0.6** **– 1.3**
0.71	– 1.19	**0.3** **0.95**	**+ 0.4** **0**	**– 0.3** **– 0.55**	**0.3** **1.2**	**+ 0.5** **0**	**– 0.3** **– 0.7**	**0.8** **2.1**	**+ 0.8** **0**	**– 0.8** **– 1.3**	**0.8** **2.8**	**+ 1.2** **0**	**– 0.8** **– 1.6**
1.19	– 1.97	**0.4** **1.1**	**+ 0.4** **0**	**– 0.4** **– 0.7**	**0.4** **1.4**	**+ 0.6** **0**	**– 0.4** **– 0.8**	**1.0** **2.6**	**+ 1.0** **0**	**– 1.0** **– 1.6**	**1.0** **3.6**	**+ 1.6** **0**	**– 1.0** **– 2.0**
1.97	– 3.15	**0.4** **1.2**	**+ 0.5** **0**	**– 0.4** **– 0.7**	**0.4** **1.6**	**+ 0.7** **0**	**– 0.4** **– 0.9**	**1.2** **3.1**	**+ 1.2** **0**	**– 1.2** **– 1.9**	**1.2** **4.2**	**+ 1.8** **0**	**– 1.2** **– 2.4**
3.15	– 4.73	**0.5** **1.5**	**+ 0.6** **0**	**– 0.5** **– 0.9**	**0.5** **2.0**	**+ 0.9** **0**	**– 0.5** **– 1.1**	**1.4** **3.7**	**+ 1.4** **0**	**– 1.4** **– 2.3**	**1.4** **5.0**	**+ 2.2** **0**	**– 1.4** **– 2.8**
4.73	– 7.09	**0.6** **1.8**	**+ 0.7** **0**	**– 0.6** **– 1.1**	**0.6** **2.3**	**+ 1.0** **0**	**– 0.6** **– 1.3**	**1.6** **4.2**	**+ 1.6** **0**	**– 1.6** **– 2.6**	**1.6** **5.7**	**+ 2.5** **0**	**– 1.6** **– 3.2**
7.09	– 9.85	**0.6** **2.0**	**+ 0.8** **0**	**– 0.6** **– 1.2**	**0.6** **2.6**	**+ 1.2** **0**	**– 0.6** **– 1.4**	**2.0** **5.0**	**+ 1.8** **0**	**– 2.0** **– 3.2**	**2.0** **6.6**	**+ 2.8** **0**	**– 2.0** **– 3.8**
9.85	–12.41	0.8 2.3	**+ 0.9** **0**	– 0.8 – 1.4	0.7 2.8	**+ 1.2** **0**	– 0.7 – 1.6	2.5 5.7	**+ 2.0** **0**	– 2.5 – 3.7	2.2 7.2	**+ 3.0** **0**	– 2.2 – 4.2
12.41	–15.75	1.0 2.7	**+ 1.0** **0**	– 1.0 – 1.7	0.7 3.1	**+ 1.4** **0**	– 0.7 – 1.7	3.0 6.6	**+ 2.2** **0**	– 3.0 – 4.4	2.5 8.2	**+ 3.5** **0**	– 2.5 – 4.7
15.75	–19.69	1.2 3.0	**+ 1.0** **0**	– 1.2 – 2.0	0.8 3.4	**+ 1.6** **0**	– 0.8 – 1.8	4.0 8.1	**+ 2.5** **0**	– 4.0 – 5.6	2.8 9.3	**+ 4.0** **0**	– 2.8 – 5.3
19.69	–30.09	1.6 3.7	+ 1.2 0	– 1.6 – 2.5	1.6 4.8	+ 2.0 0	– 1.6 – 2.8	5.0 10.0	+ 3.0 0	– 5.0 – 7.0	5.0 13.0	+ 5.0 0	– 5.0 – 8.0
30.09	–41.49	2.0 4.6	+ 1.6 0	– 2.0 – 3.0	2.0 6.1	+ 2.5 0	– 2.0 – 3.6	6.0 12.5	+ 4.0 0	– 6.0 – 8.5	6.0 16.0	+ 6.0 0	– 6.0 –10.0
41.49	–56.19	2.5 5.7	+ 2.0 0	– 2.5 – 3.7	2.5 7.5	+ 3.0 0	– 2.5 – 4.5	8.0 16.0	+ 5.0 0	– 8.0 –11.0	8.0 21.0	+ 8.0 0	– 8.0 –13.0
56.19	–76.39	3.0 7.1	+ 2.5 0	– 3.0 – 4.6	3.0 9.5	+ 4.0 0	– 3.0 – 5.5	10.0 20.0	+ 6.0 0	–10.0 –14.0	10.0 26.0	+10.0 0	–10.0 –16.0
76.39	–100.9	4.0 9.0	+ 3.0 0	– 4.0 – 6.0	4.0 12.0	+ 5.0 0	– 4.0 – 7.0	12.0 25.0	+ 8.0 0	–12.0 –17.0	12.0 32.0	+12.0 0	–12.0 –20.0
100.9	–131.9	5.0 11.5	+ 4.0 0	– 5.0 – 7.5	5.0 15.0	+ 6.0 0	– 5.0 – 9.0	16.0 32.0	+10.0 0	–16.0 –22.0	16.0 42.0	+16.0 0	–16.0 –26.0
131.9	–171.9	6.0 14.0	+ 5.0 0	– 6.0 – 9.0	6.0 19.0	+ 8.0 0	– 6.0 –11.0	18.0 38.0	+12.0 0	–18.0 –26.0	18.0 50.0	+20.0 0	–18.0 –30.0
171.9	–200	8.0 18.0	+ 6.0 0	– 8.0 –12.0	8.0 22.0	+10.0 0	– 8.0 –12.0	22.0 48.0	+16.0 0	–22.0 –32.0	22.0 63.0	+25.0 0	–22.0 –38.0

Continued on page 7

TABLE 5 RUNNING AND SLIDING FITS (continued from page 6)

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts

Data in bold face are in accordance with ABC agreements

Symbols H8, e7, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Class RC 5			Class RC 6			Class RC 7			Class RC 8			Class RC 9			Nominal Size Range Inches	
Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits			
	Hole H8	Shaft e7		Hole H9	Shaft e8		Hole H9	Shaft d8		Hole H10	Shaft c9		Hole H11	Shaft	Over	To
0.6 1.6	+ 0.6 − 0	− 0.6 − 1.0	0.6 2.2	+ 1.0 − 0	− 0.6 − 1.2	1.0 2.6	+ 1.0 0	− 1.0 − 1.6	2.5 5.1	+ 1.6 0	− 2.5 − 3.5	4.0 8.1	+ 2.5 0	− 4.0 − 5.6	0	0.12
0.8 2.0	+ 0.7 − 0	− 0.8 − 1.3	0.8 2.7	+ 1.2 − 0	− 0.8 − 1.5	1.2 3.1	+ 1.2 0	− 1.2 − 1.9	2.8 5.8	+ 1.8 0	− 2.8 − 4.0	4.5 9.0	+ 3.0 0	− 4.5 − 6.0	0.12	0.24
1.0 2.5	+ 0.9 − 0	− 1.0 − 1.6	1.0 3.3	+ 1.4 − 0	− 1.0 − 1.9	1.6 3.9	+ 1.4 0	− 1.6 − 2.5	3.0 6.6	+ 2.2 0	− 3.0 − 4.4	5.0 10.7	+ 3.5 0	− 5.0 − 7.2	0.24	0.40
1.2 2.9	+ 1.0 − 0	− 1.2 − 1.9	1.2 3.8	+ 1.6 − 0	− 1.2 − 2.2	2.0 4.6	+ 1.6 0	− 2.0 − 3.0	3.5 7.9	+ 2.8 0	− 3.5 − 5.1	6.0 12.8	+ 4.0 − 0	− 6.0 − 8.8	0.40	0.71
1.6 3.6	+ 1.2 − 0	− 1.6 − 2.4	1.6 4.8	+ 2.0 − 0	− 1.6 − 2.8	2.5 5.7	+ 2.0 0	− 2.5 − 3.7	4.5 10.0	+ 3.5 0	− 4.5 − 6.5	7.0 15.5	+ 5.0 0	− 7.0 − 10.5	0.71	1.19
2.0 4.6	+ 1.6 − 0	− 2.0 − 3.0	2.0 6.1	+ 2.5 − 0	− 2.0 − 3.6	3.0 7.1	+ 2.5 0	− 3.0 − 4.6	5.0 11.5	+ 4.0 0	− 5.0 − 7.5	8.0 18.0	+ 6.0 0	− 8.0 − 12.0	1.19	1.97
2.5 5.5	+ 1.8 − 0	− 2.5 − 3.7	2.5 7.3	+ 3.0 − 0	− 2.5 − 4.3	4.0 8.8	+ 3.0 0	− 4.0 − 5.8	6.0 13.5	+ 4.5 0	− 6.0 − 9.0	9.0 20.5	+ 7.0 0	− 9.0 − 13.5	1.97	3.15
3.0 6.6	+ 2.2 − 0	− 3.0 − 4.4	3.0 8.7	+ 3.5 − 0	− 3.0 − 5.2	5.0 10.7	+ 3.5 0	− 5.0 − 7.2	7.0 15.5	+ 5.0 0	− 7.0 − 10.5	10.0 24.0	+ 9.0 0	− 10.0 − 15.0	3.15	4.73
3.5 7.6	+ 2.5 − 0	− 3.5 − 5.1	3.5 10.0	+ 4.0 − 0	− 3.5 − 6.0	6.0 12.5	+ 4.0 0	− 6.0 − 8.5	8.0 18.0	+ 6.0 0	− 8.0 − 12.0	12.0 28.0	+ 10.0 0	− 12.0 − 18.0	4.73	7.09
4.0 8.6	+ 2.8 − 0	− 4.0 − 5.8	4.0 11.3	+ 4.5 0	− 4.0 − 6.8	7.0 14.3	+ 4.5 0	− 7.0 − 9.8	10.0 21.5	+ 7.0 0	− 10.0 − 14.5	15.0 34.0	+ 12.0 0	− 15.0 − 22.0	7.09	9.85
5.0 10.0	+ 3.0 0	− 5.0 − 7.0	5.0 13.0	+ 5.0 0	− 5.0 − 8.0	8.0 16.0	+ 5.0 0	− 8.0 − 11.0	12.0 25.0	+ 8.0 0	− 12.0 − 17.0	18.0 38.0	+ 12.0 0	− 18.0 − 26.0	9.85	12.41
6.0 11.7	+ 3.5 0	− 6.0 − 8.2	6.0 15.5	+ 6.0 0	− 6.0 − 9.5	10.0 19.5	+ 6.0 0	− 10.0 13.5	14.0 29.0	+ 9.0 0	− 14.0 − 20.0	22.0 45.0	+ 14.0 0	− 22.0 − 31.0	12.41	15.75
8.0 14.5	+ 4.0 0	− 8.0 −10.5	8.0 18.0	+ 6.0 0	− 8.0 −12.0	12.0 22.0	+ 6.0 0	− 12.0 − 16.0	16.0 32.0	+10.0 0	− 16.0 − 22.0	25.0 51.0	+ 16.0 0	− 25.0 − 35.0	15.75	19.69
10.0 18.0	+ 5.0 0	−10.0 −13.0	10.0 23.0	+ 8.0 0	−10.0 −15.0	16.0 29.0	+ 8.0 0	− 16.0 − 21.0	20.0 40.0	+12.0 0	− 20.0 − 28.0	30.0 62.0	+ 20.0 0	− 30.0 − 42.0	19.69	30.09
12.0 22.0	+ 6.0 0	−12.0 −16.0	12.0 28.0	+10.0 0	−12.0 −18.0	20.0 36.0	+10.0 0	− 20.0 − 26.0	25.0 51.0	+16.0 0	− 25.0 − 35.0	40.0 81.0	+ 25.0 0	− 40.0 − 56.0	30.09	41.49
16.0 29.0	+ 8.0 0	−16.0 −21.0	16.0 36.0	+12.0 0	−16.0 −24.0	25.0 45.0	+12.0 0	− 25.0 − 33.0	30.0 62.0	+20.0 0	− 30.0 − 42.0	50.0 100	+ 30.0 0	− 50.0 − 70.0	41.49	56.19
20.0 36.0	+10.0 0	−20.0 −26.0	20.0 46.0	+16.0 0	−20.0 −30.0	30.0 56.0	+16.0 0	− 30.0 − 40.0	40.0 81.0	+25.0 0	− 40.0 − 56.0	60.0 125	+ 40.0 0	− 60.0 − 85.0	56.19	76.39
25.0 45.0	+12.0 0	−25.0 −33.0	25.0 57.0	+20.0 0	−25.0 −37.0	40.0 72.0	+20.0 0	− 40.0 − 52.0	50.0 100	+30.0 0	− 50.0 − 70.0	80.0 160	+ 50.0 0	− 80.0 −110	76.39	100.9
30.0 56.0	+16.0 0	−30.0 −40.0	30.0 71.0	+25.0 0	−30.0 −46.0	50.0 91.0	+25.0 0	− 50.0 − 66.0	60.0 125	+40.0 0	− 60.0 − 85.0	100 200	+ 60.0 0	−100 −140	100.9	131.9
35.0 67.0	+20.0 0	−35.0 −47.0	35.0 85.0	+30.0 0	−35.0 −55.0	60.0 110.0	+30.0 0	− 60.0 − 80.0	80.0 160	+50.0 0	− 80.0 −110	130 260	+ 80.0 0	−130 −180	131.9	171.9
45.0 86.0	+25.0 0	−45.0 −61.0	45.0 110.0	+40.0 0	−45.0 −70.0	80.0 145.0	+40.0 0	− 80.0 −105.0	100 200	+60.0 0	−100 −140	150 310	+100 0	−150 −210	171.9	200

End of Table 5

TABLE 6 LOCATIONAL CLEARANCE FITS

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts.

Data in bold face are in accordance with ABC agreements.

Symbols H6, h5, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Nominal Size Range Inches		Class LC 1			Class LC 2			Class LC 3			Class LC 4			Class LC 5		
		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits	
Over	To		Hole H6	Shaft h5		Hole H7	Shaft h6		Hole H8	Shaft h7		Hole H10	Shaft h9		Hole H 7	Shaft g6
0 –	**0.12**	**0 0.45**	**+ 0.25 – 0**	**+ 0 –0.2**	**0 0.65**	**+ 0.4 – 0**	**+ 0 –0.25**	**0 1**	**+ 0.6 – 0**	**+ 0 – 0.4**	**0 2.6**	**+ 1.6 – 0**	**+ 0 –1.0**	**0.1 0.75**	**+ 0.4 – 0**	**– 0.1 – 0.35**
0.12–	**0.24**	**0 0.5**	**+ 0.3 – 0**	**+ 0 –0.2**	**0 0.8**	**+ 0.5 – 0**	**+ 0 – 0.3**	**0 1.2**	**+ 0.7 – 0**	**+ 0 – 0.5**	**0 3.0**	**+ 1.8 – 0**	**+ 0 – 1.2**	**0.15 0.95**	**+ 0.5 – 0**	**– 0.15 – 0.45**
0.24–	**0.40**	**0 0.65**	**+ 0.4 – 0**	**+ 0 –0.25**	**0 1.0**	**+ 0.6 – 0**	**+ 0 – 0.4**	**0 1.5**	**+ 0.9 – 0**	**+ 0 – 0.6**	**0 3.6**	**+ 2.2 – 0**	**+ 0 – 1.4**	**0.2 1.2**	**+ 0.6 – 0**	**– 0.2 – 0.6**
0.40–	**0.71**	**0 0.7**	**+ 0.4 – 0**	**+ 0 –0.3**	**0 1.1**	**+ 0.7 – 0**	**+ 0 – 0.4**	**0 1.7**	**+ 1.0 – 0**	**+ 0 – 0.7**	**0 4.4**	**+ 2.8 – 0**	**+ 0 – 1.6**	**0.25 1.35**	**+ 0.7 – 0**	**– 0.25 – 0.65**
0.71–	**1.19**	**0 0.9**	**+ 0.5 – 0**	**+ 0 –0.4**	**0 1.3**	**+ 0.8 – 0**	**+ 0 – 0.5**	**0 2**	**+ 1.2 – 0**	**+ 0 – 0.8**	**0 5.5**	**+ 3.5 – 0**	**+ 0 – 2.0**	**0.3 1.6**	**+ 0.8 – 0**	**– 0.3 – 0.8**
1.19–	**1.97**	**0 1.0**	**+ 0.6 – 0**	**+ 0 –0.4**	**0 1.6**	**+ 1.0 – 0**	**+ 0 – 0.6**	**0 2.6**	**+ 1.6 – 0**	**+ 0 – 1**	**0 6.5**	**+ 4.0 – 0**	**+ 0 – 2.5**	**0.4 2.0**	**+ 1.0 – 0**	**– 0.4 – 1.0**
1.97–	**3.15**	**0 1.2**	**+ 0.7 – 0**	**+ 0 –0.5**	**0 1.9**	**+ 1.2 – 0**	**+ 0 – 0.7**	**0 3**	**+ 1.8 – 0**	**+ 0 – 1.2**	**0 7.5**	**+ 4.5 – 0**	**+ 0 – 3**	**0.4 2.3**	**+ 1.2 – 0**	**– 0.4 – 1.1**
3.15–	**4.73**	**0 1.5**	**+ 0.9 – 0**	**+ 0 –0.6**	**0 2.3**	**+ 1.4 – 0**	**+ 0 – 0.9**	**0 3.6**	**+ 2.2 – 0**	**+ 0 – 1.4**	**0 8.5**	**+ 5.0 – 0**	**+ 0 – 3.5**	**0.5 2.8**	**+ 1.4 – 0**	**– 0.5 – 1.4**
4.73–	**7.09**	**0 1.7**	**+ 1.0 – 0**	**+ 0 –0.7**	**0 2.6**	**+ 1.6 – 0**	**+ 0 – 1.0**	**0 4.1**	**+ 2.5 – 0**	**+ 0 – 1.6**	**0 10**	**+ 6.0 – 0**	**+ 0 – 4**	**0.6 3.2**	**+ 1.6 – 0**	**– 0.6 – 1.6**
7.09–	**9.85**	**0 2.0**	**+ 1.2 – 0**	**+ 0 –0.8**	**0 3.0**	**+ 1.8 – 0**	**+ 0 – 1.2**	**0 4.6**	**+ 2.8 – 0**	**+ 0 – 1.8**	**0 11.5**	**+ 7.0 – 0**	**+ 0 – 4.5**	**0.6 3.6**	**+ 1.8 – 0**	**– 0.6 – 1.8**
9.85–	**12.41**	**0 2.1**	**+ 1.2 – 0**	**+ 0 –0.9**	**0 3.2**	**+ 2.0 – 0**	**+ 0 – 1.2**	**0 5**	**+ 3.0 – 0**	**+ 0 – 2.0**	**0 13**	**+ 8.0 – 0**	**+ 0 – 5**	**0.7 3.9**	**+ 2.0 – 0**	**– 0.7 – 1.9**
12.41–	**15.75**	**0 2.4**	**+ 1.4 – 0**	**+ 0 –1.0**	**0 3.6**	**+ 2.2 – 0**	**+ 0 – 1.4**	**0 5.7**	**+ 3.5 – 0**	**+ 0 – 2.2**	**0 15**	**+ 9.0 – 0**	**+ 0 – 6**	**0.7 4.3**	**+ 2.2 – 0**	**– 0.7 – 2.1**
15.75–	**19.69**	**0 2.6**	**+ 1.6 – 0**	**+ 0 –1.0**	**0 4.1**	**+ 2.5 – 0**	**+ 0 – 1.6**	**0 6.5**	**+ 4 – 0**	**+ 0 – 2.5**	**0 16**	**+ 10.0 – 0**	**+ 0 – 6**	**0.8 4.9**	**+ 2.5 – 0**	**– 0.8 – 2.4**
19.69–	30.09	0 3.2	+ 2.0 – 0	+ 0 –1.2	0 5.0	+ 3 – 0	+ 0 – 2	0 8	+ 5 – 0	+ 0 – 3	0 20	+12.0 – 0	+ 0 – 8	0.9 5.9	+ 3.0 – 0	– 0.9 – 2.9
30.09–	41.49	0 4.1	+ 2.5 – 0	+ 0 –1.6	0 6.5	+ 4 – 0	+ 0 – 2.5	0 10	+ 6 – 0	+ 0 – 4	0 26	+16.0 – 0	+ 0 –10	1.0 7.5	+ 4.0 – 0	– 1.0 – 3.5
41.49–	56.19	0 5.0	+ 3.0 – 0	+ 0 –2.0	0 8.0	+ 5 – 0	+ 0 – 3	0 13	+ 8 – 0	+ 0 – 5	0 32	+20.0 – 0	+ 0 –12	1.2 9.2	+ 5.0 – 0	– 1.2 – 4.2
56.19–	76.39	0 6.5	+ 4.0 – 0	+ 0 –2.5	0 10	+ 6 – 0	+ 0 – 4	0 16	+10 – 0	+ 0 – 6	0 41	+25.0 – 0	+ 0 –16	1.2 11.2	+ 6.0 – 0	– 1.2 – 5.2
76.39–	100.9	0 8.0	+ 5.0 – 0	+ 0 –3.0	0 13	+ 8 – 0	+ 0 – 5	0 20	+12 – 0	+ 0 – 8	0 50	+30.0 – 0	+ 0 –20	1.4 14.4	+ 8.0 – 0	– 1.4 – 6.4
100.9 –	131.9	0 10.0	+ 6.0 – 0	+ 0 –4.0	0 16	+10 – 0	+ 0 – 6	0 26	+16 – 0	+ 0 –10	0 65	+40.0 – 0	+ 0 –25	1.6 17.6	+10.0 – 0	– 1.6 – 7.6
131.9 –	171.9	0 13.0	+ 8.0 – 0	+ 0 –5.0	0 20	+12 – 0	+ 0 – 8	0 32	+20 – 0	+ 0 –12	0 80	+ 50.0 – 0	+ 0 –30	1.8 21.8	+12.0 – 0	– 1.8 – 9.8
171.9 –	200	0 16.0	+10.0 – 0	+ 0 –6.0	0 26	+16 – 0	+ 0 –10	0 41	+25 – 0	+ 0 –16	0 100	+60.0 – 0	+ 0 –40	1.8 27.8	+16.0 – 0	– 1.8 –11.8

Continued on page 9

TABLE 6 LOCATIONAL CLEARANCE FITS (continued from page 8)

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts.

Data in bold face are in accordance with ABC agreements.

Symbols H9, f8, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Class LC 6			Class LC 7			Class LC 8			Class LC 9			Class LC 10			Class LC 11			Nominal Size Range Inches	
Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits			
	Hole H9	Shaft f8		Hole H10	Shaft e9		Hole H10	Shaft d9		Hole H11	Shaft c10		Hole H12	Shaft		Hole H13	Shaft	Over	To
0.3 1.9	+ 1.0 0	− 0.3 − 0.9	0.6 3.2	+ 1.6 0	− 0.6 − 1.6	1.0 3.6	+ 1.6 − 0	− 1.0 − 2.0	2.5 6.6	+ 2.5 − 0	− 2.5 − 4.1	4 12	+ 4 − 0	− 4 − 8	5 17	+ 6 − 0	− 5 − 11	0	0.12
0.4 2.3	+ 1.2 0	− 0.4 − 1.1	0.8 3.8	+ 1.8 0	− 0.8 − 2.0	1.2 4.2	+ 1.8 − 0	− 1.2 − 2.4	2.8 7.6	+ 3.0 − 0	− 2.8 − 4.6	4.5 14.5	+ 5 − 0	− 4.5 − 9.5	6 20	+ 7 − 0	− 6 − 13	0.12	0.24
0.5 2.8	+ 1.4 0	− 0.5 − 1.4	1.0 4.6	+ 2.2 0	− 1.0 − 2.4	1.6 5.2	+ 2.2 − 0	− 1.6 − 3.0	3.0 8.7	+ 3.5 − 0	− 3.0 − 5.2	5 17	+ 6 − 0	− 5 − 11	7 25	+ 9 − 0	− 7 − 16	0.24	0.40
0.6 3.2	+ 1.6 0	− 0.6 − 1.6	1.2 5.6	+ 2.8 0	− 1.2 − 2.8	2.0 6.4	+ 2.8 − 0	− 2.0 − 3.6	3.5 10.3	+ 4.0 − 0	− 3.5 − 6.3	6 20	+ 7 − 0	− 6 − 13	8 28	+ 10 − 0	− 8 − 18	0.40	0.71
0.8 4.0	+ 2.0 0	− 0.8 − 2.0	1.6 7.1	+ 3.5 0	− 1.6 − 3.6	2.5 8.0	+ 3.5 − 0	− 2.5 − 4.5	4.5 13.0	+ 5.0 − 0	− 4.5 − 8.0	7 23	+ 8 − 0	− 7 − 15	10 34	+ 12 − 0	− 10 − 22	0.71	1.19
1.0 5.1	+ 2.5 0	− 1.0 − 2.6	2.0 8.5	+ 4.0 0	− 2.0 − 4.5	3.0 9.5	+ 4.0 − 0	− 3.0 − 5.5	5 15	+ 6 − 0	− 5 − 9	8 28	+ 10 − 0	− 8 − 18	12 44	+ 16 − 0	− 12 − 28	1.19	1.97
1.2 6.0	+ 3.0 0	− 1.2 − 3.0	2.5 10.0	+ 4.5 0	− 2.5 − 5.5	4.0 11.5	+ 4.5 − 0	− 4.0 − 7.0	6 17.5	+ 7 − 0	− 6 − 10.5	10 34	+ 12 − 0	− 10 − 22	14 50	+ 18 − 0	− 14 − 32	1.97	3.15
1.4 7.1	+ 3.5 0	− 1.4 − 3.6	3.0 11.5	+ 5.0 0	− 3.0 − 6.5	5.0 13.5	+ 5.0 − 0	− 5.0 − 8.5	7 21	+ 9 − 0	− 7 − 12	11 39	+ 14 − 0	− 11 − 25	16 60	+ 22 − 0	− 16 − 38	3.15	4.73
1.6 8.1	+ 4.0 0	− 1.6 − 4.1	3.5 13.5	+ 6.0 0	− 3.5 − 7.5	6 16	+ 6 − 0	− 6 −10	8 24	+ 10 − 0	− 8 − 14	12 44	+ 16 − 0	− 12 − 28	18 68	+ 25 − 0	− 18 − 43	4.73	7.09
2.0 9.3	+ 4.5 0	− 2.0 − 4.8	4.0 15.5	+ 7.0 0	− 4.0 − 8.5	7 18.5	+ 7 − 0	− 7 −11.5	10 29	+ 12 − 0	− 10 − 17	16 52	+ 18 − 0	− 16 − 34	22 78	+ 28 − 0	− 22 − 50	7.09	9.85
2.2 10.2	+ 5.0 0	− 2.2 − 5.2	4.5 17.5	+ 8.0 0	− 4.5 − 9.5	7 20	+ 8 − 0	− 7 −12	12 32	+ 12 − 0	− 12 − 20	20 60	+ 20 − 0	− 20 − 40	28 88	+ 30 − 0	− 28 − 58	9.85	12.41
2.5 12.0	+ 6.0 0	− 2.5 − 6.0	5.0 20.0	+ 9.0 0	− 5 −11	8 23	+ 9 − 0	− 8 −14	14 37	+ 14 − 0	− 14 − 23	22 66	+ 22 − 0	− 22 − 44	30 100	+ 35 − 0	− 30 − 65	12.41	15.75
2.8 12.8	+ 6.0 0	− 2.8 − 6.8	5.0 21.0	+ 10.0 0	− 5 −11	9 25	+10 − 0	− 9 −15	16 42	+ 16 − 0	− 16 − 26	25 75	+ 25 − 0	− 25 − 50	35 115	+ 40 − 0	− 35 − 75	15.75	19.69
3.0 16.0	+ 8.0 0	− 3.0 − 8.0	6.0 26.0	+12.0 − 0	− 6 −14	10 30	+12 − 0	−10 −18	18 50	+ 20 − 0	− 18 − 30	28 88	+ 30 − 0	− 28 − 58	40 140	+ 50 − 0	− 40 − 90	19.69	30.09
3.5 19.5	+10.0 0	− 3.5 − 9.5	7.0 33.0	+16.0 − 0	− 7 −17	12 38	+16 − 0	−12 −22	20 61	+ 25 − 0	− 20 − 36	30 110	+ 40 − 0	− 30 − 70	45 165	+ 60 − 0	− 45 −105	30.09	41.49
4.0 24.0	+12.0 0	− 4.0 −12.0	8.0 40.0	+20.0 − 0	− 8 −20	14 46	+20 − 0	−14 −26	25 75	+ 30 − 0	− 25 − 45	40 140	+ 50 − 0	− 40 − 90	60 220	+ 80 − 0	− 60 −140	41.49	56.19
4.5 30.5	+16.0 0	− 4.5 −14.5	9.0 50.0	+25.0 − 0	− 9 −25	16 57	+25 − 0	−16 −32	30 95	+ 40 − 0	− 30 − 55	50 170	+ 60 − 0	− 50 110	70 270	+100 − 0	− 70 −170	56.19	76.39
5.0 37.0	+20.0 0	− 5 −17	10.0 60.0	+30.0 − 0	−10 −30	18 68	+30 − 0	−18 −38	35 115	+ 50 − 0	− 35 − 65	50 210	+ 80 − 0	− 50 −130	80 330	+125 − 0	− 80 −205	76.39	100.9
6.0 47.0	+25.0 0	− 6 −22	12.0 67.0	+40.0 − 0	−12 −27	20 85	+40 − 0	−20 −45	40 140	+ 60 − 0	− 40 − 80	60 260	+100 − 0	− 60 −160	90 410	+160 − 0	− 90 −250	100.9	131.9
7.0 57.0	+30.0 0	− 7 −27	14.0 94.0	+50.0 − 0	−14 −44	25 105	+50 − 0	−25 −55	50 180	+ 80 − 0	− 50 −100	80 330	+125 − 0	− 80 −205	100 500	+200 − 0	−100 −300	131.9	171.9
7.0 72.0	+40.0 0	− 7 −32	14.0 114.0	+60.0 − 0	−14 −54	25 125	+60 − 0	−25 −65	50 210	+100 − 0	− 50 − 110	90 410	+160 − 0	− 90 −250	125 625	+250 − 0	−125 −375	171.9	200

End of Table 6

TABLE 7 LOCATIONAL TRANSITION FITS

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the mating parts.

Data in bold face are in accordance with ABC agreements.

"Fit" represents the maximum interference (minus values) and the maximum clearance (plus values).

Symbols H7, js6, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Nominal Size Range Inches	Class LT 1			Class LT 2			Class LT 3			Class LT 4			Class LT 5			Class LT 6		
	Fit	Standard Limits		Fit	Standard Limits		Fit	Standard Limits		Fit	Standard Limits		Fit	Standard Limits		Fit	Standard Limits	
Over – To		Hole H7	Shaft js6		Hole H8	Shaft js7		Hole H7	Shaft k6		Hole H8	Shaft k7		Hole H7	Shaft n6		Hole H7	Shaft n7
0 – 0.12	−0.10 +0.50	+0.4 −0	+0.10 −0.10	−0.2 +0.8	+0.6 −0	+0.2 −0.2							−0.5 +0.15	+0.4 −0	+0.5 +0.25	−0.65 +0.15	+0.4 −0	+0.65 +0.25
0.12 – 0.24	−0.15 +0.65	+0.5 −0	+0.15 −0.15	−0.25 +0.95	+0.7 −0	+0.25 −0.25							−0.6 +0.2	+0.5 −0	+0.6 +0.3	−0.8 +0.2	+0.5 −0	+0.8 +0.3
0.24 – 0.40	−0.2 +0.8	+0.6 −0	+0.2 −0.2	−0.3 +1.2	+0.9 −0	+0.3 −0.3	−0.5 +0.5	+0.6 −0	+0.5 +0.1	−0.7 +0.8	+0.9 −0	+0.7 +0.1	−0.8 +0.2	+0.6 −0	+0.8 +0.4	−1.0 +0.2	+0.6 −0	+1.0 +0.4
0.40 – 0.71	−0.2 +0.9	+0.7 −0	+0.2 −0.2	−0.35 +1.35	+1.0 −0	+0.35 −0.35	−0.5 +0.6	+0.7 −0	+0.5 +0.1	−0.8 +0.9	+1.0 −0	+0.8 +0.1	−0.9 +0.2	+0.7 −0	+0.9 +0.5	−1.2 +0.2	+0.7 −0	+1.2 +0.5
0.71 – 1.19	−0.25 +1.05	+0.8 −0	+0.25 −0.25	−0.4 +1.6	+1.2 −0	+0.4 −0.4	−0.6 +0.7	+0.8 −0	+0.6 +0.1	−0.9 +1.1	+1.2 −0	+0.9 +0.1	−1.1 +0.2	+0.8 −0	+1.1 +0.6	−1.4 +0.2	+0.8 −0	+1.4 +0.6
1.19 – 1.97	−0.3 +1.3	+1.0 −0	+0.3 −0.3	−0.5 +2.1	+1.6 −0	+0.5 −0.5	−0.7 +0.9	+1.0 −0	+0.7 +0.1	−1.1 +1.5	+1.6 −0	+1.1 +0.1	−1.3 +0.3	+1.0 −0	+1.3 +0.7	−1.7 +0.3	+1.0 −0	+1.7 +0.7
1.97 – 3.15	−0.3 +1.5	+1.2 −0	+0.3 −0.3	−0.6 +2.4	+1.8 −0	+0.6 −0.6	−0.8 +1.1	+1.2 −0	+0.8 +0.1	−1.3 +1.7	+1.8 −0	+1.3 +0.1	−1.5 +0.4	+1.2 −0	+1.5 +0.8	−2.0 +0.4	+1.2 −0	+2.0 +0.8
3.15 – 4.73	−0.4 +1.8	+1.4 −0	+0.4 −0.4	−0.7 +2.9	+2.2 −0	+0.7 −0.7	−1.0 +1.3	+1.4 −0	+1.0 +0.1	−1.5 +2.1	+2.2 −0	+1.5 +0.1	−1.9 +0.4	+1.4 −0	+1.9 +1.0	−2.4 +0.4	+1.4 −0	+2.4 +1.0
4.73 – 7.09	−0.5 +2.1	+1.6 −0	+0.5 −0.5	−0.8 +3.3	+2.5 −0	+0.8 −0.8	−1.1 +1.5	+1.6 −0	+1.1 +0.1	−1.7 +2.4	+2.5 −0	+1.7 +0.1	−2.2 +0.4	+1.6 −0	+2.2 +1.2	−2.8 +0.4	+1.6 −0	+2.8 +1.2
7.09 – 9.85	−0.6 +2.4	+1.8 −0	+0.6 −0.6	−0.9 +3.7	+2.8 −0	+0.9 −0.9	−1.4 +1.6	+1.8 −0	+1.4 +0.2	−2.0 +2.6	+2.8 −0	+2.0 +0.2	−2.6 +0.4	+1.8 −0	+2.6 +1.4	−3.2 +0.4	+1.8 −0	+3.2 +1.4
9.85 – 12.41	−0.6 +2.6	+2.0 −0	+0.6 −0.6	−1.0 +4.0	+3.0 −0	+1.0 −1.0	−1.4 +1.8	+2.0 −0	+1.4 +0.2	−2.2 +2.8	+3.0 −0	+2.2 +0.2	−2.6 +0.6	+2.0 −0	+2.6 +1.4	−3.4 +0.6	+2.0 −0	+3.4 +1.4
12.41 – 15.75	−0.7 +2.9	+2.2 −0	+0.7 −0.7	−1.0 +4.5	+3.5 −0	+1.0 −1.0	−1.6 +2.0	+2.2 −0	+1.6 +0.2	−2.4 +3.3	+3.5 −0	+2.4 +0.2	−3.0 +0.6	+2.2 −0	+3.0 +1.6	−3.8 +0.6	+2.2 −0	+3.8 +1.6
15.75 – 19.69	−0.8 +3.3	+2.5 −0	+0.8 −0.8	−1.2 +5.2	+4.0 −0	+1.2 −1.2	−1.8 +2.3	+2.5 −0	+1.8 +0.2	−2.7 +3.8	+4.0 −0	+2.7 +0.2	−3.4 +0.7	+2.5 −0	+3.4 +1.8	−4.3 +0.7	+2.5 −0	+4.3 +1.8

End of Table 7

TABLE 8 LOCATIONAL INTERFERENCE FITS

Limits are in thousandths of an inch.
Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts.
Data in bold face are in accordance with ABC agreements,
Symbols H7, p6, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Nominal Size Range Inches		Class LN 1			Class LN 2			Class LN 3		
		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits	
Over	To		Hole H6	Shaft n5		Hole H7	Shaft p6		Hole H7	Shaft r6
0	– 0.12	0 0.45	+ 0.25 – 0	+0.45 +0.25	0 0.65	+ 0.4 – 0	+ 0.65 + 0.4	0.1 0.75	+ 0.4 – 0	+ 0.75 + 0.5
0.12	– 0.24	0 0.5	+ 0.3 – 0	+0.5 +0.3	0 0.8	+ 0.5 – 0	+ 0.8 + 0.5	0.1 0.9	+ 0.5 0	+ 0.9 + 0.6
0.24	– 0.40	0 0.65	+ 0.4 – 0	+0.65 +0.4	0 1.0	+ 0.6 – 0	+ 1.0 + 0.6	0.2 1.2	+ 0.6 – 0	+ 1.2 + 0.8
0.40	– 0.71	0 0.8	+ 0.4 – 0	+0.8 +0.4	0 1.1	+ 0.7 – 0	+ 1.1 + 0.7	0.3 1.4	+ 0.7 – 0	+ 1.4 + 1.0
0.71	– 1.19	0 1.0	+ 0.5 – 0	+1.0 +0.5	0 1.3	+ 0.8 – 0	+ 1.3 + 0.8	0.4 1.7	+ 0.8 – 0	+ 1.7 + 1.2
1.19	– 1.97	0 1.1	+ 0.6 – 0	+1.1 +0.6	0 1.6	+ 1.0 – 0	+ 1.6 + 1.0	0.4 2.0	+ 1.0 – 0	+ 2.0 + 1.4
1.97	– 3.15	0.1 1.3	+ 0.7 – 0	+1.3 +0.8	0.2 2.1	+ 1.2 – 0	+ 2.1 + 1.4	0.4 2.3	+ 1.2 – 0	+ 2.3 + 1.6
3.15	– 4.73	0.1 1.6	+ 0.9 – 0	+1.6 +1.0	0.2 2.5	+ 1.4 – 0	+ 2.5 + 1.6	0.6 2.9	+ 1.4 – 0	+ 2.9 + 2.0
4.73	– 7.09	0.2 1.9	+ 1.0 – 0	+1.9 +1.2	0.2 2.8	+ 1.6 – 0	+ 2.8 + 1.8	0.9 3.5	+ 1.6 – 0	+ 3.5 + 2.5
7.09	– 9.85	0.2 2.2	+ 1.2 – 0	+2.2 +1.4	0.2 3.2	+ 1.8 – 0	+ 3.2 + 2.0	1.2 4.2	+ 1.8 – 0	+ 4.2 + 3.0
9.85	– 12.41	0.2 2.3	+ 1.2 – 0	+2.3 +1.4	0.2 3.4	+ 2.0 – 0	+ 3.4 + 2.2	1.5 4.7	+ 2.0 – 0	+ 4.7 + 3.5
12.41	– 15.75	0.2 2.6	+ 1.4 – 0	+2.6 +1.6	0.3 3.9	+ 2.2 – 0	+ 3.9 + 2.5	2.3 5.9	+ 2.2 – 0	+ 5.9 + 4.5
15.75	– 19.69	0.2 2.8	+ 1.6 – 0	+2.8 +1.8	0.3 4.4	+ 2.5 – 0	+ 4.4 + 2.8	2.5 6.6	+ 2.5 – 0	+ 6.6 + 5.0
19.69	– 30.09		+ 2.0 – 0		0.5 5.5	+ 3 – 0	+ 5.5 + 3.5	4 9	+ 3 – 0	+ 9 + 7
30.09	– 41.49		+ 2.5 – 0		0.5 7.0	+ 4 – 0	+ 7.0 + 4.5	5 11.5	+ 4 – 0	+11.5 + 9
41.49	– 56.19		+ 3.0 – 0		1 9	+ 5 – 0	+ 9 + 6	7 15	+ 5 – 0	+15 +12
56.19	– 76.39		+ 4.0 – 0		1 11	+ 6 – 0	+11 + 7	10 20	+ 6 – 0	+20 +16
76.39	– 100.9		+ 5.0 – 0		1 14	+ 8 – 0	+14 + 9	12 25	+ 8 – 0	+25 +20
100.9	– 131.9		+ 6.0 – 0		2 18	+10 – 0	+18 +12	15 31	+10 – 0	+31 +25
131.9	– 171.9		+ 8.0 – 0		4 24	+12 – 0	+24 +16	18 38	+12 – 0	+38 +30
171.9	– 200		+10.0 – 0		4 30	+16 – 0	+30 +20	24 50	+16 – 0	+50 +40

End of Table 8

Continued from page 5

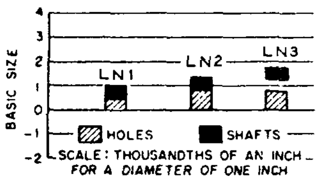

FIG. 4 GRAPHICAL REPRESENTATION OF STANDARD LOCATIONAL INTERFERENCE FITS (SHOWN IN TABLE 8)

LN *Locational Interference fits* are used where accuracy of location is of prime importance and for parts requiring rigidity and alignment with no special requirements for bore pressure. Such fits are not intended for parts designed to transmit frictional loads from one part to another by virtue of the tightness of fit, as these conditions are covered by force fits.

8.3.3 *Force Fits.* Force or shrink fits constitute a special type of interference fit, normally characterized by maintenance of constant bore pressures throughout the range of sizes. The interference therefore varies almost directly with diameter, and the difference between its minimum and maximum value is small to maintain the resulting pressures within reasonable limits.

These fits may be described briefly as follows:

FN 1 *Light drive fits* are those requiring light assembly pressures and produce more or less permanent assemblies. They are suitable for thin sections or long fits, or in cast-iron external members.

FN 2 *Medium drive fits* are suitable for ordinary steel parts or for shrink fits on light sections. They are about the tightest fits that can be used with high-grade cast-iron external members.

FN 3 *Heavy drive fits* are suitable for heavier steel parts or for shrink fits in medium sections.

FN 4, FN 5 *Force fits* are suitable for parts which can be highly stressed or for shrink fits where the heavy pressing forces required are impractical.

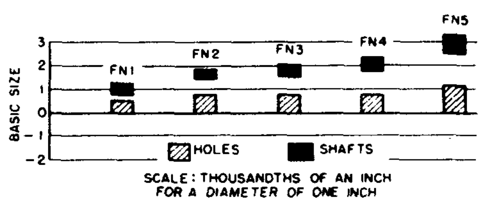

FIG. 5 GRAPHICAL REPRESENTATION OF STANDARD FORCE OR SHRINK FITS (SHOWN IN TABLE 9)

9. Modified Standard Fits

9.1 Bilateral hole or basic shaft system fits having the same amounts of clearance or interference remain the same as those shown in Tables 5 to 9, but the limits of size are calculated for holes or shafts and differ from those shown in the tables. This may be accomplished by one of the following:

(a) Bilateral holes (Symbol B)—This will result in nonstandard holes and shafts.

(b) A basic shaft system (Symbol S)—This will result in nonstandard holes and shafts.

9.2 **Bilateral Hole Fits (Symbol B).** The common case is where holes are produced with fixed tools, such as drills or reamers; to provide a longer wear life for such tools a bilateral tolerance is desired.

The symbols used for these fits are identical with standard fits except that they are followed by the letter "B." Thus "LC4B" is a locational clearance fit, class 4, except that is is produced with a bilateral hole.

The limits of clearance or interference are identical with those shown in Tables 5 to 9 for the corresponding fits.

The hole tolerance is changed so that the plus limit is that for one grade finer than the value shown in the tables, the minus limit equals the amount by which the plus limit was lowered, and the shaft limits are both lowered by the same amount as the lower limit of size of the hole. The finer grade of tolerance can be found in Table 4.

9.3 **Basic Shaft Fits (Symbol S).** For these fits the maximum size of the shaft is basic and the allowance is applied to the hole. The limits of clearance or interference are identical with those shown in Tables 5 to 9 for the corresponding fits. The symbols used for these fits are identical with those used for standard fits except that they are followed by the letter "S." Thus "LC 4S" is a locational clearance fit, class 4, except that it is produced on a basic shaft basis.

The limits for hole and shaft as given in Tables 5 to 9 are increased for clearance fits, or decreased for transition or interference fits, by the value of the upper shaft limit; that is, by the amount required to change the maximum shaft to the basic size.

9.4 If standard stock sizes or special conditions require the use of other hole sizes and shaft sizes, reference should be made for the required fit to tables in Appendix I which are taken from the ABC proposal.

10. Machining Processes.

To indicate the machining processes which may normally be expected to produce work within the tolerances indicated by the grades given in this Standard, Fig. 6 has been provided. This information is intended merely as a guide in selecting suitable processes for a particular grade.

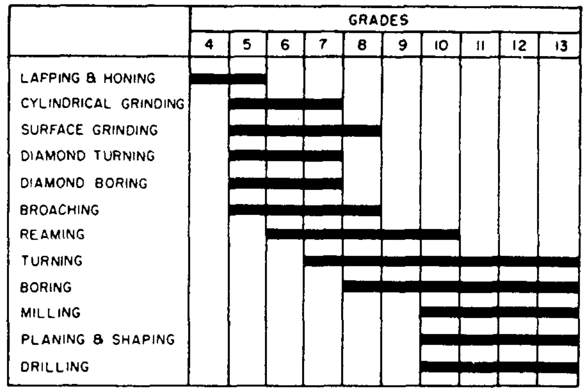

FIG. 6 MACHINING PROCESSES

TABLE 9 FORCE AND SHRINK FITS

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts.

Data in bold face are in accordance with ABC agreements.

Symbols H7, s6, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Nominal Size Range Inches	Class FN 1			Class FN 2			Class FN 3			Class FN 4			Class FN 5		
	Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits	
Over To		Hole H6	Shaft		Hole H7	Shaft s6		Hole H7	Shaft t6		Hole H7	Shaft u6		Hole H8	Shaft x7
0 – 0.12	0.05 0.5	+0.25 − 0	+ 0.5 + 0.3	0.2 0.85	+0.4 − 0	+ 0.85 + 0.6				0.3 0.95	+0.4 − 0	+ 0.95 + 0.7	0.3 1.3	+0.6 − 0	+ 1.3 + 0.9
0.12 – 0.24	0.1 0.6	+0.3 − 0	+ 0.6 + 0.4	0.2 1.0	+0.5 − 0	+ 1.0 + 0.7				0.4 1.2	+0.5 − 0	+ 1.2 + 0.9	0.5 1.7	+ 0.7 − 0	+ 1.7 + 1.2
0.24 – 0.40	0.1 0.75	+0.4 − 0	+ 0.75 + 0.5	0.4 1.4	+0.6 − 0	+ 1.4 + 1.0				0.6 1.6	+0.6 − 0	+ 1.6 + 1.2	0.5 2.0	+ 0.9 − 0	+ 2.0 + 1.4
0.40 – 0.56	0.1 0.8	+ 0.4 − 0	+ 0.8 + 0.5	0.5 1.6	+0.7 − 0	+ 1.6 + 1.2				0.7 1.8	+ 0.7 − 0	+ 1.8 + 1.4	0.6 2.3	+ 1.0 − 0	+ 2.3 + 1.6
0.56 – 0.71	0.2 0.9	+0.4 − 0	+ 0.9 + 0.6	0.5 1.6	+0.7 − 0	+ 1.6 + 1.2				0.7 1.8	+ 0.7 − 0	+ 1.8 + 1.4	0.8 2.5	+ 1.0 − 0	+ 2.5 + 1.8
0.71 – 0.95	0.2 1.1	+0.5 − 0	+ 1.1 + 0.7	0.6 1.9	+0.8 − 0	+ 1.9 + 1.4				0.8 2.1	+0.8 − 0	+ 2.1 + 1.6	1.0 3.0	+ 1.2 − 0	+ 3.0 + 2.2
0.95 – 1.19	0.3 1.2	+0.5 − 0	+ 1.2 + 0.8	0.6 1.9	+0.8 − 0	+ 1.9 + 1.4	0.8 2.1	+0.8 − 0	+ 2.1 + 1.6	1.0 2.3	+0.8 − 0	+ 2.3 + 1.8	1.3 3.3	+ 1.2 − 0	+ 3.3 + 2.5
1.19 – 1.58	0.3 1.3	+0.6 − 0	+ 1.3 + 0.9	0.8 2.4	+1.0 − 0	+ 2.4 + 1.8	1.0 2.6	+1.0 − 0	+ 2.6 + 2.0	1.5 3.1	+1.0 − 0	+ 3.1 + 2.5	1.4 4.0	+ 1.6 − 0	+ 4.0 + 3.0
1.58 – 1.97	0.4 1.4	+0.6 − 0	+ 1.4 + 1.0	0.8 2.4	+1.0 − 0	+ 2.4 + 1.8	1.2 2.8	+1.0 − 0	+ 2.8 + 2.2	1.8 3.4	+1.0 − 0	+ 3.4 + 2.8	2.4 5.0	+ 1.6 − 0	+ 5.0 + 4.0
1.97 – 2.56	0.6 1.8	+0.7 − 0	+ 1.8 + 1.3	0.8 2.7	+1.2 − 0	+ 2.7 + 2.0	1.3 3.2	+1.2 − 0	+ 3.2 + 2.5	2.3 4.2	+1.2 − 0	+ 4.2 + 3.5	3.2 6.2	+ 1.8 − 0	+ 6.2 + 5.0
2.56 – 3.15	0.7 1.9	+0.7 − 0	+ 1.9 + 1.4	1.0 2.9	+1.2 − 0	+ 2.9 + 2.2	1.8 3.7	+1.2 − 0	+ 3.7 + 3.0	2.8 4.7	+1.2 − 0	+ 4.7 + 4.0	4.2 7.2	+ 1.8 − 0	+ 7.2 + 6.0
3.15 – 3.94	0.9 2.4	+0.9 − 0	+ 2.4 + 1.8	1.4 3.7	+1.4 − 0	+ 3.7 + 2.8	2.1 4.4	+1.4 − 0	+ 4.4 + 3.5	3.6 5.9	+1.4 − 0	+ 5.9 + 5.0	4.8 8.4	+ 2.2 − 0	+ 8.4 + 7.0
3.94 – 4.73	1.1 2.6	+0.9 − 0	+ 2.6 + 2.0	1.6 3.9	+1.4 − 0	+ 3.9 + 3.0	2.6 4.9	+1.4 − 0	+ 4.9 + 4.0	4.6 6.9	+1.4 − 0	+ 6.9 + 6.0	5.8 9.4	+ 2.2 − 0	+ 9.4 + 8.0
4.73 – 5.52	1.2 2.9	+1.0 − 0	+ 2.9 + 2.2	1.9 4.5	+1.6 − 0	+ 4.5 + 3.5	3.4 6.0	+1.6 − 0	+ 6.0 + 5.0	5.4 8.0	+1.6 − 0	+ 8.0 + 7.0	7.5 11.6	+ 2.5 − 0	+11.6 +10.0
5.52 – 6.30	1.5 3.2	+1.0 − 0	+ 3.2 + 2.5	2.4 5.0	+1.6 − 0	+ 5.0 + 4.0	3.4 6.0	+1.6 − 0	+ 6.0 + 5.0	5.4 8.0	+1.6 − 0	+ 8.0 + 7.0	9.5 13.6	+ 2.5 − 0	+13.6 +12.0
6.30 – 7.09	1.8 3.5	+1.0 − 0	+ 3.5 + 2.8	2.9 5.5	+1.6 − 0	+ 5.5 + 4.5	4.4 7.0	+1.6 − 0	+ 7.0 + 6.0	6.4 9.0	+1.6 − 0	+ 9.0 + 8.0	9.5 13.6	+ 2.5 − 0	+13.6 +12.0
7.09 – 7.88	1.8 3.8	+1.2 − 0	+ 3.8 + 3.0	3.2 6.2	+1.8 − 0	+ 6.2 + 5.0	5.2 8.2	+1.8 − 0	+ 8.2 + 7.0	7.2 10.2	+1.8 − 0	+10.2 + 9.0	11.2 15.8	+ 2.8 − 0	+15.8 +14.0
7.88 – 8.86	2.3 4.3	+1.2 − 0	+ 4.3 + 3.5	3.2 6.2	+1.8 − 0	+ 6.2 + 5.0	5.2 8.2	+1.8 − 0	+ 8.2 + 7.0	8.2 11.2	+1.8 − 0	+11.2 +10.0	13.2 17.8	+ 2.8 − 0	+17.8 +16.0
8.86 – 9.85	2.3 4.3	+1.2 − 0	+ 4.3 + 3.5	4.2 7.2	+1.8 − 0	+ 7.2 + 6.0	6.2 9.2	+1.8 − 0	+ 9.2 + 8.0	10.2 13.2	+1.8 − 0	+13.2 +12.0	13.2 17.8	+ 2.8 − 0	+17.8 +16.0
9.85 – 11.03	2.8 4.9	+1.2 − 0	+ 4.9 + 4.0	4.0 7.2	+2.0 − 0	+ 7.2 + 6.0	7.0 10.2	+2.0 − 0	+10.2 + 9.0	10.0 13.2	+2.0 − 0	+13.2 +12.0	15.0 20.0	+ 3.0 − 0	+20.0 +18.0
11.03 – 12.41	2.8 4.9	+1.2 − 0	+ 4.9 + 4.0	5.0 8.2	+2.0 − 0	+ 8.2 + 7.0	7.0 10.2	+2.0 − 0	+10.2 + 9.0	12.0 15.2	+2.0 − 0	+15.2 +14.0	17.0 22.0	+ 3.0 − 0	+22.0 +20.0
12.41 – 13.98	3.1 5.5	+1.4 − 0	+ 5.5 + 4.5	5.8 9.4	+2.2 − 0	+ 9.4 + 8.0	7.8 11.4	+2.2 − 0	+11.4 +10.0	13.8 17.4	+2.2 − 0	+17.4 +16.0	18.5 24.2	+ 3.5 + 0	+24.2 +22.0
13.98 – 15.75	3.6 6.1	+1.4 − 0	+ 6.1 + 5.0	5.8 9.4	+2.2 − 0	+ 9.4 + 8.0	9.8 13.4	+2.2 − 0	+13.4 +12.0	15.8 19.4	+2.2 − 0	+19.4 +18.0	21.5 27.2	+ 3.5 − 0	+27.2 +25.0
15.75 – 17.72	4.4 7.0	+1.6 − 0	+ 7.0 + 6.0	6.5 10.6	+2.5 − 0	+10.6 + 9.0	9.5 13.6	+2.5 − 0	+13.6 +12.0	17.5 21.6	+2.5 − 0	+21.6 +20.0	24.0 30.5	+ 4.0 − 0	+30.5 +28.0
17.72 – 19.69	4.4 7.0	+1.6 − 0	+ 7.0 + 6.0	7.5 11.6	+2.5 − 0	+11.6 +10.0	11.5 15.6	+2.5 − 0	+15.6 +14.0	19.5 23.6	+2.5 − 0	+23.6 +22.0	26.0 32.5	+ 4.0 − 0	+32.5 +30.0

Continued on page 15

TABLE 9 FORCE AND SHRINK FITS (Continued from page 14)

Limits are in thousandths of an inch.

Limits for hole and shaft are applied algebraically to the basic size to obtain the limits of size for the parts.

Data in bold face are in accordance with ABC agreements.

Symbols H7, s6, etc., are Hole and Shaft designations used in ABC System (Appendix I).

Nominal Size Range Inches	Class FN 1			Class FN 2			Class FN 3			Class FN 4			Class FN 5		
	Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits	
Over To		Hole H6	Shaft		Hole H7	Shaft s6		Hole H7	Shaft t6		Hole H7	Shaft u6		Hole H8	Shaft x7
19.69 – 24.34	6.0 9.2	+ 2.0 – 0	+ 9.2 + 8.0	9.0 14.0	+ 3.0 – 0	+ 14.0 + 12.0	15.0 20.0	+ 3.0 – 0	+ 20.0 + 18.0	22.0 27.0	+ 3.0 – 0	+ 27.0 + 25.0	30.0 38.0	+ 5.0 – 0	+ 38.0 + 35.0
24.34 – 30.09	7.0 10.2	+ 2.0 – 0	+10.2 + 9.0	11.0 16.0	+ 3.0 – 0	+ 16.0 + 14.0	17.0 22.0	+ 3.0 – 0	+ 22.0 + 20.0	27.0 32.0	+ 3.0 – 0	+ 32.0 + 30.0	35.0 43.0	+ 5.0 – 0	+ 43.0 + 40.0
30.09 – 35.47	7.5 11.6	+ 2.5 – 0	+11.6 +10.0	14.0 20.5	+ 4.0 – 0	+ 20.5 + 18.0	21.0 27.5	+ 4.0 – 0	+ 27.5 + 25.0	31.0 37.5	+ 4.0 – 0	+ 37.5 + 35.0	44.0 54.0	+ 6.0 – 0	+ 54.0 + 50.0
35.47 – 41.49	9.5 13.6	+ 2.5 – 0	+13.6 +12.0	16.0 22.5	+ 4.0 – 0	+ 22.5 + 20.0	24.0 30.5	+ 4.0 – 0	+ 30.5 + 28.0	36.0 43.5	+ 4.0 – 0	+ 43.5 + 40.0	54.0 64.0	+ 6.0 – 0	+ 64.0 + 60.0
41.49 – 48.28	11.0 16.0	+ 3.0 – 0	+16.0 +14.0	17.0 25.0	+ 5.0 – 0	+ 25.0 + 22.0	30.0 38.0	+ 5.0 – 0	+ 38.0 + 35.0	45.0 53.0	+ 5.0 – 0	+ 53.0 + 50.0	62.0 75.0	+ 8.0 – 0	+ 75.0 + 70.0
48.28 – 56.19	13.0 18.0	+ 3.0 – 0	+18.0 +16.0	20.0 28.0	+ 5.0 – 0	+ 28.0 + 25.0	35.0 43.0	+ 5.0 – 0	+ 43.0 + 40.0	55.0 63.0	+ 5.0 – 0	+ 63.0 + 60.0	72.0 85.0	+ 8.0 – 0	+ 85.0 + 80.0
56.19 – 65.54	14.0 20.5	+ 4.0 – 0	+20.5 +18.0	24.0 34.0	+ 6.0 – 0	+ 34.0 + 30.0	39.0 49.0	+ 6.0 – 0	+ 49.0 + 45.0	64.0 74.0	+ 6.0 – 0	+ 74.0 + 70.0	90.0 106	+10.0 – 0	+106 +100
65.54 – 76.39	18.0 24.5	+ 4.0 – 0	+24.5 +22.0	29.0 39.0	+ 6.0 – 0	+ 39.0 + 35.0	44.0 54.0	+ 6.0 – 0	+ 54.0 + 50.0	74.0 84.0	+ 6.0 – 0	+ 84.0 + 80.0	110 126	+10.0 – 0	+126 +120
76.39 – 87.79	20.0 28.0	+ 5.0 – 0	+28.0 +25.0	32.0 45.0	+ 8.0 – 0	+ 45.0 + 40.0	52.0 65.0	+ 8.0 – 0	+ 65.0 + 60.0	82.0 95.0	+ 8.0 – 0	+ 95.0 + 90.0	128 148	+12.0 – 0	+148 +140
87.79 – 100.9	23.0 31.0	+ 5.0 – 0	+31.0 +28.0	37.0 50.0	+ 8.0 – 0	+ 50.0 + 45.0	62.0 75.0	+ 8.0 – 0	+ 75.0 + 70.0	92.0 105	+ 8.0 – 0	+105 +100	148 168	+12.0 – 0	+168 +160
100.9 – 115.3	24.0 34.0	+ 6.0 – 0	+34.0 +30.0	40.0 56.0	+10.0 – 0	+ 56.0 + 50.0	70.0 86.0	+10.0 – 0	+ 86.0 + 80.0	110 126	+10.0 – 0	+126 +120	164 190	+16.0 – 0	+190 +180
115.3 – 131.9	29.0 39.0	+ 6.0 – 0	+39.0 +35.0	50.0 66.0	+10.0 – 0	+ 66.0 + 60.0	80.0 96.0	+10.0 – 0	+ 96.0 + 90.0	130 146	+10.0 – 0	+146 +140	184 210	+16.0 – 0	+210 +200
131.9 – 152.2	37.0 50.0	+ 8.0 – 0	+50.0 +45.0	58.0 78.0	+12.0 – 0	+ 78.0 + 70.0	88.0 108	+12.0 – 0	+108 +100	148 168	+12.0 – 0	+168 +160	200 232	+20.0 – 0	+232 +220
152.2 – 171.9	42.0 55.0	+ 8.0 – 0	+55.0 +50.0	68.0 88.0	+12.0 – 0	+ 88.0 + 80.0	108 128	+12.0 – 0	+128 +120	168 188	+12.0 – 0	+188 +180	230 262	+20.0 – 0	+262 +250
171.9 – 200	50.0 66.0	+10.0 – 0	+66.0 +60.0	74.0 100	+16.0 – 0	+100 + 90	124 150	+16.0 – 0	+150 +140	184 210	+16.0 – 0	+210 +200	275 316	+25.0 – 0	+316 +300

End of Table 9

APPENDIX I

Limits for Holes C to X

Tolerance Unit 0.001 in.

U–Upper Limit   L–Lower Limit

Hole	Grade	Limit	0–0.12	0.12–0.24	0.24–0.40	0.40–0.56 / 0.56–0.71	0.71–0.95 / 0.95–1.19	1.19–1.58 / 1.58–1.97	1.97–2.56 / 2.56–3.15	3.15–3.94 / 3.94–4.73	4.73–5.52 / 5.52–6.3 / 6.3–7.09	7.09–7.88 / 7.88–8.86 / 8.86–9.85	9.85–11.03 / 11.03–12.41	12.41–13.98 / 13.98–15.75	15.75–17.72 / 17.72–19.69
			Diameters Over: To (Inches)												
C	8	U+	3.1	3.5	3.9	4.5	5.7	6.6	7.8	9.2	10.5	12.8	15.0	17.5	20.0
	9	U+	3.5	4.0	4.4	5.1	6.5	7.5	9.0	10.5	12.0	14.5	17.0	20.0	22.0
	11	U+	5.0	5.8	6.5	7.5	9.5	11.0	13.0	16.0	18.0	22.0	24.0	28.0	32.0
	8, 9, 11	L+	2.5	2.8	3.0	3.5	4.5	5.0	6.0	7.0	8.0	10.0	12.0	14.0	16.0
D	8	U+	1.6	1.9	2.5	3.0	3.7	4.6	5.8	7.2	8.5	9.8	10.0	11.5	13.0
	9	U+	2.0	2.4	3.0	3.6	4.5	5.5	7.0	8.5	10.0	11.5	12.0	14.0	15.0
	10	U+	2.6	3.0	3.8	4.8	6.0	7.0	8.5	10.0	12.0	14.0	15.0	17.0	19.0
	11	U+	3.5	4.2	5.1	6.0	7.5	9.0	11.0	14.0	16.0	19.0	19.0	22.0	25.0
	8-11	L+	1.0	1.2	1.6	2.0	2.5	3.0	4.0	5.0	6.0	7.0	7.0	8.0	9.0
E	7	U+	1.0	1.3	1.6	1.9	2.4	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.5
	8	U+	1.2	1.5	1.9	2.2	2.8	3.6	4.3	5.2	6.0	6.8	7.5	8.5	9.0
	9	U+	1.6	2.0	2.4	2.8	3.6	4.5	5.5	6.5	7.5	8.5	9.5	11.0	11.0
	7-9	L+	0.6	0.8	1.0	1.2	1.6	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.0
F	6	U+	0.55	0.7	0.9	1.0	1.3	1.6	1.9	2.3	2.6	3.2	3.4	3.9	4.4
	7	U+	0.7	0.9	1.1	1.3	1.6	2.0	2.4	2.8	3.2	3.8	4.2	4.7	5.3
	8	U+	0.9	1.1	1.4	1.6	2.0	2.6	3.0	3.6	4.1	4.8	5.2	6.0	6.8
	9	U+	1.3	1.6	1.9	2.2	2.8	...	...	...	...	...	...	...	...
	6-9	L+	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	2.0	2.2	2.5	2.8
G	6	U+	0.35	0.45	0.6	0.65	0.8	1.0	1.1	1.4	1.6	1.8	1.9	2.1	2.4
	7	U+	0.5	0.65	0.8	0.95	1.1	1.4	1.6	1.9	2.2	2.4	2.7	2.9	3.3
	6, 7	L+	0.1	0.15	0.2	0.25	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.8
H	5	U+	0.2	0.2	0.25	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0
	6	U+	0.25	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.2	1.4	1.6
	7	U+	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.5
	8	U+	0.6	0.7	0.9	1.0	1.2	1.6	1.8	2.2	2.5	2.8	3.0	3.5	4.0
	9	U+	1.0	1.2	1.4	1.6	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	6.0
	10	U+	1.6	1.8	2.2	2.8	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0
	11	U+	2.5	3.0	3.5	4.0	5.0	6.0	7.0	9.0	10.0	12.0	12.0	14.0	16.0
	12	U+	4.0	5.0	6.0	7.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	25.0
	13	U+	6.0	7.0	9.0	10.0	12.0	16.0	18.0	22.0	25.0	28.0	30.0	35.0	40.0
	5-13	L+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J	6	U+	0.15	0.2	0.25	0.25	0.3	0.4	0.5	0.7	0.7	0.9	0.9	1.1	1.3
		L–	0.1	0.1	0.15	0.15	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
	7	U+	0.25	0.3	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.3	1.5	1.6
		L–	0.15	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.7	0.9
	8	U+	0.3	0.3	0.5	0.5	0.7	1.0	1.1	1.4	1.6	1.8	2.0	2.3	2.7
		L–	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.2	1.3
	9	U+	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.7	2.0	2.2	2.5	3.0	3.0
		L–	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	2.0	2.3	2.5	3.0	3.0
	10	U+	0.8	0.9	1.1	1.4	1.7	2.0	2.2	2.5	3.0	3.5	4.0	4.5	5.0
		L–	0.8	0.9	1.1	1.4	1.8	2.0	2.3	2.5	3.0	3.5	4.0	4.5	5.0
	11	U+	1.2	1.5	1.7	2.0	2.5	3.0	3.5	4.5	5.0	6.0	6.0	7.0	8.0
		L–	1.3	1.5	1.8	2.0	2.5	3.0	3.5	4.5	5.0	6.0	6.0	7.0	8.0
K	6	U+	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.4
		L–	...	...	0.4	0.4	0.5	0.5	0.6	0.7	0.8	1.0	1.0	1.2	1.2
	7	U+	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7
		L–	...	...	0.5	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.4	1.6	1.8
	8	U+	0.0	0.1	0.2	0.2	0.3	0.5	0.5	0.7	0.8	0.8	0.8	1.1	1.3
		L–	...	...	0.7	0.8	0.9	1.1	1.3	1.5	1.7	2.0	2.2	2.4	2.7

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APPENDIX I

Limits for Holes C to X (Continued from page 16)

Tolerance Unit 0.001 in.

U-Upper Limit L-Lower Limit

Hole	Grade	Limit	Diameters Over: To (Inches)																								
			0 –0.12	0.12–0.24	0.24–0.40	0.40–0.56	0.56–0.71	0.71–0.95	0.95–1.19	1.19–1.58	1.58–1.97	1.97–2.56	2.56–3.15	3.15–3.94	3.94–4.73	4.73–5.52	5.52–6.3	6.3 –7.09	7.09–7.88	7.88–8.86	8.86–9.85	9.85–11.03	11.03–12.41	12.41–13.98	13.98–15.75	15.75–17.72	17.72–19.69
M	6	U–	0.1	0.1	0.1	0.2		0.2		0.2		0.3		0.3		0.3			0.3			0.4		0.4		0.4	
		L–	0.35	0.4	0.5	0.6		0.7		0.8		1.0		1.2		1.3			1.5			1.6		1.8		2.0	
	7	U–	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0			0.0			0.0		0.0		0.0	
		L–	0.4	0.5	0.6	0.7		0.8		1.0		1.2		1.4		1.6			1.8			2.0		2.2		2.5	
	8	U+	0.0	0.0	0.0	0.0		0.1		0.2		0.2		0.3		0.3			0.4			0.4		0.5		0.6	
		L–	0.6	0.7	0.9	1.0		1.1		1.4		1.6		1.9		2.2			2.4			2.6		3.0		3.4	
N	6	U–	0.2	0.2	0.25	0.4		0.5		0.5		0.6		0.7		0.9			1.0			1.1		1.2		1.2	
		L–	0.45	0.5	0.65	0.8		1.0		1.1		1.3		1.6		1.9			2.2			2.3		2.6		2.8	
	7	U–	0.1	0.1	0.2	0.2		0.3		0.3		0.3		0.5		0.6			0.8			0.8		0.8		0.9	
		L–	0.5	0.6	0.8	0.9		1.1		1.3		1.5		1.9		2.2			2.6			2.8		3.0		3.4	
	8	U–	0.1	0.1	0.1	0.2		0.2		0.2		0.2		0.2		0.3			0.4			0.4		0.5		0.5	
		L–	0.7	0.8	1.0	1.2		1.4		1.8		2.0		2.4		2.8			3.2			3.4		4.0		4.5	
	9-11	U–	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0			0.0			0.0		0.0		0.0	
	9	L–	1.0	1.2	1.4	1.6		2.0		2.5		3.0		3.5		4.0			4.5			5.0		6.0		6.0	
	10	L–	1.6	1.8	2.2	2.8		3.5		4.0		4.5		5.0		6.0			7.0			8.0		9.0		10.0	
	11	L–	2.5	3.0	3.5	4.0		5.0		6.0		7.0		9.0		10.0			12.0			12.0		14.0		16.0	
P	6	U–	0.35	0.4	0.5	0.6		0.7		0.8		1.2		1.3		1.5			1.6			1.9		2.1		2.2	
		L–	0.6	0.7	0.9	1.0		1.2		1.4		1.9		2.2		2.5			2.8			3.1		3.5		3.8	
	7	U–	0.25	0.3	0.4	0.4		0.5		0.6		0.9		1.1		1.2			1.4			1.4		1.7		1.9	
		L–	0.65	0.8	1.0	1.1		1.3		1.6		2.1		2.5		2.8			3.2			3.4		3.9		4.4	
R	6	U–	0.45	0.5	0.7	0.9		1.1		1.2		1.4		1.7		2.2			2.6			3.2		4.1		4.4	
		L–	0.7	0.8	1.1	1.3		1.6		1.8		2.1		2.6		3.2			3.8			4.4		5.5		6.0	
	7	U–	0.4	0.4	0.6	0.7		0.9		1.0		1.1		1.5		1.9			2.4			2.7		3.7		4.1	
		L–	0.7	0.9	1.2	1.4		1.7		2.0		2.3		2.9		3.5			4.2			4.7		5.9		6.6	
S	6	U–	0.55	0.6	0.8	1.1		1.3		1.6		1.8	2.0	2.5	2.7	3.2	3.7	4.2	4.6	4.6	5.6	5.7	6.5	6.6	7.6	8.4	9.4
		L–	0.8	0.9	1.2	1.5		1.8		2.2		2.5	2.7	3.4	3.6	4.2	4.7	5.2	5.8	5.8	6.8	6.9	7.7	8.0	9.0	10.0	11.0
	7	U–	0.5	0.5	0.8	0.9		1.1		1.4		1.5	1.7	2.3	2.5	2.9	3.4	3.9	4.4	4.4	5.2	5.2	6.2	6.2	7.2	8.1	9.1
		L–	0.8	1.0	1.4	1.6		1.9		2.4		2.7	2.9	3.7	3.9	4.5	5.0	5.5	6.2	6.2	7.0	7.2	8.2	8.4	9.4	10.6	11.6
T	6	U–	...	...	...	...		...	1.5	1.8	2.0	2.3	2.8	3.2	3.7	4.7	4.7	5.7	6.6	6.6	7.6	8.7	8.7	9.6	11.0	11.4	13.4
		L–	...	...	...	...		...	2.0	2.4	2.6	3.0	3.5	4.1	4.6	5.7	5.7	6.7	7.8	7.8	8.8	9.9	9.9	11.0	12.4	13.0	15.0
	7	U–	...	...	...	...		...	1.3	1.6	1.8	2.0	2.5	3.0	3.5	4.4	4.4	5.4	6.4	6.4	7.4	8.2	8.2	9.2	11.2	11.5	13.1
		L–	...	...	...	...		...	2.1	2.6	2.8	3.2	3.7	4.4	4.9	6.0	6.0	7.0	8.2	8.2	9.2	10.2	10.2	11.4	13.4	14.0	15.6
U	6	U–	0.65	0.8	1.0	1.3		1.5	1.7	2.3	2.6	3.3	3.8	4.7	5.7	6.7	6.7	7.7	8.6	9.6	11.6	11.7	13.7	15.6	17.6	19.4	21.4
		L–	0.9	1.1	1.4	1.7		2.0	2.2	2.9	3.2	4.0	4.5	5.6	6.6	7.7	7.7	8.7	9.8	10.8	12.8	12.9	14.9	17.0	19.0	21.0	23.0
	7	U–	0.6	0.7	1.0	1.1		1.3	1.5	2.1	2.4	3.0	3.5	4.5	5.5	6.4	6.4	7.4	8.4	9.4	11.4	11.4	13.2	15.2	17.2	19.1	21.1
		L–	1.0	1.2	1.6	1.8		2.1	2.3	3.1	3.4	4.2	4.7	5.9	6.9	8.0	8.0	9.0	10.2	11.2	13.2	13.4	15.2	17.4	19.4	21.6	23.6
V	6	U–	...	...	...	...	1.5	1.7	2.1	2.6	2.8	3.8	4.8	5.7	6.7	7.7	8.7	9.7	11.6	11.6	13.6	15.7	15.7	17.6	19.6	21.4	24.4
		L–	...	...	...	...	1.9	2.2	2.6	3.2	3.4	4.5	5.5	6.6	7.6	8.7	9.7	10.7	12.8	12.8	14.8	16.9	16.9	19.0	21.0	23.0	26.0
	7	U–	...	...	...	...	1.3	1.5	1.9	2.4	2.6	3.5	4.5	5.5	6.5	7.4	8.4	9.4	11.4	11.4	13.4	15.2	15.2	17.2	19.2	21.1	24.1
		L–	...	...	...	...	2.0	2.3	2.7	3.4	3.6	4.7	5.7	6.9	7.9	9.0	10.0	11.0	13.2	13.2	15.2	17.2	17.2	19.4	21.4	23.6	26.6
X	6	U–	0.85	1.1	1.3	1.5	1.7	2.1	2.4	2.8	3.8	4.8	5.8	6.7	7.7	9.7	11.7	11.7	13.6	15.6	15.6	17.7	19.7	21.6	24.6	27.4	29.4
		L–	1.1	1.4	1.7	1.9	2.1	2.6	2.9	3.4	4.4	5.5	6.5	7.6	8.6	10.7	12.7	12.7	14.8	16.8	16.8	18.9	20.9	23.0	26.0	29.0	31.0
	7	U–	0.8	1.0	1.2	1.3	1.5	1.9	2.2	2.6	3.6	4.5	5.5	6.5	7.5	9.4	11.4	11.4	13.4	15.4	15.4	17.2	19.2	21.2	24.2	27.1	29.1
		L–	1.2	1.5	1.8	2.0	2.2	2.7	3.0	3.6	4.6	5.7	6.7	7.9	8.9	11.0	13.0	13.0	15.2	17.2	17.2	19.2	21.2	23.4	26.4	29.6	31.6

End of Table

LIMITS FOR SHAFTS c to x
Tolerance Unit 0.001 in.
U–Upper Limit   L–Lower Limit

Shaft	Grade	Limit	Diameters Over: To (Inches)												
			0. – 0.12	0.12– 0.24	0.24– 0.40	0.40–0.56 / 0.56–0.71	0.71–0.95 / 0.95–1.19	1.19– 1.58 / 1.58– 1.97	1.97– 2.56 / 2.56– 3.15	3.15– 3.94 / 3.94– 4.73	4.73– 5.52 / 5.52– 6.3 / 6.3– 7.09	7.09– 7.88 / 7.88– 8.86 / 8.86– 9.85	9.85– 11.03 / 11.03–12.41	12.41–13.98 / 13.98–15.75	15.75–17.72 / 17.72–19.49
c	8,9,11	U–	2.5	2.8	3.0	3.5	4.5	5.0	6.0	7.0	8.0	10.0	12.0	14.0	16.0
	8	L–	3.1	3.5	3.9	4.5	5.7	6.6	7.8	9.2	10.5	12.8	15.0	17.5	20.0
	9	L–	3.5	4.0	4.4	5.1	6.5	7.5	9.0	10.5	12.0	14.5	17.0	20.0	22.0
	11	L–	5.0	5.8	6.5	7.5	9.5	11.0	13.0	16.0	18.0	22.0	24.0	28.0	32.0
d	8-11	U–	1.0	1.2	1.6	2.0	2.5	3.0	4.0	5.0	6.0	7.0	7.0	8.0	9.0
	8	L–	1.6	1.9	2.5	3.0	3.7	4.6	5.8	7.2	8.5	9.8	10.0	11.5	13.0
	9	L–	2.0	2.4	3.0	3.6	4.5	5.5	7.0	8.5	10.0	11.5	12.0	14.0	15.0
	10	L–	2.6	3.0	3.8	4.8	6.0	7.0	8.5	10.0	12.0	14.0	15.0	17.0	19.0
	11	L–	3.5	4.2	5.1	6.0	7.5	9.0	11.0	14.0	16.0	19.0	19.0	22.0	25.0
e	7-9	U–	0.6	0.8	1.0	1.2	1.6	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.0
	7	L–	1.0	1.3	1.6	1.9	2.4	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.5
	8	L–	1.2	1.5	1.9	2.2	2.8	3.6	4.3	5.2	6.0	6.8	7.5	8.5	9.0
	9	L–	1.6	2.0	2.4	2.8	3.6	4.5	5.5	6.5	7.5	8.5	9.5	11.0	11.0
f	6-8	U–	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	2.0	2.2	2.5	2.8
	6	L–	0.55	0.7	0.9	1.0	1.3	1.6	1.9	2.3	2.6	3.2	3.4	3.9	4.4
	7	L–	0.7	0.9	1.1	1.3	1.6	2.0	2.4	2.8	3.2	3.8	4.2	4.7	5.3
	8	L–	0.9	1.1	1.4	1.6	2.0	2.6	3.0	3.6	4.1	4.8	5.2	6.0	6.8
g	4-6	U–	0.1	0.15	0.2	0.25	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.8
	4	L–	0.25	0.3	0.35	0.45	0.55	0.7	0.7	0.9	1.1	1.2	1.3	1.4	1.6
	5	L–	0.3	0.35	0.45	0.55	0.7	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.8
	6	L–	0.35	0.45	0.6	0.65	0.8	1.0	1.1	1.4	1.6	1.8	1.9	2.1	2.4
h	5-13	U–	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5	L–	0.2	0.2	0.25	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0
	6	L–	0.25	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.2	1.4	1.6
	7	L–	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.5
	8	L–	0.6	0.7	0.9	1.0	1.2	1.6	1.8	2.2	2.5	2.8	3.0	3.5	4.0
	9	L–	1.0	1.2	1.4	1.6	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	6.0
	10	L–	1.6	1.8	2.2	2.8	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0
	11	L–	2.5	3.0	3.5	4.0	5.0	6.0	7.0	9.0	10.0	12.0	12.0	14.0	16.0
	12	L–	4.0	5.0	6.0	7.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	25.0
	13	L–	6.0	7.0	9.0	10.0	12.0	16.0	18.0	22.0	25.0	28.0	30.0	35.0	40.0
j	5	U+	0.1	0.1	0.15	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
	6	U+	0.15	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.7	0.9
	5,6	L–	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.7
	7	U+	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.2	1.3
		L–	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.2
	8	U+	0.3	0.4	0.5	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.5	1.8	2.0
		L–	0.3	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	2.0
	9	U+	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.8	2.0	2.3	2.5	3.0	3.0
		L–	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.7	2.0	2.2	2.5	3.0	3.0
	10	U+	0.8	0.9	1.1	1.4	1.8	2.0	2.3	2.5	3.0	3.5	4.0	4.5	5.0
		L–	0.8	0.9	1.1	1.4	1.7	2.0	2.2	2.5	3.0	3.5	4.0	4.5	5.0
	11	U+	1.3	1.5	1.8	2.0	2.5	3.0	3.5	4.5	5.0	6.0	6.0	7.0	8.0
		L–	1.2	1.5	1.7	2.0	2.5	3.0	3.5	4.5	5.0	6.0	6.0	7.0	8.0

Continued on page 19

APPENDIX I

LIMITS FOR SHAFTS c to x (continued from page 18)

Tolerance Unit 0.001 in.

U–Upper Limit L–Lower Limit

Shaft	Grade	Limit	Diameters Over: To (Inches)																								
			0 – 0.12	0.12– 0.24	0.24 – 0.40	0.40– 0.56	0.56–0.71	0.71– 0.95	0.95– 1.19	1.19– 1.58	1.58– 1.97	1.97– 2.56	2.56– 3.15	3.15– 3.94	3.94– 4.73	4.73– 5.52	5.52– 6.3	6.3 – 7.09	7.09–7.88	7.88 –8.86	8.86–9.85	9.85–11.03	11.03–12.41	12.41–13.98	13.98–15.75	15.75–17.72	17.72–19.69
k	5	U+	...	...	0.35	0.4		0.5		0.5		0.6		0.7		0.8			1.0			1.1		1.2		1.2	
	6	U+	...	...	0.5	0.5		0.6		0.7		0.8		1.0		1.1			1.4			1.4		1.6		1.8	
	7	U+	...	...	0.7	0.8		0.9		1.1		1.3		1.5		1.7			2.0			2.2		2.4		2.7	
	5-7	L+	0.0	0.1	0.1	0.1		0.1		0.1		0.1		0.1		0.1			0.2			0.2		0.2		0.2	
	8	U+	0.6	0.7	0.9	1.0		1.2		1.6		1.8		2.2		2.5			2.8			3.0		3.5		4.0	
	9	U+	1.0	1.2	1.4	1.6		2.0		2.5		3.0		3.5		4.0			4.5			5.0		6.0		6.0	
	10	U+	1.6	1.8	2.2	2.8		3.5		4.0		4.5		5.0		6.0			7.0			8.0		9.0		10.0	
	11	U+	2.5	3.0	3.5	4.0		5.0		6.0		7.0		9.0		10.0			12.0			12.0		14.0		16.0	
	8-11	L+	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0			0.0			0.0		0.0		0.0	
m	5	U+	0.35	0.4	0.45	0.6		0.7		0.8		1.0		1.1		1.3			1.4			1.7		1.8		1.9	
	6	U+	0.4	0.5	0.6	0.7		0.8		1.0		1.2		1.4		1.6			1.8			2.0		2.2		2.5	
	7	U+	0.55	0.7	0.8	1.0		1.1		1.4		1.7		1.9		2.2			2.4			2.8		3.0		3.4	
	5-7	L+	0.15	0.2	0.25	0.3		0.3		0.4		0.5		0.5		0.6			0.6			0.8		0.8		0.9	
n	5	U+	0.45	0.5	0.65	0.8		1.0		1.1		1.3		1.6		1.9			2.2			2.3		2.6		2.8	
	6	U+	0.5	0.6	0.8	0.9		1.1		1.3		1.5		1.9		2.2			2.6			2.6		3.0		3.4	
	7	U+	0.65	0.8	1.0	1.2		1.4		1.7		2.0		2.4		2.8			3.2			3.4		3.8		4.3	
	5-7	L+	0.25	0.3	0.4	0.5		0.6		0.7		0.8		1.0		1.2			1.4			1.4		1.6		1.8	
p	5	U+	0.6	0.7	0.85	1.0		1.2		1.4		1.9		2.2		2.5			2.8			3.1		3.5		3.8	
	6	U+	0.65	0.8	1.0	1.1		1.3		1.6		2.1		2.5		2.8			3.2			3.4		3.9		4.4	
	7	U+	0.8	1.0	1.2	1.4		1.6		2.0		2.6		3.0		3.4			3.8			4.2		4.7		5.3	
	5-7	L+	0.4	0.5	0.6	0.7		0.8		1.0		1.4		1.6		1.8			2.0			2.2		2.5		2.8	
r	5	U+	0.7	0.8	1.05	1.3		1.6		1.8		2.1		2.6		3.2			3.8			4.4		5.5		6.0	
	6	U+	0.75	0.9	1.2	1.4		1.7		2.0		2.3		2.9		3.5			4.2			4.7		5.9		6.6	
	7	U+	0.9	1.1	1.4	1.7		2.0		2.4		2.8		3.4		4.1			4.8			5.5		6.7		7.5	
	5-7	L+	0.5	0.6	0.8	1.0		1.2		1.4		1.6		2.0		2.5			3.0			3.5		4.5		5.0	
s	5	U+	0.8	0.9	1.25	1.5		1.8		2.2		2.5	2.7	3.4	3.6	4.2	4.7	5.2	5.8	5.8	6.8	6.9	7.9	8.0	9.0	10.0	11.0
	6	U+	0.85	1.0	1.4	1.6		1.9		2.4		2.7	2.9	3.7	3.9	4.5	5.0	5.5	6.2	6.2	7.2	7.2	8.2	8.4	9.4	10.6	11.6
	7	U+	1.0	1.2	1.6	1.9		2.2		2.8		3.2	3.4	4.2	4.4	5.1	5.6	6.1	6.8	6.8	7.8	8.0	9.0	9.2	10.2	11.5	12.5
	5-7	L+	0.6	0.7	1.0	1.2		1.4		1.8		2.0	2.2	2.8	3.0	3.5	4.0	4.5	5.0	5.0	6.0	6.0	7.0	7.0	8.0	9.0	10.0
t	5	U+	...	...	...	...		...	2.0	2.4	2.6	3.0	3.5	4.1	4.6	5.7	5.7	6.7	7.8	7.8	8.8	9.9	9.9	11.0	13.0	13.0	15.0
	6	U+	...	...	...	...		...	2.1	2.6	2.8	3.2	3.7	4.4	4.9	6.0	6.0	7.0	8.2	8.2	9.2	10.2	10.2	11.4	13.4	13.6	15.6
	7	U+	...	...	...	...		...	2.4	3.0	3.2	3.7	4.2	4.9	5.4	6.6	6.6	7.6	8.8	8.8	9.8	11.0	11.0	12.2	14.2	14.5	16.5
	5-7	L+	...	...	...	...		...	1.6	2.0	2.2	2.5	3.0	3.5	4.0	5.0	5.0	6.0	7.0	7.0	8.0	9.0	9.0	10.0	12.0	12.0	14.0
u	5	U+	0.9	1.1	1.45	1.7		2.0	2.2	2.9	3.2	4.0	4.5	5.6	6.6	7.7	7.7	8.7	9.8	10.8	12.8	12.9	14.9	17.0	19.0	21.0	23.0
	6	U+	0.95	1.2	1.6	1.8		2.1	2.3	3.1	3.4	4.2	4.7	5.9	6.9	8.0	8.0	9.0	10.2	11.2	13.2	13.2	15.2	17.4	19.4	21.6	23.6
	7	U+	1.1	1.4	1.8	2.1		2.4	2.6	3.5	3.8	4.7	5.2	6.4	7.4	8.6	8.6	9.6	10.8	11.8	13.8	14.0	16.0	18.2	20.2	22.5	24.5
	5-7	L+	0.7	0.9	1.2	1.4		1.6	1.8	2.5	2.8	3.5	4.0	5.0	6.0	7.0	7.0	8.0	9.0	10.0	12.0	12.0	14.0	16.0	18.0	20.0	22.0
v	5	U+	...	...	...	...	1.9	2.2	2.6	3.2	3.4	4.5	5.5	6.6	7.6	8.7	9.7	10.7	12.8	12.8	14.8	16.9	16.9	19.0	21.0	23.0	26.0
	6	U+	...	...	...	...	2.0	2.3	2.7	3.4	3.6	4.7	5.7	6.9	7.9	9.0	10.0	11.0	13.2	13.2	15.2	17.2	17.2	19.4	21.4	23.6	26.6
	7	U+	...	...	...	...	2.3	2.6	3.0	3.8	4.0	5.2	6.2	7.4	8.4	9.6	10.6	11.6	13.8	13.8	15.8	18.0	18.0	20.2	22.2	24.5	27.5
	5-7	L+	...	...	...	...	1.6	1.8	2.2	2.8	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	12.0	14.0	16.0	16.0	18.0	20.0	22.0	25.0
x	5	U+	1.1	1.4	1.65	1.9	2.1	2.6	2.9	3.4	4.4	5.5	6.5	7.6	8.6	10.7	12.7	12.7	14.8	16.8	16.8	18.9	20.9	23.0	26.0	29.0	31.0
	6	U+	1.15	1.5	1.8	2.0	2.2	2.7	3.0	3.6	4.6	5.7	6.7	7.9	8.9	11.0	13.0	13.0	15.2	17.2	17.2	19.2	21.2	23.4	26.4	29.6	31.6
	7	U+	1.3	1.7	2.0	2.3	2.5	3.0	3:3	4.0	5.0	6.2	7.2	8.4	9.4	11.6	13.6	13.6	15.8	17.8	17.8	20.0	22.0	24.2	27.2	30.5	32.5
	5-7	L+	0.9	1.2	1.4	1.6	1.8	2.2	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0	12.0	14.0	16.0	16.0	18.0	20.0	22.0	25.0	28.0	30.0

End of Table

APPENDIX II

LENGTH DIFFERENCES PER INCH FROM STANDARD FOR TEMPERATURES 38 TO 98 F

Temperature Deg F	Coefficient of thermal expansion of material per degree F, × 10^6									
	1	2	3	4	5	10	15	20	25	30
	Total change in length from standard, microinches per inch of length*									
38	−30	−60	−90	−120	−150	−300	−450	−600	−750	−900
39	−29	−58	−87	−116	−145	−290	−435	−580	−725	−870
40	−28	−56	−84	−112	−140	−280	−420	−560	−700	−840
41	−27	−54	−81	−108	−135	−270	−405	−540	−675	−810
42	−26	−52	−78	−104	−130	−260	−390	−520	−650	−780
43	−25	−50	−75	−100	−125	−250	−375	−500	−625	−750
44	−24	−48	−72	− 96	−120	−240	−360	−480	−600	−720
45	−23	−46	−69	− 92	−115	−230	−345	−460	−575	−690
46	−22	−44	−66	− 88	−110	−220	−330	−440	−550	−660
47	−21	−42	−63	− 84	−105	−210	−315	−420	−525	−630
48	−20	−40	−60	− 80	−100	−200	−300	−400	−500	−600
49	−19	−38	−57	− 76	− 95	−190	−285	−380	−475	−570
50	−18	−36	−54	− 72	− 90	−180	−270	−360	−450	−540
51	−17	−34	−51	− 68	− 85	−170	−255	−340	−425	−510
52	−16	−32	−48	− 64	− 80	−160	−240	−320	−400	−480
53	−15	−30	−45	− 60	− 75	−150	−225	−300	−375	−450
54	−14	−28	−42	− 56	− 70	−140	−210	−280	−350	−420
55	−13	−26	−39	− 52	− 65	−130	−195	−260	−325	−390
56	−12	−24	−36	− 48	− 60	−120	−180	−240	−300	−360
57	−11	−22	−33	− 44	− 55	−110	−165	−220	−275	−330
58	−10	−20	−30	− 40	− 50	−100	−150	−200	−250	−300
59	− 9	−18	−27	− 36	− 45	− 90	−135	−180	−225	−270
60	− 8	−16	−24	− 32	− 40	− 80	−120	−160	−200	−240
61	− 7	−14	−21	− 28	− 35	− 70	−105	−140	−175	−210
62	− 6	−12	−18	− 24	− 30	− 60	− 90	−120	−150	−180
63	− 5	−10	−15	− 20	− 25	− 50	− 75	−100	−125	−150
64	− 4	− 8	−12	− 16	− 20	− 40	− 60	− 80	−100	−120
65	− 3	− 6	− 9	− 12	− 15	− 30	− 45	− 60	− 70	− 90
66	− 2	− 4	− 6	− 8	− 10	− 20	− 30	− 40	− 50	− 60
67	− 1	− 2	− 3	− 4	− 5	− 10	− 15	− 20	− 25	− 30
68	0	0	0	0	0	0	0	0	0	0
69	1	2	3	4	5	10	15	20	25	30
70	2	4	6	8	10	20	30	40	50	60
71	3	6	9	12	15	30	45	60	75	90
72	4	8	12	16	20	40	60	80	100	120
73	5	10	15	20	25	50	75	100	125	150
74	6	12	18	24	30	60	90	120	150	180
75	7	14	21	28	35	70	105	140	175	210
76	8	16	24	32	40	80	120	160	200	240
77	9	18	27	36	45	90	135	180	225	270
78	10	20	30	40	50	100	150	200	250	300
79	11	22	33	44	55	110	165	220	275	330
80	12	24	36	48	60	120	180	240	300	360
81	13	26	39	52	65	130	195	260	325	390
82	14	28	42	56	70	140	210	280	350	420
83	15	30	45	60	75	150	225	300	375	450
84	16	32	48	64	80	160	240	320	400	480
85	17	34	51	68	85	170	255	340	425	510
86	18	36	54	72	90	180	270	360	450	540
87	19	38	57	76	95	190	285	380	475	570
88	20	40	60	80	100	200	300	400	500	600
89	21	42	63	84	105	210	315	420	525	630
90	22	44	66	88	110	220	330	440	550	660
91	23	46	69	92	115	230	345	460	575	690
92	24	48	72	96	120	240	360	480	600	720
93	25	50	75	100	125	250	375	500	625	750
94	26	52	78	104	130	260	390	520	650	780
95	27	54	81	108	135	270	405	540	675	810
96	28	56	84	112	140	280	420	560	700	840
97	29	58	87	116	145	290	435	580	725	870
98	30	60	90	120	150	300	450	600	750	900

For intermediate coefficients add appropriate listed values. For example, a length change for a coefficient of 7 is the sum of values in the 5 and 2 columns. Fractional interpolation may be similarly calculated.

*Or hundredths of micron (microns/100) per centimeter.

APPENDIX II

LENGTH DIFFERENCES PER CENTIMETER FROM STANDARD TEMPERATURE 0 TO 40 CELSIUS

Temperature Deg C	Coefficient of thermal expansion of material per degree C, × 10 ^{6}									
	1	2	3	4	5	10	15	20	25	30
	Total change in length from standard, hundredths of microns (microns/100) per centimeter of length*									
0	-20	-40	-60	-80	-100	-200	-300	-400	-500	-600
1	-19	-38	-57	-76	-95	-190	-285	-380	-475	-570
2	-18	-36	-54	-72	-90	-180	-270	-360	-450	-540
3	-17	-34	-51	-68	-85	-170	-255	-340	-425	-510
4	-16	-32	-48	-64	-80	-160	-240	-320	-400	-480
5	-15	-30	-45	-60	-75	-150	-225	-300	-375	-450
6	-14	-28	-42	-56	-70	-140	-210	-280	-350	-420
7	-13	-26	-39	-52	-65	-130	-195	-260	-325	-390
8	-12	-24	-36	-48	-60	-120	-180	-240	-300	-360
9	-11	-22	-33	-44	-55	-110	-165	-220	-275	-330
10	-10	-20	-30	-40	-50	-100	-150	-200	-250	-300
11	-9	-18	-27	-36	-45	-90	-135	-180	-225	-270
12	-8	-16	-24	-32	-40	-80	-120	-160	-200	-240
13	-7	-14	-21	-28	-35	-70	-105	-140	-175	-210
14	-6	-12	-18	-24	-30	-60	-90	-120	-150	-180
15	-5	-10	-15	-20	-25	-50	-75	-100	-125	-150
16	-4	-8	-12	-16	-20	-40	-60	-80	-100	-120
17	-3	-6	-9	-12	-15	-30	-45	-60	-75	-90
18	-2	-4	-6	-8	-10	-20	-30	-40	-50	-60
19	-1	-2	-3	-4	-5	-10	-15	-20	-25	-30
20	0	0	0	0	0	0	0	0	0	0
21	1	2	3	4	5	10	15	20	25	30
22	2	4	6	8	10	20	30	40	50	60
23	3	6	9	12	15	30	45	60	75	90
24	4	8	12	16	20	40	60	80	100	120
25	5	10	15	20	25	50	75	100	125	150
26	6	12	18	24	30	60	90	120	150	180
27	7	14	21	28	35	70	105	140	175	210
28	8	16	24	32	40	80	120	160	200	240
29	9	18	27	36	45	90	135	180	225	270
30	10	20	30	40	50	100	150	200	250	300
31	11	22	33	44	55	110	165	220	275	330
32	12	24	36	48	60	120	180	240	300	360
33	13	26	39	52	65	130	195	260	325	390
34	14	28	42	56	70	140	210	280	350	420
35	15	30	45	60	75	150	225	300	375	450
36	16	32	48	64	80	160	240	320	400	480
37	17	34	51	68	85	170	255	340	425	510
38	18	36	54	72	90	180	270	360	450	540
39	19	38	57	76	95	190	285	380	475	570
40	20	40	60	80	100	200	300	400	500	600

For intermediate coefficients add appropriate listed values. For example, a length change for a coefficient of 11 is the sum of the values in the 10 and 1 columns. Fractional interpolations may be similarly calculated.

*Or microinches per inch.
1C = 1.8 F