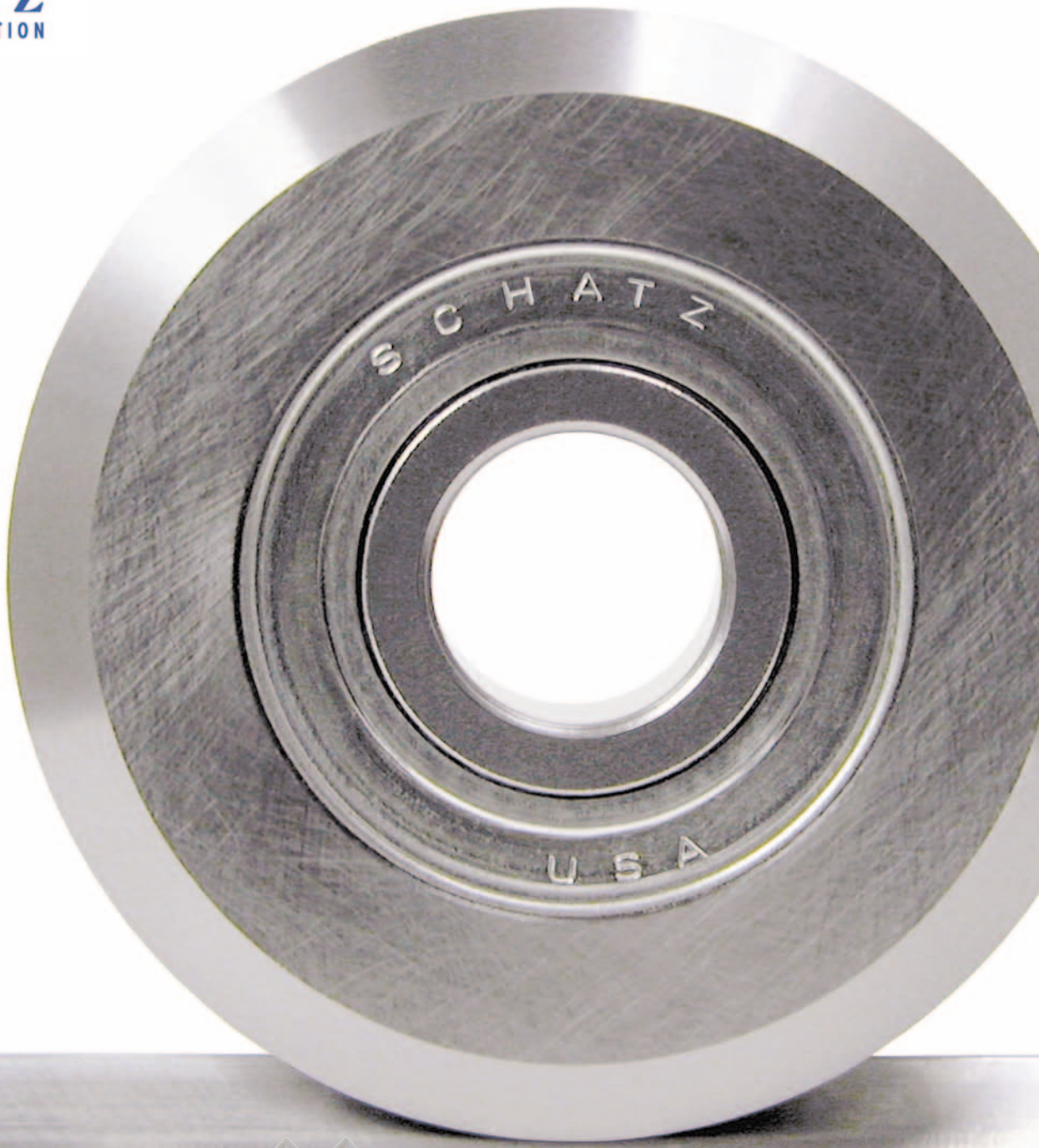
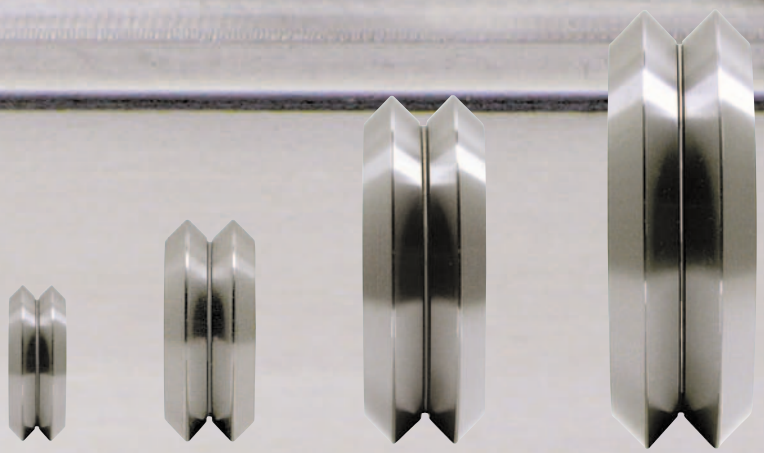
SCHATZ
BEARING CORPORATION

Schatz Double V Linear Motion Systems





A leading producer
of high-quality
ball bearings and
motion control products.

SCHATZ BEARING CORPORATION

Schatz Bearing Corporation is a leading producer of high-quality ball bearings and motion control products. The Schatz name has been associated with quality and innovation for nearly a century. Our products are used in demanding applications in numerous industries including Aerospace, Machine Tool, Automation and Robotics, Medical Equipment, and Semiconductor Manufacturing Equipment.

Our product is manufactured in our ISO 9001 certified facility in Poughkeepsie, New York. Our product lines cover a broad range of ball bearing designs:

Commercial Ball Bearings
Aircraft Control Bearings
Linear Motion Guide Wheels, Components, and Systems
Thin Section Ball Bearings

Our experience and expertise has helped numerous customers solve problems using special bearing designs suited to their specific applications. Our long history allows us to call on previous designs to expeditiously design and develop special bearings to solve problems in demanding applications. Schatz manufactures most types of commercially available ball bearing designs, including radial ball bearings, angular contact bearings, double-row angular contact bearings, duplex angular contact bearings, four point contact bearings, and thrust bearings.

Please contact us for further assistance:

Schatz Bearing Corporation
10 Fairview Avenue
Poughkeepsie, New York 12602
Tel: 845.452.6000
Fax: 845.452.1660
www.schatzbearing.com

ISO 9001:2000 CERTIFIED

QUALITY SYSTEM IS ISO 9001:2000 CERTIFIED

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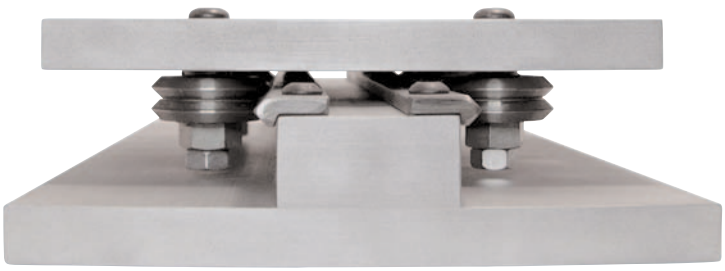

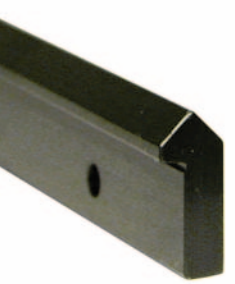

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Schatz Double V Guide Wheel Bearings

The superior choice for linear motion applications

Maintenance-free operation

- Bearings are "greased for life"
- Track surfaces hardened for long wear life
- High-precision bearings allow for smooth and quiet operation

Ideal for harsh environments

- Rolling elements are enclosed and safeguarded from contamination *(Other linear bearing systems allow contamination to ingress into rolling elements on raceways creating accelerated wear.)*
- Stainless steel options for resistance to corrosion
- Schatz's special two-piece seal is highly resistant to contamination
- Lubricant is contained in bearing cavity ensuring long lubrication life

Flexibility in configuration

Components allow for numerous mounting arrangements:

- Bearings can be mounted vertically or horizontally
- Bearings can be used in linear or rotary systems

Custom designs can be manufactured to meet your specific needs.

Schatz can design custom bearings based on application needs. *(see page 11 for details on custom guide wheel bearings)* We've built our reputation on our ability to design and manufacture ball bearings for difficult applications.

Schatz has a long history of specializing in solutions for:

- High Speed Applications
- High Load Capacity Applications
- High Temperature Applications
- Special O.D. Requirements

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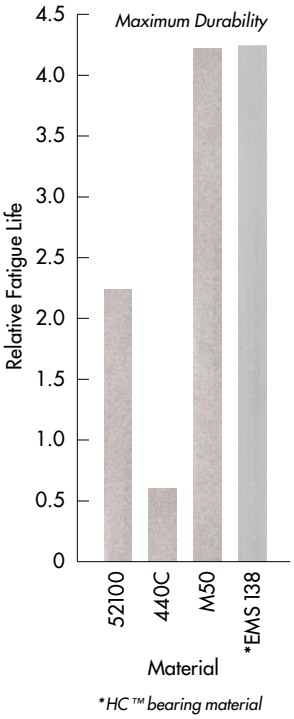
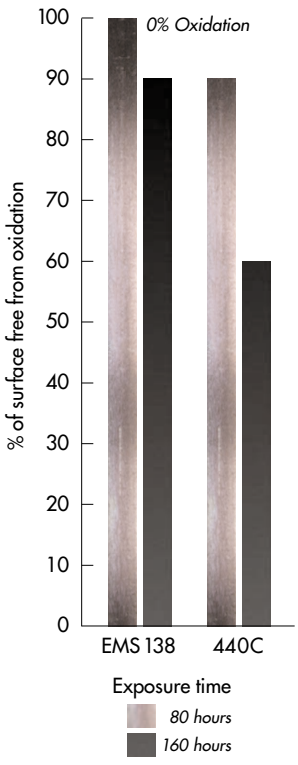
Fatigue Life Comparison



*HC™ bearing material

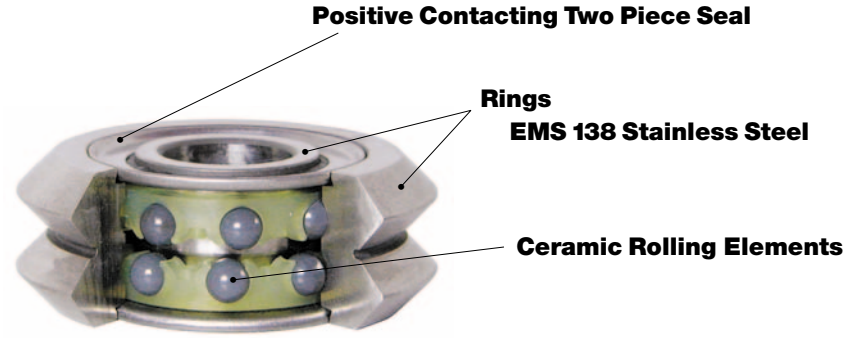
Salt Spray Testing



LINEAR BEARINGS FOR HARSH ENVIRONMENTS

Applications:

Aerospace and Defense
Medical Equipment
Semiconductor Equipment
Food and Packaging Equipment



Extremely high corrosion resistance and long fatigue life

Superior corrosion-resistance combined with excellent fatigue-resistance makes the Schatz HC™ the superior choice for demanding linear applications. Typical corrosion-resistant bearings utilize 440C for the material. Although 440C has better corrosion-resistance than standard non-stainless bearing materials, the use of the 440C results in a significant loss of fatigue or wear life. The material composition of the steel used in HC™ bearings allows the bearings to be produced with a unique combination of high fatigue-resistance and extremely high corrosion-resistance.

Schatz HC™ Guide Wheel bearings utilize EMS138 stainless steel for the inner and outer rings with silicon nitride (ceramic) balls.

Schatz HC™ linear track utilizes EMS138 stainless steel. The V section of the track is hardened to Rc53 min.

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PART NUMBERING SYSTEM

For Schatz Double V Guide Wheels

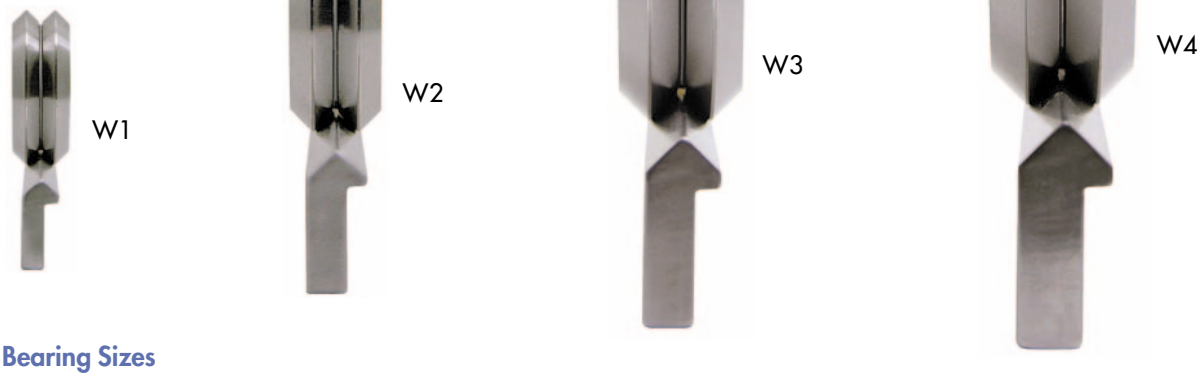
Closure

Special feature

W1 LL SS 1 2 3

Bearing Size

Bearing Material



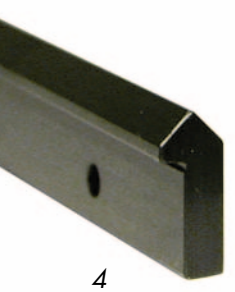
Basic Bearing Sizes

Guide wheels above are shown at actual size.

Closures FF– Two non-contacting metal shields
LL– Two face contacting Buna N seals supported by a metal shroud

Bearing Material __ __ (blank) – Rings and balls made from SAE 52100 bearing steel
SS– Rings and balls made from AISI 440C stainless steel
HC– Rings made from EMS138 stainless steel, ceramic balls

1 2 3 **Special feature designation** These numerals designate a special design feature, such as grease, or a bearing geometry, or a bearing suitable for high temperature applications, etc.



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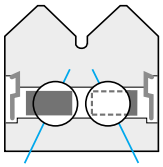
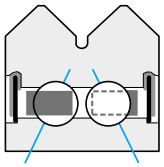


shielded



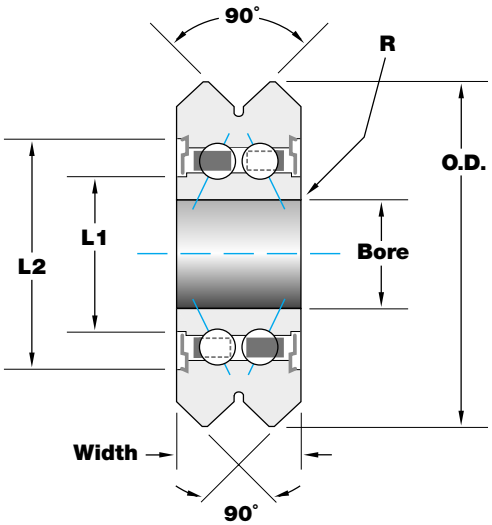
sealed

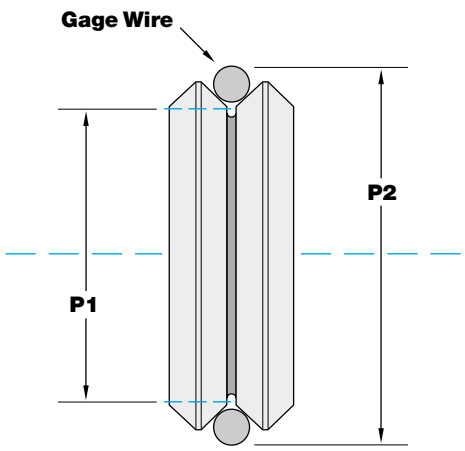
DOUBLE V GUIDE WHEEL DIMENSIONS AND LOAD RATINGS

		Basic Bearing Dimensions						Profile Dimensions			Basic Load Ratings (lbs.)		
Bearing Part Number	Interchange Number	Bore +.0000 -.0003	O.D. ±.005	Width +.0000 -.0050	L1 Land	L2 Land	R Radius*	P1 Ref.	P2 ±.002	Gage Wire Diam.	Cr (dynamic) Radial Load	Cor (static) Radial Load	Coa (static) Axial Load
W1FF	**W1**	.1875	.771	.3100	.314	.564	.012	.625	.851	.0937	500	320	145
W1LL	**W1X**												
W1LLSS	**W1SSX**												
W2FF	**W2**	.3750	1.210	.4375	.530	.797	.012	1.000	1.302	.1250	910	750	300
W2LL	**W2X**												
W2LLSS	**W2SSX**												
W3FF	**W3**	.4724	1.803	.6250	.640	1.005	.024	1.500	1.953	.1875	1710	1350	600
W3LL	**W3X**												
W3LLSS	**W3SSX**												
W4FF	**W4**	.5906	2.360	.7500	.878	1.395	.024	2.000	2.604	.2500	3260	2750	1055
W4LL	**W4X**												
W4LLSS	**W4SSX**												

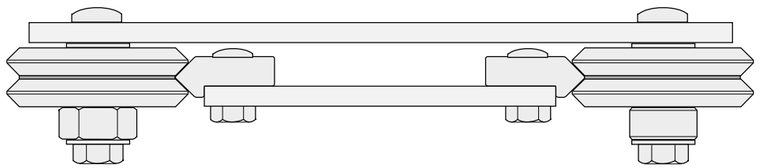
* Radius clearance (Maximum collet radius on shaft which bearing corner will clear.)

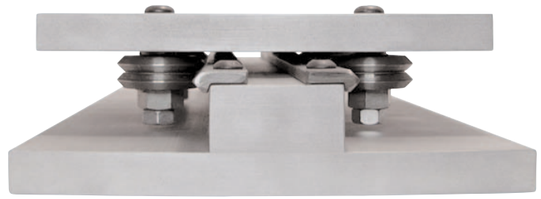
Consult Schatz's engineering department for bearing life and load ratings at specific application loads and speeds.



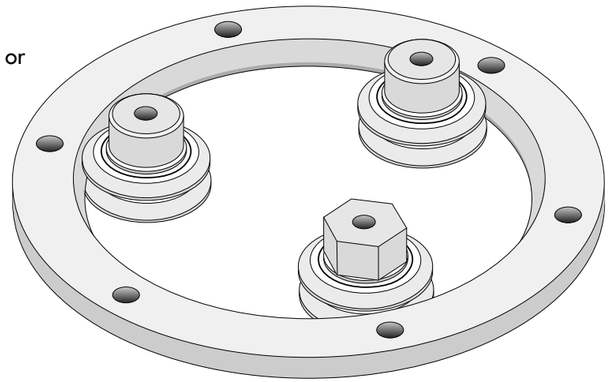


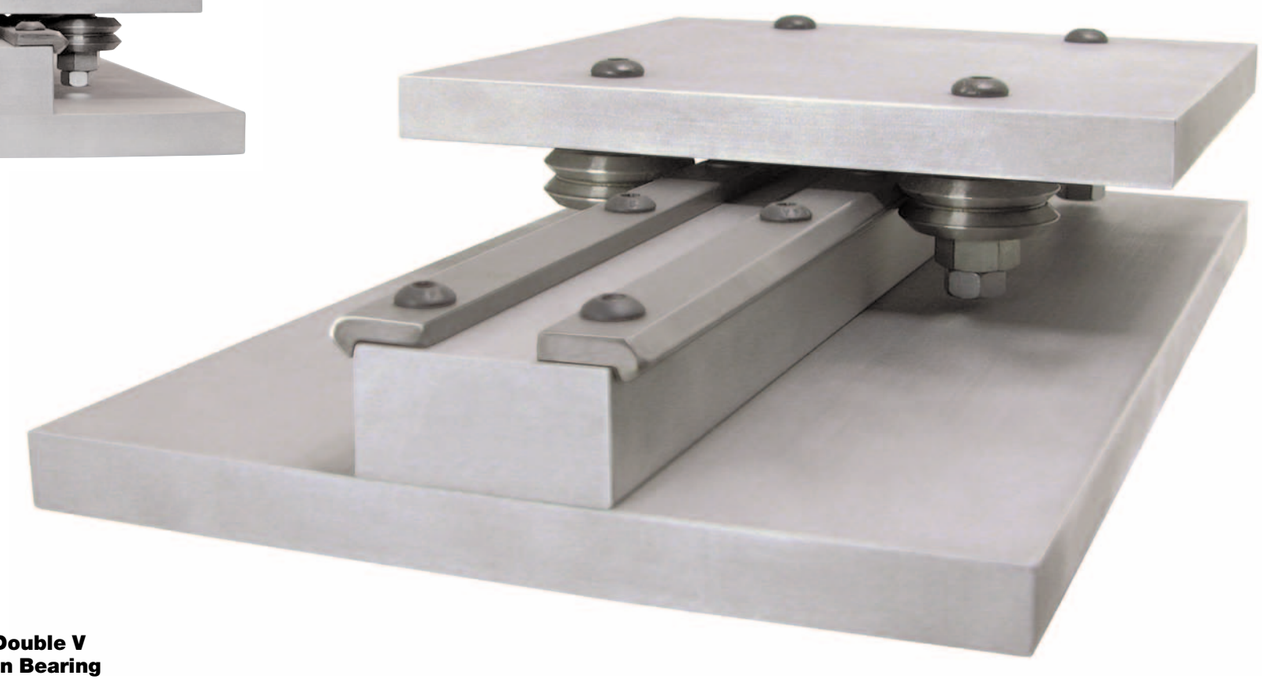
SCHATZ GUIDE WHEEL SYSTEMS AND ASSEMBLIES

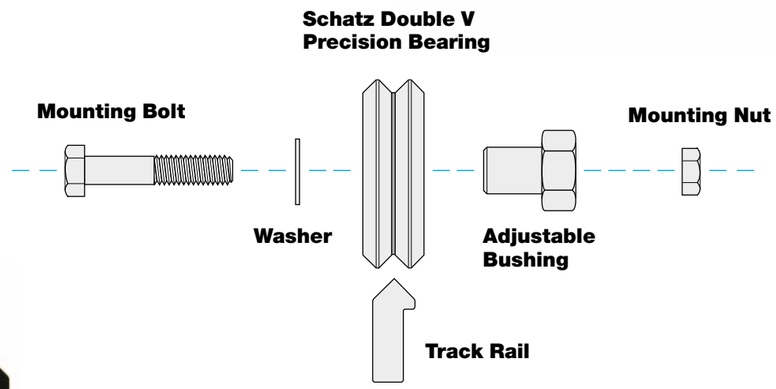


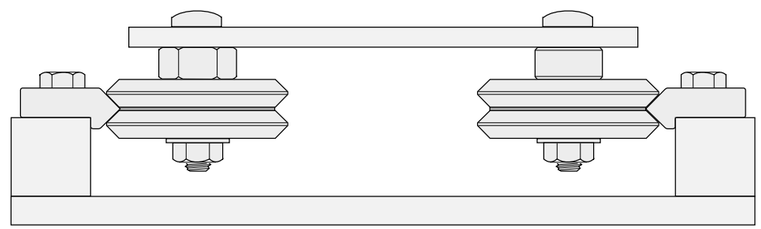


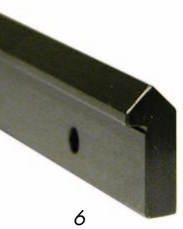
Guide wheels can be mounted vertically or horizontally to suite differing space and application requirements. Additionally, guide wheels can be used to support rotary motion.











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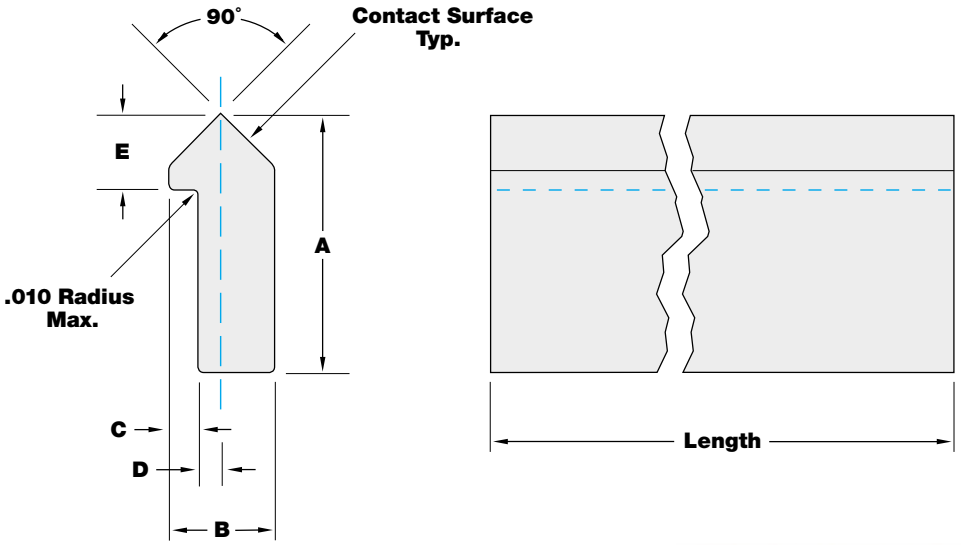
GUIDE WHEEL TRACK RAILS

Carbon Steel Rails		Stainless Steel Rails		Basic Track Rail Dimensions				
Track Rail Number	Interchange Number	Track Rail Number	Interchange Number	A	B	C	D	E
TR1	**T1**	**TR1SS**	**T1SS**	.437	.187	.062	.031	.125
TR2	**T2**	**TR2SS**	**T2SS**	.625	.250	.093	.031	.187
TR3	**T3**	**TR3SS**	**T3SS**	.875	.343	.109	.062	.250
TR4	**T4**	**TR4SS**	**T4SS**	1.062	.437	.125	.093	.312

Length *(in feet)*: 1, 2, 3, 4, 5, and 6. Custom lengths available upon request.



Carbon Track Rail Details:

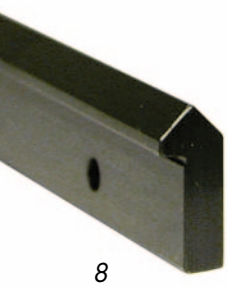
Material: Medium Carbon Steel.
Contact surface hardened Rc 58 min. and polished.

Stainless Steel Track Rail Details:

Material: 420 Stainless Steel.
Contact surface hardened Rc 48 min. and polished.

Area below contact surface left unhardened to permit drilling holes for mounting.
All track rails are available unhardened. Use **TRS-** prefix when ordering.

When ordering, specify number of pieces, rail number, and length.
Example: 4 **TR2**, 5 (Four pieces, Hardened **TR2** rail, Five feet long)



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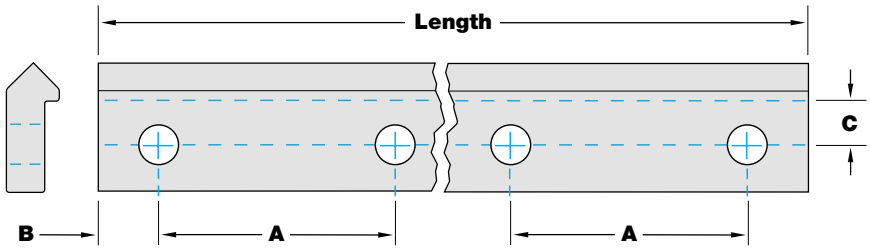
GUIDE WHEEL TRACK RAILS

Schatz Double V Guide Wheel Track Rails with Standard Hole Spacing



STANDARD HOLE SPACING

Carbon Steel Rails		Stainless Steel Rails		Track Rail Hole Layout Dimensions					
Track Rail Number	Interchange Number	Track Rail Number	Interchange Number	Length ±.015	Number of Holes	Hole Diam.	A ±.005	B ±.005	C ±.005
TR1-100	**T1-1250-7**	**TR1SS-100**	**T1SS-1250-7**	12.50	7	5/32	2.000	.25	.156
TR1-196	**T1-2450-13**	**TR1SS-196**	**T1SS-2450-13**	24.50	13				
TR1-292	**T1-3650-19**	**TR1SS-292**	**T1SS-3650-19**	36.50	19				
TR1-388	**T1-4850-25**	**TR1SS-388**	**T1SS-4850-25**	48.50	25				
TR1-484	**T1-6050-31**	**TR1SS-484**	**T1SS-6050-31**	60.50	31				
TR1-580	**T1-7250-37**	**TR1SS-580**	**T1SS-7250-37**	72.50	37				
TR2-101	**T2-1263-5**	**TR2SS-101**	**T2SS-1263-5**	12.63	5	13/64	3.000	.31	.219
TR2-197	**T2-2463-9**	**TR2SS-197**	**T2SS-2463-9**	24.63	9				
TR2-293	**T2-3663-13**	**TR2SS-293**	**T2SS-3663-13**	36.63	13				
TR2-389	**T2-4863-17**	**TR2SS-389**	**T2SS-4863-17**	48.63	17				
TR2-485	**T2-6063-21**	**TR2SS-485**	**T2SS-6063-21**	60.63	21				
TR2-581	**T2-7263-25**	**TR2SS-581**	**T2SS-7263-25**	72.63	25				
TR3-102	**T3-1275-5**	**TR3SS-102**	**T3SS-1275-5**	12.75	5	9/32	3.000	.38	.313
TR3-198	**T3-2475-9**	**TR3SS-198**	**T3SS-2475-9**	24.75	9				
TR3-294	**T3-3675-13**	**TR3SS-294**	**T3SS-3675-13**	36.75	13				
TR3-390	**T3-4875-17**	**TR3SS-390**	**T3SS-4875-17**	48.75	17				
TR3-486	**T3-6075-21**	**TR3SS-486**	**T3SS-6075-21**	60.75	21				
TR3-582	**T3-7275-25**	**TR3SS-582**	**T3SS-7275-25**	72.75	25				
TR4-104	**T4-1300-4**	**TR4SS-104**	**T4SS-1300-4**	13.00	4	11/32	4.000	.50	.375
TR4-200	**T4-2500-7**	**TR4SS-200**	**T4SS-2500-7**	25.00	7				
TR4-296	**T4-3700-10**	**TR4SS-296**	**T4SS-3700-10**	37.00	10				
TR4-392	**T4-4900-13**	**TR4SS-392**	**T4SS-4900-13**	49.00	13				
TR4-488	**T4-6100-16**	**TR4SS-488**	**T4SS-6100-16**	61.00	16				
TR4-584	**T4-7300-19**	**TR4SS-584**	**T4SS-7300-19**	73.00	19				

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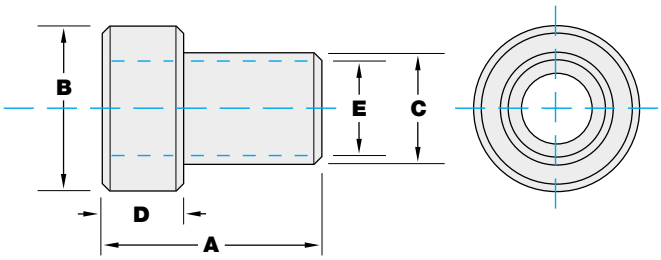
GUIDE WHEEL BUSHINGS

Schatz Double V Guide Wheel Bushings

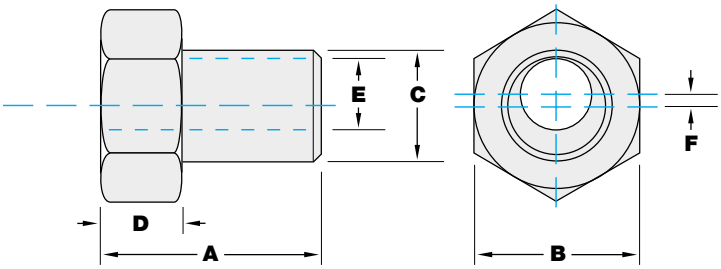
STATIONARY BUSHINGS

Part Number	Interchange Number	Stainless Steel Part Number	Stainless Steel Interchange Number	Stationary Bushing Dimensions A	B	C	D	E
BS1	**B1**	**BS1SS**	**B1SS**	.550	7/16	.1873	.250	.140
BS2	**B2**	**BS2SS**	**B2SS**	.706	9/16	.3748	.281	.250
BS3	**B3**	**BS3SS**	**B3SS**	.990	3/4	.4722	.375	.312
BS4	**B4**	**BS4SS**	**B4SS**	1.177	7/8	.5904	.437	.375



ADJUSTABLE BUSHINGS

Part Number	Interchange Number	Stainless Steel Part Number	Stainless Steel Interchange Number	Adjustable Bushing Dimensions A	B	C	D	E	F
BA1	**BX1**	**BA1SS**	**BX1SS**	.550	7/16	.1873	.250	.140	.012
BA2	**BX2**	**BA2SS**	**BX2SS**	.706	9/16	.3748	.281	.250	.024
BA3	**BX3**	**BA3SS**	**BX3SS**	.990	3/4	.4722	.375	.312	.042
BA4	**BX4**	**BA4SS**	**BX4SS**	1.177	7/8	.5904	.437	.375	.060



Material: Leaded screw stock, zinc plated to resist corrosion.

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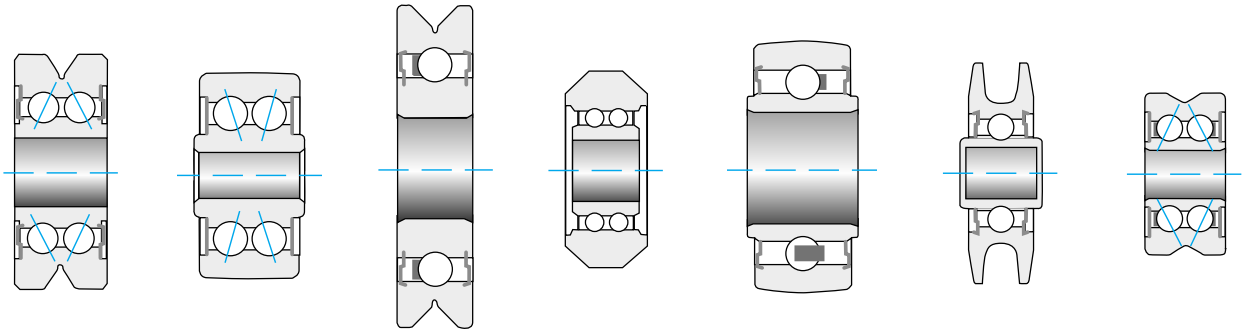
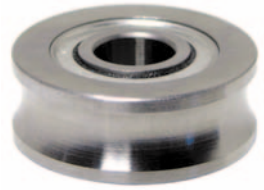
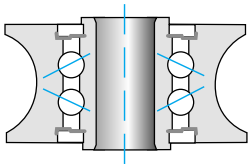
Schatz has designed and manufactured many different bearing configurations that are used in linear motion, cam follower, and guide applications. While these configurations are far too numerous to list here, the following diagrams represent a handful of examples of some of the design options that we offer.

Outer Ring Shapes

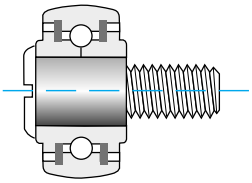


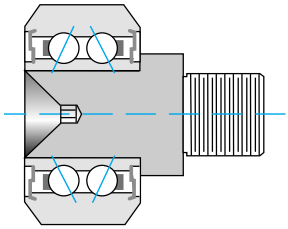




Schatz can custom design and manufacture parts and assemblies to meet the specific requirements of your particular application.

Integral Studs or Integral Mounting Hardware





High Temperature Applications

- Rings heat stabilized for operation in elevated temperatures
- Steel cages
- High temperature grease
- High temperature seal material

High Capacity Bearings - full complement for high load capacity

Special Enclosures - numerous seal and shield options to suit application needs

BASIC LOAD RATINGS

Basic Dynamic Radial Load Rating C_r

Schatz Guide Wheel basic dynamic radial load ratings are the radial bearing loads that will give a basic rating life of 1,000,000 revolutions. The basic dynamic load ratings have been determined in accordance with the methods prescribed by ISO, AFBMA, and ANSI.

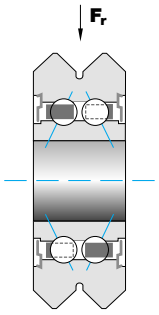


Figure 1:
Guide Wheel Bearing Under Radial Load

Basic Static Radial Load Rating C_{or}

Basic static radial load rating is the static radial load that creates a maximum Hertzian contact stress at the center of the most heavily loaded ball/raceway contact of 609ksi. Under this stress, a permanent deformation of rolling element and raceway will occur. The depth of the deformation is approximately .0001 times the diameter of the ball.

Schatz Bearing Basic P/N	C_{or} (lbs.)	C_{oa} (lbs.)
W1	320	145
W2	750	300
W3	1,350	600
W4	2,750	1,055

Basic Static Axial Load Rating C_{oa}

Basic static axial load rating is the static axial load that creates a maximum Hertzian contact stress at the center of the most heavily loaded ball/raceway contact of 609ksi. Under this stress, a permanent deformation of rolling element and raceway will occur. The depth of the deformation is approximately .0001 times the diameter of the ball. For a guide wheel bearing, the axial load is applied through the V-shaped outer ring and mating guide rail. As shown in figure 2, this axial load will induce a reactive radial load and moment load.

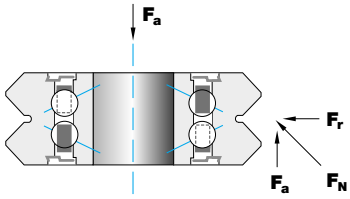


Figure 2:
Guide Wheel Bearing Under Axial Load

BEARING FATIGUE LIFE

The fatigue life of a guide wheel bearing is defined by the number of revolutions the bearing will operate before the first signs of fatigue occur. The L_{10} life is the basic rating life in hours that 90% of a sufficiently large group of apparently identical bearings will operate before the first signs of fatigue appear.

Schatz Bearing Basic P/N	C_r (lbs.)	Z
W1	500	2.20
W2	910	2.50
W3	1,740	2.25
W4	3,260	2.45

Use the formula below to calculate L_{10} life for bearings operating under radial and axial load as shown:

$$L_{10} = \frac{16{,}667}{S} * \left(\frac{C_r}{F_r + ZF_a}\right)^3$$

Where:

- F_r = Applied Radial Load
- F_a = Applied Axial Load
- S = Bearing Speed (RPM)
- L_{10} = Life (hrs.)
- Z = Factor
- C_r = Schatz Bearing Dynamic Load Rating (*see table to above*)

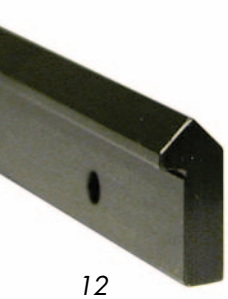
LIFE ADJUSTMENT FACTORS

Many life adjustment factors can be applied to the calculated bearing life as stated above. These factors are simply multiplied by the bearing life to determine the final expected operating life of the bearing.

L_{10} (calculated) * **A1** * **A2** * **A3** = Adjusted Bearing Life

The three life adjustment factors that Schatz recommends using are:

A1 – life adjustment factor for reliability
A2 – life adjustment factor for material
A3 – life adjustment factor for lubrication



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Reliability (A1):

All formulas are based on an L_{10} life. If a different life needs to be calculated, use the following table for the adjustment factor:

Reliability (%)	90 (L_{10})	95 (L_5)	96 (L_4)	97 (L_3)	98 (L_2)	99 (L_1)
Factor (**A1**)	1.00	.62	.53	.44	.33	.21

Material (A2):

There are several material options for use in linear guide wheel bearings. The following chart shows the life adjustment factors for the materials offered:

Material Type	52100	440C	Schatz EMS 138
Factor (**A2**)	2.2	.6	4.2

Lubrication (A3):

Lubrication and the presence of an elastic-hydrodynamic lubrication film is critical to achieving proper bearing life. Please consult the Schatz engineering department for information on determining the lubrication factor for a specific application. While the calculation for the specific lubrication film thickness is complex, in general, choosing a grease with a base oil that has a high viscosity is more suitable for low to moderate speed and high load applications. Alternatively, grease with a low viscosity base oil is more suitable for high speed applications with light to moderate loads.

Schatz's standard grease for the guide wheel bearings is Chevron SRI, which is a good general purpose grease with good water resistance. The following is a table of other greases that can be used in guide wheel applications.

Name	Manufacturer	Mil-SPEC	Lube Type	Temperature Range (°F)	Oil Type	Thickener Type	Color	Viscosity @ 100°F	Viscosity @ 210°F	Characteristics/ Application
Aeroshell 22	Shell Oil Co.	MIL-PRF-81322	Grease	-80 to 350	SH	Microgel	Dark Grey	30.5 cSt	5.7 cSt	General purpose
Aeroshell 33	Shell Oil Co.	MIL-PRF-23827	Grease	-99 to 250	SH/Ester	Lithium	Green	14.2 cSt	3.4 cSt	Aircraft, Gen. purpose, Corrosion-inhibiting
Aeroshell 7	Shell Oil Co.	MIL-PRF-23827	Grease	-100 to 300	Synthetic	Clay	Amber	10.3 cSt	3.1 cSt	Wide temperature range
Aeroshell 22	Shell Oil Co.	—	Grease	-65 to 275	Mineral	Lithium	Amber	189 cSt	15.6 cSt	General purpose
Asonic HQ 72-102	Kluber	—	Grease	-40 to 356	Ester	Polyurea	Beige	100 cSt	12 cSt	High temperature
Beacon 325	Exxon Corp.	MIL-PRF-23827	Grease	-65 to 250	Diester	Lithium	Light Tan	12 cSt	—	General purpose
Braycote 815	Castrol	—	Oil	-100 to 400	PFPE	—	—	148 cSt	45 cSt	Wide temperature range, Chemically inert
Braycote 601 EF	Castrol	—	Grease	-112 to 400	PFPE	—	Off-White	148 cSt	45 cSt	High-vacuum grease
Braycote Micronic 1613	Castrol	—	Grease	-99 to 400	PFPE	—	Off-White	148 cSt	45 cSt	High-vacuum grease, Long shelf life
Isoflex NBU 15	Kluber	—	Grease	-40 to 265	SH/Est./Min.	Alkaline Earth	Beige	21 cSt	4.7 cSt	High speed
Krytox 240 AC	Dupont	—	Grease	-30 to 550	Fluorinated	Fluorotelomer	White	270 cSt	—	Stable at high temperatures
Mobil 28	Mobil Oil	MIL-PRF-81322	Grease	-65 to 350	SH	Clay	Dark Red	29.3 cSt	—	Wide temperature range
Mobil SHC 220	Mobil Oil	—	Grease	-40 to 350	SH	Lithium	Red	220 cSt	23.8 cSt	High wear resistance, Corrosion resistance
RheoTemp 500	NYE	—	Grease	-65 to 350	Diester	Sodium	Dark Blue	51 cSt	8.9 cSt	High speed, Moderate temperature
RheoLube 2000	NYE	—	Grease	-49 to 257	SH	Organic Gel	Light Tan	110 cSt	15 cSt	Low temp. operation, Vacuum Applications
RheoLube 374-C *	NYE	—	Grease	-40 to 248	SH	Lithium	Tan	60.7 cSt	9.5 cSt	Superior washout characteristics
RheoTemp 700B	NYE	—	Grease	-40 to 347	Polyester	Lithium	Blue Black	51 cSt	8.9 cSt	High speed, High temperature
SRI-2	Chevron Oil Co.	—	Grease	-20 to 350	Mineral	Polyurea	Blue/Green	100 cSt	11 cSt	General purpose

* Replacement for Andok C SH- Synthetic Hydrocarbon

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