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ANSI/AFBMA
Std. 21.1-1988

AMERICAN NATIONAL STANDARD

AFBMA STANDARD

**THRUST NEEDLE ROLLER AND
CAGE ASSEMBLIES AND THRUST WASHERS
METRIC DESIGN**

Sponsor
**The Anti-Friction Bearing
Manufacturers Association**

Approved November 17, 1988
American National Standards Institute, Inc.

American National Standard

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FOREWORD

(This foreword is not a part of ANSI/AFBMA Standard 21.1-1988, Thrust Needle Roller and Cage Assemblies and Thrust Washers, Metric Design.)

This American National Standard consolidates the boundary dimensions, tolerance limits and fitting and mounting practices for metric design thrust needle rollers and cage assemblies and thrust washers which have been in general use in the USA in recent years. Many of the boundary dimensions are formerly found in ANSI/AFBMA Standard 21-1977.

The dimensions, tolerances and clearances stated in this standard are based on metric units and are found in Part I of the various tables. A soft conversion to U.S. customary (inch-pound) units is provided in Part II of the various tables for the convenience of the user.

Suggestions for the improvement of this standard gained through experience with its use will be welcomed. These should be sent to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

The officers of Sectional Committee B3 of the American National Standard Institute and the organizations represented at the time this standard was submitted are as follows:

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AFBMA Standards
for
Ball and Roller Bearings
and Balls

- 1 — Terminology
- 4 — Tolerance Definitions and Gaging Practices
- 7 — Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (Except Tapered Roller Bearings) Conforming to Basic Boundary Plans
- 8.1 — Ball and Roller Bearing Mounting Accessories, Metric Design
- 8.2 — Ball and Roller Bearing Mounting Accessories, Inch Design
- 9 — Load Ratings and Fatigue Life for Ball Bearings
- 10 — Metal Balls
- 11 — Load Ratings and Fatigue Life for Ball Bearings
- 12.1 — Instrument Ball Bearings, Metric Design
- 12.2 — Instrument Ball Bearings, Inch Design
- 13 — Rolling Bearing Vibration and Noise
- 14 — Housing for Bearings With Spherical Outside Surfaces
- 15 — Ball Bearings With Spherical Outside Surfaces and Extended Inner Ring Width (Includes Eccentric Locking Collars)
- 16.1 — Airframe Ball, Roller and Needle Roller Bearings, Metric Design
- 16.2 — Airframe Ball, Roller and Needle Roller Bearings, Inch Design
- 17 — Needle Rollers, Metric Design
- 18.1 — Needle Roller Bearings - Radial, Metric Design
- 18.2 — Needle Roller Bearings - Radial, Inch Design
- 19 — Tapered Roller Bearings, Radial, Metric Design
- 20 — Radial Bearings of Ball Cylindrical Roller and Spherical Roller Types, Metric Design
- 21.1 — Thrust Needle Roller and Cage Assemblies and Thrust Washers, Metric Design
- 21.2 — Thrust Needle Roller and Cage Assemblies and Thrust Washers, Inch Design
- 22.2 — Spherical Plain Bearings, Joint Type, Inch Design
- 23.2 — Thrust Bearings of Tapered Roller Type, Inch Design
- 24.1 — Thrust Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design
- 24.2 — Thrust Bearings of Ball and Cylindrical Roller Types, Inch Design

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Thrust Needle Roller and Cage Assemblies and Thrust Washers Metric Design

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|---------|---------------------------------|---|
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Thrust Needle Roller and Cage Assemblies and Thrust Washers Metric Design

1. SCOPE

This standard for metric thrust needle roller and cage assemblies and thrust washers includes:

- Identification Code
- Symbols and Nomenclature
- Boundary Dimensions
- Tolerances
- Mounting Practice

All thrust needle roller and cage assemblies and thrust washers listed in this standard are not necessarily available. For availability consult bearing manufacturers. Other applicable standards should be consulted for tolerance definitions, gaging practices and methods of evaluating load ratings.

This standard only covers external dimensions. Functional interchangeability between makers of standard thrust needle roller and cage assemblies and thrust washers of the same size may depend on features which are not standardized. Hence the substitution of one make of a standard bearing for another should only be made after careful comparison of their characteristics and consideration of the requirements of the particular application.

2. IDENTIFICATION CODE

2.1 General—This code identifies and as far as possible describes each thrust needle roller and cage assembly or thrust washer on the basis of complete interchangeability. This code establishes a universal language for describing and identifying assemblies and washers in order to facilitate communications between the user and the manufacturer. The code is also intended to simplify the handling by user personnel of identical assemblies or washers made by different manufacturers whose identification numbers may be different.

This code applies only to those metric thrust needle roller and cage assemblies or thrust washers whose boundary dimensions and tolerances conform to this standard.

2.2 Structure of the Code—As shown in the following table, Schematic Arrangement of a Complete Code Number, the code consists of one or two sections.

Section 1, called the Basic Number, includes a diameter symbol made up of a group of numerals, followed by a type symbol made up of a group of letters and finally by a dimension series symbol made up of a group of numerals. This Basic Number must always be used.

Section 2, pertains only to thrust needle roller and cage assemblies, and when used delineates cage materials.

In the Schematic Arrangement Table below, "O" represents any code numeral and "A" represents any code letter.

**SCHEMATIC ARRANGEMENT OF A
COMPLETE CODE NUMBER**

| SECTION 1, BASIC NUMBER | | | SECTION 2* |
|-------------------------|------|------------------|---------------|
| Diameter | Type | Dimension Series | Cage Material |
| 000 | AAA | 00 | A |

*Section 2, when used, pertains only to thrust needle roller and cage assemblies

2.2.1 Section 1, Basic Number

SCHEMATIC ARRANGEMENT OF SECTION 1

| SECTION 1, BASIC NUMBER | | |
|-------------------------|------|------------------|
| Diameter | Type | Dimension Series |
| 000 | AAA | 00 |

The bore diameter is indicated by two or three numerals comprising the diameter symbol as shown in Boundary Dimension Tables 1 and 2.

The type is indicated by two or three letters comprising the type symbol as shown in 2.2.2.

The dimension series is indicated by two numerals which describes the outside diameter and roller diameter (or washer thickness) as shown in Boundary Dimension Tables 1 and 2.

2.2.2 Assembly and Washer Type Symbols

A. THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES

| SYMBOL | DESCRIPTION |
|--------|---|
| NT | Thrust Needle Roller and Cage Assembly, Metric Design |

B. THRUST WASHERS

| SYMBOL | DESCRIPTION |
|--------|------------------------------|
| NTW | Thrust Washer, Metric Design |

2.2.3 Section 2, Cage Material

SCHEMATIC ARRANGEMENT OF SECTION 2

| SECTION 2 CAGE MATERIAL |
|----------------------------|
| A |

If cage material is steel, Section 2 is omitted. If not steel, the cage material for the thrust needle roller and cage assembly is indicated by a letter from the following table:

CAGE MATERIAL SYMBOLS

| SYMBOL | DESCRIPTION |
|--------|--------------|
| N | Non-Metallic |

2.2.4 Coding Examples

The following examples illustrate the application and meaning of typical identification codes for thrust needle roller and cage assemblies and for thrust washers.

35NT01. From 2.2.2, NT is found to be the type symbol for a thrust needle roller and cage assembly and Table 1 lists the Boundary Dimensions for type NT. Referring to Table 1, the diameter symbol 35 indicates a bore diameter of 35mm (1.3780 inch) and the Dimension series symbol 01 indicates an outside diameter of 52mm (2.0472 inch) and a roller diameter of 2mm (0.07874 inch). From 2.2.3, the absence of a letter indicates that the cage material is steel.

35NTW14. From 2.2.2, NTW is found to be the type symbol for a thrust washer and Table 2 lists the Boundary Dimensions for type NTW.

Referring to Table 2, the diameter symbol 35 indicates a bore of 35mm (1.3780 inch) and the dimension series symbol 14 indicates an outside diameter of 52mm (2.0472 inch) and a thickness of 1 mm (0.0394 inch).

3. Symbols and Nomenclature

The following symbols are used to identify boundary dimensions, size and size variations.

| | |
|------------------------|---|
| d | = Bore diameter of a shaft thrust washer |
| d_s | = Single diameter of a shaft thrust washer bore |
| $\Delta d_{s(\min)}$ | = Single bore diameter deviation of a shaft washer from d as measured by the use of plug gages |
| d_1 | = Outside diameter of a shaft thrust washer |
| d_{1mp} | = Single plane mean outside diameter of a shaft thrust washer |
| Δd_{1mp} | = Single plane mean outside diameter deviation of a shaft thrust washer from d_1 |
| B | = Thickness of a shaft thrust washer |
| B_s | = Single thickness of a shaft thrust washer |
| ΔB_s | = Single shaft thrust washer thickness deviation from B |
| D_{c1} | = Bore diameter of a thrust needle roller and cage assembly |
| D_{c1s} | = Single diameter of a thrust needle roller and cage assembly bore |
| $\Delta D_{c1s(\min)}$ | = Single bore diameter deviation of a thrust needle roller and cage assembly from D_{c1} as measured by the use of plug gages |

| | |
|------------------|---|
| D_c | = Outside diameter of a thrust needle roller and cage assembly |
| D_{cmp} | = Single plane mean outside diameter of a thrust needle roller and cage assembly |
| ΔD_{cmp} | = Single plane mean outside diameter deviation of a thrust needle roller and cage assembly from D_c |
| D_w | = Needle roller diameter |
| D_{ws} | = Single diameter of a needle roller |
| ΔD_{ws} | = Single needle roller diameter deviation from D_w |

4. BOUNDARY DIMENSIONS

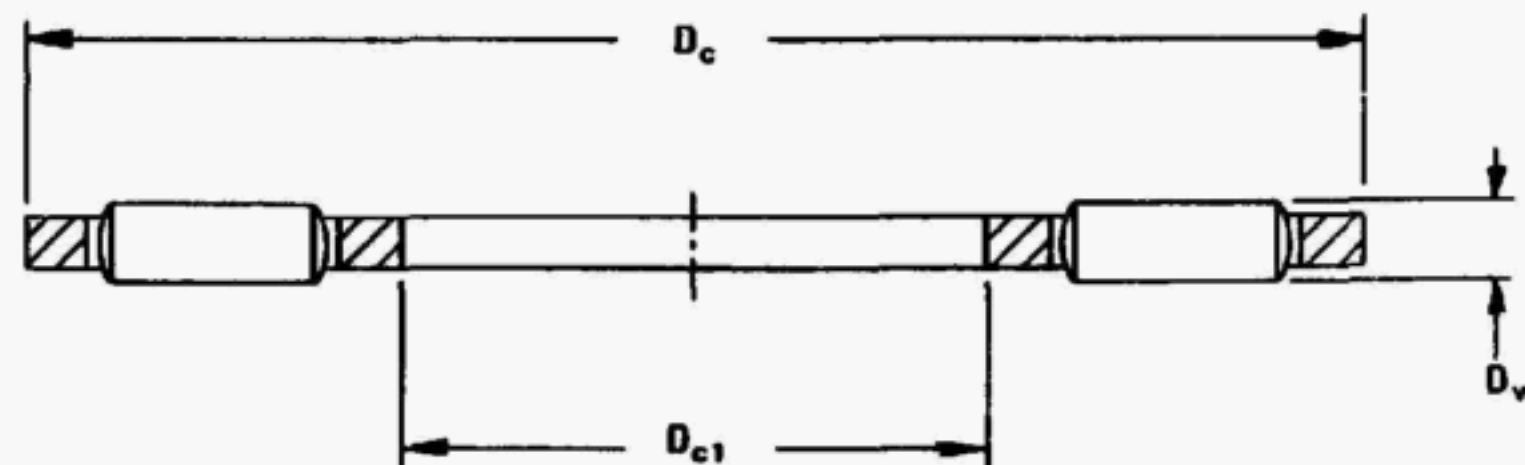
Purpose of Plans. The Boundary Plans shown in the Boundary Dimension Tables 1 and 2 are designed to reduce, as much as possible, the number of thrust needle roller and cage assemblies and thrust washers, to promote economic production and yet to provide a sufficient number of sizes and proportions to satisfy present and future needs of bearing users.

5. ASSEMBLY AND WASHER TOLERANCES

Tolerance Definitions and Gaging Practice. Definitions of terms used in the tolerance tables, as well as most gaging practices, are covered in ANSI/AFBMA Standard 4.

The metric diameter tolerances listed are in accordance with ANSI B4.2-1978—Preferred Metric Limits and Fits.

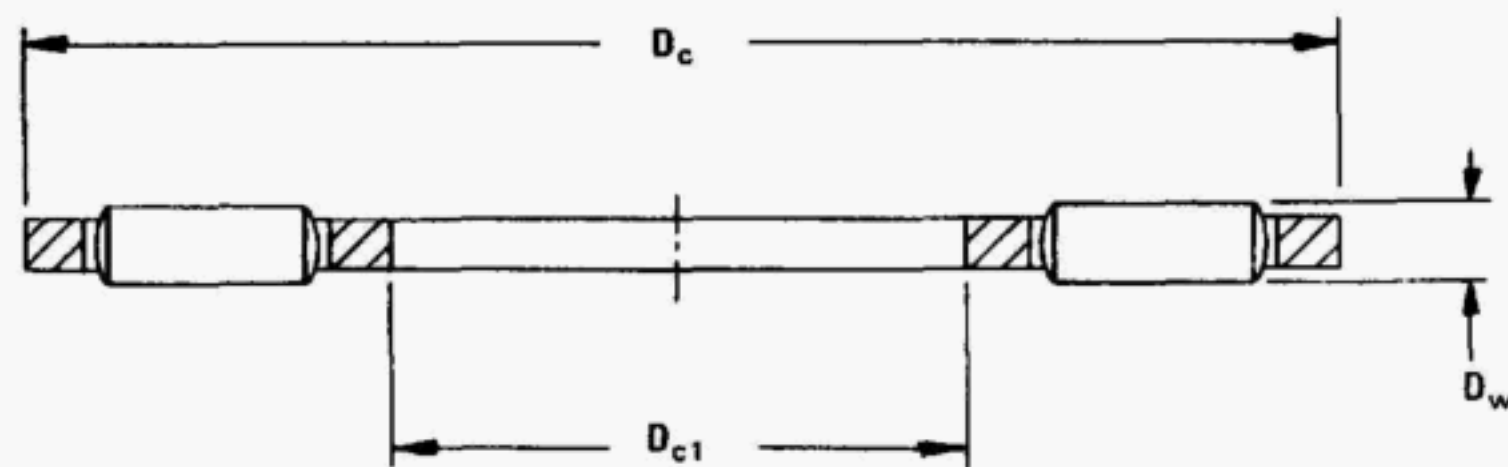
TABLE 1
BOUNDARY DIMENSIONS
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES - TYPE NT
METRIC DESIGN

**PART I**

Dimensions in millimetres

| IDENTIFICATION CODE | D_{c1} | D_c | D_w |
|------------------------|----------|-------|-------|
| 06NT01 | 6 | 19 | 2 |
| 08NT01 | 8 | 21 | 2 |
| 10NT01 | 10 | 24 | 2 |
| 12NT01 | 12 | 26 | 2 |
| 15NT01 | 15 | 28 | 2 |
| 17NT01 | 17 | 30 | 2 |
| 20NT01 | 20 | 35 | 2 |
| 25NT01 | 25 | 42 | 2 |
| 30NT01 | 30 | 47 | 2 |
| 35NT01 | 35 | 52 | 2 |
| 40NT01 | 40 | 60 | 3 |
| 45NT01 | 45 | 65 | 3 |
| 50NT01 | 50 | 70 | 3 |
| 55NT01 | 55 | 78 | 3 |
| 60NT01 | 60 | 85 | 3 |
| 65NT01 | 65 | 90 | 3 |
| 70NT01 | 70 | 95 | 4 |
| 75NT01 | 75 | 100 | 4 |
| 80NT01 | 80 | 105 | 4 |
| 85NT01 | 85 | 110 | 4 |
| 90NT01 | 90 | 120 | 4 |
| 100NT01 | 100 | 135 | 4 |
| 110NT01 | 110 | 145 | 4 |
| 120NT01 | 120 | 155 | 4 |
| 130NT01 | 130 | 170 | 5 |
| 140NT01 | 140 | 180 | 5 |
| 150NT01 | 150 | 190 | 5 |
| 160NT01 | 160 | 200 | 5 |

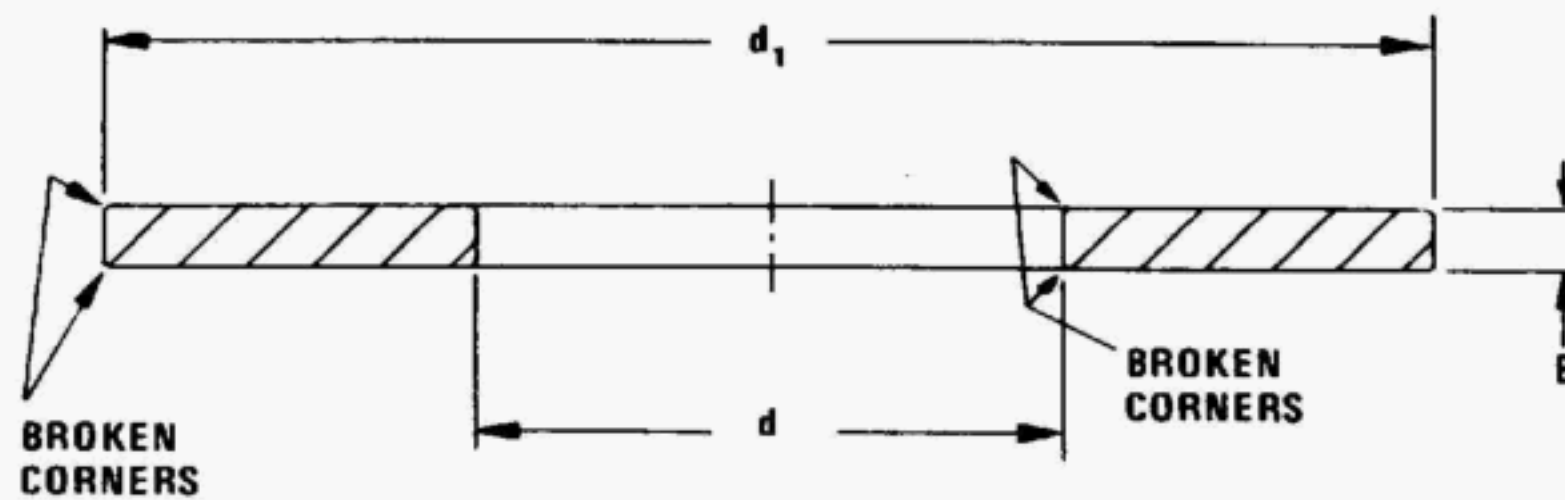
TABLE 1
BOUNDARY DIMENSIONS
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES - TYPE NT
METRIC DESIGN

**PART II**

Dimensions in inches

| IDENTIFICATION CODE | D_{c1} | D_c | D_w |
|------------------------|----------|-------|---------|
| 06NT01 | 0.2362 | 0.748 | 0.07874 |
| 08NT01 | 0.3150 | 0.827 | 0.07874 |
| 10NT01 | 0.3937 | 0.945 | 0.07874 |
| 12NT01 | 0.4724 | 1.024 | 0.07874 |
| 15NT01 | 0.5906 | 1.102 | 0.07874 |
| 17NT01 | 0.6693 | 1.181 | 0.07874 |
| 20NT01 | 0.7874 | 1.378 | 0.07874 |
| 25NT01 | 0.9843 | 1.654 | 0.07874 |
| 30NT01 | 1.1811 | 1.850 | 0.07874 |
| 35NT01 | 1.3780 | 2.047 | 0.07874 |
| 40NT01 | 1.5748 | 2.362 | 0.11811 |
| 45NT01 | 1.7717 | 2.559 | 0.11811 |
| 50NT01 | 1.9685 | 2.756 | 0.11811 |
| 55NT01 | 2.1654 | 3.071 | 0.11811 |
| 60NT01 | 2.3622 | 3.346 | 0.11811 |
| 65NT01 | 2.5591 | 3.543 | 0.11811 |
| 70NT01 | 2.7559 | 3.740 | 0.15748 |
| 75NT01 | 2.9528 | 3.937 | 0.15748 |
| 80NT01 | 3.1496 | 4.134 | 0.15748 |
| 85NT01 | 3.346 | 4.331 | 0.15748 |
| 90NT01 | 3.543 | 4.724 | 0.15748 |
| 100NT01 | 3.937 | 5.315 | 0.15748 |
| 110NT01 | 4.331 | 5.709 | 0.15748 |
| 120NT01 | 4.724 | 6.102 | 0.15748 |
| 130NT01 | 5.118 | 6.693 | 0.19685 |
| 140NT01 | 5.512 | 7.087 | 0.19685 |
| 150NT01 | 5.906 | 7.480 | 0.19685 |
| 160NT01 | 6.299 | 7.874 | 0.19685 |

TABLE 2
BOUNDARY DIMENSIONS
THRUST WASHERS - TYPE NTW
METRIC DESIGN

**PART I**

Dimensions in millimetres

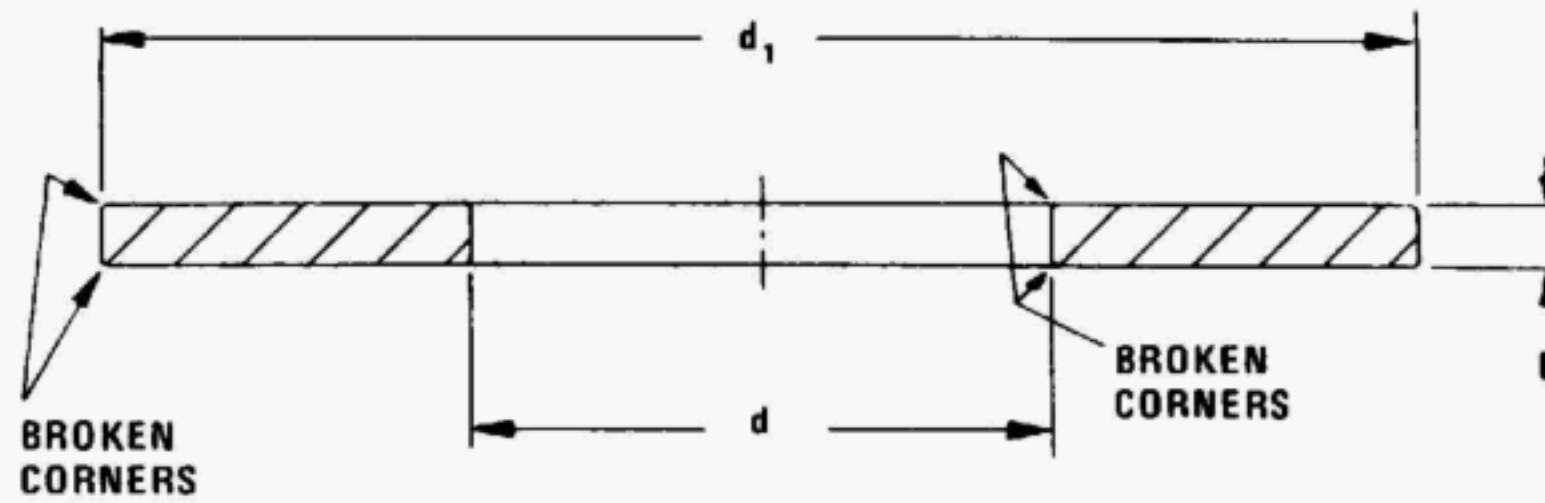
| IDENTIFICATION CODE | d | d ₁ | B |
|---------------------|----|----------------|-----|
| 06NTW12 | 6 | 19 | 0.8 |
| 06NTW14 | 6 | 19 | 1 |
| 08NTW12 | 8 | 21 | 0.8 |
| 08NTW14 | 8 | 21 | 1 |
| 10NTW12 | 10 | 24 | 0.8 |
| 10NTW14 | 10 | 24 | 1 |
| 12NTW12 | 12 | 26 | 0.8 |
| 12NTW14 | 12 | 26 | 1 |
| 15NTW12 | 15 | 28 | 0.8 |
| 15NTW14 | 15 | 28 | 1 |
| 17NTW12 | 17 | 30 | 0.8 |
| 17NTW14 | 17 | 30 | 1 |
| 20NTW12 | 20 | 35 | 0.8 |
| 20NTW14 | 20 | 35 | 1 |
| 25NTW12 | 25 | 42 | 0.8 |
| 25NTW14 | 25 | 42 | 1 |
| 30NTW12 | 30 | 47 | 0.8 |
| 30NTW14 | 30 | 47 | 1 |
| 35NTW12 | 35 | 52 | 0.8 |
| 35NTW14 | 35 | 52 | 1 |
| 40NTW12 | 40 | 60 | 0.8 |
| 40NTW14 | 40 | 60 | 1 |
| 45NTW12 | 45 | 65 | 0.8 |
| 45NTW14 | 45 | 65 | 1 |
| 50NTW12 | 50 | 70 | 0.8 |
| 50NTW14 | 50 | 70 | 1 |
| 55NTW12 | 55 | 78 | 0.8 |
| 55NTW14 | 55 | 78 | 1 |
| 60NTW12 | 60 | 85 | 0.8 |
| 60NTW14 | 60 | 85 | 1 |

PART I

Dimensions in millimetres

| IDENTIFICATION CODE | d | d ₁ | B |
|---------------------|-----|----------------|-----|
| 65NTW12 | 65 | 90 | 0.8 |
| 65NTW14 | 65 | 90 | 1 |
| 70NTW12 | 70 | 95 | 0.8 |
| 70NTW14 | 70 | 95 | 1 |
| 75NTW12 | 75 | 100 | 0.8 |
| 75NTW14 | 75 | 100 | 1 |
| 80NTW12 | 80 | 105 | 0.8 |
| 80NTW14 | 80 | 105 | 1 |
| 85NTW12 | 85 | 110 | 0.8 |
| 85NTW14 | 85 | 110 | 1 |
| 90NTW12 | 90 | 120 | 0.8 |
| 90NTW14 | 90 | 120 | 1 |
| 100NTW12 | 100 | 135 | 0.8 |
| 100NTW14 | 100 | 135 | 1 |
| 110NTW12 | 110 | 145 | 0.8 |
| 110NTW14 | 110 | 145 | 1 |
| 120NTW12 | 120 | 155 | 0.8 |
| 120NTW14 | 120 | 155 | 1 |
| 130NTW12 | 130 | 170 | 0.8 |
| 130NTW14 | 130 | 170 | 1 |
| 140NTW12 | 140 | 180 | 0.8 |
| 140NTW14 | 140 | 180 | 1 |
| 150NTW12 | 150 | 190 | 0.8 |
| 150NTW14 | 150 | 190 | 1 |
| 160NTW12 | 160 | 200 | 0.8 |
| 160NTW14 | 160 | 200 | 1 |

TABLE 2
BOUNDARY DIMENSIONS
THRUST WASHERS - TYPE NTW
METRIC DESIGN

**PART II**

Dimensions in inches

| IDENTIFICATION CODE | d | d ₁ | B |
|---------------------|--------|----------------|---------|
| 06NTW12 | 0.2362 | 0.748 | 0.0315 |
| 06NTW14 | 0.2362 | 0.748 | 0.03937 |
| 08NTW12 | 0.3150 | 0.827 | 0.0315 |
| 08NTW14 | 0.3150 | 0.827 | 0.03937 |
| 10NTW12 | 0.3937 | 0.945 | 0.0315 |
| 10NTW14 | 0.3937 | 0.945 | 0.03937 |
| 12NTW12 | 0.4724 | 1.024 | 0.0315 |
| 12NTW14 | 0.4724 | 1.024 | 0.03937 |
| 15NTW12 | 0.5806 | 1.102 | 0.0315 |
| 15NTW14 | 0.5806 | 1.102 | 0.03937 |
| 17NTW12 | 0.6683 | 1.181 | 0.0315 |
| 17NTW14 | 0.6683 | 1.181 | 0.03937 |
| 20NTW12 | 0.787 | 1.378 | 0.0315 |
| 20NTW14 | 0.787 | 1.378 | 0.03937 |
| 25NTW12 | 0.984 | 1.654 | 0.0315 |
| 25NTW14 | 0.984 | 1.654 | 0.03937 |
| 30NTW12 | 1.181 | 1.850 | 0.0315 |
| 30NTW14 | 1.181 | 1.850 | 0.03937 |
| 35NTW12 | 1.378 | 2.047 | 0.0315 |
| 35NTW14 | 1.378 | 2.047 | 0.03937 |
| 40NTW12 | 1.575 | 2.362 | 0.0315 |
| 40NTW14 | 1.575 | 2.362 | 0.03937 |
| 45NTW12 | 1.772 | 2.559 | 0.0315 |
| 45NTW14 | 1.772 | 2.559 | 0.03937 |
| 50NTW12 | 1.969 | 2.765 | 0.0315 |
| 50NTW14 | 1.969 | 2.765 | 0.03937 |
| 55NTW12 | 2.165 | 3.071 | 0.0315 |
| 55NTW14 | 2.165 | 3.071 | 0.03937 |
| 60NTW12 | 2.362 | 3.346 | 0.0315 |
| 60NTW14 | 2.362 | 3.346 | 0.03937 |

PART II

Dimensions in inches

| IDENTIFICATION CODE | d | d ₁ | B |
|---------------------|-------|----------------|---------|
| 65NTW12 | 2.559 | 3.543 | 0.0315 |
| 65NTW14 | 2.559 | 3.543 | 0.03937 |
| 70NTW12 | 2.756 | 3.740 | 0.0315 |
| 70NTW14 | 2.756 | 3.740 | 0.03937 |
| 75NTW12 | 2.953 | 3.937 | 0.0315 |
| 75NTW14 | 2.953 | 3.937 | 0.03937 |
| 80NTW12 | 3.150 | 4.134 | 0.0315 |
| 80NTW14 | 3.150 | 4.134 | 0.03937 |
| 85NTW12 | 3.346 | 4.331 | 0.0315 |
| 85NTW14 | 3.346 | 4.331 | 0.03937 |
| 90NTW12 | 3.543 | 4.724 | 0.0315 |
| 90NTW14 | 3.543 | 4.724 | 0.03937 |
| 100NTW12 | 3.937 | 5.315 | 0.0315 |
| 100NTW14 | 3.937 | 5.315 | 0.03937 |
| 110NTW12 | 4.331 | 5.709 | 0.0315 |
| 110NTW14 | 4.331 | 5.709 | 0.03937 |
| 120NTW12 | 4.724 | 6.102 | 0.0315 |
| 120NTW14 | 4.724 | 6.102 | 0.03937 |
| 130NTW12 | 5.118 | 6.693 | 0.0315 |
| 130NTW14 | 5.118 | 6.693 | 0.03937 |
| 140NTW12 | 5.512 | 7.087 | 0.0315 |
| 140NTW14 | 5.512 | 7.087 | 0.03937 |
| 150NTW12 | 5.906 | 7.480 | 0.0315 |
| 150NTW14 | 5.906 | 7.480 | 0.03937 |
| 160NTW12 | 6.299 | 7.874 | 0.0315 |
| 160NTW14 | 6.299 | 7.874 | 0.03937 |

TABLE 3
TOLERANCES
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES - TYPE NT
METRIC DESIGN

PART I

Dimensions in millimetres
 Deviations in micrometres

| D_c | | ΔD_{cmp} | |
|-------|------|------------------|------|
| OVER | INCL | HIGH | LOW |
| 18 | 30 | -110 | -320 |
| 30 | 40 | -120 | -370 |
| 40 | 50 | -130 | -380 |
| 50 | 65 | -140 | -440 |
| 65 | 80 | -150 | -450 |
| | | | |
| 80 | 100 | -170 | -520 |
| 100 | 120 | -180 | -530 |
| 120 | 140 | -200 | -600 |
| 140 | 160 | -210 | -610 |
| 160 | 180 | -230 | -630 |
| 180 | 200 | -240 | -700 |
| 200 | 225 | -260 | -720 |

| D_{c1} | | (1) $\Delta D_{c1s(min)}$ | | ΔD_{ws} |
|----------|------|---------------------------|-----|-----------------|
| OVER | INCL | HIGH | LOW | |
| 6 | 10 | +115 | +25 | NOTE (2) |
| 10 | 18 | +142 | +32 | NOTE (2) |
| 18 | 30 | +170 | +40 | NOTE (2) |
| 30 | 50 | +210 | +50 | NOTE (2) |
| 50 | 80 | +250 | +60 | NOTE (2) |
| | | | | NOTE (2) |
| 80 | 120 | +292 | +72 | |
| 120 | 180 | +335 | +85 | |

PART II

Dimensions in inches
 Deviations in 0.0001 inch

| D_c | | ΔD_{cmp} | |
|--------|--------|------------------|------|
| OVER | INCL | HIGH | LOW |
| 0.7087 | 1.1811 | -43 | -126 |
| 1.1811 | 1.5748 | -47 | -146 |
| 1.5748 | 1.9685 | -51 | -150 |
| 1.9685 | 2.5591 | -55 | -173 |
| 2.5591 | 3.1496 | -59 | -177 |
| | | | |
| 3.1496 | 3.9370 | -67 | -205 |
| 3.9370 | 4.7244 | -71 | -209 |
| 4.7244 | 5.5118 | -79 | -236 |
| 5.5118 | 6.2992 | -83 | -240 |
| 6.2992 | 7.0866 | -91 | -248 |
| 7.0866 | 7.8740 | -94 | -276 |
| 7.8740 | 8.8583 | -102 | -283 |

| D_{c1} | | (1) $\Delta D_{c1s(min)}$ | | ΔD_{ws} |
|----------|--------|---------------------------|-----|-----------------|
| OVER | INCL | HIGH | LOW | |
| 0.2362 | 0.3937 | +45 | +10 | NOTE (2) |
| 0.3937 | 0.7087 | +56 | +13 | NOTE (2) |
| 0.7087 | 1.1811 | +67 | +16 | NOTE (2) |
| 1.1811 | 1.9685 | +83 | +20 | NOTE (2) |
| 1.9685 | 3.1496 | +98 | +24 | NOTE (2) |
| | | | | NOTE (2) |
| 3.1496 | 4.7244 | +115 | +28 | |
| 4.7244 | 7.0866 | +132 | +33 | NOTE (2) |

- (1) The assembly bore diameter is gaged with "go" and "no go" plug gages.
 The "go" plug gage size is the minimum assembly bore diameter.
 The "no go" plug gage size is the maximum assembly bore diameter.
 (2) Assemblies will be supplied containing needle rollers in accordance with one of the needle roller grades described in ANSI/AFBMA Standard 17.

TABLE 4
TOLERANCES
THRUST WASHERS - TYPE NTW
METRIC DESIGN

PART I

| d | | (1) $\Delta d_{s(min)}$ | |
|------|------|----------------------------|-----|
| OVER | INCL | HIGH | LOW |
| 3 | 6 | +140 | +20 |
| 6 | 10 | +175 | +25 |
| 10 | 18 | +212 | +32 |
| 18 | 30 | +250 | +40 |
| 30 | 50 | +300 | +50 |
| 50 | 80 | +360 | +60 |
| 80 | 120 | +422 | +72 |
| 120 | 180 | +485 | +85 |

| d ₁ | | Δd_{1mp} | |
|----------------|------|------------------|------|
| OVER | INCL | HIGH | LOW |
| 18 | 30 | -40 | -370 |
| 30 | 50 | -50 | -440 |
| 50 | 80 | -60 | -520 |
| 80 | 120 | -72 | -612 |
| 120 | 180 | -85 | -715 |
| 180 | 250 | -100 | -820 |

Dimensions in millimetres
Deviations in micrometres

| B | | ΔB_s | |
|------|------|--------------|-----|
| OVER | INCL | HIGH | LOW |
| 0 | 3 | +50 | -50 |

PART II

| d | | (1) $\Delta d_{s(min)}$ | |
|--------|--------|----------------------------|-----|
| OVER | INCL | HIGH | LOW |
| 0.1181 | 0.2362 | +55 | +8 |
| 0.2362 | 0.3937 | +69 | +10 |
| 0.3937 | 0.7087 | +83 | +13 |
| 0.7087 | 1.1811 | +98 | +16 |
| 1.1811 | 1.9685 | +118 | +20 |
| 1.9685 | 3.1496 | +142 | +24 |
| 3.1496 | 4.7244 | +166 | +28 |
| 4.7244 | 7.0866 | +191 | +33 |

| d ₁ | | Δd_{1mp} | |
|----------------|--------|------------------|------|
| OVER | INCL | HIGH | LOW |
| 0.7087 | 1.1811 | -16 | -146 |
| 1.1811 | 1.9685 | -20 | -173 |
| 1.9685 | 3.1496 | -24 | -205 |
| 3.1496 | 4.7244 | -28 | -241 |
| 4.7244 | 7.0866 | -33 | -281 |
| 7.0866 | 9.8425 | -39 | -323 |

Dimensions in inches
Deviations in 0.0001 inch

| B | | ΔB_s | |
|------|--------|--------------|-----|
| OVER | INCL | HIGH | LOW |
| 0 | 0.1181 | +20 | -20 |

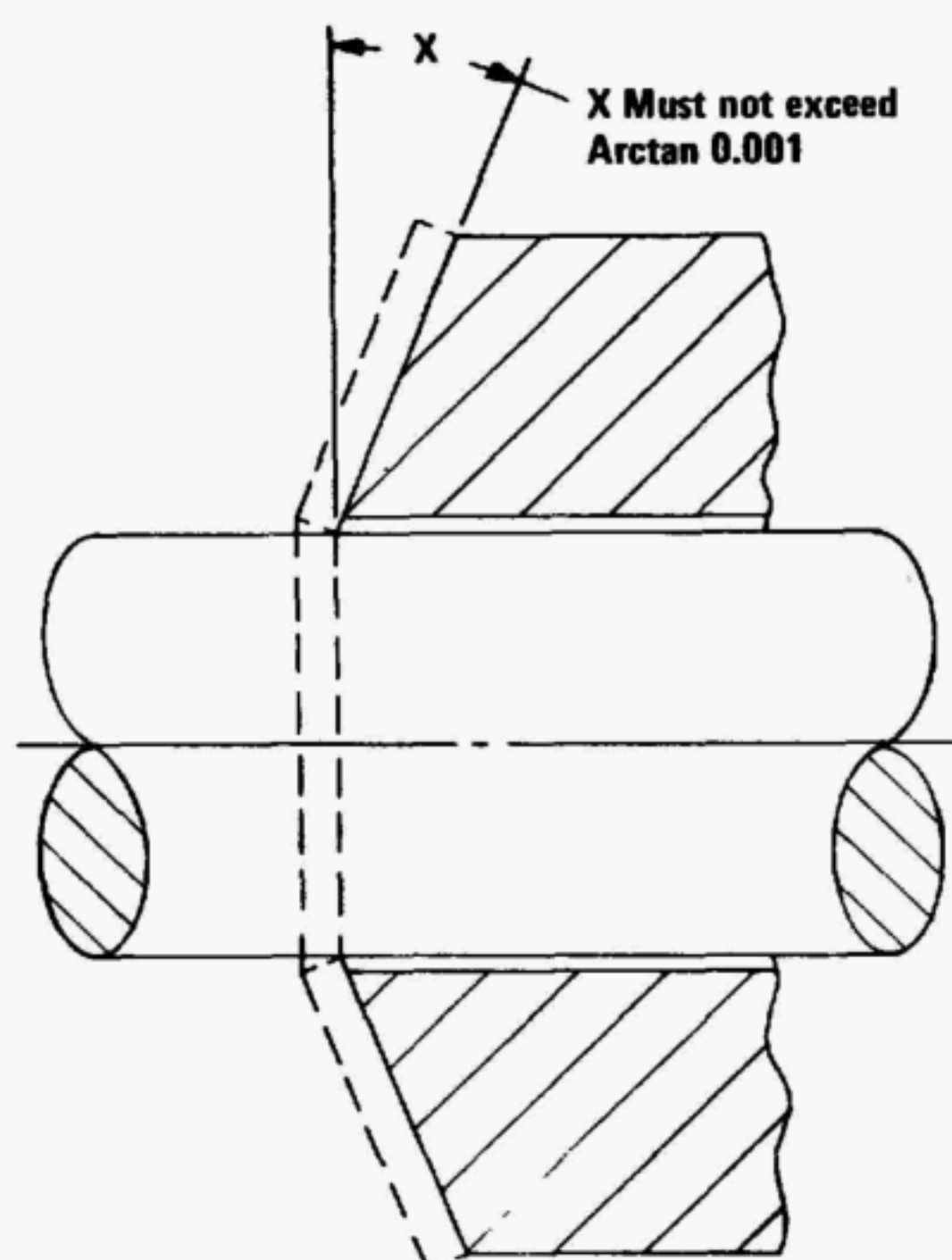
- (1) The thrust washer bore diameter is gaged with "go" and "no go" plug gages.
The "go" plug gage size is the minimum thrust washer bore diameter.
The "no go" plug gage size is the maximum thrust washer bore diameter.

6. MOUNTING PRACTICE

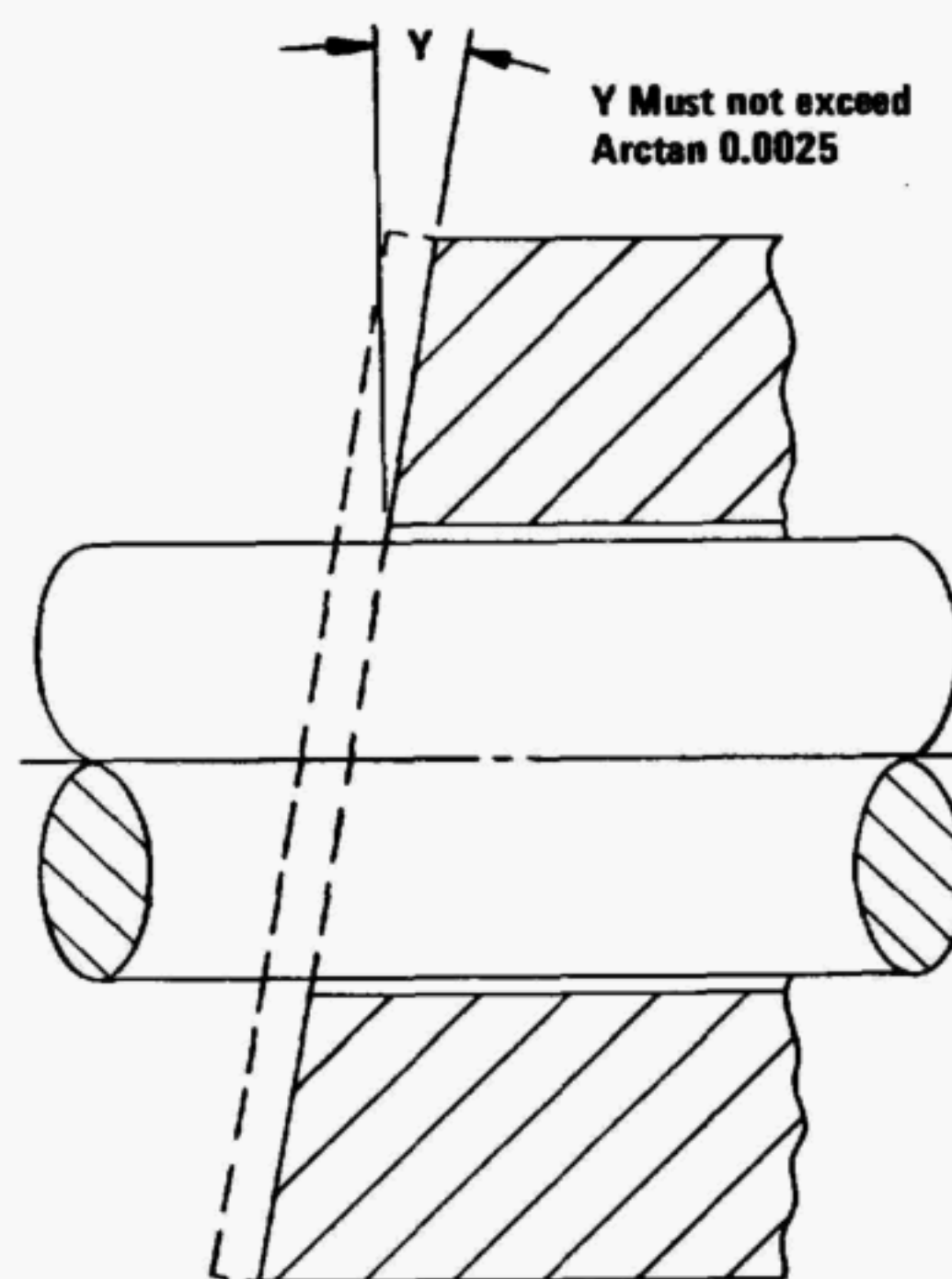
6.1 General. This section covers thrust needle roller and cage assembly and thrust washer mounting practice for normal operating conditions. Table 5 lists the shaft diameter dimensions and the tolerances required for shaft piloting assemblies and washers.

If the cage assembly is to be piloted on its outside diameter, bearing manufacturers should be consulted.

6.2 Washer Back-up Surfaces. The surfaces which back-up the washers shall not be coned or out-of-square by an amount exceeding the tolerances described in the following diagrams.



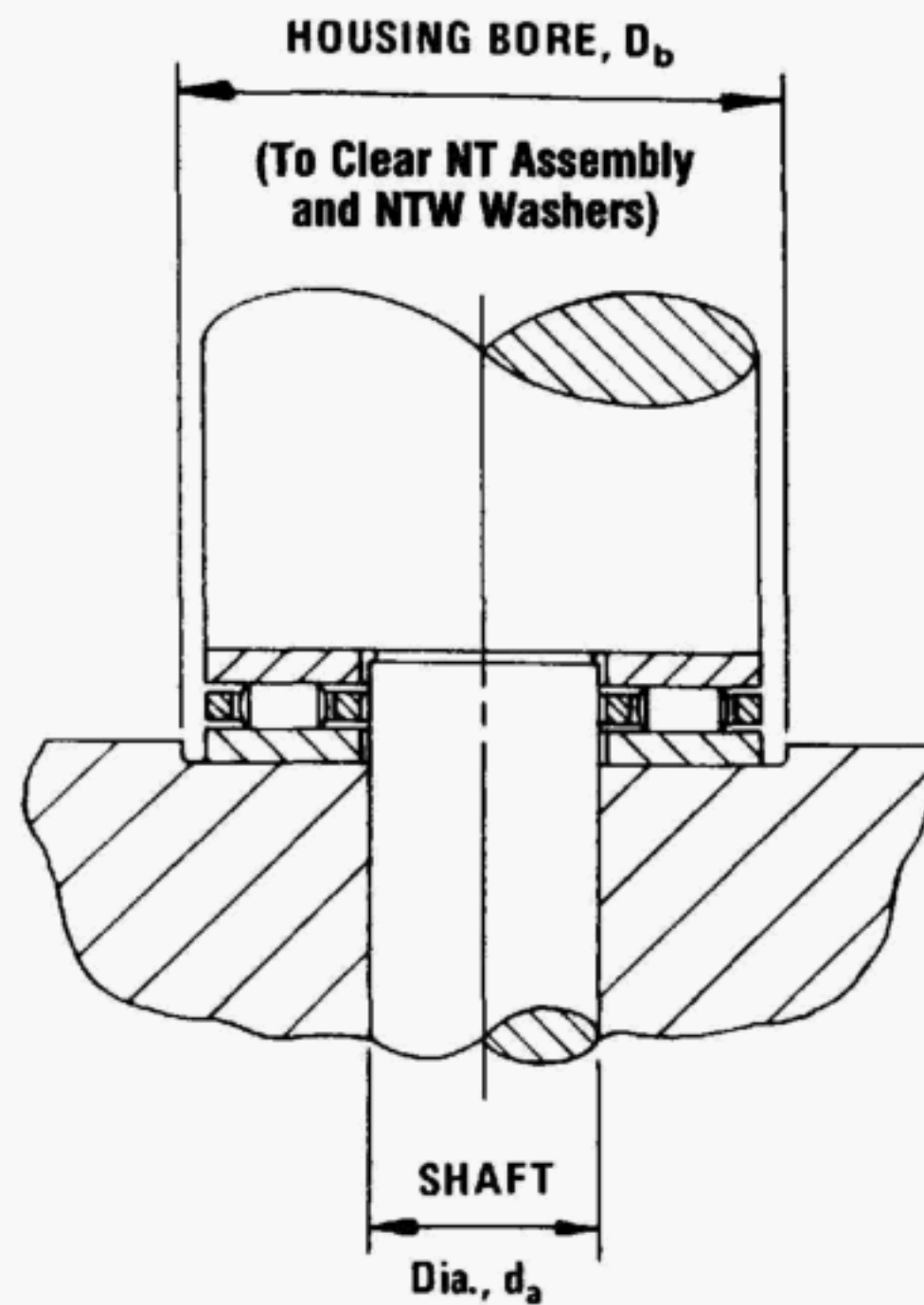
DISHED OR CONED SURFACE



OUT-OF-SQUARE SURFACE

Deflection of the thrust washers under load must be considered. For optimum performance, washers should be completely supported.

TABLE 5
MOUNTING DIMENSIONS
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES
AND THRUST WASHERS - TYPES NT AND NTW
METRIC DESIGN

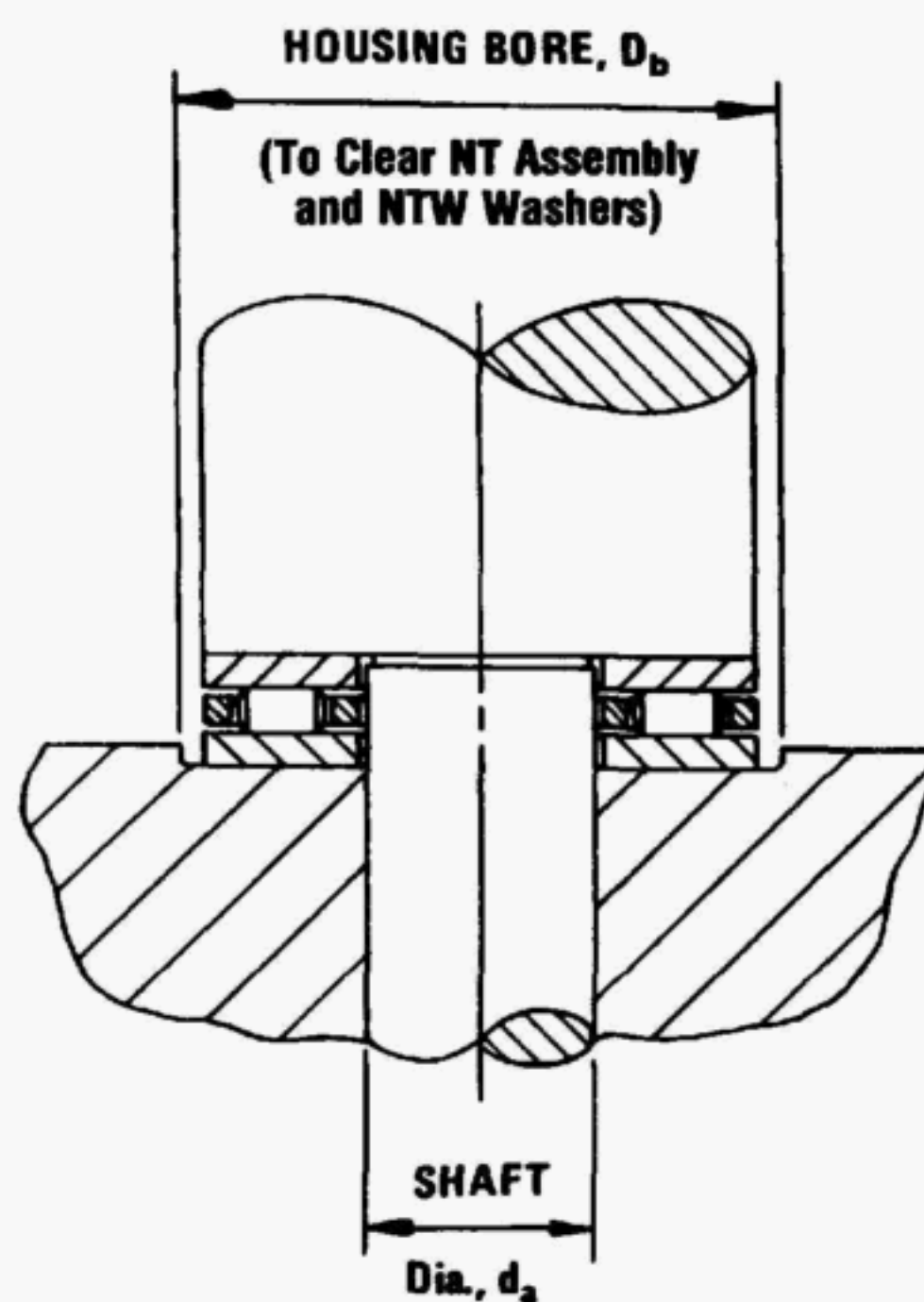
**PART I**

Dimensions in millimetres
 Deviations in micrometres

| BASIC ASSEMBLY BORE D_{c1} AND/OR WASHER BORE, d | | SHAFT DIAMETER d_a FOR NT ASSEMBLY AND/OR NTW WASHER ALLOWABLE DEVIATION FROM D_{c1} AND/OR d | |
|--|------|---|------|
| OVER | INCL | HIGH | LOW |
| 3 | 6 | +0 | - 48 |
| 6 | 10 | +0 | - 58 |
| 10 | 18 | +0 | - 70 |
| 18 | 30 | +0 | - 84 |
| 30 | 50 | +0 | -100 |
| 50 | 80 | +0 | -120 |
| 80 | 120 | +0 | -140 |
| 120 | 180 | +0 | -160 |

| BASIC ASSEMBLY OUTSIDE DIAMETER D_c AND/OR WASHER OUTSIDE DIAMETER d_1 | | HOUSING BORE D_b FOR NT ASSEMBLY AND/OR NTW WASHER ALLOWABLE DEVIATION FROM D_c AND/OR d_1 |
|---|------|--|
| OVER | INCL | MINIMUM |
| 18 | 30 | +1000 |
| 30 | 50 | +1000 |
| 50 | 80 | +1000 |
| 80 | 120 | +1000 |
| 120 | 180 | +1000 |
| 180 | 250 | +1000 |

TABLE 5
MOUNTING DIMENSIONS
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES
AND THRUST WASHERS - TYPES NT AND NTW
METRIC DESIGN



PART II

Dimensions in inches
 Deviations in 0.0001 inch

| BASIC ASSEMBLY BORE D_{c1} AND/OR WASHER BORE, d | | SHAFT DIAMETER d_s FOR NT ASSEMBLY AND/OR NTW WASHER | |
|--|--------|---|-----|
| | | ALLOWABLE DEVIATION FROM D_{c1} AND/OR d | |
| OVER | INCL | HIGH | LOW |
| 0.1181 | 0.2362 | +0 | -19 |
| 0.2362 | 0.3937 | +0 | -23 |
| 0.3937 | 0.7087 | +0 | -28 |
| 0.7087 | 1.1811 | +0 | -33 |
| 1.1811 | 1.9685 | +0 | -39 |
| 1.9685 | 3.1496 | +0 | -47 |
| 3.1496 | 4.7244 | +0 | -55 |
| 4.7244 | 7.0866 | +0 | -63 |

| BASIC ASSEMBLY OUTSIDE DIAMETER D_c AND/OR WASHER OUTSIDE DIAMETER d_1 | | HOUSING BORE D_b FOR NT ASSEMBLY AND/OR NTW WASHER | |
|---|--------|---|--|
| | | ALLOWABLE DEVIATION FROM D_c AND/OR d_1 | |
| OVER | INCL | MINIMUM | |
| 0.7087 | 1.1811 | +4 | |
| 1.1811 | 1.9685 | +4 | |
| 1.9685 | 3.1496 | +4 | |
| 3.1496 | 4.7244 | +4 | |
| 4.7244 | 7.0866 | +4 | |
| 7.0866 | 9.8425 | +4 | |

American National Standards

The standard in this booklet is one of more than 10,000 standards approved to date by the American National Standards Institute.

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Each standard represents general agreement among maker, seller, and user groups as to the best current practice with regard to some specific problem. Thus the completed standards cut across the whole fabric of production, distribution, and consumption of goods and services. American National Standards, by reason of Institute procedures, reflect a national consensus of manufacturers, consumers, and scientific, technical, and professional organizations, and governmental agencies. The completed standards are used widely by industry and commerce and often by municipal, state, and federal governments.

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