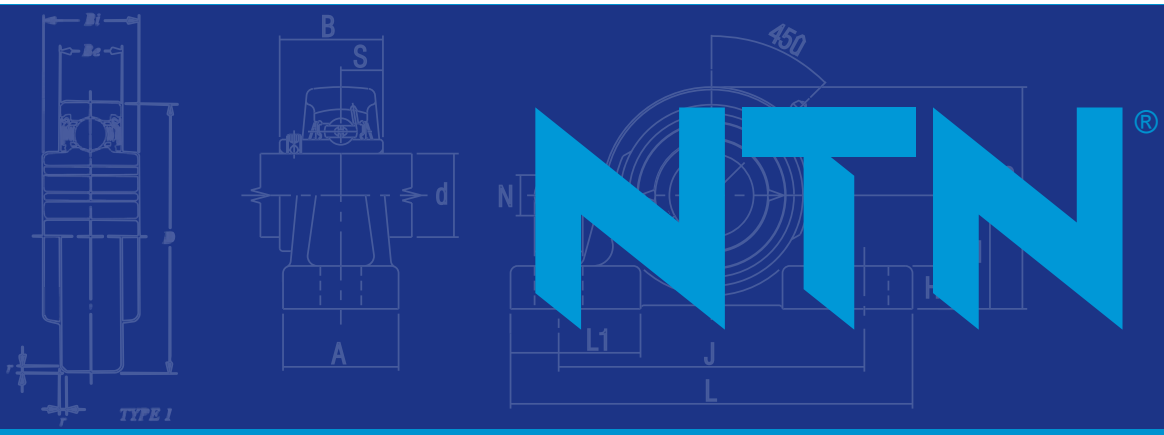


BALL AND ROLLER BEARINGS

CATALOG A-1000-XI

BALL AND ROLLER BEARINGS

CATALOG A-1000-XI

Equal Opportunity Employer
Printed in USA 12/2009

NTN Terms and Conditions of Sale

Offer; Acceptance. These terms and conditions (these "Terms") are deemed part of all quotations, acknowledgments, invoices, purchase orders and other documents relating to the sale of goods and services (the "Goods") by Seller. If these Terms differ in any way from any purchase order, release or other document from Buyer, these Terms shall be construed as a counteroffer and will not be effective as an acceptance of any other term except on the express condition that Buyer assents to these Terms; provided that Buyer is deemed to have accepted these Terms upon the earlier of 10 days after receipt without objection and acceptance by Buyer of any Goods.

Warranties. (a) Exclusive Warranty. The exclusive Seller warranty is that the Goods are free from defects in materials and workmanship. This warranty is extended solely to Buyer and not to any successive buyers, users or other third parties. SELLER MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT THE MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE GOODS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE GOODS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. SELLER DISCLAIMS ALL OTHER EXPRESS WARRANTIES. (b) Buyer Remedy. The exclusive remedy of Buyer as to any Good is that Seller shall repair or replace (at Seller's option) the Good (with Buyer responsible for labor charges for removal or replacement thereof), such obligation being subject to the following: (i) the Good's application was approved by Seller; (ii) Buyer delivers the Good to Seller with transportation charges prepaid; and (iii) analysis by Seller verifies that the Good was properly handled, installed, maintained, lubricated and not subject to abuse, misuse or inappropriate modification. (c) Damage Limits; Etc. SELLER SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE GOODS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY. Further, in no event shall liability of Seller for any act exceed the price of the Good on which liability is asserted. Buyer must commence any action within one year after the sale of such Good by Seller.

Delivery; Packaging. (a) Dates. Delivery and shipment dates are estimated dates only. (b) Partial Shipment; Etc. Each partial shipment is deemed a separate contract for the delivered Goods. (c) Shipment Terms. All shipments are freight collect - FOB shipping point and Seller reserves the right to select transportation methods and routing. (d) Packaging. Seller will package Goods as it deems proper for protection against normal handling and extra charges apply to special conditions. (e) Risk of Loss. Risk of loss will pass to Buyer upon tender by Seller at the point of shipment defined as Seller's dock.

Pricing; Payment; Etc. (a) Pricing. Prices are subject to change without notice, and prices in effect on the shipping date will govern. Any increases in freight rates or transportation charges before shipment will be for Buyer's account. Prices also are subject to increase for any taxes, duties (including dumping duties) or other charges imposed on Seller by any governmental authority for the sale, delivery or use of the Goods. (b) Payment. Terms of payment are net 30 days from the invoice date. If Buyer fails to make any payment when due or Seller otherwise deems itself insecure, Seller reserves the right to change terms of payment and discontinue shipments. Buyer agrees to pay Seller's customary late and interest charges for any failed or late payments.

Inspection; Etc. Buyer promptly shall inspect all delivered Goods. If Buyer does not inspect any Goods within six days of delivery, Buyer is deemed to have waived its right to inspect and to accept the Goods. Buyer must report to Seller shortages or defective Goods within ten days of receipt. Buyer may not return Goods without Seller's written consent, and Buyer's acceptance shall be final and irrevocable.

Cancellation; Etc. Orders approved and accepted by Seller shall constitute firm commitments of Buyer and are not subject to cancellation or rescheduling. Orders for non-standard Goods not listed in Seller's catalogs may not be canceled at all, nor will Seller accept return of such Goods for credit.

Indemnities. Buyer shall indemnify and hold harmless Seller, its employees and representatives from and against all liabilities, claims, actions, costs, expenses and disbursements (including attorney's fees and disbursements) related to any investigation, litigation or other proceeding (whether or not Seller is a party thereto) which arises or is alleged to arise from Buyer's acts or omissions under these Terms. Without limiting the foregoing, Buyer shall indemnify and hold harmless Seller and defend or settle any action brought against Seller to the extent that it is based on a claim that any Good made to Buyer specifications infringed intellectual property rights of another party.

Confidentiality; Inventions. (a) Confidentiality. All information and materials supplied by Seller to Buyer relating to the Goods are confidential and proprietary, and Buyer shall limit distribution thereof to its trusted employees and use its best efforts to preserve the confidentiality thereof. (b) Inventions; Etc. If Seller or any of its affiliates makes a discovery or invention pertaining to any research, development or design work contemplated hereby, such discovery or invention shall be the sole property of Seller and licensing shall be at the discretion of Seller.

Force Majeure. Seller shall not be liable for any delay or failure in delivery resulting from causes beyond its control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the requirements of any government authority.

Miscellaneous. (a) Waiver. No failure or delay by Seller in exercising any right and no course of dealing between Buyer and Seller shall operate as a waiver of rights by Seller. (b) Assignment. Buyer may not assign its rights hereunder without the Seller's written consent. (c) Law. This Agreement is governed by Illinois law (without regard to conflict of law principles). (d) Amendment. This Agreement constitutes the entire agreement between Buyer and Seller relating to the Goods, and no provision may be changed or waived unless in a writing signed by the parties. (e) Severability. If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (f) Setoff. All claims hereunder by Seller are subject to setoff by Seller for any counterclaim arising out of any transaction with Buyer. (g) Tooling; Etc. All materials, equipment, facilities and special tooling Seller uses to manufacture Goods shall remain the property of Seller. (h) Definitions. "Including" means "including without limitation.

Although care has been taken to assure the accuracy of the data compiled in this catalog, NTN does not assume any liability to any company or person for errors or omissions.

Table of Contents

IN NORTH AMERICA

NTN is one of the three largest bearing companies in the world. With facilities at the hub of industrial centers around the globe, NTN Bearing Corporation is in an enviable position to best serve its customers, both domestic and worldwide.

In North America, as in all our manufacturing facilities, we attain maximum efficiency using our automated production equipment and processes to produce quality high-volume standard bearing sizes. Low-volume bearings and sizes are manufactured in a single facility and then exported worldwide according to customer requirements. All bearing types and sizes currently used in North America are in inventory at warehouses across the continent.

To best serve our customers, NTN devotes all resources to a single objective: production of the finest quality ball and roller bearings. All of our plants use advanced processing and high speed automated production equipment, engineered and built by NTN, to support our capacity for ultra-high quality bearings. NTN's Statistical Process Control programs ensure that during the production run, every bearing produced meets or exceeds AFBMA and ISO standards. Electro-mechanical quality inspection is present at every phase of manufacturing.

Proof of NTN's success at meeting our objective are the many quality awards received from our customers. Another cherished award was received in 1954 when NTN became the first bearing manufacturer to win the Deming Prize. This prestigious award is given for outstanding performance above all mechanical industries in statistical quality control, and efficiency of machinery and management. NTN's rigid quality standards originated with the company in 1918, and is the basis for every product innovation and corporate decision made today.

NTN's highly trained employees are here to serve your engineering, sales, and manufacturing needs. Customers receive unparalleled attention through technical assistance from over 700 engineers in North America, Europe and the Far East — all linked through 24-hour global communications. This

provides you with access to support from research and development engineers, application experts and field engineers. Our extensive testing and development laboratories keep us at the leading edge of bearing technology.

NTN became a world leader through attention to our customers' needs and constant technological innovations. Value-added bearings are NTN's forte. Our quality level allows purchasers to take them directly from receiving dock to application, eliminating incoming inspection costs. They add value to your end product with longer lifetime, less downtime and less maintenance.

HISTORY

1918 Began research and manufacture of ball bearings at Nishizono Ironworks (Uchibori, Kuwana-cho, Kuwanagun, Mie Pref.)

1923 Nishizono Ironworks and Tomoe Trading Co. (Nishi-ku, Osaka) inaugurated joint manufacture and sale of bearings under the brand name NTN.

1927 NTN Mfg. Co., Ltd. established with capital of ~50, 000.

1937 Renamed the Toyo Bearing Mfg. Co., Ltd.

1938 Established Showa Bearing Mfg. Co., Ltd. (Muko-gun, Hyogo Pref.)

1939 Kuwana Plant constructed.

Showa Bearing Mfg. Co., Ltd. merged to become Muko-gawa Plant.

1950 Established NTN Sales Co., Ltd.

1954 Awarded Deming Prize for statistical quality control for the first time in the machinery industry.

1960 Established Toyo Bearing Iwata Co., Ltd.

Established NTN Walzlager (Europa).

1962 Constructed needle bearing factory in Toyo Bearing Iwata Co., Ltd.

Changed name of Muko-gawa Plant to Takarazuka Plant.

Established Toyo Bearing Machine Tool Laboratory Co., Ltd.

1963 Established NTN Bearing Corp. of America, New York.

Skokie, IL, office and warehouse opened.

1964 Established NTN France S.A.

Established NTN Bearings (UK) Ltd.

1966 Established NTN Powdered Metal Co., Ltd.

1967 Executed Technical Assistance Agreement with Tung Yang Bearing Mfg. Co., Ltd. (Taiwan)

NBCA Lincolnwood, IL, Head Office and warehouse established.

1968 Established NTN Bearing Corp. of Canada Ltd.

1970 NBCA California sales office opened.

1971 Established American NTN Bearing Mfg. Corp. (Schiller Park, IL)

Established NTN Trading-Hong Kong Ltd.

Established Toyo Bearing Okayama Co.,Ltd.

Established NTN Kugellagerfabrik. (Deutschland)

NBCA Atlanta sales office opened.

1972 Renamed as NTN Toyo Bearing Co., Ltd.

Established NTN Product Development Institute.

NBCA Irvine, CA, office and warehouse occupied.

NBCA Headquarters building occupied. (Des Plaines, IL)

1973 Established NTN Bearing Mfg. (Canada) Ltd. (Merged into NTN Bearing Corp. of Canada Ltd. in 1980.)

Constructed constant-velocity joint factory in Toyo Bearing Iwata Co., Ltd.

1975 Established NTN Elgin Corp. (U.S.A.). (Merged into American NTN Bearing Mfg. Corp. in 1985.)

New Takarazuka Plant completed.

NBCA Michigan sales office opened.

1976 NBCA Dallas sales office opened.

1977 NBCA Totowa, NJ, office and warehouse occupied.

1980 NBCA Automitve Sales/Engineering Office established, Southfield, MI.

NBCA Distribution office and warehouse established, Mt. Prospect, IL.

1981 Research Departments reorganized into General Engineering Laboratory.

1982 Constructed constant-velocity joint factory in Toyo Bearing Okayama Co. Ltd.

Constant Velocity joint technology licensed to Hyundai Motors (South Korea).

NBCA Norcross, GA, office and warehouse occupied.

1983 Constant velocity joint technology licensed to Lepco Co, Ltd. (Australia)

Merged with Toyo Bearing Iwata Co., Ltd. and Toyo Bearing Okayama Co., Ltd.

Constant velocity joint technology licensed to Taiway Ltd. (Taiwan)

NBCA Irving, TX, office and warehouse occupied.

NBCA Headquarters building expanded. (Des Plaines, IL)

NBCA Midwest and Central sales offices established. (Des Plaines, IL)

NBCA Peopria, IL, sales office opened.

1984 Ground broken for Elgin, IL, tapered roller bearing manufacturing facility.

1985 Established Toyo Bearing Nagano Co. Ltd.

Bearing production technology licensed to National Engineering Industries Ltd. (India)

Established NTN-Bower Corporation, a joint venture with Federal-Mogul Corporation. (U.S.A.)

1986 Constructed (in Kuwana Plant) Japan's first plant dedicated to aerospace bearings.

1987 NTN-Bower Corporation became 100% owned affiliate.

1988 Established NTN Technical Center (U.S.A.) Inc. (Ann Arbor, MI)

Established Unidrive Pty. Ltd., a joint venture manufacturer of constant velocity joints in Australia.

Ground broken for Elgin, IL, bearing hub unit manufacturing facility.

1989 Built new building for R&D at Iwata Plant.

Merged with Toyo Bearing Nagano Co.

Established NTN Driveshaft Inc. (Columbus, IN — CVJ facility)

Renamed parent company NTN Corporation.

Bearing hub unit production began at Elgin, IL, facility.

1990 Built new building for R&D at Kuwana Plant.

NTN USA Corporation founded as headquarters in the U.S.A.

1991 NBCA and NTN USA Corp. occupied new Head Office in Mt. Prospect, IL.

NBCA Eastern Region occupied new offices, training center and warehouse in Exton, PA.

1994 Obtained ISO9002 certification (Kuwana Plant).

Established a distribution center in Singapore.

1996 Bought the ball bearing division of American firm Federal-Mogul Corporation (U.S.A.), NTN-BCA established.

Achieved 200-million target for domestic production of constant velocity joints

1997 Nagano Plant and 4 engineering departments obtained ISO9001/QS-9000 certification for their quality systems

Established NTN do Brazil Ltda.

1998 Established NTN Manufacturing (Thailand) Co., Ltd.

Iwata area NTN enterprises obtained ISO14001 certification

Established NTN Transmission Europe for CVJ production through a joint corporation with Renault of France.

1999 All plants and R&D Centers in Japan obtained ISO14001 certification by a multi-site qualification procedure

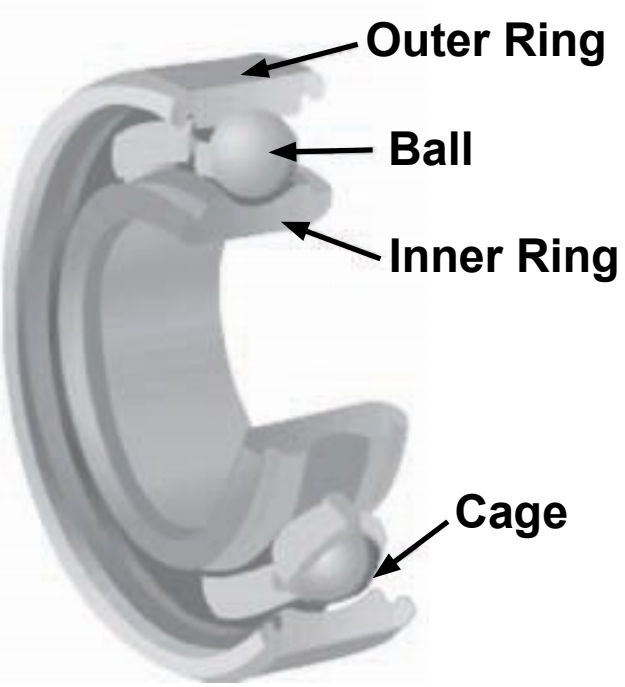
2000 NTN Group completed full certification for the ISO9000 series

2002 In a joint venture, established SHANGHAI NTN CORPORATION in China for the manufacture of CVJ cassetles and other products. In a joint venture with Nidec Corporation of Japan, established NTN-NIDEC (ZHEJIANG) CORPORATION for the manufacture of FDB units in China.

In a joint venture with Taiwan Yulong Group Corporation, established GUANGZHOU NTN-YULON DRIVETRAIN CO., LTD. for the manufacture of C.V. Joint Units in Guang Zhou, China.

2003 In the U.S.A. established NTK Precision Axle Corporation and Asahi Forge of America Corporation, joint ventures for production of constant velocity joint components. In China established Beijing NTN-Seohan Driveshaft Co., Ltd., a joint venture with Korea Flange Co., Ltd. for constant velocity joint production

BEARING CLASSIFICATION

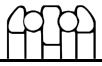


CLASSIFICATION OF ANTI-FRICTION BEARINGS

Most rolling bearings consist of bearing rings (an inner ring and an outer ring), rolling elements and a rolling element retainer (cage). The retainer separates the rolling elements at regular intervals, holds them in place within the inner and outer raceways, and allows them to rotate freely.

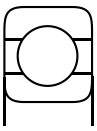
Rolling bearings fall into two main classifications: ball bearings and roller bearings. Balls geometrically contact the raceway surfaces of the inner and outer rings at “points,” while the contact surface of rollers is a “line” contact. Rollers come in four basic geometric styles: cylindrical, needle, tapered and spherical. Rolling bearings can further be classified according to the direction in which the load is applied: radial, thrust, or a combination of both.

While the rolling elements and the bearing rings take any load applied to the bearings (at the contact point between the rolling elements and raceway surfaces), the retainer takes no direct load. It only serves to hold the rolling elements at equal distances from each other, forcing the rolling elements to enter the load zones and prevent them from falling out.

- Rolling bearings
  - Ball bearings
    - Radial ball bearings
      -  Single row deep groove ball bearings
      -  Maximum capacity type ball bearings
      -  Single row angular contact ball bearings
      -  Duplex angular contact ball bearings
      -  Double row angular contact ball bearings
      -  Four-point contact ball bearings
      -  Self-aligning ball bearings
    - Thrust ball bearings
      -  Single direction thrust ball bearings with flat back face
      -  Single direction thrust ball bearings with seating ring
      -  Double direction thrust ball bearings with flat back face
      -  Double direction thrust ball bearings with seating rings
      -  Double direction angular contact thrust ball bearings
  - Roller bearings
    - Radial roller bearings
      -  Single row cylindrical roller bearings
      -  Double row cylindrical roller bearings
      -  Needle roller bearings
      -  Single row tapered roller bearings
      -  Double row tapered roller bearings
      -  Spherical roller bearings
    - Thrust roller bearings
      -  Cylindrical roller thrust bearings
      -  Needle roller thrust bearings
      -  Tapered roller thrust bearings
      -  Spherical roller thrust bearings

DESIGN AND CHARACTERISTICS OF BALL AND ROLLER BEARINGS

SINGLE ROW RADIAL BALL BEARINGS are the most widely used bearings and utilize an uninterrupted raceway, which makes these bearings suitable for radial loads, or a combination of thrust and radial loads. This design permits precision tolerances even at high speed operation.



The cage in this bearing is pressed steel. For high speed bearings, machined brass cages are available. Bearings with locating snap rings are also available.

PRELUBRICATED BEARINGS have integral seals, or shields, which are packed with long-life grease. In many applications, these bearings may be used without supplementary seals, closures, or protective devices. This design offers the lowest possible manufacturing cost to the consumer.

The boundary dimension of this type is the same as the corresponding bearings without the seals or shields.

SHIELDED BALL BEARINGS are protected on one, or both sides (suffixes Z and ZZ, respectively) by metal shields fastened to the outer ring. This close clearance labyrinth seal retains the lubricant and prevents the entrance of foreign matter.

SEALED BALL BEARINGS incorporate steel reinforced rubber seals securely fastened to a groove on the outer ring. Contact with the inner ring is by sealing lip (Contact Suffix LLU). Or, non-contact with the inner ring is by labyrinth seal (Non-contact Suffix LLB) to provide positive sealing at all times.

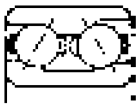
SINGLE ROW ANGULAR CONTACT BALL BEARINGS feature raceways with high and low shoulders. These opposing raceways are designed to carry thrust load in one direction.

These bearings may be preloaded at the factory so that the correct preload will develop within the bearing.

The bearings in this series are assembled with a specific internal clearance so that they will have a specified contact angle under load. The standard contact load used by NTN is 30°; bearings made to a 40° contact angle carry the suffix B.

For high speed grinding spindles, the 7000C, 7200C and the 7300C series are available. They are high accuracy bearings with a 15° contact angle, and phenolic resin cages for high speed operations.

DOUBLE ROW ANGULAR CONTACT BALL BEARINGS have an inner and outer ring with a double raceway. The two rows are so related that the contact angle is similar to a pair of back-to-back single row bearings. The 5200 and 5300 series offer continuous races and can carry thrust loads in either direction. Since the 3200 and 3300 series have filling slots, it is necessary to mount them with the thrust load acting against the unnotched face of the rings.



DOUBLE ROW SELF-ALIGNING BEARINGS utilize an inner ring with two rows of balls in two deep raceways, and an outer ring with a single spherical raceway. In this way, the inner and outer rings can be misaligned relative to each other. The resulting effect is a comparatively large angle imposing moment loads upon the balls.

The boundary dimensions of the 1200 and 1300 series are the same as the 6200 and 6300 single row deep groove bearings.

CYLINDRICAL ROLLER BEARINGS have rollers which are essentially cylindrical in shape. This provides a modified line contact with the cylindrical inner and outer ring raceways, while the rollers are guided by ground ribs on either the inner or outer ring.

The cylindrical shape allows the inner ring to have axial movement relative to the outer ring (except the NH type). This is especially important when accommodating thermal expansion when both rings must be press fitted.

In this series, the NJ, NF and NH types can carry light or intermittent thrust loads.

The NN3000 and NN3000K series are available in high precision tolerances and are well suited for use in machine tool spindles.

TAPERED ROLLER BEARINGS utilize conical rollers and raceways arranged so that the rollers and raceways meet at a common apex. The rollers are guided by contact between the large end of the roller and a rib on the inner ring. This provides high capacity for radial and single thrust loads.

SPHERICAL ROLLER BEARINGS have two rows of rollers in separate raceways which allows the bearing to compensate for angular thrust errors. They have large radial and thrust load capacity for heavy shock and impact loads, making them suitable for heavy industrial equipment.

DUPLEX BEARINGS use a set of two on a common shaft with the inner and outer rings clamped solidly together. They are used to gain axial shaft control, rigidity and extra capacity.

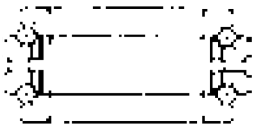
There are three fundamental combinations in duplex bearings: face-to-face (DF), back-to-back (DB), and tandem (DT).

DF DB DT

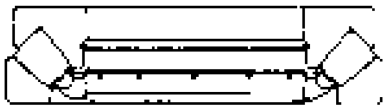
SINGLE DIRECTION THRUST BEARINGS consist of two washers having ball grooves ground into their adjacent faces with balls and cages mounted between these grooves. They are normally equipped with either pressed or machined cages and are suitable for carrying thrust loads at moderate speeds.

DOUBLE DIRECTION ANGULAR CONTACT THRUST BALL BEARINGS are back-to-back duplex bearings with a larger contact angle than that of normal angular contact ball bearings.

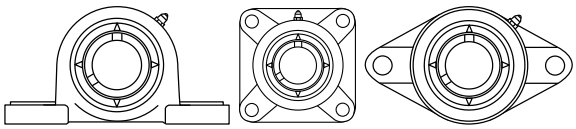
These bearings are primarily designed as thrust bearings for machine tools. They utilize machined brass cages.



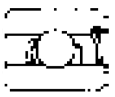
SPHERICAL ROLLER THRUST BEARINGS are similar to double row spherical roller bearings, but have a greater contact angle. They are guided by ground flanges on the inner ring and operate against the spherical raceway in the outer ring. The contact angle is approximately 45°. Machined cages are normally used, and oil lubrication is recommended.

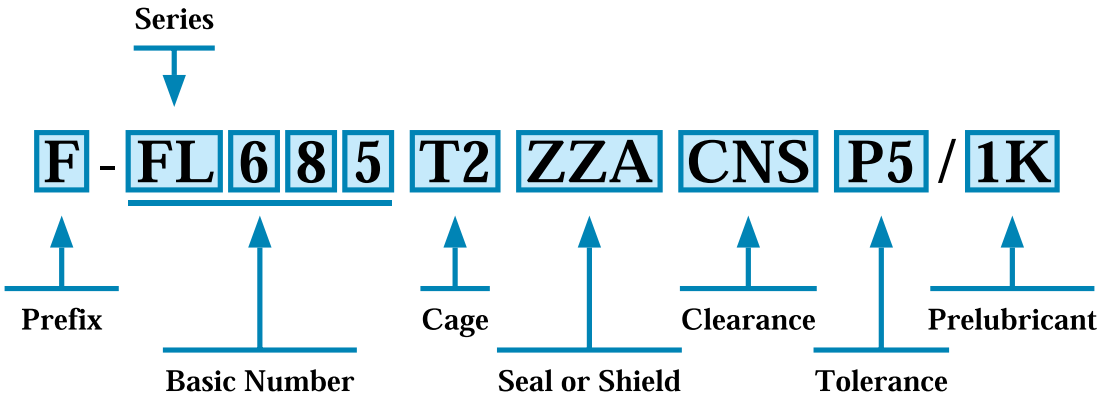


BEARING UNITS consist of a ball or roller bearing installed within a housing. The housings are most commonly made of cast iron but may also be made of other metals or nonmetallic materials. The housing provides rigidity and secure positioning for the bearing within the application. It also simplifies the task of replacing the bearing as the housing and bearing can be replaced as a complete unit.



MICRO BEARING NUMBERING SYSTEM

Open Type	Single Shield Type	Double Shield Type	Flanged Outer Ring: Open Type	Flanged Outer Ring: Single Shield Type	Flanged Outer Ring: Double Shield Type
					
67 68 69 60 62 63 R(A)	W(A)67ZA W68Z(A) (W)69Z(A) (W)60Z(A) 62Z 63Z R(A)-Z(A)	W(A)67ZZA W68ZZ(A) (W)69ZZ(A) (W)60ZZ(A) 62ZZ 63ZZ R(A)-ZZ(A)	FL67 FL68 FL69 FL60 FL62 FL63 FLR(A)	FL(A)W(A)67ZA FLW68Z(A) FL(W)69Z(A) FL(W)60Z(A) FL62Z FL63Z FLR(A)-Z(A)	FL(A)W(A)67ZZA FLW68ZZ(A) FL(W)69ZZ(A) FL(W)60ZZ(A) FL62ZZ FL63ZZ FLR(A)-ZZ(A)
					
RW	R(A)W-ZA	R(A)W-ZZA	FLRW	FLR(A)W-ZA	FLR(A)W-ZZA



1. PREFIX
   - No Symbol: High carbon chrome bearing steel (equivalent to AISI E52100)
   - F: Martensitic stainless steel (equivalent to AISI 440C)

2. SERIES
   - 67, 68: Metric series
   - 69, 60: Metric series
   - 62, 63: Metric series
   - R: Inch series
   - W: Wider than standard width (sealed type)
   - WA: Non-standard sizes
   - RA: Wider than standard width of inch series (open and sealed types)
   - FL: Flanged outer ring
   - FLA: Flanged outer ring, provided non-standard flange dimensions

3. CAGE
   - No Symbol: Pressed steel cage
   - J1: Pressed stainless steel cage
   - T1: Phenolic resin cage
   - T2: Nylon cage

4. SEAL OR SHIELD
   - No symbol: Open Type
   - Z, ZZ: Steel shield(s)
   - ZA, ZZA: Removable steel shield(s)
   - ZA1, ZZA1: Removable stainless steel shield(s)
   - Z1, ZZ1: Stainless steel shield(s)
   - LB, LLB: Non-contact type rubber seal(s)
   - LU, LLU: Contact type rubber seal(s)

5. INTERNAL CLEARANCE
   - No Symbol: Normal clearance
   - C2: Clearance less than normal
   - C3: Clearance greater than normal
   - C4: Clearance greater than C3
   - C2S: Low group of C2 clearance
   - CNS: Low group of normal clearance
   - CNM: Medium group of normal clearance
   - CNL: High group of normal clearance
   - C3S: Low group of C3 clearance
   - C3M: Medium group of C3 clearance
   - C3L: High group of C3

6. TOLERANCE
   - No Symbol: ISO class 0 (equivalent to ABEC 1)
   - P6: ISO class 6 (equivalent to ABEC 3)
   - P5: ISO class 5 (equivalent to ABEC 5)
   - P4: ISO class 4 (equivalent to ABEC 7)
   - P2: ISO class 2 (equivalent to ABEC 9)
   - P5A: ISO class 5A
   - P4A: ISO class 4A
   - PS5: NTN PS class 5
   - PS4: NTN PS class 4
   - PX1: Special tolerance

7. PRELUBRICANT
   - 1K: Kyodo Yushi Multemp PS No. 2
   - 2AS: Shell Alvania 2
   - 1E: Exxon Andok C
   - 6K: Klüber Isoflex Super LDS18
   - 5C: Chevron SRI2
   - 5K: Kyodo Yushi Multemp SRL
   - 1W: Anderson Oil Winsor Lube L245X (oil)
   - L627: Exxon Polyrex EM

10. SPECIAL SPECIFICATION
    - V1...Vn

NTN

MICRO SERIES

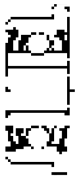
INCH

Units: **INCHES**

MICRO BEARING (INCH SERIES)

OPEN TYPE | DOUBLE SHIELD TYPE

Flanged Outer Ring



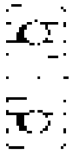
Flanged Outer Ring

Bearing No.	Boundary Dimensions				Bearing No. Flange Type	Boundary Dimensions		Bearing No.	Boundary Dimensions			Flange Width	Basic Load Ratings (lbs)		Limiting Speeds (RPM)	
	Bore	O.D.	Width	Min. Chamfer		Flange O.D.	Flange Width		Width	Bearing No. Flange Type w/Shields	OD		C Dynamic	Co Static	Grease	Oil
R01	0.0400	0.1250	0.0469	0.003	—	—	—	—	—	—	—	—	22	6	110,000	130,000
R0	0.0469	0.1562	0.0625	0.003	FLR0	0.203	0.013	RA0ZZA	0.0937	FLRA0ZZA	0.203	0.031	36	10	93,000	110,000
R1	0.0550	0.1875	0.0781	0.003	FLR1	0.234	0.023	RA1ZZA	0.1094	FLRA1ZZA	0.234	0.031	42	13	81,000	95,000
R1-4	0.0781	0.2500	0.0937	0.003	FLR1-4	0.296	0.023	RA1-4ZZA	0.1406	FLRA1-4ZZA	0.296	0.031	63	20	67,000	79,000
R133	0.0937	0.1875	0.0625	0.003	FLR133	0.234	0.018	RA133ZZA	0.0937	FLRA133ZZA	0.234	0.031	28	9.5	73,000	85,000
R1-5	0.0937	0.3125	0.1094	0.005	FLR1-5	0.359	0.023	RA1-5ZZA	0.1406	FLRA1-5ZZA	0.359	0.031	96	34	56,000	66,000
R144	0.1250	0.2500	0.0937	0.003	FLR144	0.296	0.023	RA144ZZA	0.1094	FLRA144ZZA	0.296	0.031	64	22	59,000	70,000
R2-5	0.1250	0.3125	0.1094	0.003	FLR2-5	0.359	0.023	RA2-5ZZA	0.1406	FLRA2-5ZZA	0.359	0.031	126	40	54,000	63,000
R2-6	0.1250	0.3750	0.1094	0.005	—	—	—	RA2-6ZZA	0.1406	—	—	—	144	50	49,000	58,000
R2	0.1250	0.3750	0.1562	0.012	FLR2	0.440	0.030	R2ZZA	0.1562	FLR2ZZA	0.440	0.030	144	50	49,000	58,000
RA2	0.1250	0.5000	0.1719	0.012	—	—	—	RA2ZZ	0.1719	—	—	—	258	89	43,000	51,000
R155	0.1562	0.3125	0.1094	0.003	FLR155	0.359	0.023	RA155ZZA	0.1250	FLRA155ZZA	0.359	0.036	76	30	51,000	60,000
R156	0.1875	0.3125	0.1094	0.003	FLR156	0.359	0.023	RA156ZZA	0.1250	FLRA156ZZA	0.359	0.036	89	32	49,000	58,000
R166	0.1875	0.3750	0.1250	0.003	FLR166	0.422	0.023	R166ZZA	0.1250	FLRA166ZZA	0.422	0.031	160	60	46,000	55,000
R3	0.1875	0.5000	0.1562	0.012	—	—	—	—	0.1875	—	—	—	295	110	41,000	48,000
RA3	0.1875	0.5000	0.1960	0.012	FLRA3	0.565	0.042	RA3ZZ	0.1960	FLRA3ZZ	0.565	0.042	295	110	41,000	48,000
R168	0.2500	0.3750	0.1250	0.003	FLR168	0.422	0.023	R168ZZA	0.1250	FLRA168ZZA	0.422	0.036	60	31	43,000	51,000
R188	0.2500	0.5000	0.1250	0.005	FLR188	0.547	0.023	RA188ZZA	0.1875	FLRA188ZZA	0.547	0.045	186	84	39,000	46,000
R4	0.2500	0.6250	0.1960	0.012	FLR4	0.690	0.042	R4ZZ	0.1960	FLR4ZZ	0.690	0.042	335	136	36,000	43,000
R6	0.3750	0.8750	0.2812	0.016	FLR6	0.989	0.062	R6ZZ	0.2812	FLR6ZZ	0.989	0.062	526	199	31,000	37,000

Bearing numbers listed above are for bearings made of high carbon chrome bearing steel; bearings made of stainless steel (equivalent to AISI 440 C) are also available upon request, for which “F” should be prefixed to the bearing numbers.

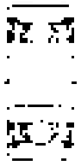
Notes

OPEN TYPE



Flanged Outer Ring

DOUBLE SHIELD TYPE



Flanged Outer Ring

Units: Millimeters

NTN
MICRO SERIES
METRIC

MICRO BEARING (METRIC SERIES)

Bearing No.	Boundary Dimesions				Bearing No.	Flange Dimensions		Bearing No.		Bearing No.	Flange Dimensions		Limiting Speed (RPM)		Basic Load Ratings (lbs)	
	Bore	O.D.	Width	Min. Chamfer		O.D.	Width		Width		O.D.	Width	Grease	Oil	Dynamic C	Static C_0
68/1.5	1.5	4	1.2	0.15	FL68/1.5	5.0	0.4	W68/1.5ZZA	2.0	FLW68/1.5ZZA	5.0	0.60	88,000	100,000	23	6
69/1.5A	1.5	5	2.0	0.15	FL69/1.5	6.5	0.6	W69/1.5ZZA	2.6	FLW69/1.5ZZA	6.5	0.80	79,000	93,000	53	15
60/1.5	1.5	6	2.5	0.15	FL60/1.5	7.5	0.6	W60/1.5ZZA	3.0	FLW60/1.5ZZA	7.5	0.80	71,000	84,000	62	19
672	2.0	4	1.2	0.05	—	—	—	W672ZZA	2.0	—	—	—	83,000	98,000	23	8.5
682	2.0	5	1.5	0.08	FL682	6.1	0.5	W682ZZA	2.3	FLW682ZZA	6.1	0.60	74,000	87,000	38	11
692	2.0	6	2.3	0.15	FL692	7.5	0.6	W692ZZA	3.0	FLW692ZZA	7.5	0.80	67,000	79,000	63	20
602	2.0	7	2.8	0.15	FL602	8.5	0.7	W602ZZA	3.5	FLW602ZZA	8.5	0.90	62,000	73,000	86	28
67/2.5	2.5	5	1.5	0.08	—	—	—	W67/2.5ZZA	2.3	—	—	—	70,000	82,000	34	13
68/2.5	2.5	6	1.8	0.08	FL68/2.5	7.1	0.5	W68/2.5ZZA	2.6	FLW68/2.5ZZA	7.1	0.80	35,000	76,000	47	16
69/2.5	2.5	7	2.5	0.15	FL69/2.5	8.5	0.7	W69/2.5ZZA	3.5	FLW69/2.5ZZA	8.5	0.90	59,000	70,000	64	22
60/2.5	2.5	8	2.8	0.15	FL60/2.5	9.5	0.7	W60/2.5ZZA	4.0	FLW60/2.5ZZA	9.5	0.90	56,000	66,000	123	39
673	3.0	6	2.0	0.08	FL673	7.2	0.6	WA673ZZA	2.5	FLWA673ZZA	7.2	0.60	60,000	71,000	54	21
683	3.0	7	2.0	0.1	FL683	8.1	0.5	W683ZZA	3.0	FLW683ZZA	8.1	0.80	58,000	68,000	87	29
693	3.0	8	3.0	0.15	FL693	9.5	0.7	W693ZZA	4.0	FLW693ZZA	9.5	0.90	54,000	63,000	126	40
603	3.0	9	3.0	0.15	FL603	10.5	0.7	W603ZZA	5.0	FLW603ZZA	10.5	1.00	50,000	59,000	142	49
623	3.0	10	4.0	0.15	FL623	11.5	1.0	623ZZA	4.0	FL623ZZA	11.5	1.00	50,000	58,000	144	50
694	4.0	11	4.0	0.15	FL694	12.5	1.0	694ZZA	4.0	FL694ZZA	12.5	1.00	45,000	52,000	161	62
604	4.0	12	4.0	0.20	FL604	13.5	1.0	604ZZ	4.0	FL604ZZ	13.5	1.00	43,000	51,000	218	80
624	4.0	13	5.0	0.20	FL624	15.0	1.0	624ZZ	5.0	FL624ZZ	15.0	1.00	42,000	49,000	295	110
634	4.0	16	5.0	0.30	—	—	—	634ZZ	5.0	—	—	—	37,000	44,000	395	153
675	5.0	8	2.0	0.08	FL675	9.2	0.6	WA675ZZA	2.5	FLWA675ZZA	9.2	0.60	49,000	57,000	66	32
685	5.0	11	3.0	0.15	FL685	12.5	0.8	W685ZZA	5.0	FLW685ZZA	12.5	1.00	43,000	51,000	161	63
695	5.0	13	4.0	0.20	FL695	15.0	1.0	695ZZA	4.0	FL695ZZA	15.0	1.00	40,000	47,000	242	97
605	5.0	14	5.0	0.20	FL605	16.0	1.0	605ZZ	5.0	FL605ZZ	16.0	1.00	39,000	46,000	299	114
625	5.0	16	5.0	0.30	FL625	18.0	1.0	625ZZ	5.0	FL625ZZ	18.0	1.00	37,000	44,000	395	153
635	5.0	19	6.0	0.30	—	—	—	635ZZ	6.0	—	—	—	34,000	40,000	525	199
686	6.0	13	3.5	0.15	FL686	15.0	1.0	W686ZZA	5.0	FLW686ZZA	15.0	1.10	39,000	46,000	243	99
696	6.0	15	5.0	0.20	FL696	17.0	1.2	696ZZ	5.0	FL696ZZ	17.0	1.20	37,000	44,000	305	119
606	6.0	17	6.0	0.30	FL606	19.0	1.2	606ZZ	6.0	FL606ZZ	19.0	1.20	35,000	42,000	495	195
626	6.0	19	6.0	0.30	FL626	22.0	1.5	626ZZ	6.0	FL626ZZ	22.0	1.50	34,000	40,000	525	199
677	7.0	11	2.5	0.10	FL677	12.2	0.6	WA677ZZA	3.0	FLWA677ZZA	12.2	0.60	40,000	47,000	124	60
687	7.0	14	3.5	0.15	FL687	16.0	1.0	W687ZZA	5.0	FLW687ZZA	16.0	1.10	37,000	44,000	264	115
697	7.0	17	5.0	0.30	FL697	19.0	1.2	697ZZ	5.0	FL697ZZ	19.0	1.20	35,000	41,000	360	160
607	7.0	19	6.0	0.30	—	—	—	607ZZ	6.0	—	—	—	34,000	40,000	505	205
627	7.0	22	7.0	0.30	—	—	—	627ZZ	7.0	—	—	—	32,000	37,000	750	315
698	8.0	19	6.0	0.30	FL698	22.0	1.5	698ZZ	6.0	FL698ZZ	22.0	1.50	33,000	39,000	445	194
608	8.0	22	7.0	0.30	FL608	25.0	1.5	608ZZ	7.0	FL608ZZ	25.0	1.50	32,000	37,000	750	315
628	8.0	24	8.0	0.30	—	—	—	628ZZ	8.0	—	—	—	31,000	36,000	900	355
679	9.0	14	3.0	0.10	—	—	—	W679ZZA	4.5	—	—	—	36,000	42,000	207	105
689	9.0	17	4.0	0.20	FL689	19.0	1.0	W689ZZ	5.0	FLW689ZZ	19.0	1.10	33,000	39,000	390	184
699	9.0	20	6.0	0.30	—	—	—	699ZZ	6.0	—	—	—	32,000	38,000	560	245
609	9.0	24	7.0	0.30	—	—	—	609ZZ	7.0	—	—	—	31,000	36,000	765	325
629	9.0	26	8.0	0.60	—	—	—	629ZZ	8.0	—	—	—	30,000	35,000	1030	440

Bearing numbers listed above are for bearings made of high carbon chrome bearing steel; bearings made of stainless steel (equivalent to AISI 440 C) are also available upon request, for which “F” should be prefixed to the bearing numbers.

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
D									
—	—	—	—	—	—	29,000	34,000	21,000	00
—	—	—	—	—	—				
—	—	—	—	—	—	26,000	30,000	18,000	01
—	—	—	—	—	—				
—	—	—	—	—	—	22,000	26,000	15,000	02
—	—	—	—	—	—				
—	—	—	—	—	—	20,000	24,000	14,000	03
—	—	—	—	—	—				
1.565	.081	.065	1.82	.042	.125	18,000	21,000	11,000	04
39.75	2.06	1.65	46.3	1.07	3.17				
1.644	.081	.053	1.90	.044	.129	17,000	20,000	10,000	/22
41.75	2.06	1.35	48.3	1.12	3.28				
1.756	.081	.065	2.07	.042	.156	15,000	18,000	9,400	05
44.60	2.06	1.65	52.7	1.07	3.96				
1.958	.081	.053	2.28	.044	.161	14,000	16,000	8,400	/28
49.73	2.06	1.35	57.9	1.12	4.09				
2.071	.082	.065	2.39	.042	.156	13,000	15,000	7,700	06
52.60	2.08	1.65	60.7	1.07	3.96				
2.189	.082	.053	2.51	.044	.159	12,000	15,000	7,200	/32
55.60	2.08	1.35	63.7	1.12	4.05				
2.347	.082	.087	2.67	.065	.156	12,000	14,000	6,800	07
59.61	2.08	2.21	67.7	1.65	3.96				
2.552	.098	.087	2.94	.065	.188	10,000	12,000	6,100	08
64.82	2.49	2.21	74.6	1.65	4.78				
2.828	.098	.087	3.21	.065	.188	9,200	11,000	5,400	09
71.83	2.49	2.21	81.6	1.65	4.78				
3.024	.098	.087	3.41	.065	.188	8,400	9,800	5,000	10
76.81	2.49	2.21	86.6	1.65	4.78				
3.417	.113	.118	3.80	.095	.188	7,700	9,000	4,500	11
86.79	2.87	3.00	96.5	2.41	4.78				
3.615	.113	.118	4.00	.095	.188	7,000	8,300	4,100	12
91.82	2.87	3.00	101.6	2.41	4.78				
3.811	.113	.118	4.19	.095	.188	6,500	7,700	3,900	13
96.80	2.87	3.00	106.5	2.41	4.78				
4.205	.113	.118	4.59	.095	.188	6,100	7,100	3,600	14
106.81	2.87	3.00	116.6	2.41	4.78				
4.402	.113	.118	4.79	.095	.188	5,700	6,700	3,300	15
111.81	2.87	3.00	121.6	2.41	4.78				
4.733	.113	.134	5.30	.109	.281	5,300	6,200	3,100	16
120.22	2.87	3.40	134.7	2.77	7.14				
4.930	.113	.134	5.50	.109	.281	5,000	5,900	2,900	17
125.22	2.87	3.40	139.7	2.77	7.14				
5.324	.146	.134	5.89	.109	.281	4,700	5,600	2,800	18
135.23	3.71	3.40	149.7	2.77	7.14				
5.521	.146	.134	6.09	.109	.281	4,500	5,300	2,600	19
140.23	3.71	3.40	154.7	2.77	7.1				
5.718	.146	.134	6.29	.109	.281	4,200	5,000	2,600	20
145.24	3.71	3.40	159.7	2.77	7.14				
6.111	.146	.134	6.68	.109	.281	4,000	4,700	2,400	21
155.22	3.71	3.40	169.7	2.77	7.14				
6.443	.146	.150	7.20	.120	.375	3,800	4,500	2,300	22
163.65	3.71	3.81	182.9	3.05	9.53				
—	—	—	—	—	—	3,500	4,100	2,100	24
—	—	—	—	—	—				
—	—	—	—	—	—	3,200	3,800	1,900	26
—	—	—	—	—	—				
—	—	—	—	—	—	3,000	3,500	1,800	28
—	—	—	—	—	—				
—	—	—	—	—	—	2,800	3,200	1,700	30
—	—	—	—	—	—				
—	—	—	—	—	—	2,600	3,000	1,600	32
—	—	—	—	—	—				
—	—	—	—	—	—	2,400	2,800	—	34
—	—	—	—	—	—				
—	—	—	—	—	—	2,300	2,700	—	36
—	—	—	—	—	—				
—	—	—	—	—	—	2,100	2,500	—	38
—	—	—	—	—	—				
—	—	—	—	—	—	2,000	2,400	—	40
—	—	—	—	—	—				

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
—	—	—	—	—	—	1,800	2,200	—	44
—	—	—	—	—	—	1,700	2,000	—	48
—	—	—	—	—	—	1,500	1,800	—	52
—	—	—	—	—	—	1,400	1,600	—	56
—	—	—	—	—	—	1,300	1,500	—	60
—	—	—	—	—	—	1,200	1,400	—	64
—	—	—	—	—	—	1,100	1,300	—	68
—	—	—	—	—	—	1,100	1,200	—	72
—	—	—	—	—	—	990	1,200	—	76
—	—	—	—	—	—	930	1,100	—	80
—	—	—	—	—	—	880	1,000	—	84

	Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)		
D									
1.109	**.081**	**.065**	**1.37**	**.042**	**.125**	**25,000**	**30,000**	**18,000**	**00**
28.17	2.06	1.65	34.7	1.07	3.17				
1.187	**.081**	**.065**	**1.44**	**.042**	**.125**	**22,000**	**26,000**	**16,000**	**01**
30.15	2.06	1.65	36.7	1.07	3.17				
1.187	**.081**	**.065**	**1.44**	**.042**	**.125**	**22,000**	**26,000**	**16,000**	**01**
30.15	2.06	1.65	36.7	1.07	3.17				
1.187	**.081**	**.065**	**1.44**	**.042**	**.125**	**22,000**	**26,000**	**16,000**	**01**
30.15	2.06	1.65	36.7	1.07	3.17				
1.187	**.081**	**.065**	**1.44**	**.042**	**.125**	**22,000**	**26,000**	**16,000**	**01**
30.15	2.06	1.65	36.7	1.07	3.17				
1.187	**.081**	**.065**	**1.44**	**.042**	**.125**	**22,000**	**26,000**	**16,000**	**01**
30.15	2.06	1.65	36.7	1.07	3.17				
1.306	**.081**	**.065**	**1.56**	**.042**	**.125**	**19,000**	**23,000**	**15,000**	**02**
33.17	2.06	1.65	39.7	1.07	3.17				
1.306	**.081**	**.065**	**1.56**	**.042**	**.125**	**19,000**	**23,000**	**15,000**	**02**
33.17	2.06	1.65	39.7	1.07	3.17				
1.306	**.081**	**.065**	**1.56**	**.042**	**.125**	**19,000**	**23,000**	**15,000**	**02**
33.17	2.06	1.65	39.7	1.07	3.17				
1.306	**.081**	**.065**	**1.56**	**.042**	**.125**	**19,000**	**23,000**	**15,000**	**02**
33.17	2.06	1.65	39.7	1.07	3.17				
1.500	**.081**	**.065**	**1.76**	**.042**	**.125**	**18,000**	**21,000**	**12,000**	**03**
38.10	2.06	1.65	44.6	1.07	3.17				
1.500	**.081**	**.065**	**1.76**	**.042**	**.125**	**18,000**	**21,000**	**12,000**	**03**
38.10	2.06	1.65	44.6	1.07	3.17				
1.500	**.081**	**.065**	**1.76**	**.042**	**.125**	**18,000**	**21,000**	**12,000**	**03**
38.10	2.06	1.65	44.6	1.07	3.17				
1.500	**.081**	**.065**	**1.76**	**.042**	**.125**	**18,000**	**21,000**	**12,000**	**03**
38.10	2.06	1.65	44.6	1.07	3.17				
1.500	**.081**	**.065**	**1.76**	**.042**	**.125**	**18,000**	**21,000**	**12,000**	**03**
38.10	2.06	1.65	44.6	1.07	3.17				
1.756	**.097**	**.065**	**2.07**	**.042**	**.156**	**16,000**	**18,000**	**10,000**	**04**
44.60	2.46	1.65	52.7	1.07	3.96				
1.874	**.097**	**.065**	**2.19**	**.042**	**.156**	**14,000**	**17,000**	**9,700**	**/22**
47.60	2.46	1.65	55.7	1.07	3.96				
1.958	**.097**	**.065**	**2.28**	**.042**	**.156**	**13,000**	**15,000**	**8,900**	**05**
49.73	2.46	1.65	57.9	1.07	3.96				
1.958	**.097**	**.065**	**2.28**	**.042**	**.156**	**13,000**	**15,000**	**8,900**	**05**
49.73	2.46	1.65	57.9	1.07	3.96				
2.189	**.097**	**.065**	**2.51**	**.042**	**.156**	**12,000**	**14,000**	**8,100**	**/28**
55.60	2.46	1.65	63.7	1.07	3.96				
2.347	**.129**	**.087**	**2.67**	**.065**	**.156**	**11,000**	**13,000**	**7,300**	**06**
59.61	3.28	2.21	67.7	1.65	3.96				
2.465	**.129**	**.087**	**2.78**	**.065**	**.156**	**11,000**	**12,000**	**7,100**	**/32**
62.61	3.28	2.21	70.7	1.65	3.96				
2.709	**.129**	**.087**	**3.09**	**.065**	**.188**	**9,800**	**11,000**	**6,300**	**07**
68.81	3.28	2.21	78.6	1.65	4.77				
3.024	**.129**	**.087**	**3.41**	**.065**	**.188**	**8,700**	**10,000**	**5,600**	**08**
76.81	3.28	2.21	86.6	1.65	4.77				
3.221	**.129**	**.087**	**3.61**	**.065**	**.188**	**7,800**	**9,200**	**5,200**	**09**
81.81	3.28	2.21	91.6	1.65	4.77				
3.417	**.129**	**.118**	**3.80**	**.095**	**.188**	**7,100**	**8,300**	**4,700**	**10**
86.79	3.28	3.00	96.5	2.41	4.77				
3.811	**.129**	**.118**	**4.19**	**.095**	**.188**	**6,400**	**7,600**	**4,300**	**11**
96.80	3.28	3.00	106.5	2.41	4.77				
4.205	**.129**	**.118**	**4.59**	**.095**	**.188**	**6,000**	**7,000**	**3,800**	**12**
106.81	3.28	3.00	116.6	2.41	4.77				
4.536	**.160**	**.134**	**5.11**	**.109**	**.281**	**5,500**	**6,500**	**3,600**	**13**
115.21	4.06	3.40	129.7	2.77	7.13				
4.733	**.160**	**.134**	**5.30**	**.109**	**.281**	**5,100**	**6,000**	**3,400**	**14**
120.22	4.06	3.40	134.7	2.77	7.13				
4.930	**.160**	**.134**	**5.50**	**.109**	**.281**	**4,800**	**5,600**	**3,200**	**15**
125.22	4.06	3.40	139.7	2.77	7.13				
5.324	**.193**	**.134**	**5.89**	**.109**	**.281**	**4,500**	**5,300**	**3,000**	**16**
135.23	4.90	3.40	149.7	2.77	7.13				
5.718	**.193**	**.134**	**6.29**	**.109**	**.281**	**4,200**	**5,000**	**2,800**	**17**
145.24	4.90	3.40	159.7	2.77	7.13				
6.111	**.193**	**.134**	**6.68**	**.109**	**.281**	**4,000**	**4,700**	**2,600**	**18**
155.22	4.90	3.40	169.7	2.77	7.13				
6.443	**.224**	**.150**	**7.20**	**.120**	**.375**	**3,700**	**4,400**	**2,500**	**19**
163.65	5.69	3.81	182.9	3.05	9.52				
6.837	**.224**	**.150**	**7.59**	**.120**	**.375**	**3,500**	**4,200**	**2,300**	**20**
173.66	5.69	3.81	192.9	3.05	9.52				

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
D									
7.230	**.224**	**.150**	**7.99**	**.120**	**.375**	**3,400**	**4,000**	**2,300**	**21**
183.64	5.69	3.81	202.9	3.05	9.52				
7.624	**.224**	**.150**	**8.38**	**.120**	**.375**	**3,200**	**3,800**	**2,200**	**22**
193.65	5.69	3.81	212.9	3.05	9.52				
—	**—**	**—**	**—**	**—**	**—**	**2,900**	**3,400**	**2,000**	**24**
—	**—**	**—**	**—**	**—**	**—**	**2,300**	**2,700**	**—**	**26**
—	**—**	**—**	**—**	**—**	**—**	**2,100**	**2,500**	**—**	**28**
—	**—**	**—**	**—**	**—**	**—**	**2,000**	**2,400**	**—**	**30**
—	**—**	**—**	**—**	**—**	**—**	**1,900**	**2,200**	**—**	**32**
—	**—**	**—**	**—**	**—**	**—**	**1,800**	**2,100**	**—**	**34**
—	**—**	**—**	**—**	**—**	**—**	**1,700**	**1,800**	**—**	**36**
—	**—**	**—**	**—**	**—**	**—**	**1,800**	**2,100**	**—**	**38**
—	**—**	**—**	**—**	**—**	**—**	**1,700**	**2,000**	**—**	**40**
—	**—**	**—**	**—**	**—**	**—**	**1,500**	**1,800**	**—**	**44**

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
D									
1.306	**.081**	**.065**	**1.56**	**.042**	**.125**	**23,000**	**27,000**	**16,000**	**00**
33.17	2.06	1.65	39.7	1.07	3.18				
1.369	**.081**	**.065**	**1.63**	**.042**	**.125**	**20,000**	**24,000**	**15,000**	**01**
34.77	2.06	1.65	41.3	1.07	3.18				
1.565	**.081**	**.065**	**1.82**	**.042**	**.125**	**17,000**	**21,000**	**12,000**	**02**
39.75	2.06	1.65	46.3	1.07	3.18				
1.756	**.097**	**.065**	**2.07**	**.042**	**.156**	**16,000**	**19,000**	**11,000**	**03**
44.60	2.46	1.65	52.7	1.07	3.96				
1.958	**.097**	**.065**	**2.28**	**.042**	**.156**	**14,000**	**17,000**	**10,000**	**04**
49.73	2.46	1.65	57.9	1.07	3.96				
2.110	**.097**	**.065**	**2.43**	**.042**	**.156**	**13,000**	**15,000**	**9,200**	**/22**
53.59	2.46	1.65	61.7	1.07	3.96				
2.347	**.129**	**.087**	**2.67**	**.065**	**.156**	**12,000**	**14,000**	**8,100**	**05**
59.61	3.28	2.20	67.7	1.65	3.96				
2.552	**.129**	**.087**	**2.94**	**.065**	**.188**	**11,000**	**13,000**	**7,400**	**/28**
64.82	3.28	2.20	74.6	1.65	4.77				
2.709	**.129**	**.087**	**3.09**	**.065**	**.188**	**10,000**	**12,000**	**6,600**	**06**
68.81	3.28	2.20	78.6	1.65	4.77				
2.828	**.129**	**.087**	**3.21**	**.065**	**.188**	**9,500**	**11,000**	**6,500**	**/32**
71.83	3.28	2.20	81.6	1.65	4.77				
3.024	**.129**	**.087**	**3.41**	**.065**	**.188**	**8,800**	**10,000**	**6,000**	**07**
76.81	3.28	2.20	86.6	1.65	4.77				
3.417	**.129**	**.118**	**3.80**	**.095**	**.188**	**7,800**	**9,200**	**5,300**	**08**
86.79	3.28	3.00	96.5	2.41	4.77				
3.811	**.129**	**.118**	**4.19**	**.095**	**.188**	**7,000**	**8,200**	**4,700**	**09**
96.80	3.28	3.00	106.5	2.41	4.77				
4.205	**.129**	**.118**	**4.59**	**.095**	**.188**	**6,400**	**7,500**	**4,200**	**10**
106.81	3.28	3.00	116.6	2.41	4.77				
4.536	**.160**	**.134**	**5.11**	**.109**	**.281**	**5,800**	**6,800**	**3,900**	**11**
115.21	4.06	3.40	129.7	2.77	7.13				
4.930	**.160**	**.134**	**5.50**	**.109**	**.281**	**5,400**	**6,300**	**3,600**	**12**
125.22	4.06	3.40	139.7	2.77	7.13				
5.324	**.193**	**.134**	**5.89**	**.109**	**.281**	**4,900**	**5,800**	**3,300**	**13**
135.23	4.90	3.40	149.7	2.77	7.13				
5.718	**.193**	**.134**	**6.29**	**.109**	**.281**	**4,600**	**5,400**	**3,100**	**14**
145.24	4.90	3.40	159.7	2.77	7.13				
6.111	**.193**	**.134**	**6.68**	**.109**	**.281**	**4,300**	**5,000**	**2,900**	**15**
155.22	4.90	3.40	169.7	2.77	7.13				
6.443	**.224**	**.150**	**7.20**	**.120**	**.375**	**4,000**	**4,700**	**2,700**	**16**
163.65	5.69	3.80	182.9	3.05	9.52				
6.837	**.224**	**.150**	**7.59**	**.120**	**.375**	**3,800**	**4,500**	**2,600**	**17**
173.66	5.69	3.80	192.9	3.05	9.52				
7.230	**.224**	**.150**	**7.99**	**.120**	**.375**	**3,600**	**4,200**	**2,400**	**18**
183.64	5.69	3.80	202.9	3.05	9.52				
7.624	**.224**	**.150**	**8.38**	**.120**	**.375**	**3,300**	**3,900**	**2,300**	**19**
193.65	5.69	3.80	212.9	3.05	9.52				
—	**—**	**—**	**—**	**—**	**—**	**3,200**	**3,700**	**2,200**	**20**
—	**—**	**—**	**—**	**—**	**—**	**3,000**	**3,600**	**2,100**	**21**
—	**—**	**—**	**—**	**—**	**—**	**2,900**	**3,400**	**1,900**	**22**
—	**—**	**—**	**—**	**—**	**—**	**2,600**	**3,100**	**—**	**24**
—	**—**	**—**	**—**	**—**	**—**	**2,400**	**2,800**	**—**	**26**
—	**—**	**—**	**—**	**—**	**—**	**2,200**	**2,600**	**—**	**28**
—	**—**	**—**	**—**	**—**	**—**	**2,100**	**2,400**	**—**	**30**
—	**—**	**—**	**—**	**—**	**—**	**1,900**	**2,300**	**—**	**32**
—	**—**	**—**	**—**	**—**	**—**	**1,800**	**2,100**	**—**	**34**
—	**—**	**—**	**—**	**—**	**—**	**1,700**	**2,000**	**—**	**36**
—	**—**	**—**	**—**	**—**	**—**	**1,600**	**1,900**	**—**	**38**
—	**—**	**—**	**—**	**—**	**—**	**1,500**	**1,800**	**—**	**40**
—	**—**	**—**	**—**	**—**	**—**	**1,400**	**1,600**	**—**	**44**

Snap Ring			Limiting Speed		Bore
a					
.097	**2.28**	**.042**	**12,000**	**14,000**	**05**
2.46	57.9	1.07			
.097	**2.51**	**.042**	**11,000**	**13,000**	**/28**
2.46	63.7	1.07			
.129	**2.67**	**.065**	**10,000**	**12,000**	**06**
3.28	67.7	1.65			
.129	**2.78**	**.065**	**9,500**	**11,000**	**/32**
3.28	70.7	1.65			
.129	**3.09**	**.065**	**8,800**	**10,000**	**07**
3.28	78.6	1.65			
.129	**3.41**	**.065**	**7,800**	**9,200**	**08**
3.28	86.6	1.65			
.129	**3.61**	**.065**	**7,000**	**8,200**	**09**
3.28	91.6	1.65			
.129	**3.80**	**.095**	**6,400**	**7,500**	**10**
3.28	96.5	2.41			
.129	**4.19**	**.095**	**5,800**	**6,800**	**11**
3.28	106.5	2.41			
.129	**4.59**	**.095**	**5,400**	**6,300**	**12**
3.28	116.6	2.41			
.160	**5.11**	**.109**	**4,900**	**5,800**	**13**
4.06	129.7	2.77			
.160	**5.30**	**.109**	**4,600**	**5,400**	**14**
4.06	134.7	2.77			
.160	**5.50**	**.109**	**4,300**	**5,000**	**15**
4.06	139.7	2.77			
.193	**5.89**	**.109**	**4,000**	**4,700**	**16**
4.90	149.7	2.77			
.193	**6.29**	**.109**	**3,800**	**4,400**	**17**
4.90	159.7	2.77			
.193	**6.68**	**.109**	**3,600**	**4,200**	**18**
4.90	169.7	2.77			
.224	**7.20**	**.120**	**3,400**	**3,900**	**18**
5.69	182.9	3.05			
.224	**7.59**	**.120**	**3,200**	**3,700**	**20**
5.69	192.9	3.05			
.224	**7.99**	**.120**	**3,000**	**3,600**	**21**
5.69	202.9	3.05			
.224	**8.38**	**.120**	**2,900**	**3,400**	**22**
5.69	212.9	3.05			

Snap Ring			Limiting Speed		Bore
a					
.097	2.28	.042	13,000	15,000	04
2.46	57.9	1.07			
.097	2.43	.042	12,000	14,000	/22
2.46	61.7	1.07			
.129	2.67	.065	11,000	12,000	05
3.28	67.7	1.65			
.129	2.94	.065	9,600	11,000	/28
3.28	74.6	1.65			
.129	3.09	.065	9,000	11,000	06
3.28	78.6	1.65			
.129	3.21	.065	8,600	10,000	/32
3.28	81.6	1.65			
.129	3.41	.065	7,900	9,300	07
3.28	86.6	1.65			
.129	3.80	.095	7,000	8,200	08
3.28	96.5	2.41			
.129	4.19	.095	6,300	7,400	09
3.28	106.5	2.41			
.129	4.59	.095	5,700	6,700	10
3.28	116.6	2.41			
.160	5.11	.109	5,200	6,100	11
4.06	129.7	2.77			
.160	5.50	.109	4,800	5,700	12
4.06	139.7	2.77			
.193	5.89	.109	4,400	5,200	13
4.90	149.7	2.77			
.193	6.29	.109	4,100	4,800	14
4.90	159.7	2.77			
.193	6.68	.109	3,800	4,500	15
4.90	169.7	2.77			
.224	7.20	.120	3,600	4,200	16
5.69	182.9	3.05			
.224	7.59	.120	3,400	4,000	17
5.69	192.9	3.05			
.224	7.99	.120	3,200	3,800	18
5.69	202.9	3.05			
.224	8.38	.120	3,000	3,500	19
5.69	212.9	3.05			
—	—	—	2,900	3,400	20
—	—	—			
—	—	—	2,700	3,200	21
—	—	—			
—	—	—	2,600	3,100	22
—	—	—			

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
D									
1.109	**.081**	**.065**	**1.37**	**.042**	**.125**	**25,000**	**30,000**	**18,000**	**00**
28.17	2.06	1.65	34.7	1.07	3.17				
1.756	**.097**	**.065**	**2.07**	**.042**	**.156**	**16,000**	**18,000**	**10,000**	**04**
44.60	2.46	1.65	52.7	1.07	3.96				
1.874	**.097**	**.065**	**2.19**	**.042**	**.156**	**14,000**	**17,000**	**9,700**	**/22**
47.60	2.46	1.65	55.7	1.07	3.96				
2.189	**.097**	**.065**	**2.51**	**.042**	**.156**	**12,000**	**14,000**	**8,100**	**/28**
55.60	2.46	1.65	63.7	1.07	3.96				
2.347	**.129**	**.087**	**2.67**	**.065**	**.156**	**11,000**	**13,000**	**7,300**	**06**
59.61	3.28	2.21	67.7	1.65	3.96				
2.465	**.129**	**.087**	**2.78**	**.065**	**.156**	**11,000**	**12,000**	**7,100**	**/32**
62.61	3.28	2.21	70.7	1.65	3.96				
2.709	**.129**	**.087**	**3.09**	**.065**	**.188**	**9,800**	**11,000**	**6,300**	**07**
68.81	3.28	2.21	78.6	1.65	4.77				
3.024	**.129**	**.087**	**3.41**	**.065**	**.188**	**8,700**	**10,000**	**5,600**	**08**
76.81	3.28	2.21	86.6	1.65	4.77				
3.221	**.129**	**.087**	**3.61**	**.065**	**.188**	**7,800**	**9,200**	**5,200**	**09**
81.81	3.28	2.21	91.6	1.65	4.77				
3.417	**.129**	**.118**	**3.80**	**.095**	**.188**	**7,100**	**8,300**	**4,700**	**10**
86.79	3.28	3.00	96.5	2.41	4.77				
3.811	**.129**	**.118**	**4.19**	**.095**	**.188**	**6,400**	**7,600**	**4,300**	**11**
96.80	3.28	3.00	106.5	2.41	4.77				
4.205	**.129**	**.118**	**4.59**	**.095**	**.188**	**6,000**	**7,000**	**3,800**	**12**
106.81	3.28	3.00	116.6	2.41	4.77				
4.536	**.160**	**.134**	**5.11**	**.109**	**.281**	**5,500**	**6,500**	**3,600**	**13**
115.21	4.06	3.40	129.7	2.77	7.13				
4.733	**.160**	**.134**	**5.30**	**.109**	**.281**	**5,100**	**6,000**	**3,400**	**14**
120.22	4.06	3.40	134.7	2.77	7.13				
4.930	**.160**	**.134**	**5.50**	**.109**	**.281**	**4,800**	**5,600**	**3,200**	**15**
125.22	4.06	3.40	139.7	2.77	7.13				
5.324	**.193**	**.134**	**5.89**	**.109**	**.281**	**4,500**	**5,300**	**3,000**	**16**
135.23	4.90	3.40	149.7	2.77	7.13				
5.718	**.193**	**.134**	**6.29**	**.109**	**.281**	**4,200**	**5,000**	**2,800**	**17**
145.24	4.90	3.40	159.7	2.77	7.13				
6.111	**.193**	**.134**	**6.68**	**.109**	**.281**	**4,000**	**4,700**	**2,600**	**18**
155.22	4.90	3.40	169.7	2.77	7.13				
6.443	**.224**	**.150**	**7.20**	**.120**	**.375**	**3,700**	**4,400**	**2,500**	**19**
163.65	5.69	3.81	182.9	3.05	9.52				
6.837	**.224**	**.150**	**7.59**	**.120**	**.375**	**3,500**	**4,200**	**2,300**	**20**
173.66	5.69	3.81	192.9	3.05	9.52				

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
D									
7.230	**.224**	**.150**	**7.99**	**.120**	**.375**	**3,400**	**4,000**	**2,300**	**21**
183.64	5.69	3.81	202.9	3.05	9.52				
7.624	**.224**	**.150**	**8.38**	**.120**	**.375**	**3,200**	**3,800**	**2,200**	**22**
193.65	5.69	3.81	212.9	3.05	9.52				
—	**—**	**—**	**—**	**—**	**—**	**2,900**	**3,400**	**2,000**	**24**
—	**—**	**—**	**—**	**—**	**—**	**2,300**	**2,700**	**—**	**26**
—	**—**	**—**	**—**	**—**	**—**	**2,100**	**2,500**	**—**	**28**
—	**—**	**—**	**—**	**—**	**—**	**2,000**	**2,400**	**—**	**30**
—	**—**	**—**	**—**	**—**	**—**	**1,900**	**2,200**	**—**	**32**
—	**—**	**—**	**—**	**—**	**—**	**1,800**	**2,100**	**—**	**34**
—	**—**	**—**	**—**	**—**	**—**	**1,700**	**1,800**	**—**	**36**
—	**—**	**—**	**—**	**—**	**—**	**1,800**	**2,100**	**—**	**38**
—	**—**	**—**	**—**	**—**	**—**	**1,700**	**2,000**	**—**	**40**
—	**—**	**—**	**—**	**—**	**—**	**1,500**	**1,800**	**—**	**44**

Snap Ring Groove Dimensions			Snap Ring Dimensions			Limiting Speed (RPM)			
D									
1.306	**.081**	**.065**	**1.56**	**.042**	**.125**	**23,000**	**27,000**	**16,000**	**00**
33.17	2.06	1.65	39.7	1.07	3.18				
1.369	**.081**	**.065**	**1.63**	**.042**	**.125**	**20,000**	**24,000**	**15,000**	**01**
34.77	2.06	1.65	41.3	1.07	3.18				
1.565	**.081**	**.065**	**1.82**	**.042**	**.125**	**17,000**	**21,000**	**12,000**	**02**
39.75	2.06	1.65	46.3	1.07	3.18				
1.756	**.097**	**.065**	**2.07**	**.042**	**.156**	**16,000**	**19,000**	**11,000**	**03**
44.60	2.46	1.65	52.7	1.07	3.96				
1.958	**.097**	**.065**	**2.28**	**.042**	**.156**	**14,000**	**17,000**	**10,000**	**04**
49.73	2.46	1.65	57.9	1.07	3.96				
2.110	**.097**	**.065**	**2.43**	**.042**	**.156**	**13,000**	**15,000**	**9,200**	**/22**
53.59	2.46	1.65	61.7	1.07	3.96				
2.347	**.129**	**.087**	**2.67**	**.065**	**.156**	**12,000**	**14,000**	**8,100**	**05**
59.61	3.28	2.20	67.7	1.65	3.96				
2.552	**.129**	**.087**	**2.94**	**.065**	**.188**	**11,000**	**13,000**	**7,400**	**/28**
64.82	3.28	2.20	74.6	1.65	4.77				
2.709	**.129**	**.087**	**3.09**	**.065**	**.188**	**10,000**	**12,000**	**6,600**	**06**
68.81	3.28	2.20	78.6	1.65	4.77				
2.828	**.129**	**.087**	**3.21**	**.065**	**.188**	**9,500**	**11,000**	**6,500**	**/32**
71.83	3.28	2.20	81.6	1.65	4.77				
3.024	**.129**	**.087**	**3.41**	**.065**	**.188**	**8,800**	**10,000**	**6,000**	**07**
76.81	3.28	2.20	86.6	1.65	4.77				
3.417	**.129**	**.118**	**3.80**	**.095**	**.188**	**7,800**	**9,200**	**5,300**	**08**
86.79	3.28	3.00	96.5	2.41	4.77				
3.811	**.129**	**.118**	**4.19**	**.095**	**.188**	**7,000**	**8,200**	**4,700**	**09**
96.80	3.28	3.00	106.5	2.41	4.77				
4.205	**.129**	**.118**	**4.59**	**.095**	**.188**	**6,400**	**7,500**	**4,200**	**10**
106.81	3.28	3.00	116.6	2.41	4.77				
4.536	**.160**	**.134**	**5.11**	**.109**	**.281**	**5,800**	**6,800**	**3,900**	**11**
115.21	4.06	3.40	129.7	2.77	7.13				
4.930	**.160**	**.134**	**5.50**	**.109**	**.281**	**5,400**	**6,300**	**3,600**	**12**
125.22	4.06	3.40	139.7	2.77	7.13				
5.324	**.193**	**.134**	**5.89**	**.109**	**.281**	**4,900**	**5,800**	**3,300**	**13**
135.23	4.90	3.40	149.7	2.77	7.13				
5.718	**.193**	**.134**	**6.29**	**.109**	**.281**	**4,600**	**5,400**	**3,100**	**14**
145.24	4.90	3.40	159.7	2.77	7.13				
6.111	**.193**	**.134**	**6.68**	**.109**	**.281**	**4,300**	**5,000**	**2,900**	**15**
155.22	4.90	3.40	169.7	2.77	7.13				
6.443	**.224**	**.150**	**7.20**	**.120**	**.375**	**4,000**	**4,700**	**2,700**	**16**
163.65	5.69	3.80	182.9	3.05	9.52				
6.837	**.224**	**.150**	**7.59**	**.120**	**.375**	**3,800**	**4,500**	**2,600**	**17**
173.66	5.69	3.80	192.9	3.05	9.52				
7.230	**.224**	**.150**	**7.99**	**.120**	**.375**	**3,600**	**4,200**	**2,400**	**18**
183.64	5.69	3.80	202.9	3.05	9.52				
7.624	**.224**	**.150**	**8.38**	**.120**	**.375**	**3,300**	**3,900**	**2,300**	**19**
193.65	5.69	3.80	212.9	3.05	9.52				
—	**—**	**—**	**—**	**—**	**—**	**3,200**	**3,700**	**2,200**	**20**
—	**—**	**—**	**—**	**—**	**—**	**3,000**	**3,600**	**2,100**	**21**
—	**—**	**—**	**—**	**—**	**—**	**2,900**	**3,400**	**1,900**	**22**
—	**—**	**—**	**—**	**—**	**—**	**2,600**	**3,100**	**—**	**24**
—	**—**	**—**	**—**	**—**	**—**	**2,400**	**2,800**	**—**	**26**
—	**—**	**—**	**—**	**—**	**—**	**2,200**	**2,600**	**—**	**28**
—	**—**	**—**	**—**	**—**	**—**	**2,100**	**2,400**	**—**	**30**
—	**—**	**—**	**—**	**—**	**—**	**1,900**	**2,300**	**—**	**32**
—	**—**	**—**	**—**	**—**	**—**	**1,800**	**2,100**	**—**	**34**
—	**—**	**—**	**—**	**—**	**—**	**1,700**	**2,000**	**—**	**36**
—	**—**	**—**	**—**	**—**	**—**	**1,600**	**1,900**	**—**	**38**
—	**—**	**—**	**—**	**—**	**—**	**1,500**	**1,800**	**—**	**40**
—	**—**	**—**	**—**	**—**	**—**	**1,400**	**1,600**	**—**	**44**

Basic Load		Weight								
C	*C*									
3,750	**3,150**	**.240**	**.245**	**HJ204**	**.787**	**1.181**	**.266**	**.118**	**.024**	**.026**
					20	30.0	6.75	3	.6	
4,200	**3,800**	**.295**	**.302**	**HJ205**	**.984**	**1.378**	**.285**	**.118**	**.024**	**.033**
					25	35.0	7.25	3	.6	
5,600	**5,250**	**.448**	**.456**	**HJ206**	**1.181**	**1.646**	**.325**	**.157**	**.024**	**.055**
					30	41.8	8.25	4	.6	
8,000	**7,700**	**.637**	**.650**	**HJ207**	**1.378**	**1.874**	**.315**	**.157**	**.024**	**.066**
					35	47.6	8.00	4	.6	
9,850	**9,650**	**.816**	**.833**	**HJ208**	**1.575**	**2.134**	**.354**	**.197**	**.059**	**.101**
					40	54.2	9.00	5	1.5	
10,400	**10,500**	**.933**	**.952**	**HJ209**	**1.772**	**2.323**	**.374**	**.197**	**.059**	**.117**
					45	59.0	9.50	5	1.5	
11,400	**12,200**	**1.06**	**1.08**	**HJ210**	**1.969**	**2.543**	**.394**	**.197**	**.059**	**.139**
					50	64.6	10.00	5	1.5	
13,700	**14,900**	**1.38**	**1.41**	**HJ211**	**2.165**	**2.787**	**.433**	**.236**	**.059**	**.185**
					55	70.8	11.00	6	1.5	
16,200	**18,000**	**1.77**	**1.80**	**HJ212**	**2.362**	**3.087**	**.433**	**.236**	**.079**	**.238**
					60	78.4	11.00	6	2.0	
18,900	**21,200**	**2.20**	**2.25**	**HJ213**	**2.559**	**3.339**	**.433**	**.236**	**.079**	**.271**
					65	84.8	11.00	6	2.0	
19,600	**22,700**	**2.43**	**2.47**	**HJ214**	**2.756**	**3.528**	**.492**	**.276**	**.079**	**.331**
					70	89.6	12.50	7	2.0	
22,700	**26,400**	**2.67**	**2.71**	**HJ215**	**2.953**	**3.701**	**.492**	**.276**	**.079**	**.344**
					75	94.0	12.50	7	2.0	
25,000	**29,200**	**3.24**	**3.31**	**HJ216**	**3.150**	**3.984**	**.531**	**.315**	**.098**	**.456**
					80	101.2	13.50	8	2.5	
28,300	**33,500**	**4.03**	**4.12**	**HJ217**	**3.346**	**4.260**	**.551**	**.315**	**.098**	**.551**
					85	108.2	14.00	8	2.5	
34,000	**40,000**	**4.96**	**5.07**	**HJ218**	**3.543**	**4.496**	**.591**	**.354**	**.098**	**.672**
					90	114.2	15.00	9	2.5	
37,000	**44,000**	**6.00**	**6.13**	**HJ219**	**3.740**	**4.764**	**.610**	**.354**	**.118**	**.776**
					95	121.0	15.50	9	2.5	
41,000	**49,000**	**7.19**	**7.34**	**HJ220**	**3.937**	**5.039**	**.669**	**.394**	**.118**	**.979**
					100	128.0	17.00	10	2.5	
45,000	**54,000**	**8.53**	**8.71**	**HJ221**	**4.134**	**5.315**	**.689**	**.394**	**.118**	**1.11**
					105	135.0	17.50	10	2.5	
54,000	**65,000**	**10.0**	**10.2**	**HJ222**	**4.331**	**5.571**	**.728**	**.433**	**.118**	**1.36**
					110	141.5	18.50	11	2.5	
61,000	**76,000**	**12.0**	**12.3**	**HJ224**	**4.724**	**6.024**	**.748**	**.433**	**.118**	**1.58**
					120	153.0	19.00	11	2.5	
63,500	**81,500**	**16.3**	**16.6**	**HJ226**	**5.118**	**6.516**	**.748**	**.433**	**.118**	**1.85**
					130	165.5	19.00	11	3.0	
73,000	**94,500**	**20.4**	**20.9**	**HJ228**	**5.512**	**7.067**	**.748**	**.433**	**.118**	**2.20**
					140	179.5	19.00	11	3.0	
84,500	**111,000**	**25.8**	**26.2**	**HJ230**	**5.906**	**7.598**	**.807**	**.472**	**.118**	**2.73**
					150	193.0	20.50	12	3.0	
96,000	**128,000**	**31.3**	**32.0**	**HJ232**	**6.299**	**8.150**	**.827**	**.472**	**.118**	**3.26**
					160	207.0	21.00	12	3.0	
					170	220.5	22.00	12	4.0	
					180	230.5	22.00	12	4.0	
					190	244.5	23.50	13	4.0	
					200	258.0	25.00	14	4.0	
					220	286.0	27.50	15	4.0	
					240	313.0	29.50	16	4.0	
					260	340.0	33.00	18	5.0	
					280	360.0	33.00	18	5.0	
					300	387.0	34.50	20	5.0	
					320	415.0	37.00	21	5.0	

Basic Load		Weight								
C	*C*									
5,200	**4,350**	**.328**	**.337**	**HJ304**	**.787**	**1.252**	**.295**	**.157**	**.024**	**.037**
					20	31.8	7.5	4	.6	
7,050	**6,250**	**.518**	**.531**	**HJ305**	**.984**	**1.535**	**.315**	**.157**	**.059**	**.055**
					25	39.0	8.0	4	1.5	
8,700	**7,900**	**.772**	**.789**	**HJ306**	**1.181**	**1.807**	**.374**	**.197**	**.059**	**.086**
					30	45.9	9.5	5	1.5	
11,200	**10,500**	**1.03**	**1.05**	**HJ307**	**1.378**	**2.000**	**.433**	**.236**	**.059**	**.123**
					35	50.8	11.0	6	1.5	
13,200	**12,800**	**1.42**	**1.45**	**HJ308**	**1.575**	**2.299**	**.492**	**.276**	**.079**	**.183**
					40	58.4	12.5	7	2.0	
17,700	**17,400**	**1.89**	**1.93**	**HJ309**	**1.772**	**2.520**	**.492**	**.276**	**.079**	**.218**
					45	64.0	12.5	7	2.0	
19,500	**19,400**	**2.45**	**2.51**	**HJ310**	**1.969**	**2.795**	**.551**	**.315**	**.098**	**.313**
					50	71.0	14.0	8	2.5	
24,900	**25,000**	**3.13**	**3.20**	**HJ311**	**2.165**	**3.039**	**.591**	**.354**	**.098**	**.401**
					55	77.2	15.0	9	2.5	
27,800	**28,400**	**3.90**	**3.99**	**HJ312**	**2.362**	**3.315**	**.610**	**.354**	**.098**	**.485**
					60	84.2	15.5	9	2.5	
30,500	**31,000**	**4.81**	**4.92**	**HJ313**	**2.559**	**3.583**	**.669**	**.394**	**.098**	**.617**
					65	91.0	17.0	10	2.5	
35,500	**38,000**	**5.84**	**5.97**	**HJ314**	**2.756**	**3.858**	**.689**	**.394**	**.098**	**.728**
					70	98.0	17.5	10	2.5	
43,000	**46,000**	**7.01**	**7.17**	**HJ315**	**2.953**	**4.102**	**.728**	**.433**	**.098**	**.882**
					75	104.2	18.5	11	2.5	
45,000	**50,000**	**8.31**	**8.51**	**HJ316**	**3.150**	**4.402**	**.768**	**.433**	**.098**	**1.04**
					80	111.8	19.5	11	2.5	
50,500	**55,500**	**9.79**	**10.0**	**HJ317**	**3.346**	**4.626**	**.807**	**.472**	**.118**	**1.23**
					85	117.5	20.5	12	3.0	
54,000	**59,500**	**11.4**	**11.7**	**HJ318**	**3.543**	**4.921**	**.827**	**.472**	**.118**	**1.39**
					90	125.0	21.0	12	3.0	
61,500	**70,000**	**13.2**	**13.5**	**HJ319**	**3.740**	**5.197**	**.886**	**.512**	**.118**	**1.68**
					95	132.0	22.5	13	3.0	
71,000	**81,500**	**16.1**	**16.5**	**HJ320**	**3.937**	**5.531**	**.886**	**.512**	**.118**	**1.97**
					100	140.5	22.5	13	3.0	
81,000	**94,000**	**22.1**	**22.5**	**HJ321**	**4.134**	**5.787**	**.886**	**.512**	**.118**	**2.14**
					105	147.0	22.5	13	3.0	
90,500	**105,000**	**25.8**	**26.5**	**HJ322**	**4.331**	**6.122**	**.906**	**.551**	**.118**	**2.58**
					110	155.5	23.0	14	3.0	
					120	168.5	23.5	14	3.0	
					130	182.0	24.0	14	4.0	
					140	196.0	26.0	15	4.0	
					150	210.0	26.5	15	4.0	
					160	225.0	28.0	15	4.0	
					170	238.0	29.5	16	4.0	
					180	252.0	30.5	17	4.0	
					190	265.0	32.0	18	5.0	
					200	280.0	33.0	18	5.0	
					220	307.0	36.0	20	5.0	
					240	335.0	39.5	22	5.0	
					260	362.0	43.0	24	6.0	
					280	390.0	46.0	26	6.0	

C	*C*									
14,100	**12,400**	**1.75**	**1.79**	**HJ406**	**1.181**	**1.988**	**.453**	**.276**	**.079**	**.176**
					30	50.5	11.5	7	2.0	
16,900	**15,500**	**2.29**	**2.36**	**HJ407**	**1.378**	**2.323**	**.512**	**.315**	**.079**	**.265**
					35	59.0	13.0	8	2.0	
21,500	**20,000**	**3.02**	**3.09**	**HJ408**	**1.575**	**2.551**	**.512**	**.315**	**.098**	**.309**
					40	64.8	13.0	8	2.5	
25,900	**25,100**	**3.77**	**3.86**	**HJ409**	**1.772**	**2.827**	**.531**	**.315**	**.098**	**.386**
					45	71.8	13.5	8	2.5	
31,000	**30,500**	**4.70**	**4.81**	**HJ410**	**1.969**	**3.102**	**.571**	**.354**	**.098**	**.507**
					50	78.8	14.5	9	2.5	
31,500	**31,000**	**5.78**	**5.91**	**HJ411**	**2.165**	**3.354**	**.650**	**.394**	**.098**	**.639**
					55	85.2	16.5	10	2.5	
37,500	**38,000**	**6.97**	**7.14**	**HJ412**	**2.362**	**3.614**	**.650**	**.394**	**.098**	**.750**
					60	91.8	16.5	10	2.5	
44,000	**45,500**	**8.36**	**8.55**	**HJ413**	**2.559**	**3.878**	**.709**	**.433**	**.098**	**.926**
					65	98.5	18.0	11	2.5	
54,500	**58,000**	**12.2**	**12.5**	**HJ414**	**2.756**	**4.350**	**.787**	**.472**	**.118**	**1.33**
					70	110.5	20.0	12	3.0	
59,000	**61,500**	**14.5**	**14.8**	**HJ415**	**2.953**	**4.567**	**.846**	**.512**	**.118**	**1.57**
					75	116.0	21.5	13	3.0	
67,500	**71,000**	**17.0**	**17.4**	**HJ416**	**3.150**	**4.803**	**.866**	**.512**	**.118**	**1.72**
					80	122.0	22.0	13	3.0	
75,000	**78,500**	**20.2**	**20.7**	**HJ417**	**3.346**	**4.961**	**.945**	**.551**	**.157**	**1.94**
					85	126.0	24.0	14	4.0	
84,000	**90,000**	**24.0**	**24.7**	**HJ418**	**3.543**	**5.394**	**.945**	**.551**	**.157**	**2.31**
					90	137.0	24.0	14	4.0	
90,000	**99,500**	**28.4**	**29.1**	**HJ419**	**3.740**	**5.787**	**1.004**	**.591**	**.157**	**2.87**
					95	147.0	25.5	15	4.0	
101,000	**111,000**	**32.0**	**32.8**	**HJ420**	**3.937**	**6.043**	**1.063**	**.630**	**.157**	**3.31**
					100	153.5	27.0	16	4.0	
112,000	**125,000**	**35.7**	**36.6**	**HJ421**	**4.134**	**6.280**	**1.063**	**.630**	**.157**	**3.64**
					105	159.5	27.0	16	4.0	
123,000	**140,000**	**45.4**	**46.5**	**HJ422**	**4.331**	**6.732**	**1.161**	**.669**	**.157**	**4.63**
					110	171.0	29.5	17	4.0	
151,000	**173,000**	**62.2**	**63.7**	**HJ424**	**4.724**	**7.402**	**1.201**	**.669**	**.197**	**5.73**
					120	188.0	30.5	17	5.0	
185,000	**215,000**	**81.1**	**83.1**	**HJ426**	**5.118**	**8.071**	**1.260**	**.709**	**.197**	**7.28**
					130	205.0	32.0	18	5.0	
197,000	**230,000**	**95.2**	**97.7**	**HJ428**	**5.512**	**8.622**	**1.299**	**.709**	**.197**	**8.27**
					140	219.0	33.0	18	5.0	
209,000	**253,000**	**190**	**112**	**HJ430**	**5.906**	**9.213**	**1.437**	**.787**	**.197**	**10.40**
					150	234.0	36.5	20	5.0	

Ratings (lbs)			(lbs)	Thrust						Weight
C	*C*									
5,650	**5,550**	**.412**	**.401**	**HJ2205**	**.984**	**1.378**	**.295**	**.118**	**.024**	**.033**
					25	35.0	7.5	3.0	.6	
7,850	**8,050**	**.639**	**.631**	**HJ2206**	**1.181**	**1.646**	**.335**	**.157**	**.024**	**.055**
					30	41.8	8.5	4.0	.6	
11,700	**12,500**	**1.00**	**.974**	**HJ2207**	**1.378**	**1.874**	**.335**	**.157**	**.024**	**.068**
					35	47.6	8.5	4.0	.6	
13,100	**13,900**	**1.21**	**1.18**	**HJ2208**	**1.575**	**2.134**	**.374**	**.197**	**.059**	**.104**
					40	54.2	9.5	5.0	1.5	
13,800	**15,200**	**1.31**	**1.28**	**HJ2209**	**1.772**	**2.323**	**.374**	**.197**	**.059**	**.117**
					45	59.0	9.5	5.0	1.5	
15,200	**17,700**	**1.42**	**1.38**	**HJ2210**	**1.969**	**2.543**	**.374**	**.197**	**.059**	**.134**
					50	64.6	9.5	5.0	1.5	
17,800	**20,900**	**1.94**	**1.88**	**HJ2211**	**2.165**	**2.787**	**.433**	**.236**	**.059**	**.185**
					55	70.8	11.0	6.0	1.5	
22,700	**27,800**	**2.65**	**2.58**	**HJ2212**	**2.362**	**3.087**	**.433**	**.236**	**.079**	**.238**
					60	78.4	11.0	6.0	2.0	
27,000	**33,500**	**3.48**	**3.40**	**HJ2213**	**2.559**	**3.339**	**.453**	**.236**	**.079**	**.278**
					65	84.8	11.5	6.0	2.0	
28,100	**36,000**	**3.70**	**3.59**	**HJ2214**	**2.756**	**3.528**	**.492**	**.276**	**.079**	**.331**
					70	89.6	12.5	7.0	2.0	
30,500	**38,500**	**3.88**	**3.77**	**HJ2215**	**2.953**	**3.701**	**.492**	**.276**	**.079**	**.344**
					75	94.0	12.5	7.0	2.0	
34,500	**44,500**	**4.83**	**4.70**	**HJ2216**	**3.150**	**3.984**	**.531**	**.315**	**.098**	**.456**
					80	101.2	13.5	8.0	2.5	
40,000	**52,000**	**6.11**	**5.93**	**HJ2217**	**3.346**	**4.260**	**.551**	**.315**	**.098**	**.551**
					85	108.2	14.0	8.0	2.5	
46,500	**59,500**	**7.78**	**7.56**	**HJ2218**	**3.543**	**4.496**	**.630**	**.354**	**.098**	**.694**
					90	114.2	16.0	9.0	2.5	
52,000	**67,000**	**9.50**	**9.24**	**HJ2219**	**3.740**	**4.764**	**.650**	**.354**	**.098**	**.800**
					95	121.0	16.5	9.0	2.5	
58,000	**76,000**	**11.4**	**11.1**	**HJ2220**	**3.937**	**5.039**	**.709**	**.394**	**.098**	**1.01**
					100	128.0	18.0	10.0	2.5	
75,000	**99,500**	**16.4**	**16.0**	**HJ2222**	**4.331**	**5.571**	**.807**	**.433**	**.098**	**1.42**
					110	141.5	20.5	11.0	2.5	
86,000	**118,000**	**20.5**	**19.9**	**HJ2224**	**4.724**	**6.024**	**.866**	**.433**	**.098**	**1.69**
					120	153.0	22.0	11.0	2.5	
89,000	**126,000**	**25.6**	**24.9**	**HJ2226**	**5.118**	**6.516**	**.984**	**.433**	**.118**	**2.10**
					130	165.5	25.0	11.0	3.0	
105,000	**151,000**	**32.4**	**31.5**	**HJ2228**	**5.512**	**7.067**	**.984**	**.433**	**.118**	**2.51**
					140	179.5	25.0	11.0	3.0	
123,000	**180,000**	**40.8**	**39.7**	**HJ2230**	**5.906**	**7.598**	**1.043**	**.472**	**.118**	**3.06**
					150	193.0	26.5	12.0	3.0	
142,000	**211,000**	**52.0**	**50.7**	**HJ2232**	**6.299**	**8.150**	**1.102**	**.472**	**.118**	**3.73**
					160	207.0	28.0	12.0	3.0	
161,000	**242,000**	**64.2**	**62.4**	**HJ2234**	**6.693**	**8.681**	**1.142**	**.472**	**.157**	**4.25**
					170	220.5	29.0	12.0	4.0	
167,000	**257,000**	**66.8**	**65.0**	**HJ2236**	**7.087**	**9.075**	**1.142**	**.472**	**.157**	**4.50**
					180	230.5	29.0	12.0	4.0	
187,000	**290,000**	**81.1**	**78.9**	**HJ2238**	**7.480**	**9.626**	**1.240**	**.512**	**.157**	**5.56**
					190	244.5	31.5	13.0	4.0	
208,000	**325,000**	**97.4**	**94.8**	**HJ2240**	**7.874**	**10.157**	**1.339**	**.551**	**.157**	**6.59**
					200	258.0	34.0	14.0	4.0	

Ratings (lbs)		(lbs)		Thrust						Weight
C	*C*									
10,300	**10,100**	**.840**	**.816**	**HJ2305**	**.984**	**1.535**	**.354**	**.157**	**.059**	**.060**
					25	39.0	9.0	4	1.5	
11,600	**11,400**	**1.26**	**1.22**	**HJ2306**	**1.181**	**1.807**	**.453**	**.197**	**.059**	**.095**
					30	45.9	11.5	5	1.5	
14,500	**14,800**	**1.74**	**1.69**	**HJ2307**	**1.378**	**2.000**	**.551**	**.236**	**.059**	**.141**
					35	50.8	14.0	6	1.5	
18,500	**19,800**	**2.31**	**2.25**	**HJ2308**	**1.575**	**2.299**	**.571**	**.276**	**.079**	**.198**
					40	58.4	14.5	7	2.0	
23,800	**25,500**	**3.11**	**3.02**	**HJ2309**	**1.772**	**2.520**	**.591**	**.276**	**.079**	**.240**
					45	64.0	15.0	7	2.0	
27,100	**29,500**	**4.14**	**4.03**	**HJ2310**	**1.969**	**2.795**	**.669**	**.315**	**.098**	**.346**
					50	71.0	17.0	8	2.5	
33,500	**36,500**	**5.31**	**5.16**	**HJ2311**	**2.165**	**3.039**	**.728**	**.354**	**.098**	**.448**
					55	77.2	18.5	9	2.5	
38,000	**40,500**	**6.61**	**6.44**	**HJ2312**	**2.362**	**3.315**	**.748**	**.354**	**.098**	**.540**
					60	84.2	19.0	9	2.5	
42,000	**48,000**	**8.00**	**7.76**	**HJ2313**	**2.559**	**3.583**	**.787**	**.394**	**.098**	**.670**
					65	91.0	20.0	10	2.5	
50,000	**59,000**	**9.72**	**9.44**	**HJ2314**	**2.756**	**3.858**	**.807**	**.394**	**.098**	**.789**
					70	98.0	20.5	10	2.5	
61,500	**73,500**	**11.9**	**11.6**	**HJ2315**	**2.953**	**4.102**	**.846**	**.433**	**.098**	**.952**
					75	104.2	21.5	11	2.5	
61,500	**74,500**	**14.6**	**14.2**	**HJ2316**	**3.150**	**4.402**	**.906**	**.433**	**.098**	**1.13**
					80	111.8	23.0	11	2.5	
71,000	**86,000**	**16.9**	**16.4**	**HJ2317**	**3.346**	**4.626**	**.945**	**.472**	**.118**	**1.34**
					85	117.5	24.0	12	3.0	
73,500	**88,500**	**20.0**	**19.5**	**HJ2318**	**3.543**	**4.921**	**1.024**	**.472**	**.118**	**1.55**
					90	125.0	26.0	12	3.0	
88,500	**112,000**	**23.1**	**22.5**	**HJ2319**	**3.740**	**5.197**	**1.043**	**.512**	**.118**	**1.82**
					95	132.0	26.5	13	3.0	
104,000	**133,000**	**29.5**	**28.7**	**HJ2320**	**3.937**	**5.531**	**1.083**	**.512**	**.118**	**2.17**
					100	140.5	27.5	13	3.0	
136,000	**177,000**	**40.6**	**39.5**	**HJ2322**	**4.331**	**6.122**	**1.102**	**.551**	**.118**	**2.82**
					110	155.5	28.0	14	3.0	
159,000	**206,000**	**51.1**	**49.6**	**HJ2324**	**4.724**	**6.634**	**1.102**	**.551**	**.118**	**3.37**
					120	168.5	28.0	14	3.0	
189,000	**253,000**	**63.9**	**62.2**	**HJ2326**	**5.118**	**7.165**	**1.161**	**.551**	**.157**	**3.97**
					130	182.0	29.5	14	4.0	
207,000	**281,000**	**80.2**	**77.8**	**HJ2328**	**5.512**	**7.717**	**1.319**	**.591**	**.157**	**4.87**
					140	196.0	33.5	15	4.0	
229,000	**315,000**	**96.6**	**93.7**	**HJ2330**	**5.906**	**8.268**	**1.339**	**.591**	**.157**	**5.93**
					150	210.0	34.0	15	4.0	
241,000	**340,000**	**115**	**111**	**HJ2332**	**6.299**	**8.858**	**1.457**	**.591**	**.157**	**6.97**
					160	225.0	37.0	15	4.0	
275,000	**395,000**	**135**	**131**	**HJ2334**	**6.693**	**9.370**	**1.516**	**.630**	**.157**	**8.18**
					170	238.0	38.5	16	4.0	
310,000	**450,000**	**158**	**153**	**HJ2336**	**7.087**	**9.921**	**1.575**	**.669**	**.157**	**9.74**
					180	252.0	40.0	17	4.0	
340,000	**500,000**	**183**	**177**	**HJ2338**	**7.480**	**10.433**	**1.634**	**.709**	**.197**	**11.1**
					190	265.0	41.5	18	5.0	
340,000	**505,000**	**210**	**204**	**HJ2340**	**7.874**	**11.024**	**1.752**	**.709**	**.197**	**12.7**
					200	280.0	44.5	18	5.0	