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ANSI/AFBMA
STD. 21.2-1988

AMERICAN NATIONAL STANDARD

AFBMA STANDARD

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

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

Approved November 29, 1988
American National Standards Institute, Inc.

American National Standard

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Published by

**The Anti-Friction Bearing Manufacturers Association, Inc.
1101 Connecticut Ave. N.W., Suite 700
Washington, D.C. 20036**

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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 U.S. customary (inch-pound) units and are found in Part II of the various tables. A soft conversion to metric units is provided in Part I 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

An AFBMA Standard is intended as a guide to aid the manufacturer, the consumer and the general public. The existence of an AFBMA Standard does not in any respect preclude anyone, whether he has approved the Standard or not from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. AFBMA Standards are subject to revision or withdrawal at any time and users who refer to an AFBMA Standard should satisfy themselves that they have the latest information from the Association.

Thrust Needle Roller and Cage Assemblies and Thrust Washers Inch Design

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Thrust Needle Roller and Cage Assemblies and Thrust Washers - Inch Design

1. SCOPE

This standard for inch thrust needle roller and cage assemblies and thrust washers covers:

- 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 different makes of standard thrust needle roller and cage assemblies and thrust washers of the same size may depend on bearing 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 dimensional interchangeability. This code establishes a universal language for describing and identifying inch design thrust needle roller and cage assemblies and thrust washers in order to facilitate communication between the user and the manufacturer. The

code is also intended to simplify the handling by user personnel of identical bearings made by different manufacturers, whose identification numbers may be different.

This code applies only to those inch design thrust needle roller and cage assemblies and 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 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, "0" 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
00	AAA	000	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
00	AAA	000

The bore diameter is indicated by two numerals in sixteenths of an inch comprising the diameter symbol as shown in Boundary Dimension Tables 1 and 2.

The type is indicated by a "T" to identify a thrust bearing and two 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
NR	Thrust Needle Roller and Cage Assembly, Inch Design

B. THRUST WASHERS

SYMBOL	DESCRIPTION
NP	Thrust Washer, Inch 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 inch design thrust needle roller and cage assemblies and for thrust washers.

40TNR461. From 2.2 TNR is found to be the type symbol for a thrust needle roller and cage assembly. Table 1 lists the Boundary Dimensions for type TNR. Referring to Table 1, the diameter symbol 40 indicates a bore diameter of 2.5 inches (63.500 mm) and the dimension series symbol 461 indicates an outside diameter of 3.25 inches (82.550 mm) and a roller diameter of 0.0781 inches (1.984 mm).

12TNP459. From 2.2 TNP is found to be the type symbol for a thrust washer. Table 2 lists the Boundary Dimensions for type TNP. Referring to Table 2, the diameter symbol 12 indicates a bore diameter of 0.75 inches (19.050 mm) and the dimension series symbol 459 indicates an outside diameter of 1.25 inches (31.750 mm) and a thickness of 0.1260 inches (3.200 mm).

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

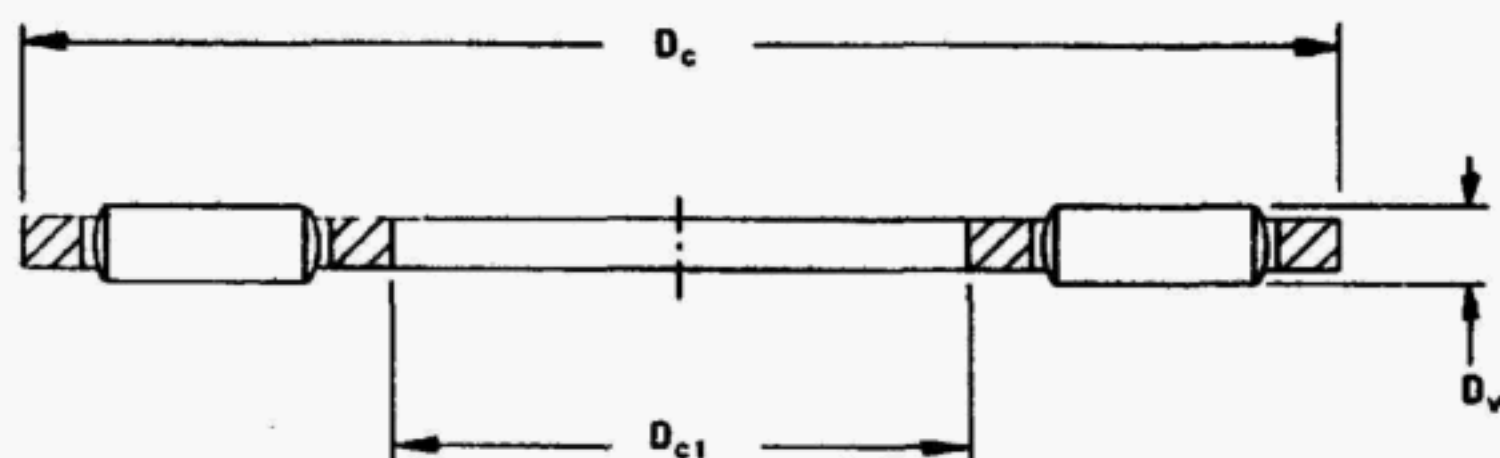
4. BOUNDARY DIMENSIONS

Purpose of Plans. The boundary plans shown in the Boundary 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.

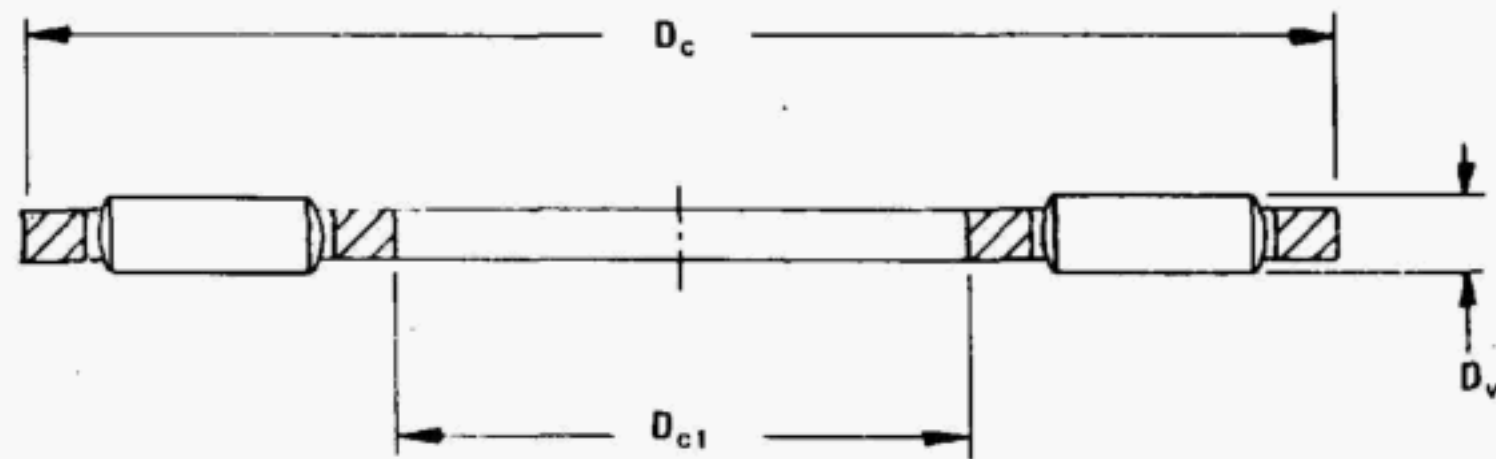
TABLE 1
BOUNDARY DIMENSIONS
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES - TYPE TNR
INCH DESIGN

**PART I**

Dimensions in millimetres

IDENTIFICATION CODE	D_{c1}	D	D_w
4TNR461	6.350	17.450	1.984
5TNR461	7.925	19.050	1.984
6TNR461	9.525	20.625	1.984
7TNR461	11.100	22.225	1.984
8TNR461	12.700	23.800	1.984
9TNR461	14.275	25.400	1.984
10TNR461	15.875	28.575	1.984
12TNR461	19.050	31.750	1.984
14TNR461	22.225	36.500	1.984
16TNR461	25.400	39.675	1.984
18TNR461	28.575	44.450	1.984
20TNR461	31.750	49.200	1.984
22TNR461	34.925	52.375	1.984
24TNR461	38.100	55.550	1.984
26TNR461	41.275	60.325	1.984
28TNR461	44.450	63.500	1.984
30TNR461	47.625	66.675	1.984
32TNR461	50.800	69.850	1.984
34TNR461	53.975	73.025	1.984
36TNR461	57.150	76.200	1.984
40TNR461	63.500	82.550	1.984
48TNR461	76.200	95.250	1.984

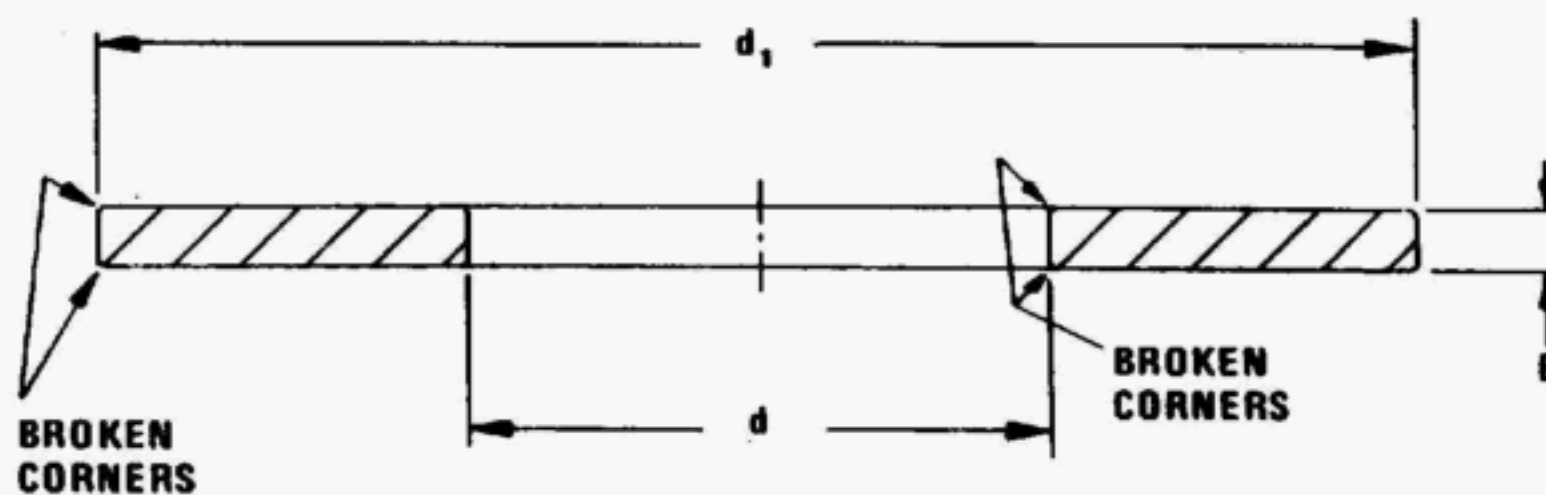
TABLE 1
BOUNDARY DIMENSIONS
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES - TYPE TNR
INCH DESIGN

**PART II**

Dimensions in inches

IDENTIFICATION CODE	D_{c1}	D_c	D_w
4TNR461	0.2500	0.6870	0.0781
5TNR461	0.3120	0.7500	0.0781
6TNR461	0.3750	0.8120	0.0781
7TNR461	0.4370	0.8750	0.0781
8TNR461	0.5000	0.9370	0.0781
9TNR461	0.5620	1.0000	0.0781
10TNR461	0.6250	1.1250	0.0781
12TNR461	0.7500	1.2500	0.0781
14TNR461	0.8750	1.4370	0.0781
16TNR461	1.0000	1.5620	0.0781
18TNR461	1.1250	1.7500	0.0781
20TNR461	1.2500	1.9370	0.0781
22TNR461	1.3750	2.0620	0.0781
24TNR461	1.5000	2.1870	0.0781
26TNR461	1.6250	2.3750	0.0781
28TNR461	1.7500	2.5000	0.0781
30TNR461	1.8750	2.6250	0.0781
32TNR461	2.0000	2.7500	0.0781
34TNR461	2.1250	2.8750	0.0781
36TNR461	2.2500	3.0000	0.0781
40TNR461	2.5000	3.2500	0.0781
48TNR461	3.0000	3.7500	0.0781

TABLE 2
BOUNDARY DIMENSIONS
THRUST WASHERS - TYPE TNP
INCH DESIGN

**PART I**

Dimensions in millimetres

IDENTIFICATION CODE	d	d_1	B
4TNP456	6.350	17.450	0.813
4TNP457	6.350	17.450	1.600
4TNP458	6.350	17.450	2.413
5TNP456	7.925	19.050	0.813
5TNP457	7.925	19.050	1.600
5TNP458	7.925	19.050	2.413
6TNP456	9.525	20.625	0.813
6TNP457	9.525	20.625	1.600
6TNP458	9.525	20.625	2.413
7TNP456	11.100	22.225	0.813
7TNP457	11.100	22.225	1.600
7TNP458	11.100	22.225	2.413
8TNP456	12.700	23.800	0.813
8TNP457	12.700	23.800	1.600
8TNP458	12.700	23.800	2.413
9TNP456	14.275	25.400	0.813
9TNP457	14.275	25.400	1.600
9TNP458	14.275	25.400	2.413
10TNP456	15.875	28.575	0.813
10TNP457	15.875	28.575	1.600
10TNP458	15.875	28.575	2.413
10TNP459	15.875	28.575	3.200
10TNP460	15.875	28.575	3.988
12TNP456	19.050	31.750	0.813
12TNP457	19.050	31.750	1.600
12TNP458	19.050	31.750	2.413
12TNP459	19.050	31.750	3.200
12TNP460	19.050	31.750	3.988

Table 2 Part I continued . . .

TABLE 2

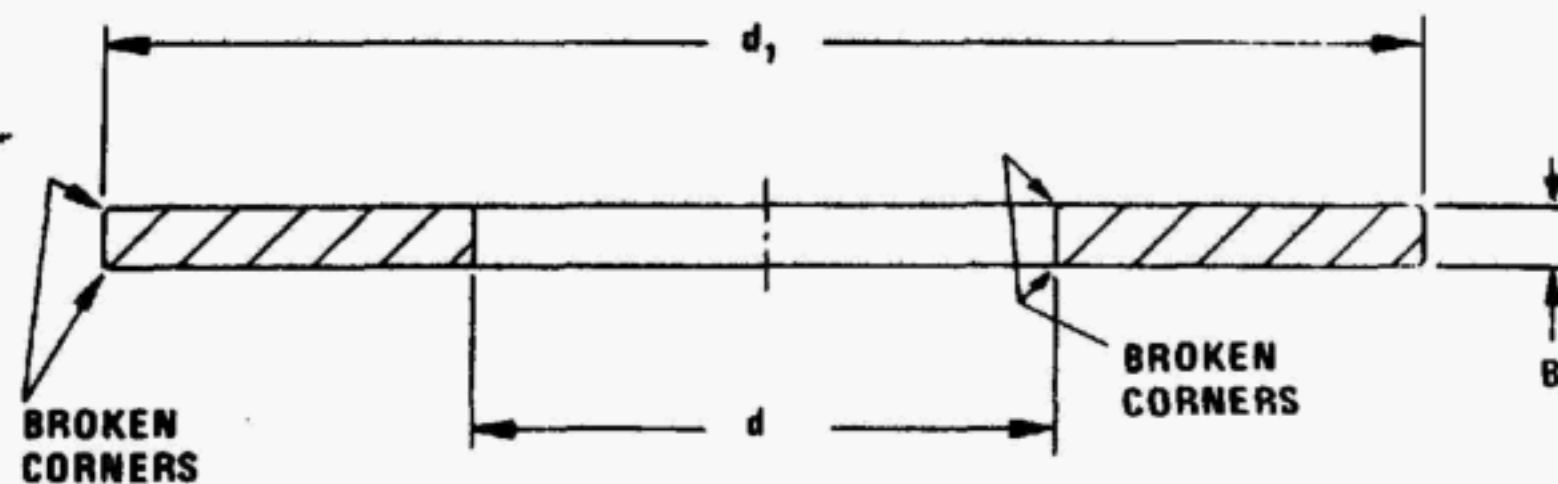
IDENTIFICATION CODE	d	d ₁	B
14TNP456	22.225	36.500	0.813
14TNP457	22.225	36.500	1.600
14TNP458	22.225	36.500	2.413
14TNP459	22.225	36.500	3.200
14TNP460	22.225	36.500	3.988
16TNP456	25.400	39.675	0.813
16TNP457	25.400	39.675	1.600
16TNP458	25.400	39.675	2.413
16TNP459	25.400	39.675	3.200
16TNP460	25.400	39.675	3.988
18TNP456	28.575	44.450	0.813
18TNP457	28.575	44.450	1.600
18TNP458	28.575	44.450	2.413
18TNP459	28.575	44.450	3.200
18TNP460	28.575	44.450	3.988
20TNP456	31.750	49.200	0.813
20TNP457	31.750	49.200	1.600
20TNP458	31.750	49.200	2.413
20TNP459	31.750	49.200	3.200
20TNP460	31.750	49.200	3.988
20TNP461	31.750	49.200	4.775
22TNP456	34.925	52.375	0.813
22TNP457	34.925	52.375	1.600
22TNP458	34.925	52.375	2.413
22TNP459	34.925	52.375	3.200
22TNP460	34.925	52.375	3.988
22TNP461	34.925	52.375	4.775
24TNP456	38.100	55.550	0.813
24TNP457	38.100	55.550	1.600
24TNP458	38.100	55.550	2.413
24TNP459	38.100	55.550	3.200
24TNP460	38.100	55.550	3.988
24TNP461	38.100	55.550	4.775
26TNP456	41.275	60.325	0.813
26TNP457	41.275	60.325	1.600
26TNP458	41.275	60.325	2.413
26TNP459	41.275	60.325	3.200
26TNP460	41.275	60.325	3.988
26TNP461	41.275	60.325	4.775

Table 2 Part I continued . . .

TABLE 2

IDENTIFICATION CODE	d	d ₁	B
28TNP456	44.450	63.500	0.813
28TNP457	44.450	63.500	1.600
28TNP458	44.450	63.500	2.413
28TNP459	44.450	63.500	3.200
28TNP460	44.450	63.500	3.988
28TNP461	44.450	63.500	4.775
30TNP456	47.625	66.675	0.813
30TNP457	47.625	66.675	1.600
30TNP458	47.625	66.675	2.413
30TNP459	47.625	66.675	3.200
30TNP460	47.625	66.675	3.988
30TNP461	47.625	66.675	4.775
32TNP456	50.800	69.850	0.813
32TNP457	50.800	69.850	1.600
32TNP458	50.800	69.850	2.413
32TNP459	50.800	69.850	3.200
32TNP460	50.800	69.850	3.988
32TNP461	50.800	69.850	4.775
34TNP456	53.975	73.025	0.813
34TNP457	53.975	73.025	1.600
34TNP458	53.975	73.025	2.413
34TNP459	53.975	73.025	3.200
34TNP460	53.975	73.025	3.988
34TNP461	53.975	73.025	4.775
36TNP456	57.150	76.200	0.813
36TNP457	57.150	76.200	1.600
36TNP458	57.150	76.200	2.413
36TNP459	57.150	76.200	3.200
36TNP460	57.150	76.200	3.988
36TNP461	57.150	76.200	4.775
40TNP456	63.500	82.550	0.813
40TNP457	63.500	82.550	1.600
40TNP458	63.500	82.550	2.413
40TNP459	63.500	82.550	3.200
40TNP460	63.500	82.550	3.988
40TNP461	63.500	82.550	4.775
48TNP456	76.200	95.250	0.813
48TNP457	76.200	95.250	1.600
48TNP458	76.200	95.250	2.413
48TNP459	76.200	95.250	3.200
48TNP460	76.200	95.250	3.988
48TNP461	76.200	95.250	4.775

TABLE 2
BOUNDARY DIMENSIONS
THRUST WASHERS - TYPE TNP
INCH DESIGN

**PART II**

Dimensions in inches

IDENTIFICATION CODE	d	d_1	B
4TNP456	0.2500	0.6870	0.0320
4TNP457	0.2500	0.6870	0.0630
4TNP458	0.2500	0.6870	0.0950
5TNP456	0.3120	0.7500	0.0320
5TNP457	0.3120	0.7500	0.0630
5TNP458	0.3120	0.7500	0.0950
6TNP456	0.3750	0.8120	0.0320
6TNP457	0.3750	0.8120	0.0630
6TNP458	0.3750	0.8120	0.0950
7TNP456	0.4370	0.8750	0.0320
7TNP457	0.4370	0.8750	0.0630
7TNP458	0.4370	0.8750	0.0950
8TNP456	0.5000	0.9370	0.0320
8TNP457	0.5000	0.9370	0.0630
8TNP458	0.5000	0.9370	0.0950
9TNP456	0.5620	1.0000	0.0320
9TNP457	0.5620	1.0000	0.0630
9TNP458	0.5620	1.0000	0.0950
10TNP456	0.6250	1.1250	0.0320
10TNP457	0.6250	1.1250	0.0630
10TNP458	0.6250	1.1250	0.0950
10TNP459	0.6250	1.1250	0.1260
10TNP460	0.6250	1.1250	0.1570
12TNP456	0.7500	1.2500	0.0320
12TNP457	0.7500	1.2500	0.0630
12TNP458	0.7500	1.2500	0.0950
12TNP459	0.7500	1.2500	0.1260
12TNP460	0.7500	1.2500	0.1570

Table 2 Part II continued . . .

TABLE 2

IDENTIFICATION CODE	d	d ₁	B
14TNP456	0.8750	1.4370	0.0320
14TNP457	0.8750	1.4370	0.0630
14TNP458	0.8750	1.4370	0.0950
14TNP459	0.8750	1.4370	0.1260
14TNP460	0.8750	1.4370	0.1570
16TNP456	1.0000	1.5620	0.0320
16TNP457	1.0000	1.5620	0.0630
16TNP458	1.0000	1.5620	0.0950
16TNP459	1.0000	1.5620	0.1260
16TNP460	1.0000	1.5620	0.1570
18TNP456	1.1250	1.7500	0.0320
18TNP457	1.1250	1.7500	0.0630
18TNP458	1.1250	1.7500	0.0950
18TNP459	1.1250	1.7500	0.1260
18TNP460	1.1250	1.7500	0.1570
20TNP456	1.2500	1.9370	0.0320
20TNP457	1.2500	1.9370	0.0630
20TNP458	1.2500	1.9370	0.0950
20TNP459	1.2500	1.9370	0.1260
20TNP460	1.2500	1.9370	0.1570
20TNP461	1.2500	1.9370	0.1880
22TNP456	1.3750	2.0620	0.0320
22TNP457	1.3750	2.0620	0.0630
22TNP458	1.3750	2.0620	0.0950
22TNP459	1.3750	2.0620	0.1260
22TNP460	1.3750	2.0620	0.1570
22TNP461	1.3750	2.0620	0.1880
24TNP456	1.5000	2.1870	0.0320
24TNP457	1.5000	2.1870	0.0630
24TNP458	1.5000	2.1870	0.0950
24TNP459	1.5000	2.1870	0.1260
24TNP460	1.5000	2.1870	0.1570
24TNP461	1.5000	2.1870	0.1880
26TNP456	1.6250	2.3750	0.0320
26TNP457	1.6250	2.3750	0.0630
26TNP458	1.6250	2.3750	0.0950
26TNP459	1.6250	2.3750	0.1260
26TNP460	1.6250	2.3750	0.1570
26TNP461	1.6250	2.3750	0.1880

Table 2 Part II continued . . .

TABLE 2

IDENTIFICATION CODE	d	d ₁	B
28TNP456	1.7500	2.5000	0.0320
28TNP457	1.7500	2.5000	0.0630
28TNP458	1.7500	2.5000	0.0950
28TNP459	1.7500	2.5000	0.1260
28TNP460	1.7500	2.5000	0.1570
28TNP461	1.7500	2.5000	0.1880
30TNP456	1.8750	2.6250	0.0320
30TNP457	1.8750	2.6250	0.0630
30TNP458	1.8750	2.6250	0.0950
30TNP459	1.8750	2.6250	0.1260
30TNP460	1.8750	2.6250	0.1570
30TNP461	1.8750	2.6250	0.1880
32TNP456	2.0000	2.7500	0.0320
32TNP457	2.0000	2.7500	0.0630
32TNP458	2.0000	2.7500	0.0950
32TNP459	2.0000	2.7500	0.1260
32TNP460	2.0000	2.7500	0.1570
32TNP461	2.0000	2.7500	0.1880
34TNP456	2.1250	2.8750	0.0320
34TNP457	2.1250	2.8750	0.0630
34TNP458	2.1250	2.8750	0.0950
34TNP459	2.1250	2.8750	0.1260
34TNP460	2.1250	2.8750	0.1570
34TNP461	2.1250	2.8750	0.1880
36TNP456	2.2500	3.0000	0.0320
36TNP457	2.2500	3.0000	0.0630
36TNP458	2.2500	3.0000	0.0950
36TNP459	2.2500	3.0000	0.1260
36TNP460	2.2500	3.0000	0.1570
36TNP461	2.2500	3.0000	0.1880
40TNP456	2.5000	3.2500	0.0320
40TNP457	2.5000	3.2500	0.0630
40TNP458	2.5000	3.2500	0.0950
40TNP459	2.5000	3.2500	0.1260
40TNP460	2.5000	3.2500	0.1570
40TNP461	2.5000	3.2500	0.1880
48TNP456	3.0000	3.7500	0.0320
48TNP457	3.0000	3.7500	0.0630
48TNP458	3.0000	3.7500	0.0950
48TNP459	3.0000	3.7500	0.1260
48TNP460	3.0000	3.7500	0.1570
48TNP461	3.0000	3.7500	0.1880

TABLE 3
TOLERANCES
THRUST NEEDLE ROLLER AND CAGE ASSEMBLIES - TYPE TNR
INCH DESIGN

PART I

Dimensions in millimetres
Deviations in micrometres

D_{c1}, D_c, D_w	$^{(1)}\Delta D_{c1s(min)}$		ΔD_{cmp}		ΔD_w	
	HIGH	LOW	HIGH	LOW	HIGH	LOW
ALL SIZES	+178	+51	-254	-508	+0	-5

PART II

Dimensions in inches
Deviations in 0.0001 inches

D_{c1}, D_c, D_w	$^{(1)}\Delta D_{c1s(min)}$		ΔD_{cmp}		ΔD_w	
	HIGH	LOW	HIGH	LOW	HIGH	LOW
ALL SIZES	+70	+20	-100	-200	+0	-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.

TABLE 4
TOLERANCES
THRUST WASHERS - TYPE TNP
INCH DESIGN

PART I

Dimensions in millimetres
Deviations in micrometres

d		$^{(1)}\Delta d_{s(min)}$	
OVER	INCL	HIGH	LOW
4.750	57.150	+305	+51
57.150	76.200	+432	+51

d_1	Δd_{1mp}	
	HIGH	LOW
ALL SIZES	-254	-762

B		ΔB_s	
OVER	INCL	HIGH	LOW
0	0.813	+0	-51
0.813	4.775	+0	-76

PART II

Dimensions in inches
Deviations in 0.0001 inches

d		$^{(1)}\Delta d_{s(min)}$	
OVER	INCL	HIGH	LOW
0.1870	2.2500	+120	+20
2.2500	3.0000	+170	+20

d_1	Δd_{1mp}	
	HIGH	LOW
ALL SIZES	-100	-300

B		ΔB_s	
OVER	INCL	HIGH	LOW
0	0.0320	+0	-20
0.0320	0.1880	+0	-30

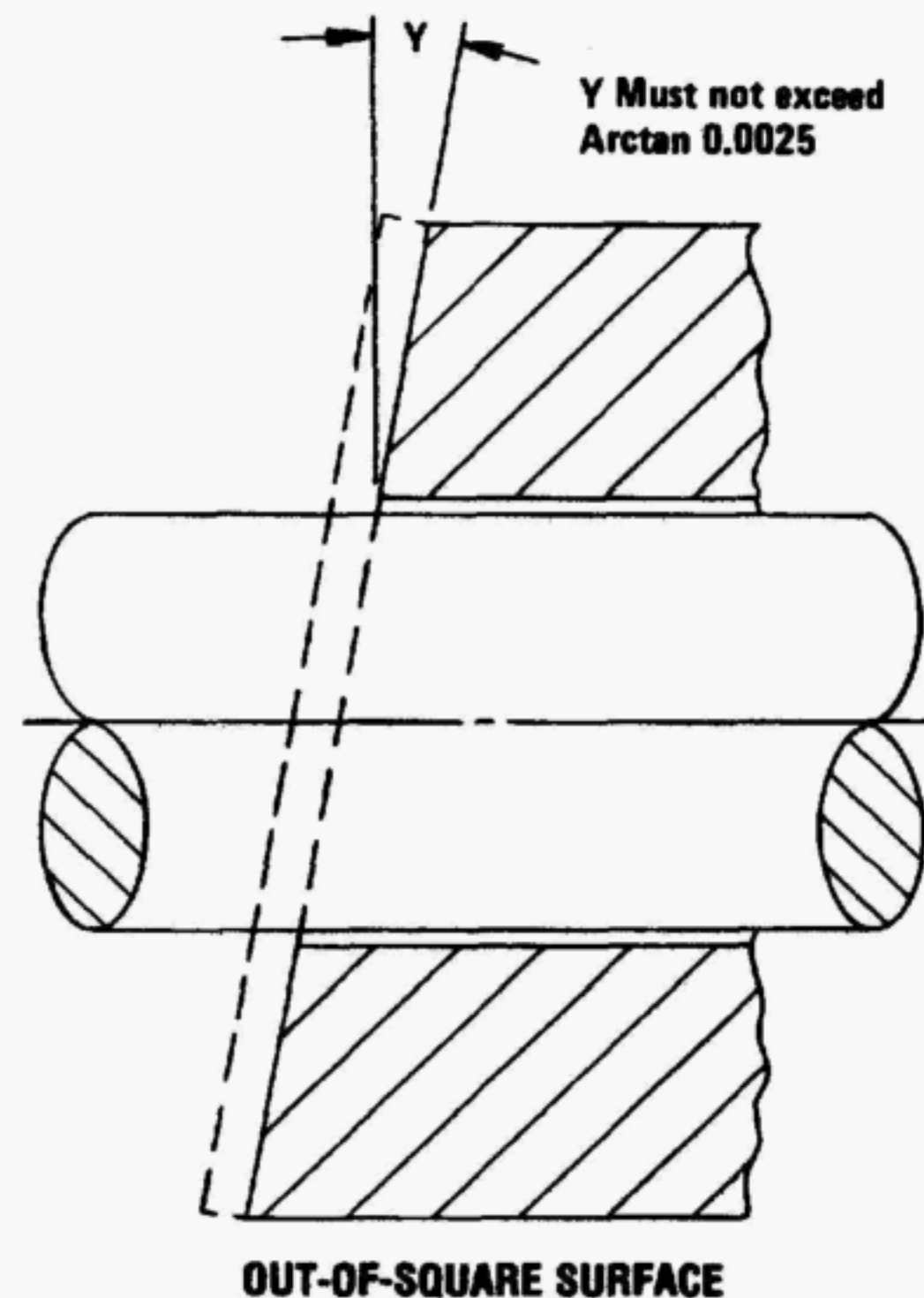
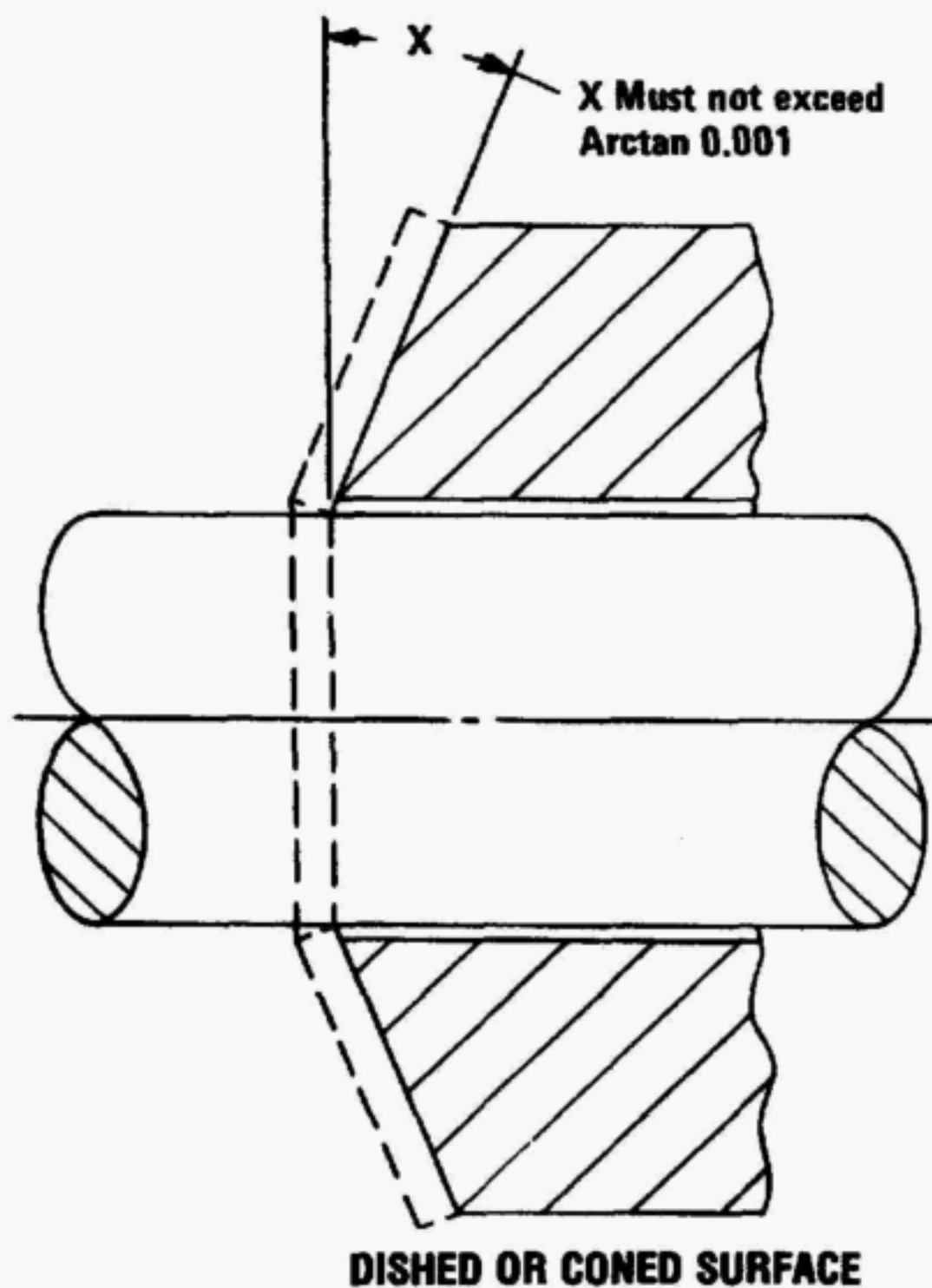
- (1) The thrust washer bore diameter is gaged with "go" and "no go" plug gages.
The "go" plug gage size is the minimum thrust washer bore diameter.
The "no go" plug gage size is the maximum thrust washer bore diameter.

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.

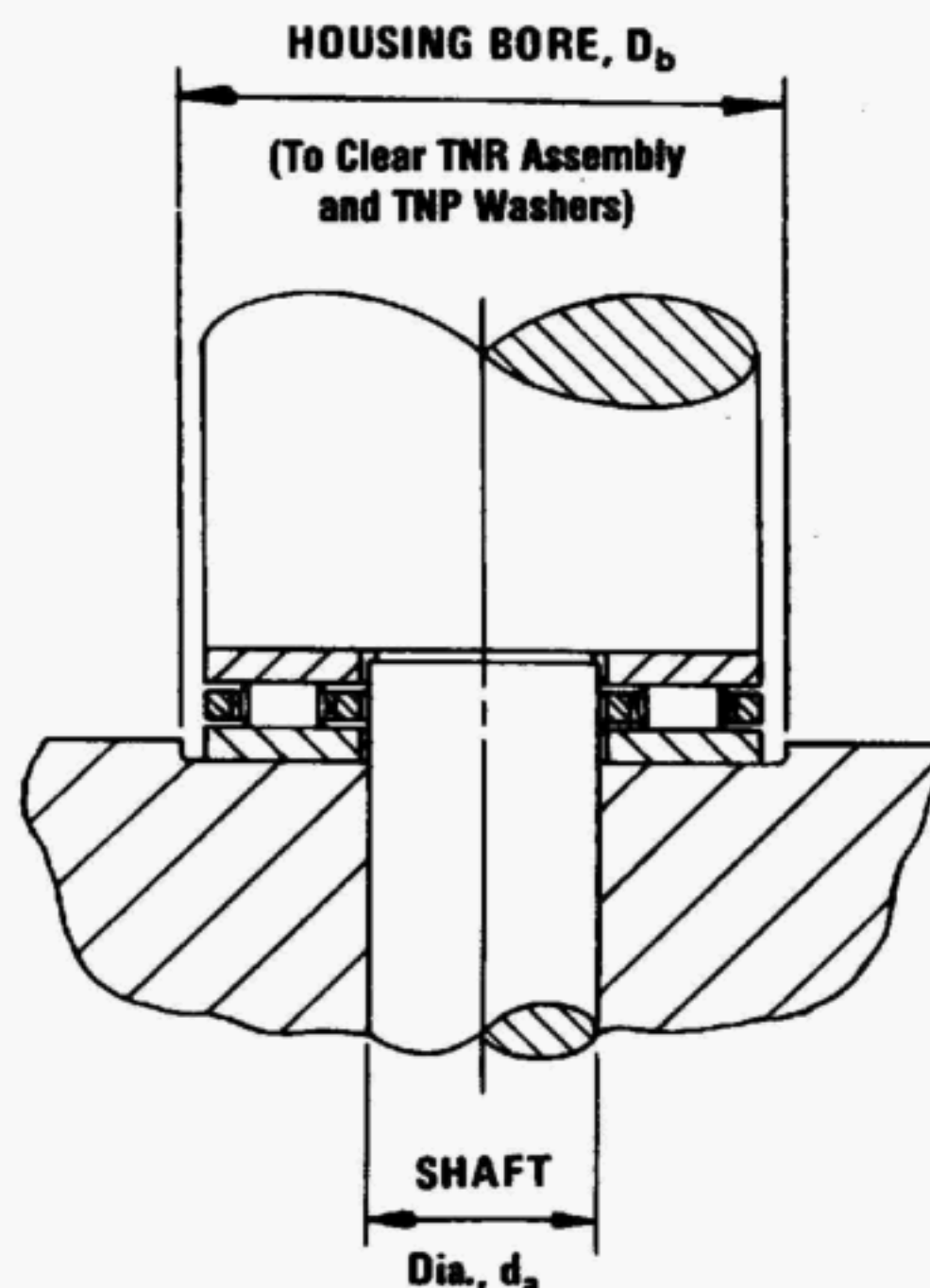
If the cage assembly is to be piloted on its outside diameter, bearing manufacturers should be consulted.

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.



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 CASE ASSEMBLIES AND THRUST WASHERS -
TYPES TNR AND TNP
INCH DESIGN

**PART I**

Dimensions in millimetres
 Deviations in micrometres

BASIC ASSEMBLY BORE D_{c1} AND/OR WASHER BORE, d	SHAFT DIAMETER d_s FOR TNR ASSEMBLY AND/OR TNP WASHER ALLOWABLE DEVIATION FROM D_{c1} AND/OR d	
ALL SIZES	HIGH	LOW
	+0	-76

BASIC ASSEMBLY OUTSIDE DIAMETER D_c AND/OR WASHER OUTSIDE DIAMETER d_1	HOUSING BORE D_b FOR TNR ASSEMBLY AND/OR TNP WASHER ALLOWABLE DEVIATION FROM D_c AND/OR d_1
ALL SIZES	MINIMUM
	+787 ⁽¹⁾

PART II

Dimensions in inches
 Deviations in 0.0001 inches

BASIC ASSEMBLY BORE D_{c1} AND/OR WASHER BORE, d	SHAFT DIAMETER d_s FOR TNR ASSEMBLY AND/OR TNP WASHER ALLOWABLE DEVIATION FROM D_{c1} AND/OR d	
ALL SIZES	HIGH	LOW
	+0	-30

BASIC ASSEMBLY OUTSIDE DIAMETER D_c AND/OR WASHER OUTSIDE DIAMETER d_1	HOUSING BORE D_b FOR TNR ASSEMBLY AND/OR TNP WASHER ALLOWABLE DEVIATION FROM D_c AND/OR d_1
ALL SIZES	MINIMUM
	+310 ⁽¹⁾

(1) When the shaft and housing are not concentric, twice the amount of eccentricity is to be added to the minimum housing diameter.

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.

The Standards Institute provides the machinery for creating voluntary standards. It serves to eliminate duplication of standards activities and to weld conflicting standards into single, nationally accepted standards under the designation "American National Standards."

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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**American National Standards Institute, Inc
1430 Broadway
New York, N.Y. 10018**