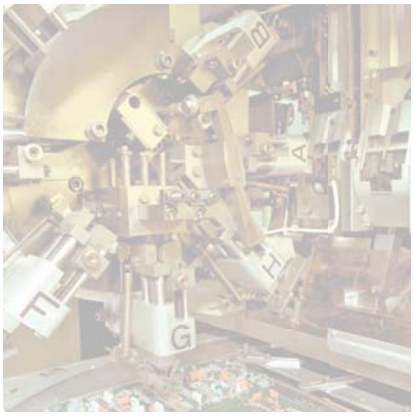
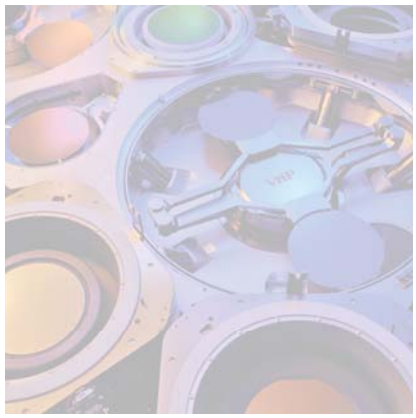
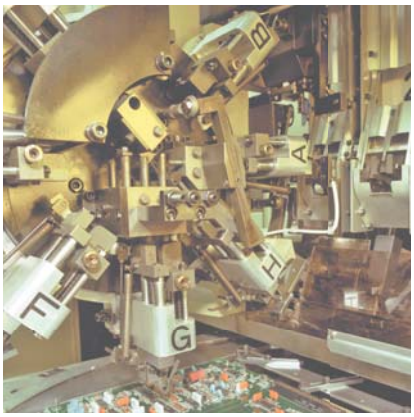
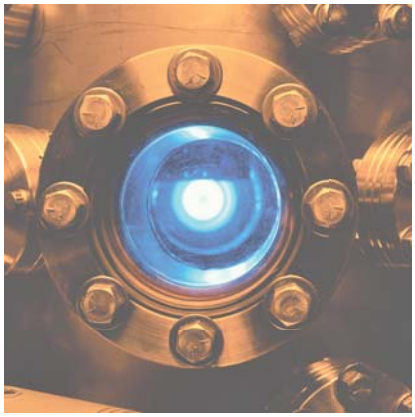
Reali-Slim® Thin-Section Bearings for Semiconductor Applications

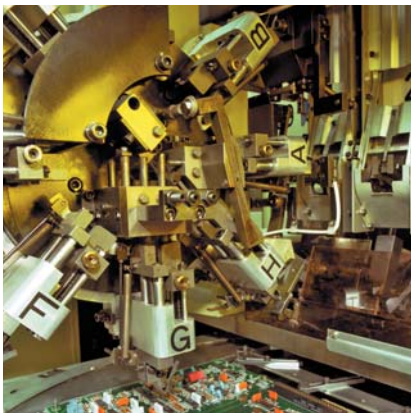
Design Engineer's Selection Guide

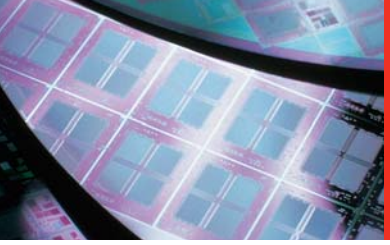
KAYDON®

TURNING IDEAS INTO ENGINEERED SOLUTIONS





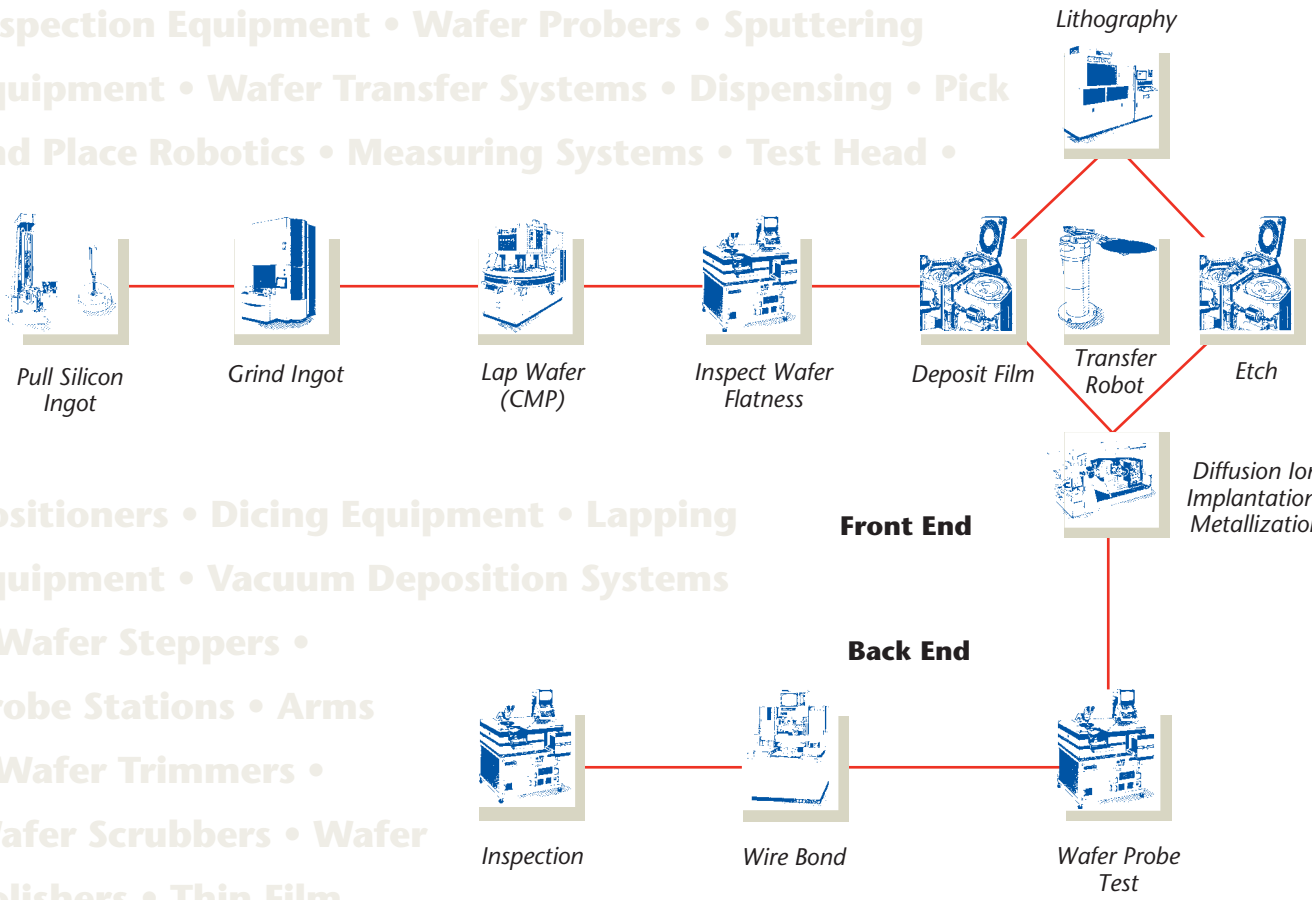


Kaydon Reali-Slim Thin-Section Bearings:

At the Heart of More Semiconductor Eq

Semiconductor Process

Inspection Equipment • Wafer Probers • Sputtering Equipment • Wafer Transfer Systems • Dispensing • Pick and Place Robotics • Measuring Systems • Test Head • Positioners • Dicing Equipment • Lapping Equipment • Vacuum Deposition Systems • Wafer Steppers • Probe Stations • Arms • Wafer Trimmers • Wafer Scrubbers • Wafer Polishers • Thin-Film Deposition Systems • CVD Systems • Measuring Systems • Etching Systems



Whether you are looking for a bearing or you need a higher-level assembly — call Kaydon 800-514-3066.

Equipment illustrations by David Kimble, courtesy of Semiconductor Equipment and Materials International.
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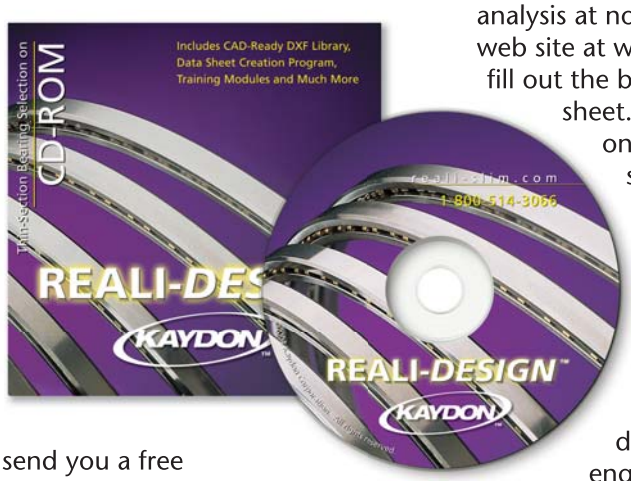
uipment Applications than Any Other Bearing

As the world leader in thin-section bearings, Kaydon is uniquely suited to meet the ever-changing needs of the semiconductor equipment industry. By blending technical innovation with cost-effective JIT manufacturing, we supply more than 350 sizes of Reali-Slim bearings from stock—and deliver over 9,000 versions of these base bearings with very short lead times.

Kaydon makes it easy to select the right bearings for your specific semiconductor equipment applications. We offer a number of helpful tools that take the guesswork out of bearing selection, including:

Free Customized Engineering Review

Kaydon will be happy to perform a detailed bearing analysis based on your specific equipment designs. Within as little as 48 hours after receiving the necessary data, we'll



send you a free Engineering Review. All dimensional information and mounting recommendations for your bearing application will be included. This document will also contain a report covering static and dynamic capacities, stiffness and deflection expectations, frictional torque, and the effect of fitup and temperature on bearing performance. The review even includes proposal drawings of the bearing. Formal specification drawings containing a unique part number for traceability, design verification, and simplification of orders can be provided upon request. To initiate a bearing analysis at no charge, just visit our web site at www.reali-slim.com and fill out the bearing application sheet. Or, fill out the sheet on the next page and send it by fax to Kaydon at 1-231-759-4102.

Reali-Design™ Software

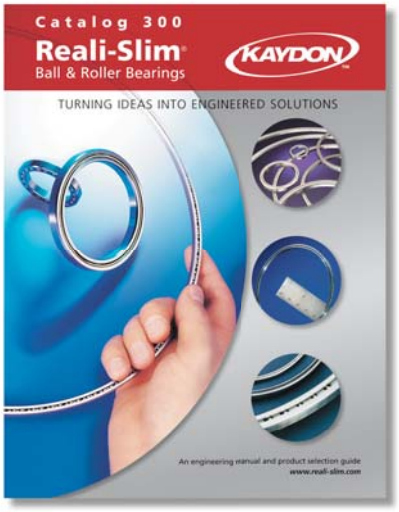
Bearing selection guidance and specifications can be determined from this engineering program. It can be downloaded from Kaydon's web site, or mailed to you as desired.

Toll-Free Engineering Services Hotline

Our application engineers are standing by to answer your inquiries. They're familiar with a broad range of semiconductor equipment applications and can help you quickly determine which Reali-Slim bearing will provide optimal performance in your product. For free assistance, call 1-800-514-3066

Reali-Slim Catalog 300

Catalog 300 is much more than an ordinary product catalog. It shows how load, speed, and accuracy requirements affect the selection of a thin-section bearing. Torque, clearance, and deflection are explained and calculated to help define suitable bearing selection. Installation, shaft and housing fits, and maintenance are also covered for over 350 stock bearing sizes.



Engineering recommendations backed up

Compact design

The space-saving design of Reali-Slim bearings allows you to engineer rotating devices that are smaller, simpler and lighter.

Precision tolerances

Reali-Slim bearings are manufactured in a range of classes for optimal precision and design flexibility.

Temperature Limits

Kaydon can provide off-the-shelf bearings suitable for temperatures up to 250° F. With a wide selection of materials and lubricants available, alternative materials may permit even higher operating temperatures.

Vacuum compatibility

Standard bearings are intended for atmospheric conditions. Vacuum levels of 10^{-6} to 10^{-8} Torr can be achieved with special lubricants and materials.

Low particulates

Particulate generation is the primary failure mode of bearings in vacuum surface treatments. Materials and lubricants can be specified to extend bearing operational life.

Non-magnetic bearings

For lightly loaded applications, hybrid bearings can improve torque characteristics and extend life.

Chemical compatibility

Kaydon can recommend special materials or processing for corrosive chemical environments such as acidic or basic vapors and liquids.

Design verification

To help you optimize the performance of your Reali-Slim bearings, Kaydon will be happy to provide a bearing recommendation and a specification control drawing for your reference.

Relative suitability of Reali-Slim bearing materials for various operating conditions[A]

Race Materials	Resistance[B]	Load Capacity	High Temp. Capability	Chemical[C]
AISI 52100 steel	—	1	3	5
Martensitic CRES	2	1	2	3
Precipitation CRES	1	2	4	1
Ball Materials	**Resistance[B]**	**Load Capacity**	**High Temp. Capability**	**Chemical[C]**
High carbon	—	2	3	5
Martensitic CRES	3	2	3	3
Glass	2	4	5	2
Ceramic	1	1	1	1

[A]Lower numbers are better than higher numbers.
[B]Endurakote® corrosion-resistant coating is available for bearing races and provides corrosive resistance equivalent to 440C stainless steel.
[C]Due to the many combinations of chemicals and environment, consult Kaydon for specific application recommendations.

Engineered for the special environments found in IC production

Race Materials
- AISI 52100 steel
- AISI 440C stainless steel
- 17-4 PH stainless steel

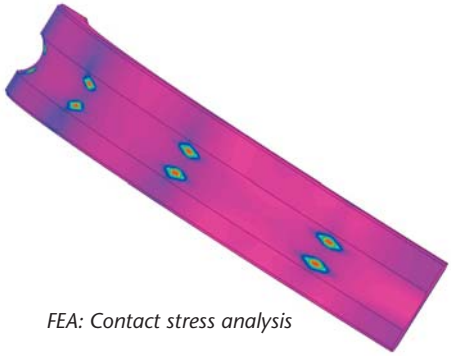
Ball Materials
- AISI 52100 steel
- AISI 440C stainless steel
- Silicon nitride
- Borosilicate glass

Cage Materials
- Nylon
  - Temperature limits of 180°F
  - Low torque
- Peek
  - Excellent for vacuums
  - Temperature limits of 250°F
- Brass
  - Temperature limits of 250°F
  - Good for atmospheric conditions
- 300 series stainless steel
- Phenolic
  - Good for high speed
- 17-7 PH stainless steel
- PTFE
  - Low torque
  - Good for vacuums
- Alternative custom alloys and polymers

Lubrication
- Oils or greases
- Vacuum compatible options
- High temperature lubricants
- Corrosion protection additives

Shields and Seals
- NBR (standard)
- Viton*
- Acetal
- PTFE
- Corrosion resistant steel
- Custom integral designs

Whatever the special demands of your semiconductor manufacturing equipment application, we can recommend a bearing with the specific combination of the characteristics you need. Our Reali-Slim bearings can be optimized to minimize friction, outgassing, contamination, corrosion and even wear. All of these can be achieved without sacrificing bearing accuracy.



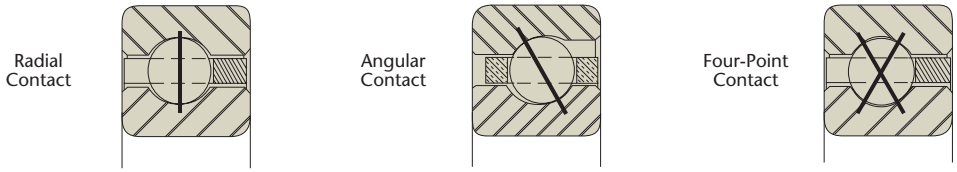
FEA: Contact stress analysis

by experience and testing

Open bearing types

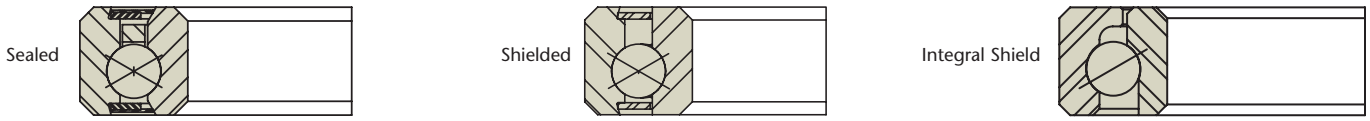
Kaydon Reali-Slim Bearings are the industry standard in thin-section ball bearings, available from stock in 1" to 40" bores and 3/16" to 1" cross sections.

In each of the eight dimensional series, bearing cross section is held constant over a wide range of bore diameter sizes. Three basic configurations support various combinations of applied loads—Type "C" for pure radial loads, Type "A" for radial and thrust loading, and Type "X" 4-point contact design for any combination of radial, thrust and moment loading on a single bearing.



Shields and seals can help retain lubricant

Shields or seals can be added into these thin-section bearings without increasing their space requirements. Seals are often used in atmospheric environments, but due to particle generation, are generally unsuitable for vacuums. In these ultra-clean environments, shields become the designer's choice. There is no torque penalty due to the shields not quite touching the inner race. This also means that there is no particle generation from the shield, as there is no sliding between the shield and inner bearing race.

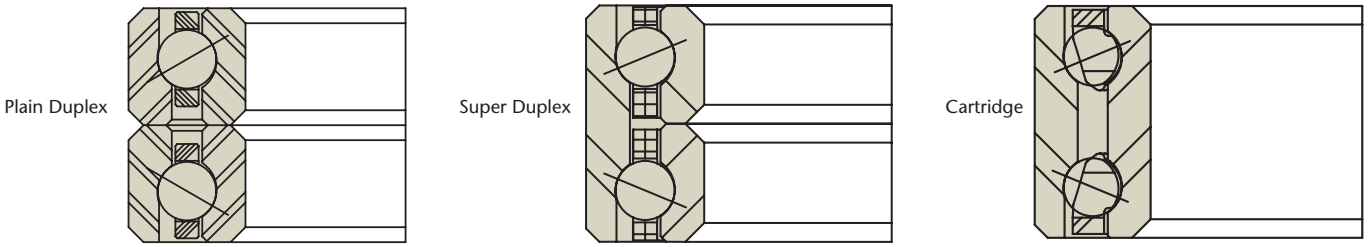


Duplex Bearing Evolution

Designers typically specify a duplexed pair of angular contact bearings when high speed or smooth torque is the overriding requirement. Unfortunately, the disadvantages of using two separable bearings are potential errors in alignment and orientation during assembly.

The Super Duplex has a common race, either a single outer or a single inner, which has two bearing paths in it. As these are ground at the same time, they "run-out" together. This further helps to smooth out potential torque variations that would be caused by the variations in axial runout adding torque into the bearing. A further advantage is that since the bearing assembly is not separable, the possibility for installation orientation errors is eliminated. Another advantage is stiffness gained through a more rigid outer race.

The "Cartridge" bearing takes this design a step further. A cartridge style bearing has both a single outer and a single inner race. This design results in the absolute best torque performance. Like the Super Duplex, this design also eliminates potential installation errors.



A Size to Fit Your Application

For additional design information, consult Kaydon Catalog 300.

Standard Reali-Slim® Series Availability Chart

Series	Type	Bore Diameter In Inches																														
		1	1 1/2	1 3/4	2	2 1/2	3	3 1/2	4	4 1/4	4 1/2	4 3/4	5	5 1/2	6	6 1/2	7	7 1/2	8	9	10	11	12	14	16	18	20	21	22	25	30	35	40
KAA Series 3/16" Radial Section	A	•	•	•																												
	C	•	•	•																												
	X	•	•	•																												
JA Series 1/4" Radial Section	A																															
	C				•	•	•	•	•	•	•		*																			
	X				•	•	•	•	•	•	•		*			•																
KA Series 1/4" Radial Section	A				•	•	•	•	•	•	•	•	•	•	•	•	•	•	*	*	•	*										
	C				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•									
	X				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	*	•									
JB Series 5/16" Radial Section	A																															
	C				•	•	•	•	•	•			*																			
	X				•	•	•	•	•	•																						
KB Series 5/16" Radial Section	A				•	•	•	•	•	•	*		*	•	•	*		*	*	•			*		*		*					
	C				•	•	•	•	•	•	•	*	•	*	•	•			•	*												
	X				•	•	•	•	•	•	•	*	•	•	•	•	*		•	•				*		•						
KC Series 3/8" Radial Section	A								•	*	•	•	•	•	•	*	•	*	*	•			•	•			*					
	C								•	•	•	•	•	•	•	•	•	•	•	*	•	*	*									
	X								•		•	•	•	•	•	•	•		•	•	•	•	•		•		•					
JU Series 3/8" Radial Section	A																															
	C								•		•	*	•	•	•	•	•	•	•	•	•	•	*									
	X								•		•	*	•	•	•	•	•	•	•	•	•	•	*									
KD Series 1/2" Radial Section	A								•	•	•	•	•	•	•	•	•	•	•	•	*	*	•	*	*	*	*	*		*	*		
	C								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	*	*								
	X								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	*		*			
KF Series 3/4" Radial Section	A										*	•		•	•	•	*	•	•	•	*	*	•	*	*		*					
	C								•	•	*	•	•	•	•	•	*	•	•	•	•	•	•	*									
	X								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			*			*			
KG Series 1" Radial Section	A													*	•	*	*	•	•	•	•	*	•	•	•	•	•		*	*	*		*
	C									*			•	•	*	•	•	•	•	•	•	•	•	•	•	•	•		*	*	*	*	*
	X								*		*		•	•	•	*	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•

• *Available from stock.* * *Limited availability – contact Kaydon for lead time and minimum purchase requirement.*

Metric Reali-Slim® Series Availabillity Chart

Series	Type	Bore Diameter in Millimeters																						
		20	25	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	250	300	320	340	360
8 mm	A	*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	*	•	•	•	•	•	•
	C	*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	*	•	•	•	•	•	•
	X	*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	*	•	•	•	•	•	•
13 mm	A	*	*	*	*	•	*	*	*	*	*	*	*	*	*	•	*	•	*	*	*	*	*	*
	C	*	*	*	*	•	*	*	*	*	*	*	*	*	*	•	*	•	*	*	*	*	*	*
	X	*	*	*	*	•	*	*	*	*	*	*	*	*	*	•	*	•	*	*	*	*	*	*
20 mm	A	*	*	*	*	*	*	*	*	*	*	*	*	•	•	•	•	*	•	•	•	*	*	*
	C	*	*	*	*	*	*	*	*	*	*	*	*	•	•	•	•	*	•	•	•	*	*	*
	X	*	*	*	*	*	*	*	*	*	*	*	*	•	•	•	•	*	•	•	•	*	*	*

• *Available from stock.* * *Limited availability – contact Kaydon for lead time and minimum purchase requirement.*

Stainless Steel Reali-Slim® Series Availabillity Chart

Series	Type	Bore Diameter in Inches							
		1	1½	2	2½	3	3½	4	6
SAA Series 3/16" Radial Section	A	*	*	*	*	*	*	*	*
	C	*	*	*	*	*	*	*	*
	X	*	*	*	*	*	*	*	*
SA Series 1/4" Radial Section	A	*	*	*	*	*	*	*	*
	C	*	*	*	*	*	*	*	*
	X	*	*	*	*	*	*	*	*
SB Series 5/16" Radial Section	A	*	*	*	*	*	*	*	*
	C	*	*	*	*	*	*	*	*
	X	*	*	*	*	*	*	*	*

* *Limited availability – contact Kaydon for lead time and minimum purchase requirement.*

Type A = Angular Contact

Type C = Radial Contact

Type X = Four-Point Contact

Bearing Application Data Fax Sheet
Fax: 231-759-4102

Need application assistance on a current project? Please answer the questions on this form as completely as possible. Include a drawing (or sketch) of the application if available. Be sure to show all parts and information relevant to the application and then photocopy and fax the sheet to Kaydon for a free design review.

TO: Kaydon Corporation, Muskegon, Michigan 49441 Date _____

FROM: Name _____ Title _____

Company _____ Telephone (____)_____

Address_____

City _____ State _____Zip_____

E-Mail _____

Application _____ Project _____

Experimental: ❑ Prototype ❑ Production ❑ Special Machine ❑ Other_____

Quantity:_____ ❑ Resale ❑ Own Use ❑ Replacement ❑ Original Equipment Manufacturer

ENVIRONMENT: ❑ Atmosphere ❑ Vacuum Torr _____

LOADS: Static Radial (Max.) _____ Dynamic Radial (Mean) _____

Static Thrust (Max.) _____ Dynamic Thrust (Mean) _____

Static Moment (Max.) _____ Dynamic Moment (Mean) _____

If mean dynamic loads are unknown, attach all conditions with percent of time each occurs.

Vibration or shock?_____ Explain: _____

Factor of Safety of_____ ❑ (is) ❑ (is not) included in loads above.

ACCURACY: Kaydon Precision Class _____ or:

Permissible Eccentricity: Inner _____ Outer_____

Permissible Face Run-out: Inner _____ Outer_____

Permissible Looseness: Radial _____ Axial_____

LIFE: Hours (Min.) _____ Hours (Avg.) _____ Other _____

OSCILLATION: Angle_____° Frequency_____

SPEED: RPM (Max.)_____ RPM (Mean)_____or attach conditions with percent of time.

TEMPERATURE: Normal Operating _____°F Minimum _____°F Maximum _____°F

Differential between shaft and housing _____°F

LUBRICATION: Proposed lubricant _____ and method _____

BEARING: Preferred Size: Bore _____ Outside Dia. _____ Width _____

Min. Bore_____ Max. Outside Dia. _____ Max. Width_____

Preferred Type: _____

Bearing Axis in ❑ (vertical) ❑ (horizontal) position with ❑ (outer) ❑ (inner) race rotation relative to load.

MATERIAL: Shaft_____ Housing_____

SPECIAL: Allowable Bearing Torque_____

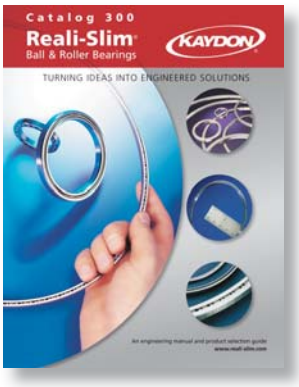
REQUIREMENTS: Sealing _____ Protective Coating _____ Other _____

REMARKS: _____

_____

_____

Application Information to Help In Your Designs

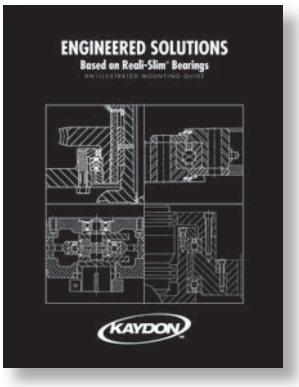


Reali-Slim® thin-section bearings catalog

Complete engineering and selection information on the entire product line, including Metric Reali-Slim® and Ultra-Slim series. Request **Catalog 300**.

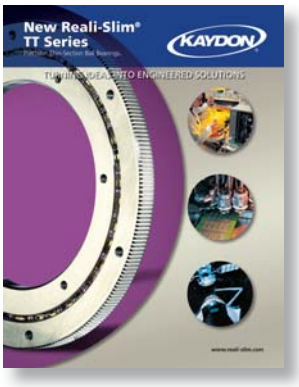
Custom Miniature Ball Bearings Design Manual and Selection Guide

Metric and inch series, bore diameters from 1 mm to 12.7 mm. Open and shielded designs to meet the performance for demanding applications. Request **Catalog 320**.



An illustrated mounting guide for Reali-Slim® bearings

Gives ideas on how to improve designs through better mounting and use of bearing assemblies. 24-pages. Request **Catalog 306**.



Kaydon's new generation of miniature precision thin-secton turntable bearings.

Request New Reali-Slim® Turntable Series 6-page brochure. Request **Mini TT Brochure**.

KAYDON®

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www.reali-slim.com

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ISO 9001

Warranty: *Kaydon Corporation guarantees its products to be free from defects in materials and workmanship for a period of one year from date of shipment from our plant. Any product proving defective within this one-year period will be replaced free of charge provided the defective product is returned, charges prepaid, to the appropriate Kaydon facility, under Kaydon's authorization (Return Goods Authorization number issued), and found to have been properly mounted, lubricated, loaded, and used. No responsibility will be assumed by Kaydon for contingent charges.*

Printed in U.S.A.

Catalog No. 315