NOMENCLATURE

In order to provide our customers with clear and concise labeling, Timken has endeavored to keep things simple when creating references. The following should cover the majority of ordering situations however, as always, your local Timken engineer will be pleased to provide further assistance if required.

PRECISION TAPERED ROLLER BEARINGS TIMKEN SYSTEM

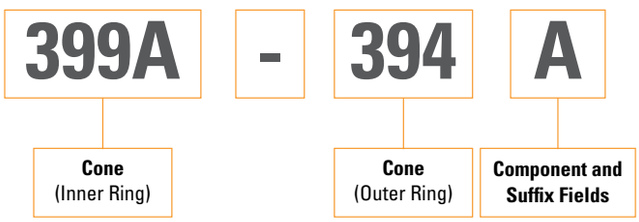


Fig 98. Precision tapered roller bearing nomenclature.

PRECISION TAPERED ROLLER BEARINGS ISO 355 NUMBERING SYSTEM

Cone Inner Ring

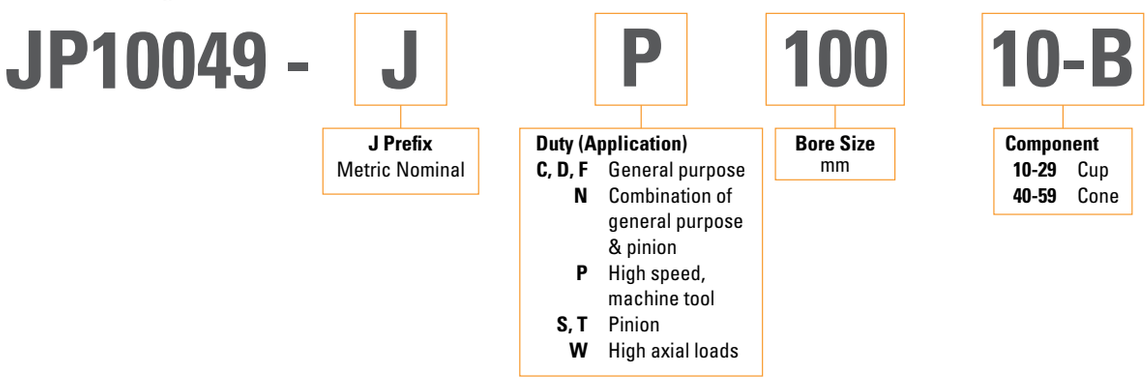


Fig 99. Precision tapered roller bearing ISO 355 nomenclature.

PRECISION TAPERED ROLLER BEARINGS ABMA NUMBERING SYSTEM

Cone Inner Ring

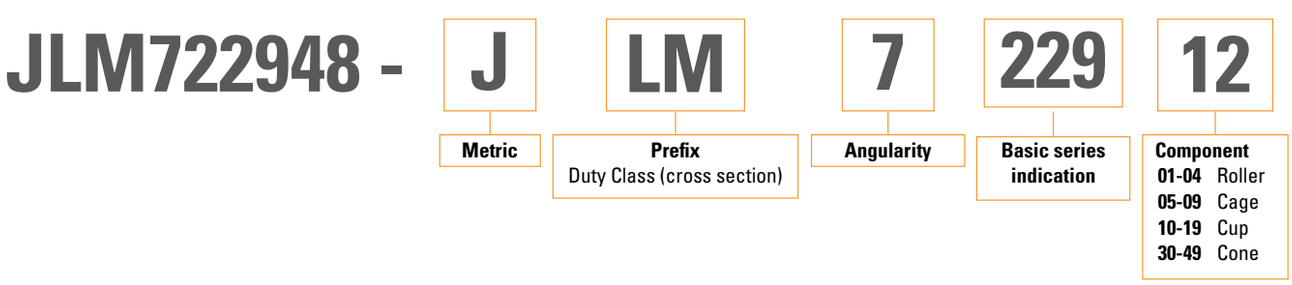


Fig 100. Precision tapered roller bearing ABMA nomenclature.

TIMKEN PRECISION TAPERED ROLLER BEARINGS

The Timken bearing part numbering system has evolved over the years to accommodate various international standards put forth by both the ISO and ABMA organizations. To retain the integrity of Timken's proven initial designs and to support its extensive customer base, Timken recognizes the key numbering schemes as they have developed in the tapered roller bearing industry and as indicated here.

ORIGINAL TIMKEN SYSTEM

(cone) - (cup)

Ex: 399A-394A (see common component/suffix)

- Family-design bearing group around a common roller (quantity and angle CAN vary).

TABLE 68. UNIQUE COMPONENT PART NUMBERS.

	Ex. I	Ex. II
Series	395	52000
Cup	399	52618
Cone	394	52387

- Numerical portion of part number has no significance in describing bearing size or type.

ISO 355 NUMBERING SYSTEM

(application-oriented)

(cone) - (cup)

Ex: JP100 49 - JP100 10-B

see common component and suffix fields

"J" Prefix
metric nominal bearings

Duty class
[C/D/F]: general purpose
[N]: general purpose+pinion
[P]: high speed, machine tool
[S/T]: pinions
[W]: high thrust loading

Cone bore (in mm)

TABLE 69. COMPONENT AND SUFFIX CODES

Component Field (Final Two Digits Of Part Number)	
Series	00 (indicated by zeroes) Ex: 87000 or 36600
Cups	10 through 19 (thinnest cup section is #10)
Cones	30 through 49 (thinnest cone section is #49)

(Overflow numbers : 20 through 29 as needed; 50 through 99 as needed)

Suffix Code Fields (One To Three Letters Max.)	
B:	Flanged cup
HR(A):	Hydra-Rib™ design (modified cup from standard)
P(H):	Customized for performance (non-interchangeable component)
E:	(Exclusive) non-interchangeable component

All components and variations in a given series are interchangeable.

ABMA NUMBERING SYSTEM

(for inch and metric radial bearings)

(cone) (cup)

Ex: JLM7229 48 - JLM7229 12

see common component and suffix fields

"J" Prefix
metric nominal bearings

EL: Extra light
LL: Lighter than light
L: Light
LM: Light-medium
M: Medium
HM: Heavy medium
H: Heavy
HH: Heavier than heavy
EH: Extra heavy
T: Thrust ONLY

Angularity Code Field

1	0 < 24°
2	24° < 25.5°
3	25.5° < 27°
4	27° < 28.5°
5	28.5° < 30.5°
6	30.5° < 32.5°
7	32.5° < 36°
8	36° < 45°
9	45° + (excluding pure thrust)
0	(thrust only)

Series Code Field

(Cone bore) over/inl.

in.	mm	Code
<1	<25.4	00 to 19
1-2	25.4-50.8	20 to 99;000 to 029
2-3	50.8-76.2	030 to 129
3-4	76.2-101.6	130 to 189
4-5	101.6-127.0	190 to 239
5-6	127.0-152.4	240 to 289
6-7	152.4-177.8	290 to 339
7-8	177.8-203.2	340 to 389
8-9	203.2-228.6	390 to 429
9-10	228.6-254.0	430 to 469
10-11	254.0-279.4	470 to 509
11-12	279.4-304.8	510 to 549
12-13	304.8-330.2	550 to 570
13-14	330.2-355.6	580 to 609
14-15	355.6-381.0	610 to 639
15-16	381.0-406.4	640 to 659
16-17	406.4-431.8	660 to 679
17-18	431.8-457.2	680 to 694
18-19	457.2-482.6	695 to 709
19-20	482.6-508.0	710 to 724
20-21	508.0-534.4	725 to 739
21-22	534.4-558.8	740 to 754
22-23	558.8-584.2	755 to 769
23-24	584.2-609.6	770 to 784
24-25	609.6-635.0	785 to 799
25-30	635.0-762.0	800 to 829
30-35	762.0-889.0	830 to 859
35-40	889.0-1016.0	860 to 879
40-50	1016.0-1270.0	880 to 889
50-72.5	1270.0-1841.0	890 to 899
>72.5	>1841.0	900 to 999

ASSEMBLY CODES

- Five digit code:
  [Assy. No.]+[Timken code]+[Bill of material code (first field is bearing precision class)]

Ex: 90B01 [Timken (internal) numbering system]

- Code is created at entry of initial custom order.
- For matched bearing assemblies: [cone PN]-[5-digit code]
  Ex: JP13049-90B01.
- For interchangeable components: [cone PN]-[cup PN]
  Ex: 29585-29520.

INSPECTION CODES

- Five characters (as 3 fields).

Component: [Precision class]+[Timken code]+[Performance code]

Ex: C0030

IDENTIFICATION TAGS

See the following page for a detailed description of the use and purpose of component or assembly attached identification tags.

BEARING PRECISION CLASS

- Indicated in inspection code.
- Each component is made to a precision class (tolerance and runout values are given in the Engineering Section).
- Tolerance structure differences within nominal inch and metric bearings.

TAG MARKINGS

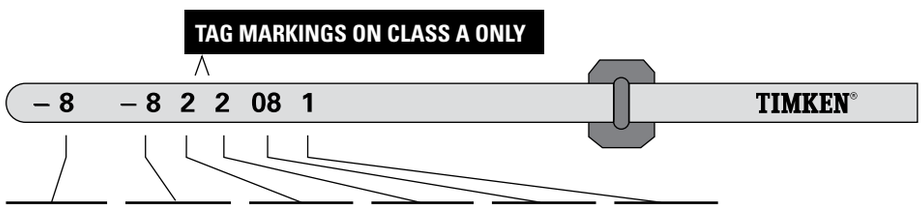
Bearing tag markings are a device to indicate accuracy of bearings and facilitate selective assembly.

The information given on the tag varies by metric and inch systems, bearing class and type.

All components more precise than Class C or 3 cones and cups are supplied as matched assemblies and are shipped as complete bearings.

1. METRIC SYSTEM PRECISION BEARING TAG MARKINGS

Tags shown below are supplied with all Class A single-row matched assemblies.
Class B cups and cones are tagged if indicated on the performance code.



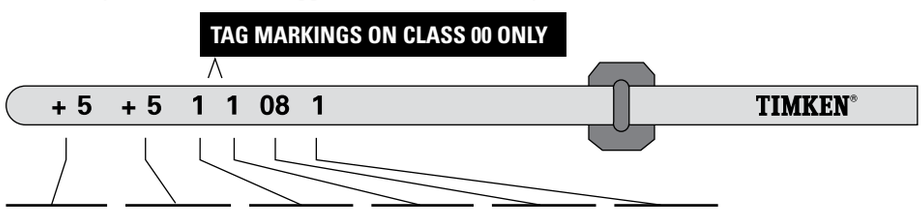
TS-TSF

FIRST NUMBER	SECOND NUMBER	THIRD NUMBER	FOURTH NUMBER	FIFTH NUMBER	SIXTH NUMBER
Indicates average deviation in cone bore from nominal dimension. *Use pages 233-234.*	Indicates average deviation in cup O.D. from nominal dimension. *Use pages 233-234.*	Indicates runout (total indicator reading) of cone assembly. *Use pages 233-234.*	Indicates runout (total indicator reading) of cup. *Use pages 233-234.*	Indicates year of manufacture: 07 … 2007 08 … 2008 etc. *Found only on matched assemblies.*	Indicates numerical number of bearing in yearly manufacture. *Found only on matched assemblies.*

Fig. 101. Metric system precision bearing tag markings.

2. INCH SYSTEM PRECISION BEARING TAG MARKINGS

Tags shown below are supplied with all Class 00 cups and cones.
Class 0 cups and cones are tagged if indicated on the performance code.



TS-TSF

FIRST NUMBER	SECOND NUMBER[1]	THIRD NUMBER	FOURTH NUMBER	FIFTH NUMBER	SIXTH NUMBER
Indicates average deviation in cone bore from nominal dimension. *Use pages 233-234.*	Indicates average deviation in cup O.D. from nominal dimension. *Use pages 233-234.*	Indicates runout (total indicator reading) of cone assembly. *Use pages 233-234.*	Indicates runout (total indicator reading) of cup. *Use pages 233-234.*	Indicates year of manufacture: 07 … 2007 08 … 2008 etc. *Found only on matched assemblies.*	Indicates numerical number of bearing in yearly manufacture. *Found only on matched assemblies.*

Fig. 102. Inch system precision bearing tag markings.

[1]Second number marked only on Class 3 product over 304.800 mm (12.0000 in.) cup O.D.

INTRODUCTION

Timken® tapered roller bearings have been used for many years in machine tool applications due to their widely recognized advantages in stiffness, load-carrying capacity, precision and reliability over other bearing designs.

The use of new ceramic and CBN cutting tools, together with increased spindle motor powers, has allowed much higher cutting speeds to be achieved in many applications. To maintain the same global accuracy level at these higher cutting speeds poses a challenge to develop optimum spindle designs. Timken has met this challenge by developing:

- Special internal bearing geometry.
- Innovative bearing designs.

Technical information is provided in the Engineering Section of this catalog to assist the designer in selecting the right bearing arrangement for a given application.

Because of their high capability to carry loads together with a relatively low level of applied loads in the machine tool industry, precision tapered roller bearings are seldom replaced for fatigue damage. The bearings are mainly replaced when a global loss of precision of the machine is observed leading to a complete refurbishment of the machine. At this stage, it is advisable to replace the bearings, even if they may appear to be in good condition; they may be worn to a point where the accuracy is no longer effective.

BEARING REPLACEMENT

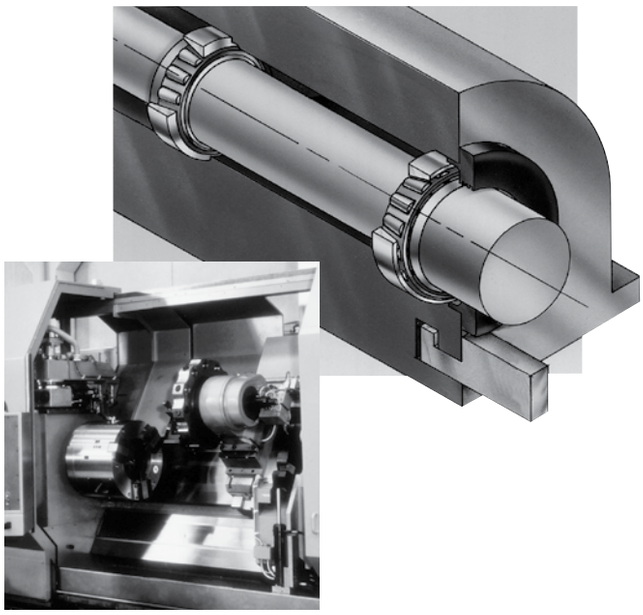
Even if a machine is considered old after several years of service, it is not recommended to fit standard class bearings in place of the original precision ones. This practice would most likely result in uncontrolled movements of the spindle due to the higher runout of standard bearings. This can lead to poor accuracy of machined pieces and premature tool wear.

The best practice is to install a bearing of an equivalent precision class to the original equipment recommended by the builder.

Both inner and outer rings have to be replaced to achieve the same accuracy level as the original equipment.

INSPECTION

The replacement of the bearings on any precision equipment is not necessarily sufficient to restore the original accuracy. If the surrounding components (spindle, housing, nut, spacer) show considerable defects in size or form, the bearing will simply transmit the consecutive default to the workpiece. The total runout of the system is the combination of the runout of each component. A precision bearing will add no more runout than is specified by the bearing class, but it will not reduce any runout already present from the spindle and housing.



Careful inspection of the adjacent components followed by an appropriate refurbishment, if needed, must be made before remounting the bearings. Particular points to be checked are geometry (roundness, cylindricity, concentricity), surface conditions (nicks, burrs), sizes (bore, O.D. and width) and resultant fitting practice (see Engineering Section).

REMOUNTING

The guidelines described in the Engineering Section apply exactly in the same way for replacement purposes as for original equipment.

BEARING TYPES

The most popular tapered roller bearing types made in precision classes are the single-row bearings, types TS and TSF, and the two-row bearing, type TDO.

These bearing types are supported by a range of special bearings that have been designed for machine tool applications, such as the variable preload Hydra-RibTM bearing, the high-speed TSMA bearing and the compact TXR crossed roller bearing, which are available only in precision classes.

The size range of Timken precision bearings starts from less than 20.000 mm (0.7874 in.) bore and extends to over 2000.000 mm (78.7402 in.) outside diameter, depending upon bearing type.

The importance of this market segment is demonstrated by Timken's commitment to having a plant dedicated to producing precision-class tapered roller bearings. This simply means that the precision quality is built into the bearing during manufacturing and is not achieved by selecting from standard bearings. For increased reliability, Timken bearings are manufactured from high-quality alloy steels.

The application of precision tapered roller bearings is not just limited to machine tools. Wherever spindles turn and rotational accuracy is essential to the machine's performance, precision

tapered roller bearings are encountered. Other typical applications are printing presses, optical grinders, profile cutters, indexing tables, precision drives and measuring gauges.

SINGLE-ROW BEARINGS

TS – SINGLE ROW(1)

This is the basic and the most widely used type of tapered roller bearing. It consists of two main, separable parts: the inner ring (cone) assembly and the outer ring (cup). It is usually fitted as one of an opposing pair. During equipment assembly, single-row bearings can be "set" to the required clearance (endplay) or preload condition to optimize performance.

Fig. 103.TS single-row bearing.

TSF – SINGLE-ROW, WITH FLANGED OUTER RING(1)

This variation on the basic single-row bearing, type TSF has a flanged outer ring to facilitate axial location and accurately aligned seats in a through-bored housing.

Fig. 104.TSF single-row bearing.

TWO-ROW BEARINGS

TDO – DOUBLE OUTER RACE

This has a one-piece (double) outer race and two single inner races and is usually supplied complete with an inner ring spacer as a pre-set assembly. This configuration gives a wide effective bearing spread and is frequently chosen for applications where overturning moments are a significant load component. TDO bearings can be used in fixed (locating) positions or allowed to float in the housing bore, for example, to compensate for shaft expansion.

Fig. 105.TDO two-row bearing.

TXR – CROSSED ROLLER BEARING(1)

A crossed roller bearing is two sets of bearing races and rollers brought together at right angles – with alternate rollers facing opposite directions – within a section height not much greater than that of a single bearing. The steep angle, tapered geometry of the bearing causes the load-carrying center of each of the races to be projected along the axis, resulting in a total effective bearing spread many times greater than the width of the bearing itself. This type of bearing offers a high resistance to overturning moments.

The normal design of the bearing is type TXRDO, which has a double outer race and two inner races, with rollers spaced by polymer separators.

Fig. 106.TXR crossed roller bearing.

HIGH-SPEED BEARINGS

For many applications, notably in the machine tool industry, bearings are required to run at speeds in excess of those for which standard bearings are designed.

TSMA – SINGLE-ROW, WITH AXIAL OIL HOLES

The TSMA type is a single-row bearing with axial oil holes for lubrication of the critical roller-rib contact area to ensure adequate lubrication at high speeds. The concept works by capturing oil in a manifold (attached to the inner ring), which is then directed to the rib-roller contact area through holes drilled axially through the large rib.

Fig. 107.TSMA single-row bearing with axial oil holes.

TSHR – HYDRA-RIB BEARING WITH PRELOAD ADJUSTMENT DEVICE(1)

The Hydra-Rib bearing has a "floating" outer ring rib controlled by hydraulic or pneumatic pressure, which ensures that the required preload is maintained irrespective of the differential expansions or changes in loading taking place within the system.

Fig. 108. Hydra-Rib bearing with preload adjustment device.

The list of part numbers in the TS and TSF design styles tables is not exhaustive. These represent most of the common selections for the precision machine tool industry. Many tapered roller bearings currently are manufactured to "standard" precision classes (Class 3 or 0/ C or B) but can be readily produced to higher precision levels. Bearing modifications such as conversion to a two row design, a high speed TSMA, or use of ceramic rolling elements to meet specific application demands can usually be accommodated. Please contact your Timken representative for more information.

(1)These bearing types are described in detail in the bearing data tables at the end of this publication.

TAPERED ROLLER BEARING BORE DIAMETERS FOUND IN THIS CATALOG

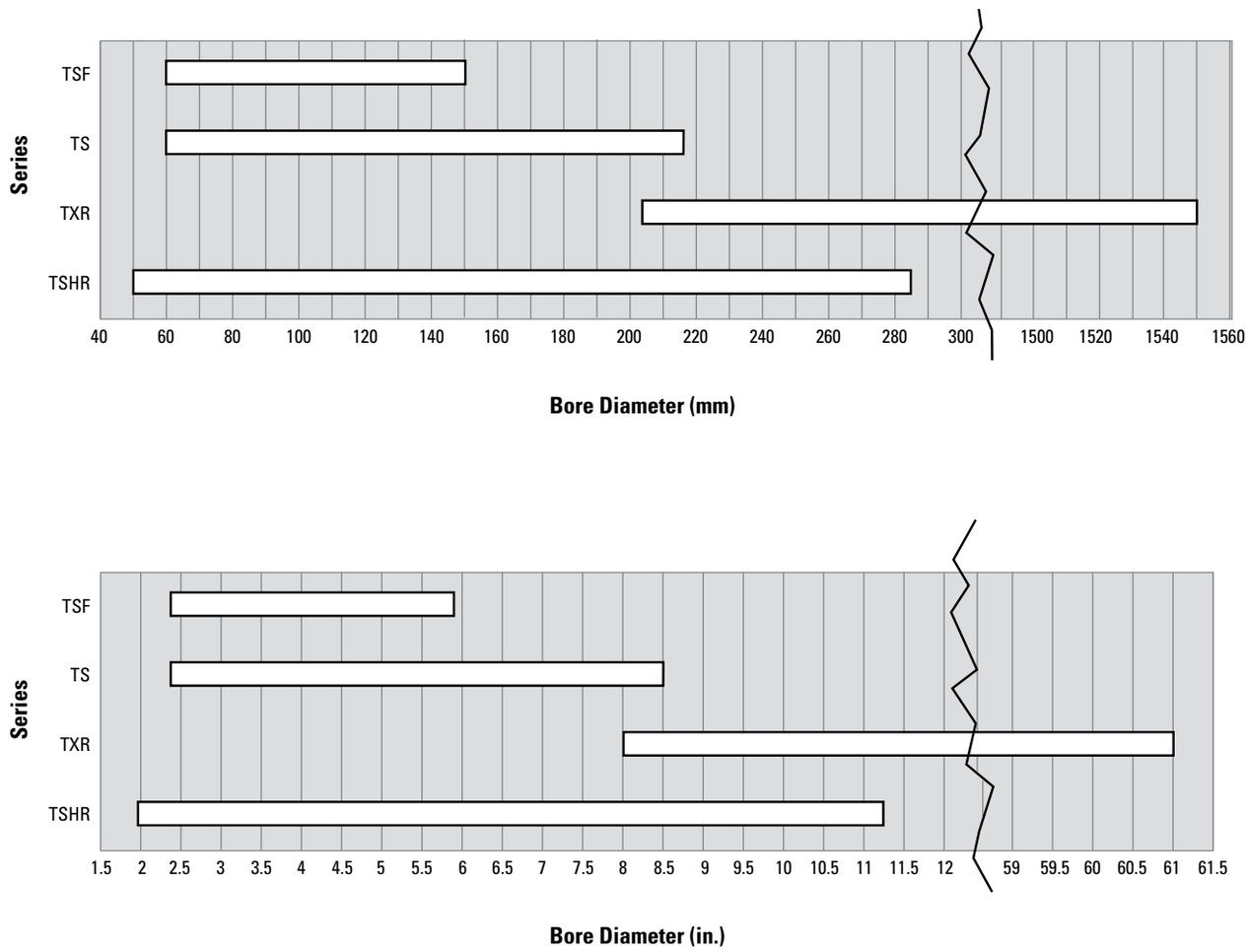


Fig. 109. Bore diameters.

SUPER PRECISION BALL BEARINGS

The following topics are covered within this section:

NOMENCLATURE
ISO

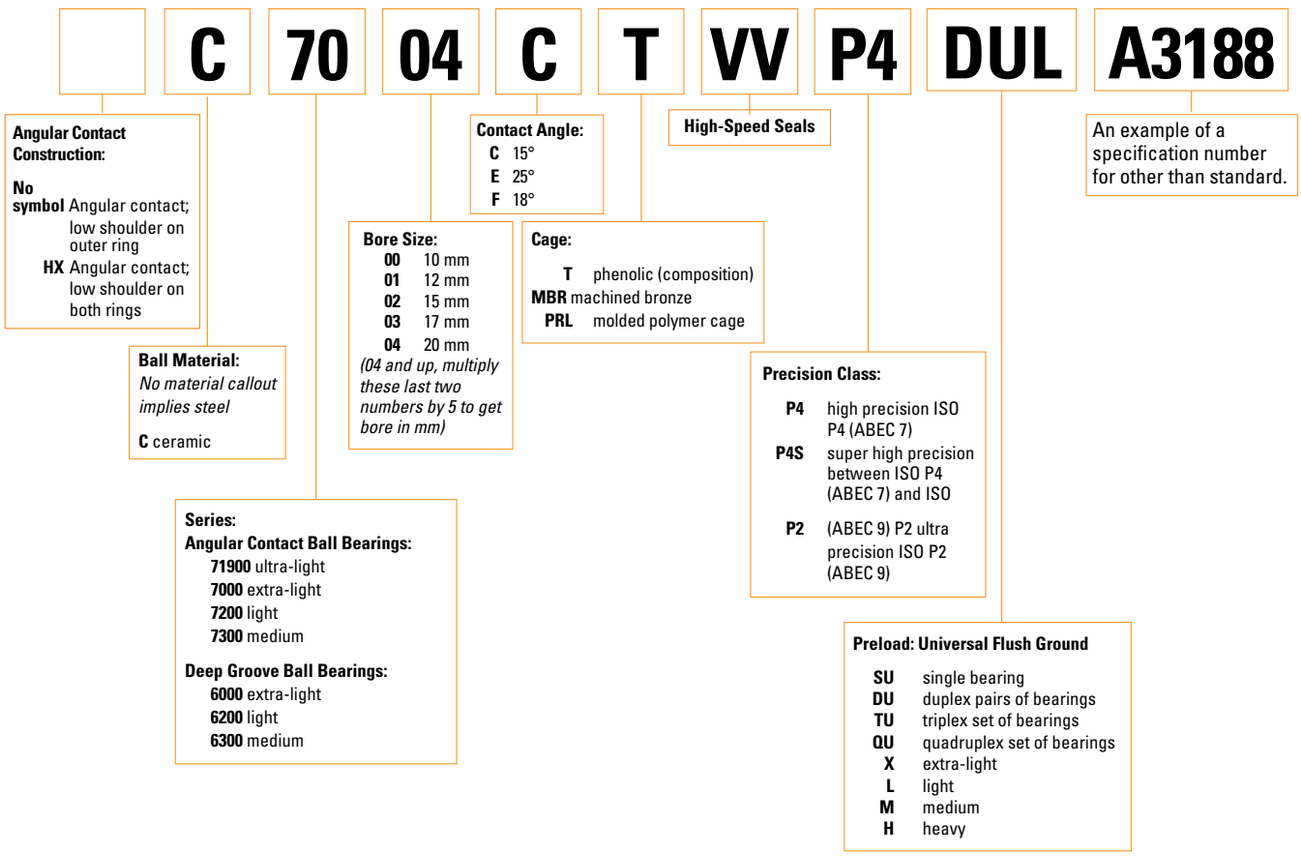


Fig. 110. ISO nomenclature.

SUPER PRECISION BALL BEARINGS
ANGULAR CONTACT

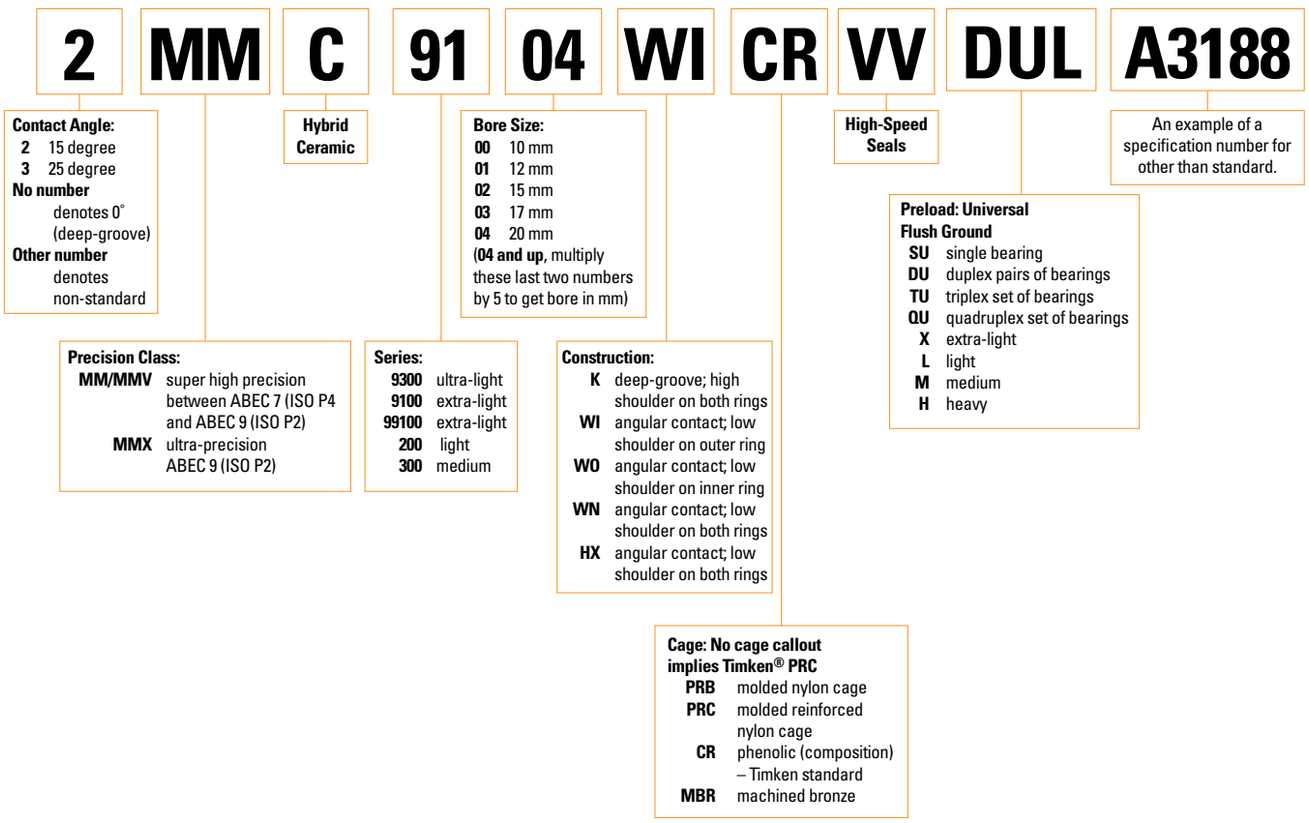


Fig. 111. Super precison ball bearings, angular conatct nomenclature.

SUPER PRECISION BALL BEARINGS
BALL SCREW SUPPORT – DOUBLE ROW
METRIC

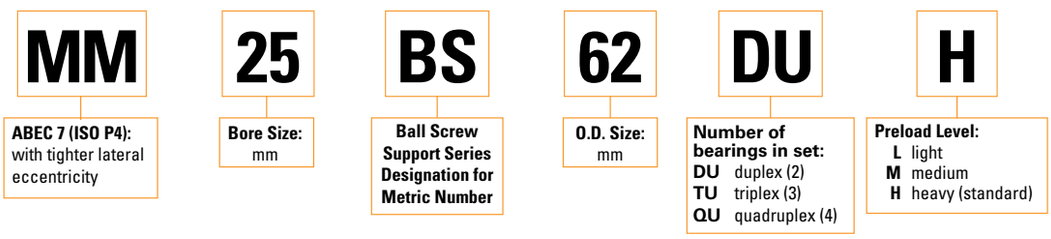


Fig. 112. Super precision ball bearing, ball screw support, single-row nomenclature - metric.

INCH

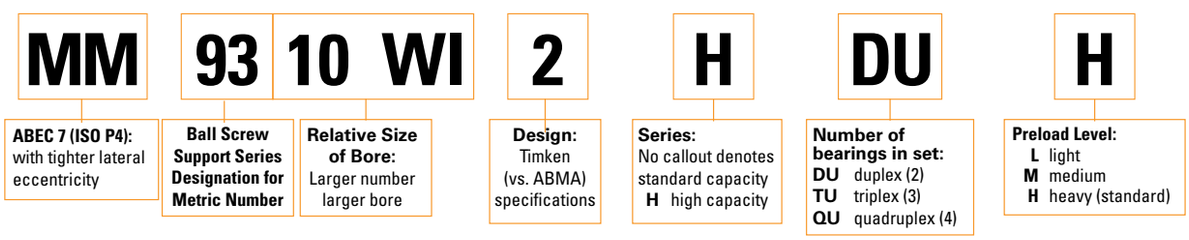


Fig. 113. Super precision ball bearing, ball screw support, single-row nomenclature - inch.

SUPER PRECISION BALL BEARINGS
BALL SCREW SUPPORT – DOUBLE ROW
METRIC

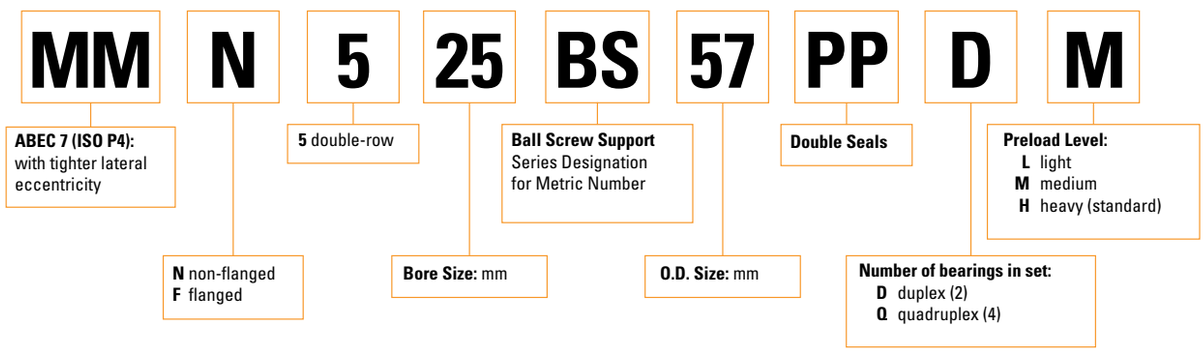


Fig. 114. Super precision ball bearing, ball screw support, double-row nomenclature - metric.

SUPER PRECISION BALL BEARINGS
BALL SCREW CARTRIDGE UNITS
METRIC

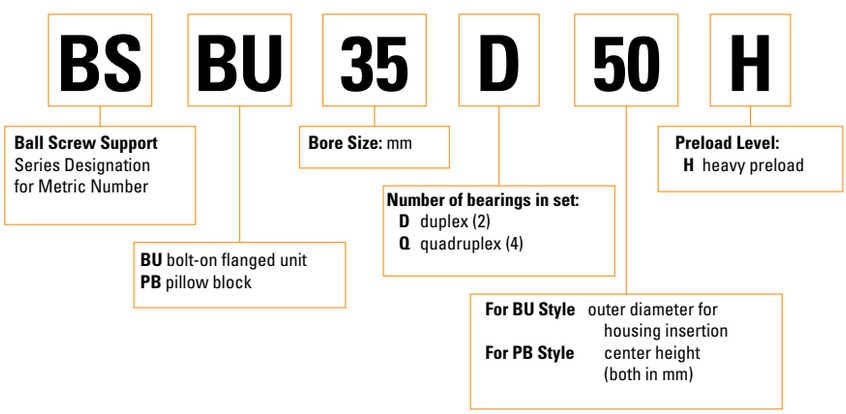


Fig. 115. Super precision ball bearing, ball screw cartridge units nomenclature - metric.

MEANINGS OF PREFIXES AND SUFFIXES

In the Timken numbering system, the basic number, which denotes the size and series, is always retained. When special variations are made, as in the case of precision bearings, prefixes and suffixes are added, which have definite meanings as follows:

MV P4	High Precision, ABEC 7 (ISO P4)
MM (P4S)	Super Precision, ABEC 7/ABEC 9 (ISO P4/P2)
2MM/2MMV (C-P4S)	Super Precision between ABEC 7 and ABEC 9 (ISO P4/P2), Low contact angle - 15 degree
3MM/3MMV (E-P4S)	Super Precision between ABEC 7 and ABEC 9 (ISO P4/P2), High contact angle - 25 degree
MMX (P2)	Ultra-precision, ABEC 9, (ISO P2)
K(6)	Deep-groove high shoulder on both inner and outer ring
W(7)	Angular contact low shoulder on outer ring
HX(7)	Angular contact low shoulder on both inner and outer ring
CR(T)	Composition cage (non-metallic)
MBR	Machined bronze cage
SR	Machined steel cage
PRB	Molded nylon cage
PRC	Molded nylon cage (reinforced)
PRL	Molded reinforced nylon cage
PRF, PRG	Special high-performance material
SUL	Universally ground single bearing, Light preload
SUM	Universally ground single bearing, Medium preload
SUH	Universally ground single bearing, Heavy preload
DUL	Universally ground duplex bearings, Light preload
DUM	Universally ground duplex bearings, Medium reload
DUH	Universally ground duplex bearings, Heavy preload
TUL	Universally ground triplex bearings, Light preload
TUM	Universally ground triplex bearings, Medium preload
TUH	Universally ground triplex bearings, Heavy preload
QUL	Universally ground quadruplex bearings Light preload
QUM	Universally ground quadruplex bearings Medium preload
QUH	Universally ground quadruplex bearings Heavy preload

PERFORMANCE

The most widely recognized definition of quality is contained within the ABEC/ISO classes; however some factors affecting performance of a bearing are not completely defined within these standards. This allows for a significant range of variability in product performance among bearing manufacturers. To provide premium performance, all Timken ball bearing MV(P4), MM(P4S), MMV(P4S) and MMX(P2) precision grades comply with strict controls over these non-specified parameters – all of which can have a direct impact on the service life and performance of a bearing.

OPTIMIZED GRADES OF PRECISION

MV (P4) – HIGH PRECISION (ABEC 7, ISO P4)

Precision bearings manufactured to the MV tolerance class operate with running accuracy, performance levels and dimensional controls meeting ABEC 7 (ISO P4). Bore and O.D. surfaces are coded in micron units to help with selection of the appropriate tolerance spread for universal adjacent-mounting to ensure optimum shaft and housing fits.

MM, MMV (P4S) – SUPER PRECISION, SUPER HIGH PRECISION (ABEC 7/9, ISO P4/P2)

Super precision bearings manufactured to the MM(V) tolerance class operate with running accuracy and performance levels meeting ABEC 9 (ISO P2) and remaining features at ABEC 7 (ISO P4) levels. Bore and O.D. surfaces are coded in micron units for the convenience of the discriminating machine tool builder striving for optimum fitting of crucial spindle components.

MMX (P2) – ULTRA-PRECISION (ABEC 9, ISO P2)

Super precision bearings with closer tolerances and running accuracies than ABEC 7 (ISO P4) bearings are made to ABEC 9 (ISO P2) tolerances. Bearings produced to these tolerances are generally used on ultra-high-speed grinding spindles designed for tight dimensional tolerances and superfine surface finishes. Contact your Timken representative for availability of product range.

BEARING TYPES

ANGULAR-CONTACT BEARINGS

2MV-WI (7-C-P4)

2MV-WI (7-C-P4) types with 15 degree initial contact angle are designed to meet the needs of machine builders for precision bearings that are highly precise, cost effective and are radially stiff while also accommodating thrust loads to a certain extent. As a result, these bearings are used extensively in cutting tools, live spindles and textile applications.

3MV-WI (7-E-P4)

3MV-WI (7-E-P4) bearings are manufactured with a 25 degree initial contact angle and exhibit a high axial rigidity and take up relatively higher axial loads. These bearings are the common choice for use in precision commercial lathes and vertical spindle applications.

2MM-WI (7-C-P4S)

2MM-WI (7-C-P4S) types with 15 degree initial contact angle are designed to meet the needs of machine builders for precision bearings that will operate at as low a temperature as possible for a wide range of speeds and operating loads. In order for machines to produce more accurate work at a higher production rate, the bearings must provide a high degree of rigidity in both axial and radial directions while operating at minimum temperatures. For example, precision machining or cutting tools impose heavier loads on bearings than those encountered in precision grinding. In the former, speeds are slower and loads heavier than the latter, where speeds are high and loads light. The 2MM-WI (7-C-P4S) Type gives the machine builder the flexibility required to meet such variations in applications.

3MM-WI (7-E-P4S)

3MM-WI (7-E-P4S), manufactured with 25 degree initial contact angle, are for use on applications where the loading on the initial bearings is predominately axial and a high degree of axial rigidity is required. Typical applications for these are large vertical rotary surface grinders, horizontal and vertical disc grinders, and thrust bearing applications for heavy-duty lathes where the bearings must directly carry extremely high tail stock or chucking pressure.

Fig. 116.
7-C-P4, 7-E-P4, 7-C-P4S and 7-E-P4S Types (7-C-P4S and 7-E-P4S).

2MMV AND 3MMV-HX (HX7-C-P4S AND HX7-E-P4S)

2MMV and 3MMV-HX (HX7-C-P4S and HX7-E-P4S) are dimensionally interchangeable with equivalent 9100, 99100, 9300 and ISO Series 10 and 19 bearings. These designs enable spindle heads to remove more material in less time while maintaining superior machining tolerances. This is achieved through a proven combination of unique ball complements with precision engineering of raceway geometries.

Fig. 117.
2MMV-HXVV and 3MMV-HXVV Types (HX7-C-VV-P4S and HX7-E-VV-P4S).

2MMV AND 3MMV-HX VV (HX7-C-VV-P4S AND HX7-E-VV-P4S)

2MMV and 3MMV-HX VV (HX7-C-VV-P4S and HX7-E-VV-P4S) possess all of the high-speed advantages of the HX but add pre-lubrication and true-high-speed seals. These bearing seals help protect the lubricant from outside contaminants while ensuring internal lubricant retention.

Fig. 118.
MM9300WI DUH (Inch)
MM-BS-DUH (Metric).

BALL SCREW SUPPORT BEARINGS

To meet the demands of the servo-controlled machinery field, the Timken® ball screw support bearings (BSSB) are specially designed with steep contact angles and offer high levels of stiffness for ball screw application requirements. Timken's most recent product offering in this area is a series of double-row, sealed, flanged (or cartridge) units that use an integral double-row outer ring to help simplify installation procedures. Timken offers the following ball screw support bearing products:

- Inch Series BSSB (MM9300).
- Metric Series BSSB (MMBS).
- Flanged cylindrical cartridge housed units (BSBU).
- Pillow block housed units (BSPB).
- Integral double-row units (MMN, MMF).

MICRON BORE AND O.D. CODING FOR BALL BEARINGS

To better match machine tool bearings to spindles, Timken offers micron coding for its super precision angular contact ball bearing line. (Micron coding is standard on all products except ball screw support bearings and Ex-Cell-O bearings.)

Micron coding is based on average bore and O.D. diameters. This type of coding indicates the deviation from the nominal size in microns.

Multiple bearing set coding will reflect maximum O.D. and minimum bore diameters found within the set.

The coding is marked on the inner and outer rings and on the box label.

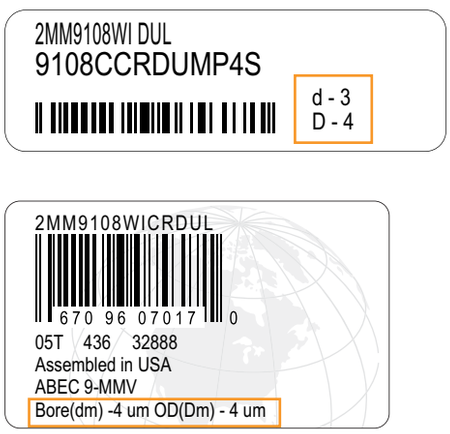


Fig. 119. Packaging coding.

TABLE 70.
DEVIATION FROM NOMINAL.

Micron coding	Micron		Inch	
	Over	Incl.	Over	Incl.
1	**0**	**-1**	0.000000	-0.000039
2	**-1**	**-2**	-0.000039	-0.000079
3	**-2**	**-3**	-0.000079	-0.000118
4	**-3**	**-4**	-0.000118	-0.000157
5	**-4**	**-5**	-0.000157	-0.000197
6	**-5**	**-6**	-0.000197	-0.000236
7	**-6**	**-7**	-0.000236	-0.000276
8	**-7**	**-8**	-0.000276	-0.000315
9	**-8**	**-9**	-0.000315	-0.000354
10	**-9**	**-10**	-0.000354	-0.000394
11	**-10**	**-11**	-0.000394	-0.000433
12	**-11**	**-12**	-0.000433	-0.000472
13	**-12**	**-13**	-0.000472	-0.000512

BALL SCREW SUPPORT BEARING MOUNTING ARRANGEMENTS

An alignment mark is placed on the outer rings of bearing sets as shown. This mark is in the form of a "V" when bearings are in the "O" arrangement (triplex and quadruplex sets only).

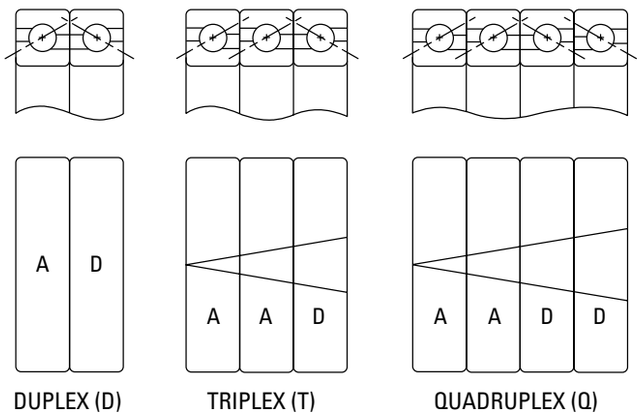


Fig. 120. Ball screw support bearing mounting configurations.

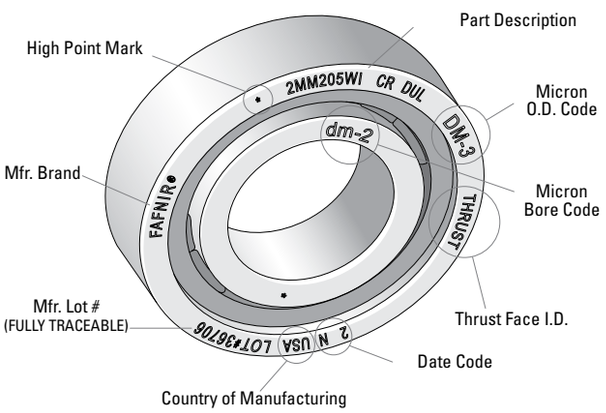
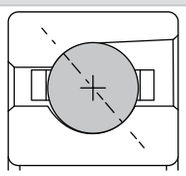
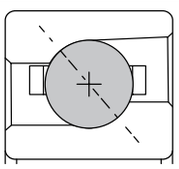
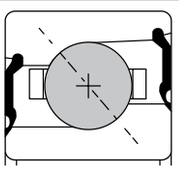
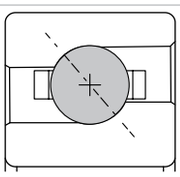
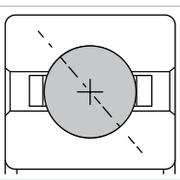
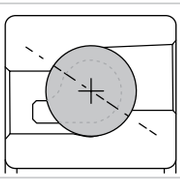
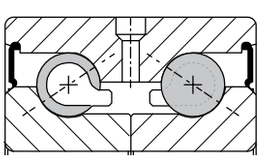
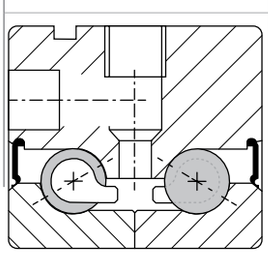


Fig. 121. Super precision markings.

TABLE 71.
TIMKEN'S PRECISION PRODUCT OFFERING

	Series	Design		Size Series	Precision	Contact Angle	Features
Ball Bearings	Spindle Bearings		WI	9300 (71900) 9100 (7000) 200 (7200) 300 (7300)	MV, MM MV, MM MV, MM MM	15°, 25°	High capacity design with outer piloted cage. Ball-piloted cage (PRL) available in 9100 and 200 series.
			HX	9300 (71900) 9100 (7000)	MMV	15°, 25°	High-speed design with outer piloted cage.
			HXVV	9300 (71900) 9100 (7000	MMV	15°, 25°	Sealed high-speed design with outer piloted cage.
			WN	99100	MMV	15°, 25°	High rigidity design with outer piloted cage.
			K	9100 (7000) 200 (7200) 300 (7300	MM	0°	Radial (deep groove) bearing with inner piloted cage.
	Ball Screw Support Bearings		Single Row	200 (7200) 300 (7300)	MM	60°	Single-row high axial capacity and rigidity design with ball-piloted cage.
			Double Row	MMN	MM	60°	Sealed double-row high axial capacity design with split inner rings.
				MMF	MM	60°	Flanged and sealed double-row high axial capacity design with split inner rings and optional snap ring.

APPLICATIONS

Workhead and tool spindles are often the most important components of machine tools. Consequently, to reach the requirements for spindle speed, work accuracy and finish, selection of the proper size and type of ball bearings to support these spindles is critical.

Of all the rolling bearing types, super precision ball bearings have proved to be the best value for the wide variety of machine tool bearing applications, which cover broad ranges of operating loads, speeds and lubrication conditions. Duplexed, preloaded, angular contact bearings with one-piece composition cages have excellent capacity and provide maximum spindle rigidity. These bearings are widely used to help machines achieve faster speeds, greater accuracy, smoother finishes and higher production rates.

Many considerations are involved in the choice of bearings for precision applications. Among those that influence the performance of machine tool spindles are the internal geometry of the bearings, the mounting arrangement, the shaft and housing mounting fits, the balance and alignment of the rotating parts, and last, but equally important, the lubrication. While many of these factors are significant in slow-speed applications, all of them must be considered for high-speed spindles.

To minimize deflection under load, shafts for machine tool spindles are designed to have a minimum unsupported length and maximum cross section. For the same reason, spindle housings are designed heavy enough to carry the work load. Their cross sections are made as uniform as possible to reduce stress concentration during uneven deflection of the frame due to thermal changes. In addition, heavy, well-proportioned housings can function as sinks to conduct heat away from ball bearings.

SELECTIVE ASSEMBLY

Under certain conditions, it may be desirable to control fits more accurately without the added expense of using tighter tolerance bearings and assembly parts. This can be accomplished by selective assembly of the bearings, shafts and housings after they are sized and sorted according to bores and outside diameters. Timken provides bore and O.D. micron coding as standard practice for super precision angular contact radial ball bearings. This improved fit-up at assembly helps to maximize spindle precision.

APPLICATION EXAMPLES

Detailed assembly drawings on the following pages are representative of successful applications of Timken® super precision ball bearings; high-cycle wheel heads; high-speed internal grinding spindles; super precision workheads; and high-speed router spindles. Contact your Timken representative regarding any of your application problems.

SPECIAL REQUIREMENTS

High-speed, grease-lubricated spindles and heavy-precision workheads requiring unusual rigidity and running accuracy are a few of the many special problems involving super precision bearings. These and many other applications generally require design features that can be reviewed by your Timken representative.

HIGH-SPEED INTERNAL-GRINDING SPINDLE

Designed for internal precision grinding, this spindle incorporates 2MM9106WI-CR (7006C-T-P4S) super precision ball bearings, preloaded by a coiled helical spring cartridge. Thrust load exerted by the springs ensures close contact of the balls with the bearing raceways under all operating conditions. The sealed construction provides highly effective protection against intrusion of coolant and foreign matter. Grease is packed and sealed in each bearing prior to assembly. Operating speed of this spindle is 25000 RPM.

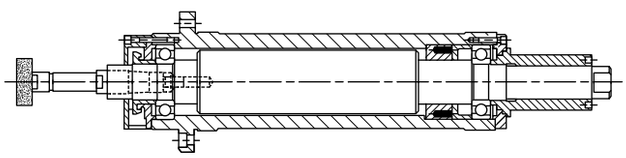


Fig. 122. High-speed internal-grinding spindle.

ULTRA-PRECISION SURFACE-GRINDING SPINDLE

2MMX9122WI-DUM (7022C-P2-DUM) super precision bearings, produced to ABEC 9 (ISO P2) tolerances, are employed in this horizontal surface-grinding spindle for maximum rigidity and accuracy. A back-to-back pair of 2MM312WI-CR-DUL (7312C-CR-P4S-DUL) super precision bearings is used at the floating location. This spindle grinds surfaces that are accurate within 0.0006 mm (0.000025 in.), flat and parallel, square within 0.0003 mm (0.000010 in.), to a surface finish of 5 rms, or better. The spindle, driven by a 30 hp motor, operates at 900 RPM. Bearings are packed with grease prior to assembly.

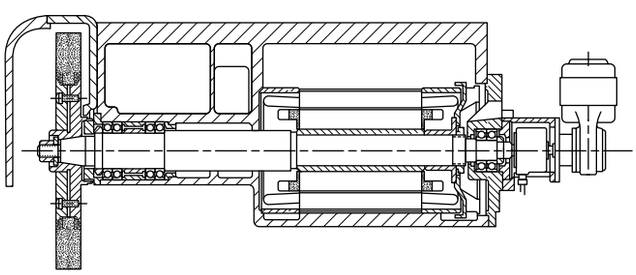


Fig. 123. Ultra-precision surface-grinding spindle.

PRECISION SURFACE-GRINDING SPINDLE

This motorized surface-grinding spindle, operating at 3600 RPM, uses 2MM9107WI-DUM (7007C-P4S-DUM)duplex super precision preloaded bearings at both locations, mounted back-to-back, with one pair floating. Labyrinth slinger-type sealing prevents entry of contaminants and seals in the grease lubrication.

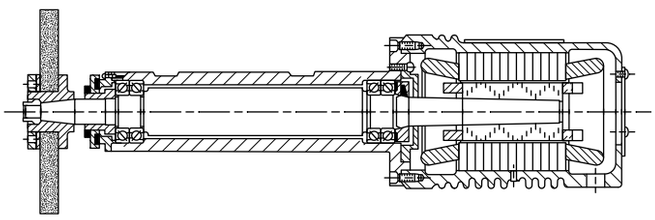


Fig. 124. Precision surface-grinding spindle.

HEAVY-DUTY PRECISION-BORING SPINDLE

Super precision, duplexed, preloaded bearings mounted back-to-back are used at each location in this boring spindle to help ensure smooth performance and a high degree of radial and axial rigidity. Operating speeds vary between 200 and 3000 RPM. Equal-length spacers between the bearings at the workend increase spindle rigidity. When the bearings are properly positioned on the shaft and the respective rings securely clamped, the preload is reproduced and no subsequent adjustment is required. Just prior to assembly, each bearing is packed with grease.

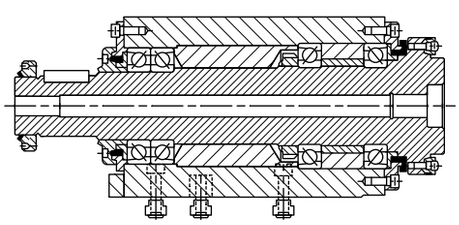


Fig. 125. Heavy-duty precision-boring spindle.

SIX-SPINDLE AUTOMATIC-SCREW MACHINE

This bearing arrangement meets the demand for a high-speed, heavy-duty, multiple-spindle screw machine to operate with constant accuracy at maximum production. Because of the hollow shaft construction and the short distance between bearings, extra-light series duplex pairs are used at each location. This affords a high degree of radial rigidity and adds stiffness to the shaft. By mounting a duplex pair of flanged (3MMF) (F-E-P4S) bearings back-to-back with a duplexed pair of 2MM (C-P4S) super precision bearings, accuracy and rigidity of the spindle are ensured and permit a straight housing bore. The rear pair of back-to-back bearings is allowed to float in the housing. Lubrication is by pressure-feed oil circulation.

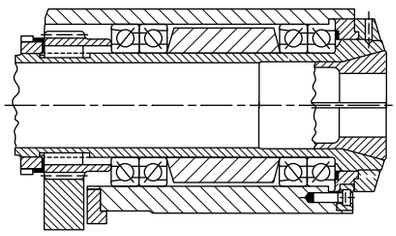


Fig. 126. Six-spindle automatic-screw machine.

HIGH-SPEED PRECISION-BORING HEAD

This high-speed boring head operates at 2500 to 3000 RPM, employing angular contact super precision bearings. The front bearings are of different sizes. The outer ring of the larger bearing abuts and is clamped against the housing shoulder. The inboard bearing is permitted to move axially in its housing under spring load. At the rear location, two spring-loaded bearings of the same size are allowed to float in the housing as temperature differentials occur in the operation spindle. With this head, interference shaft fits may be permitted without affecting bearing preload. Excessive heat generation is prevented, resulting in lower operating temperatures. Bearings are grease lubricated.

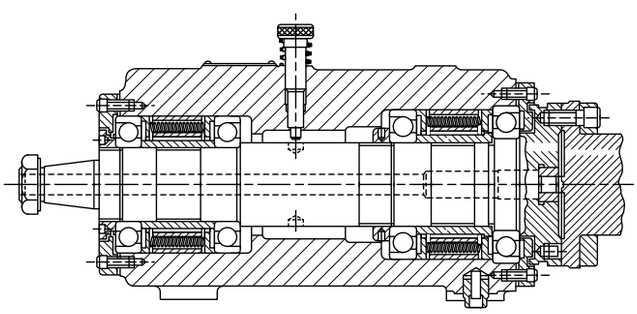


Fig. 127. High-speed precision-boring head.

ULTRA-PRECISION GRINDING WORKHEAD

This workhead must maintain straightness and roundness accuracy within 0.00025 mm (0.000010 in.). To meet such rigid requirements for extremely close dimensional control, ultra-precision ball bearings and a shaft of extra stiffness are used. The bearings for such applications are manufactured to tolerances closer than those for ABEC 9 (ISO P2) specifications. Equally important is the high degree of workmanship and accuracy in which the shaft, housing and component parts of the workhead must be made. The upper section shows a four-bearing arrangement for heavy work. The lower half shows a two-bearing mounting for lighter work. Bearings are packed with grease prior to mounting.

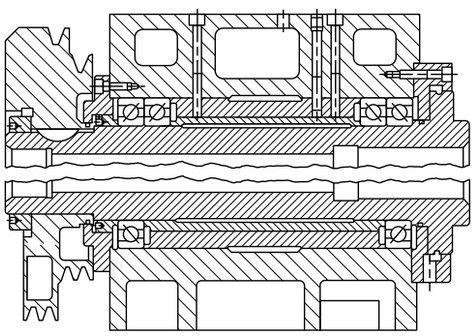


Fig. 128. Ultra-precision grinding workhead.

PRECISION TOOLROOM SURFACE GRINDER SPINDLE

Timken duplexed, super precision, preloaded bearings used in this spindle provide a high degree of rigidity in both radial directions that is necessary to meet modern surface grinding requirements. This design provides more efficient performance at a lower operating temperature. The housing is bored straight through to assure true alignment; the housing shoulders are eliminated. The precision-ground outer sleeve is doweled to the housing to provide the means for stabilizing the spindle axially at the workend bearing location. The rear pair of bearings floats to compensate for thermal changes. Bearings are grease lubricated prior to assembly.

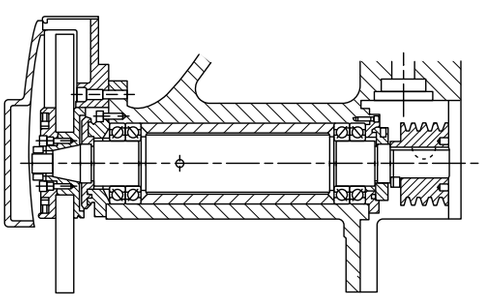


Fig. 129. Precision toolroom surface grinder spindle.

SINGLE-BAR MACHINE

This spindle is supported by two pairs of 2MM9124WI-DUM (7024C-P4S-DUM) super precision bearings mounted back-to-back in tandem pairs. Operating speeds vary from 78 to 1500 RPM. A pair of 2MM9122WI-DUM (7022C-P4S-DUM) bearings mounted in tandem carries a 11340 kg (25000 lb.) thrust load during the unchucking operation. The bearings are grease packed prior to assembly.

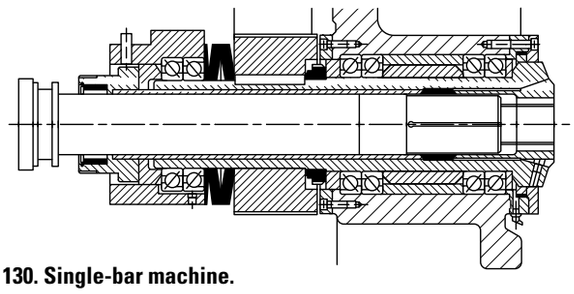


Fig. 130. Single-bar machine.

100000 RPM HIGH-CYCLE WHEELHEAD

Super precision 2MMX9101WO-CR (WO7001C-T-P2) bearings produced to ABEC 9 (ISO P2) tolerances are spring-loaded in this wheelhead, which operates at 100000 RPM. Oil-mist lubrication is employed and the motor is water cooled.

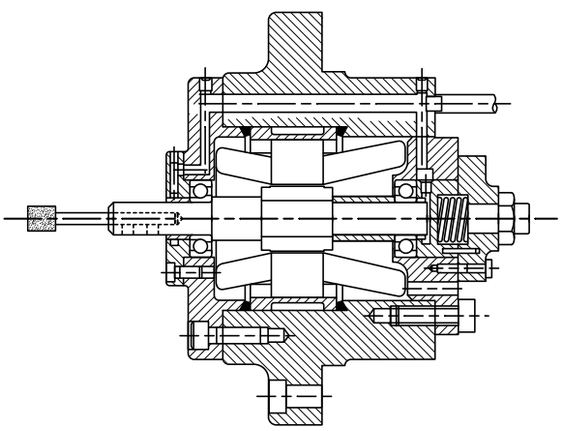


Fig. 131. 100000 RPM high-cycle wheelhead.

PRECISION JIG-BORING SPINDLE

This jig-boring spindle delivers extreme accuracy over a wide range of speeds. It is supported with 2MM210WI-DUM (7210C-P4S-DUM) grease-lubricated super precision bearings. With this spindle, holes located to an accuracy of 0.0025 mm (0.0001 in.) are bore-ground straight and to size limits of better than 0.005 mm (0.0002 in.).

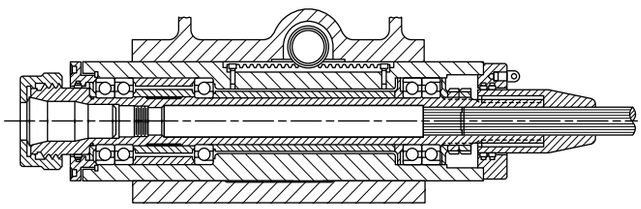


Fig. 132. Precision jig-boring spindle.

SUPER PRECISION LATHE HEADSTOCK

This lathe spindle produces work held to a roundness of 0.0009 mm (0.000035 in.). Maximum operating speed is 4800 RPM. A tandem pair of 3MM9114WI-DUL (7014E-P4S-DUL) bearings is opposed by a spring-loaded 3MM9113WI (7013E-P4S) bearing, resulting in excellent spindle rigidity. Bearings are prelubricated with grease.

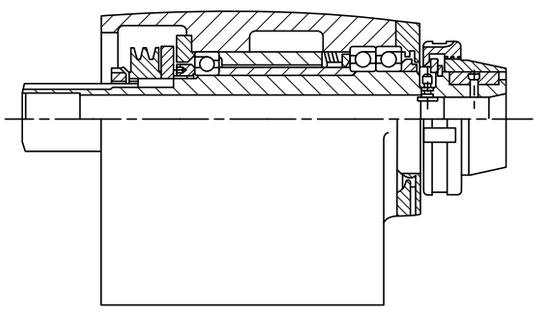


Fig. 133. Super precision lathe headstock.

HIGH-SPEED MOTORIZED ROUTER

A specially matched duplex pair of Timken 2MM210WI-DU-FS223 (7210C-P4S-DU-FS223)super precision ball bearings, mounted back-to-back at the workend, affords the necessary bearing rigidity to permit routing through aluminum plate 25.400 mm (1.0000 in.) thick with a single pass. The upper bearing is spring-loaded and permitted to float. The router is driven by a 30 hp motor at speeds up to 15000 RPM and uses oil-mist lubrication.

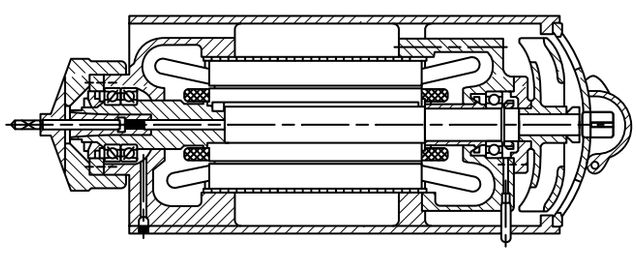


Fig. 134. High-speed motorized router.

PRECISION VERTICAL MILLING SPINDLE

This spindle operates at 12 different speeds ranging from 260 to 6200 RPM under a wide variety of conditions. At the workend, two duplex pairs of Timken 2MM212WI-DUL (7212C-P4S-DUL) preloaded bearings are mounted in tandem in a back-to-back arrangement, separated by spacers of equal length. This affords extremely high radial and axial rigidity. At the center, a pair of 2MM210WI-DUL (7210C-P4S-DUL) bearings mounted back-to-back permits axial float of the spindle to compensate for thermal changes.

The driving pulley shaft is rigidly supported by a widely spaced duplex pair of 2MM212WI-DUL (7212C-P4S-DUL) preloaded bearings. All bearings are grease packed.

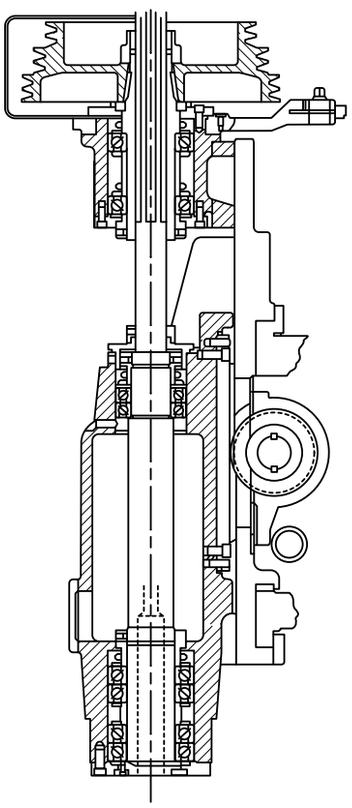
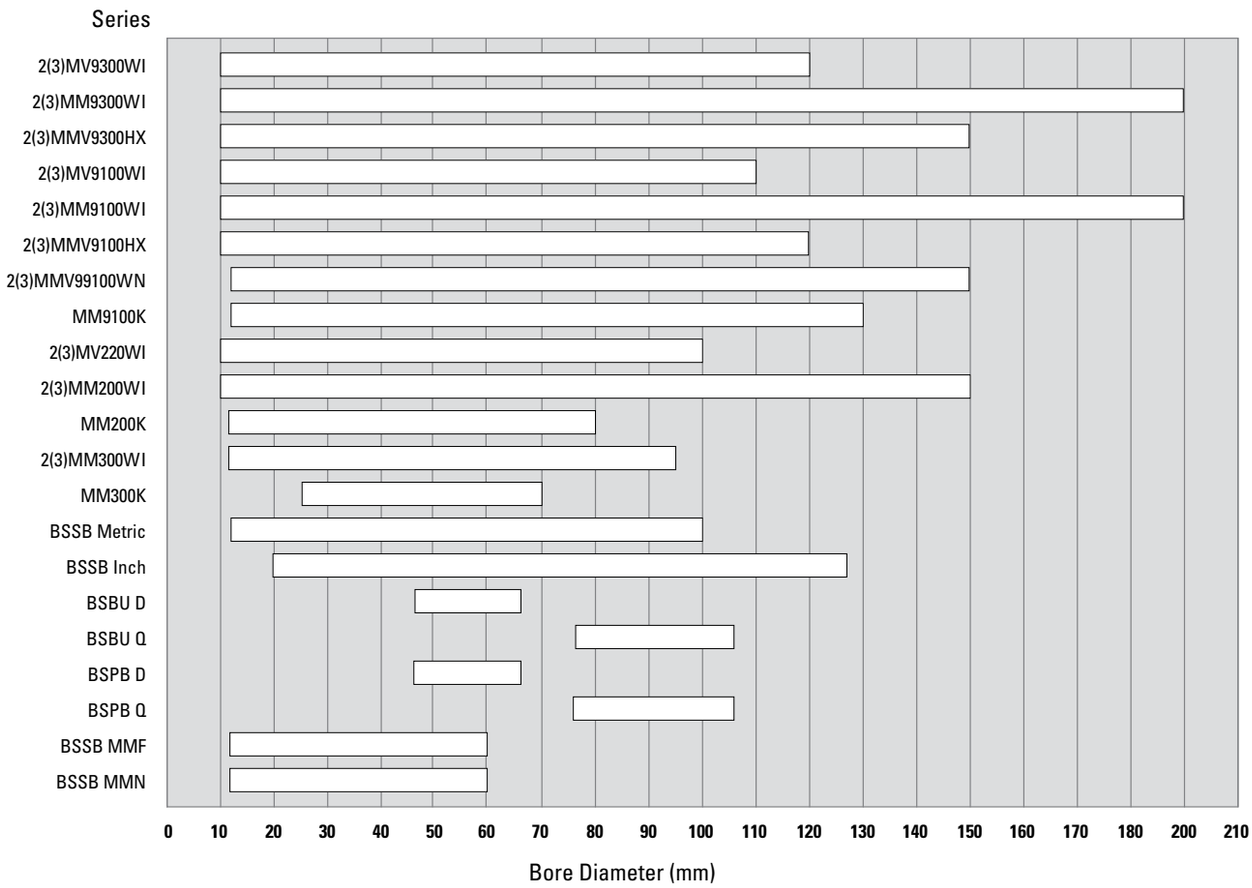


Fig. 135. Precision vertical milling spindle.

BALL BEARING BORE DIAMETERS FOUND IN THIS CATALOG



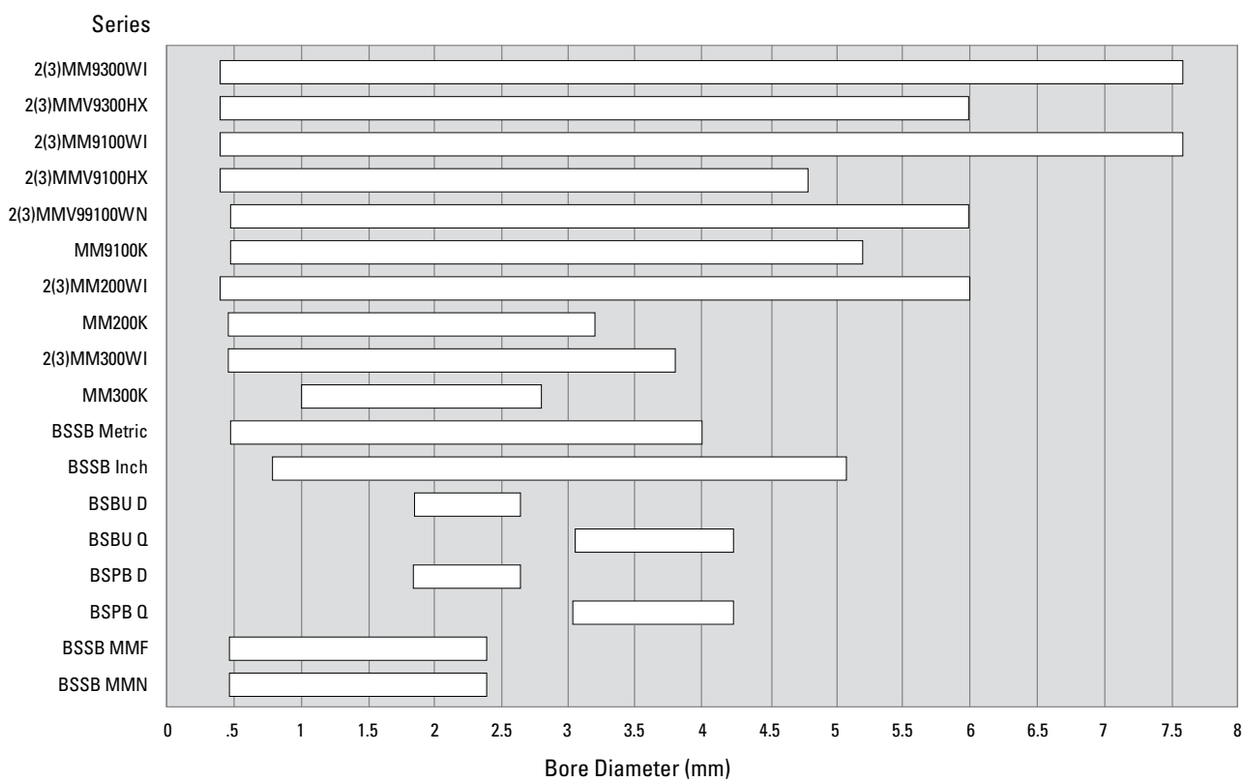


Fig. 136. Bore diameters.