Units Conversion Tables

Force conversions:

Multiply	By conversion factor	Result
pound-force	4.448	Newton
Newton	0.225	pound-force
kilogram-force	9.807	Newton
Newton	0.102	kilogram-force

Acceleration conversions:

Multiply	By conversion factor	Result
feet/section^2	0.305	meter/second^2
meter/second^2	3.281	feet/second^2
inch/second^2	0.025	meter/second^2
meter/second^2	39.370	inch/second^2

Mass conversions:

Multiply	By conversion factor	Result
ounce	28.349	gram
gram	0.035	ounce
kilogram	35.279	ounce
gram	0.001	kilgram
pound	0.453	kilogram
kilogram	2.205	pound

Bending moment or torque conversions:

Multiply	By conversion factor	Result
pound-foot	1.356	Newton-meter
Newton-meter	0.737	pound-foot
Newton-meter	0.102	kilogram-meter
Kilogram-meter	9.807	Newton-meter

Length conversions:

Multiply	By conversion factor	Result
inch	25.4	millimeter
millimeter	0.039	inch
inch	0.025	meter
meter	39.370	inch
foot	0.305	meter
meter	3.281	foot

Velocity conversions:

Multiply	By conversion factor	Result
mile/hour	1.609	kilometer/hour
kilometer/hour	0.621	mile/hour
feet/second	0.305	meter/second
meter/second	3.281	feet/second
inch/minute	0.025	meter/minute
meter/minute	39.370	inch/minute

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GDL Aluminum Roller Guides
Technical information

1. Features of the guide system

Aluminum roller guides consist of a double sided rail and a roller cassette or two single sided rails and two roller shoes. Aluminum roller guide rails and cassettes are made of aluminum alloy. The rollers are very smooth running on precision polished guideways made of high alloy spring steel. The special cross pattern orientation of the running rollers provides high load and moment capacity in all directions.

Their special features are: light weight, small dimensions, and high speed of displacement. Aluminum roller guides are economical and universal handling components, which are mostly or all corrosion-resistant and available at a favorable price.

2. Size of the guide system

To select the right guide size, first the moments and forces acting on the bearing have to be determined.

Recommended safety factors (with ISO screws quality 8.8):
Thrust load S > 1.3
Tensile load S > 4.0
Moment load S > 6.0

Generally the first decision has to be whether the guide system should be built with double sided rail and cassette, or with two single sided rails and a pair of roller shoes.

3. Material

The basic body of GDL aluminum roller guides is made of aluminum alloy. The giudeways consist of hardened, high alloy spring steel or of stainless steel. By using basic bodies of aluminum, the moved masses are reduced which allows light-weight construction requiring lower moving forces and reduced energy consumption. Still the integrated GDL system sustains high load and moment ratings.

4. Operating temperature

GDL linear guides can be operated within a temperature range from -10° C up to + 80° C. For other temperatures, please consult factory.

5. Screwed connections

GDL linear gudies are fixed to the mating structure by the mounting holes in the rails and the cassettes. ISO screw quality 8.8 should be used with DIN 433 washers.

To secure the screwed connections, we recommend that suitable locking means be utilized as necessary.

Mounting screw torque specifications:

	Quality 8.8 [Nm]
M3	1.1
M4	2.5
M5	5.0
M6	8.5
M8	21.0
M10	41.0
M12	71.0

6. Wipers

The guideways of aluminum roller guides are equipped with wipers to protect against coarse environmental contamination.

7. Slide resistance / adjustment

Follow the steps on how to adjust GDL cassettes to the rail.

The new GDL catalog has many changes due to an expanded product line. The change to feature descriptive part numbering was done to accommodate all current and future offerings of the GDL product. The goal is to have standard features and options available, for a perfect fit into your application.

Included in the chart below are hex sizes, drag resistance and torque ratings for adjusting the cassette.

GDL CHART						
	FDC 12	FDC 15	FDC 20	FDC 25	FDC 35	FDC 45
Top plate hex (mm)	2	3	4	4	5	6
Top plate torque (in lbs)	n/a	22.1	44.3	44.3	75.2	186
Adjustment hex (mm)	1	3	3	4	4	4
Drag resistance (oz) HP, HC, GF, VA	1.8-7.9	3.6-10.8	5.4-16.2	7.2-21.6	10.8-32.4	12.6-37.7
Drag resistance (oz) SP & SC	.7-1.8	1.8-3.6	3.6-7.2	5.4-10.8	7.2-14.4	9-18
Drag resistance (oz) HD	n/a	n/a	n/a	9-18	14.4 25	18-28.7

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7.1 GDL adjustment procedure

Do not measure sliding resistance with wipers on.

1) Lay the rail out on the flat surface with the ***datum*** line facing away from you. Anchor the rail to keep it from shifting when sliding resistance is applied to the cassette.

The datum line is a reference groove on one side of the rail.

2) Set the roller cassette on the rail with the adjustment screw facing towards you, while the datum line on the rail is away from you. Do not install the wipers on the cassette yet.

Do not install the wipers yet.

3) Make sure the four bolts on the adjustable side of the cassette are slightly loose and the bolts on the fixed side are tight before adjuting the drag screw.

One side of the cassette is fixed and the other side is floating.

4) The drag hex screw is located on one side of the cassette. Adjust the screw in for more drag and out for less. Do not try to adjust cassette with top plates bolts tight.

See the chart for drag adjustment hex screw size.

5) Adjust the drag on the cassette by sliding as it slides down the rail. Feel for an even amount of resistance as you turn the hex screw in and out.

6) Tighten down the top plate bolts to the proper torque specification. The tightening of the top plate bolts will add some resistance. If necessary, the adjustment procedure can be repeated for better sliding resistance for your application.

See the chart for top plate hex size and torque rating.

7) If the adjustment is done without a scale, it should move evenly. Some examples of improper adjustment are: If the cassette “hops”, it is too tight. If it is too loose, the top plate of the cassette will have play. Try to be in the middle.

8) To check your settings use a pull or push style scale. Slide the cassette down the entire rail at an even speed, measuring the drag resistance. Your hightest drag rating should be referenced when looking at the chart.

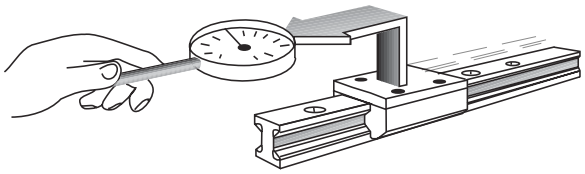
See the chart for drag resistance ratings for the size and type of cassette.

9) Install the clip on wipers. The wipers will add between 1-3 ounces of resistance. The wipers do not add any additional roller preload to the rail.

The clip on wipers can be installed at this time.

7.2 Double sided rail and cassette

Aluminum roller guides are adjusted in such a way that the required stiffness under load is obtained. If self adjustment is preferred, we recommend that you measure the slide resistance as shown below. Before doing so, the mating structure should be checked for dimensional accuracy and flatness.



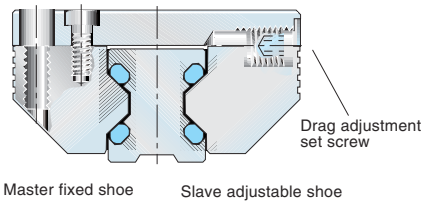
The cassettes which are mounted on the rails are adjusted clearance-free, without play. This adjusting method is required at the point on the rail where the cassette travels with the least slide resistance. Adjustment is completed in the non-loaded condition. The tolerances below refer to this condition.

	Slide resistance adjusment tolerance [N]														
Series	FDC__HP, FDC__HC, FDC__AM, FDC__GF, FDC__VA						FDC__SP, FDC__SC						FDC__HD		
Size	12	15	20	25	35	45	12	15	20	25	35	45	25	35	45
Adjust. value	0.5	1.0	1.5	2.0	3.0	3.5	0.2	0.5	1.0	1.5	2.0	2.5	2.5	4.0	5.0
Max. value	2.0	3.0	4.5	6.0	9.0	10.5	0.5	1.0	2.0	3.0	4.0	5.0	5.0	7.0	8.0

All values are without wipers

Tolerances in the guide system may cause slight variations in the slide resistance, when the adjusted cassette is moved along the guide rail.

7.3 Double sided rail and roller cassette



To change the clearance setting, first the slave adjustable shoe screws on the cassette top plate are slightly loosened. Afterwards, the drag adjustment set screw is turned to increase or decrease slide resistance of the cassette. Turning the drag adjustment set screw effects a displacement of the roller shoe in relation to the cassette top plate.

After re-tightening of the cassette top plate, the slide resistance can be checked. This procedure can be repeated until the desired slide resistance is achieved.

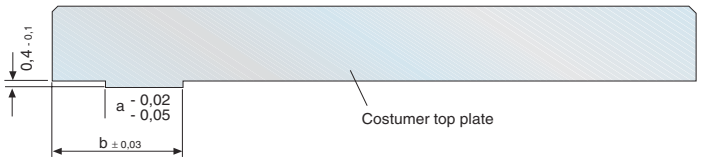
7.4 Rails and rollershoes

When installing, it is important to distinguish between the master fixed side and the slave adjustable side rollershoe and rail. The rail on the master fixed side is aligned to the mating structure and fastened securely by all screws.

The rail on the slave adjustable side should be lighly tightened and movable with light force during initial alignment of parallel rails. Guage blocks should be used between the parallel rails, by locating off the aligned and mounted master rail, in order to align the slave rail parallel to the master rail. Slave rail mounting bolts should be tightened as the slave rail is aligned at each bolt position. See paragraph 11.3 for further instructions on mounting parallel single sided rails.

7.5 Centering groove on the master fixed shoe and custom top plate

Each pair of rollershoes are provided with centering grooves for optimum alignment to their mating top plate during mounting. One rollershoe should be designated as the master fixed rollershoe, even though both are designed with a centering groove on their top surface. The other shoe will serve as the slave adjustable side rolelrshoe. The mating customized top plate should be machined with a centering shoulder according to the following data.



Size	a	b
12	4,5	9,6
15	5,0	12,6
20	7,5	16,1
25	10,5	17,6
35	12,5	26,1

7.6 Adjusting cassette built with rollershoes and custom top plate

The centering shoulder on the top plate should be assembled with its respective fixed rollershoe centering groove and securely torqued to recommended specification. See cassette screw torque specifications under step 5, on page 20.

Assemble the adjustable rollershoe to the top plate also, parallel to the fixed rollershoe on the same side of the top plate. Its fasteners should be lightly tightened so that the adjustable rollershoe can be moved with light finger presssure.

As assembled cassette can then be slid onto parallel rails, while keeping the fixed rollershoe on the master fixed rail side. The incorporated drag adjustment set screw can then be turned clockwise to remove cassette play, or counter clockwise to reduce slide resistance while maintaining zero play.

Once the desired slide resistance is achieved with no cassette play, the adjustable rollershoe fasteners can also be torqued to specification.

8. Running accuracy

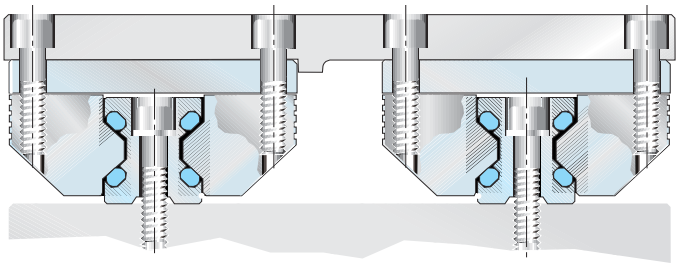
The running accuracy is measured from the top plate surface of the cassette, to the ideal straight line of travel. Running accuracy of the cassette to the rail is +/- .03mm (.0012") per meter, granted no greater than (.0024") straightness deviation per meter is maintained when mounting the rail.

9. Contact and support surfaces

The contact and support surfaces have a substantial influence on functioning and precision of linear guides. Depending on the functional requirements of the system, the mating structure has to be machined with the corresponding degree of precision. Machining errors on the mating structure will otherwise add to the running error of the guide system. In order to assure troublefree functioning, we recommend that a max. straightness deviation of ≤ 0.1 mm (.0039") per running meter be maintained when mounting the rail.

10. Design hints

10.1 Parallel double sided rails and cassettes



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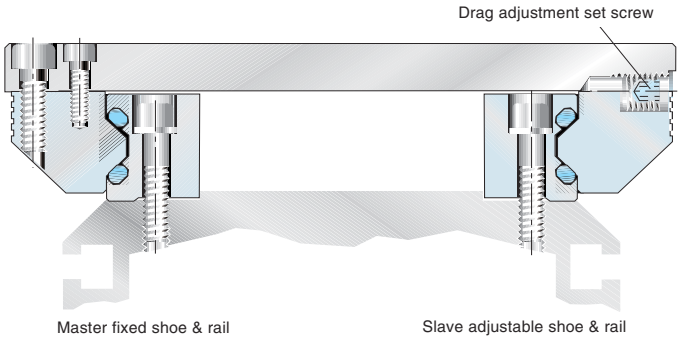
The master fixed rail should always be established straight and true first, within the maximum straightness deviation specified in paragraph 9. With parallel rail arrangements, both rails should be mounted on the same mounting surface elevation and treated with equal surface preparation and tolerancing practices. Precise alignment in terms of spacing, parallelism and height is very important.

When coupled parallel to a driving actuator system, the adjustable side of the cassette should be placed on the side closest to the driving actuator. This will minimize driving actuator torque transferred to the adjustable side of the cassette.

10.2 Parallel single sided rails and roller shoes



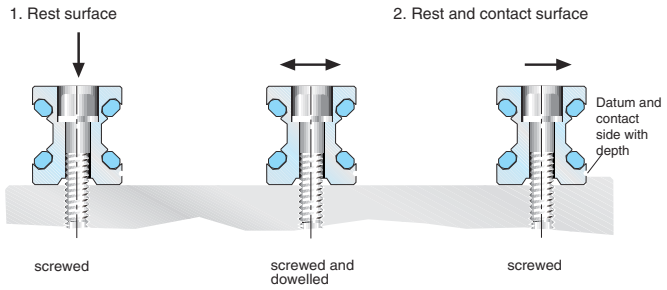
Aluminum roller guides consisting of single sided rails and roller shoes can be varied in rail spacing. They are well suited for assembly on structural aluminum extrusions, due to their homogeneous corrosion resistance and temperature behavior.

11. Guide mounting instructions

The useable load capacity is influenced by the connection between the guide elements and the mating structure. For this reason, a flat, straight and solid secure mounting surface should be provided. Adequate support of qualified loads and moments can then be achieved, along with desired running accuracy.

11.1 Mounting double sided rails and cassette

Depending on the load situation, certain double sided rails should either be screwed or screwed and dowelled, and respectively put into grooves or against a shoulder.



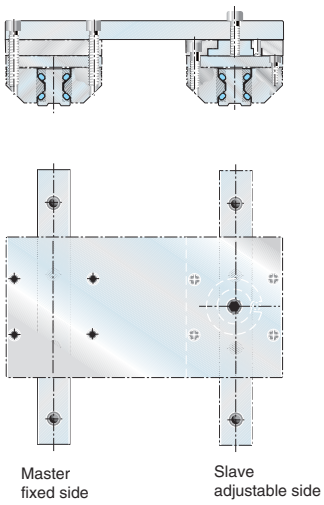
The rails can be secured best against shoulders and are screwed or screwed and dowelled to the mating structure. After final adjustment of rail straightness and parallelism, the rail mounting screws are tightened starting in the middle of the rail length. Rail mounting bolts should be torqued to specification by alternating between each bolt. The installer should start with the bolt in the center of the rail length and proceed by alternating between each bolt left of center and each bolt right of center, while working towards both ends of the rail.

Afterwards, the cassette should be moved back and forth along the total stroke distance of the rail. If the cassette travels smoothly, the mounting process can proceed or be completed.

11.2 Mounting parallel double sided rails and cassettes

With parallel double sided rail arrangements, we recommend that the master fixed rail side and slave adjustment rail sides of the guide system be identified. This allows optimum tolerances in parallelism to be achieved best by adjusting the slave adjustable rail, parallel to the master rail. The master fixed rail side should be mounted first to achieve the initial line of straight travel.

The example below displays a convenient method for adjusting the slave adjustable rail parallel to the fixed master rail. Once the cassette travel is smooth, without play, one can proceed with rail mounting.



Note that the top plate spanning across the cassettes on opposite rails is completely bolted down to the cassette on the master fixed side only. The top plate end over the slave adjustable side is only bolted in one location, in the center of the slave adjustment side cassette. With one bolt holding the top plate to the slave adjustment side cassette, this cassette can pivot while the slave adjustable rail self-aligns parallel to the fixed master rail side. The floating top plate setup is stroked along the entire rail length, to establish the parallelism between the two rails.

Calibrated guage blocks can also be used to establish equal integrity in rail parallelism. The installer should seat and temporarily clamp short pieces of precision ground round stock, tangent to the two guideways on the inside of each rail.

Rail Size	Precision round stock sizes Ø mm
12	11
15	11
20	14
25	16
35	27
45	35

The calibrated guage blocks can then be used, to locate off the precision round stock on the master fixed rail, in order to set the slave adjustable rail parallel. The guage blocks are then locating the same way that the floating top plate is, by referencing both the master and slave rail guideway surfaces to establish parallelism.

Once the slave adjustable rail has been self-aligned, its bolts should also be torqued to specification in the order mentioned in paragraph 11.1. The top spanning across both cassettes on opposite rails, can then be securely fastened using all cassette mounting bolt holes.

11.3 Mounting parallel single sided rails and rollershoes

Aluminum roller guides consisting of single sided rails and rollershoes can be varied in rail spacing. They are well suited for assembly on profiled aluminum extrusions because of their homogeneous corrosion resistance and temperature behavior.

Ideally, both single sided rails should be installed against parallel machined shoulders, but this will not always be practiced. With parallel single sided rail arrangements, precise alignment in terms of parallelism and height is necessary. For parallel single sided rails, we also recommend that the master fixed side and slave adjustment sides of the guide system be identified. This allows for the best control of parallelism to be achieved by locating off of the master fixed rail, to establish the proper location for the slave adjustable side rail. The master rail must be mounted first to achieve the initial line of straight travel.

If parallel singled sided rails are set-up with the guideways facing each other, then the method using guage blocks, described under paragraph 11.2, should be used. In the majority of applications though, the guideways of parallel single sided rails are facing away from one another.

When parallel singled sided rails are set-up with the guideways facing away from one another, a vernier caliper should be used to measure and set the rail span parallelism. The installer should seat and temporarily clamp short pieces of precision ground round stock, tangent to the two guideways on the outside of each rail. A calibrated vernier caliper should be used, to measure and locate off the precision round stock on the master fixed rail, in order to set the slave adjustable rail parallel. The vernier caliper is then locating the same way that the floating top plate is, by referencing both the master and slave rail guideway surfaces to establish parallelism.

The rail on the slave adjustable side, should be lightly tightened and movable with light force during initial alignment of parallel rails. Guage blocks should be used between the parallel rails, by locating off the aligned and mounted master rail, in order to align the slave rail parallel to the master rail. Slave rail mounting bolts should be tightened as the slave rail is aligned at each bolt position.

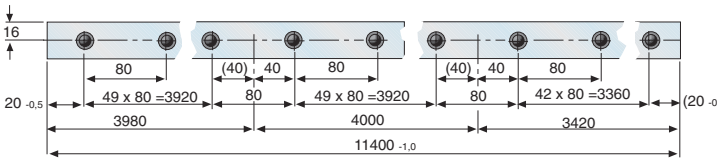
Each pair of rollershoes are provided with centering grooves for optimum alignment to their mating top plate during mounting. One rollershoe should be designated as the master fixed rollershoe, even though both are designed with a centering groove on their top surface. The other shoe will serve as the slave adjustable side rollershoe. A mating customized top plate should be machined with a centering shoulder according to the data provided in paragraph 7.5.

The rollershoes can then be assembled to the customized top plate, to make a complete cassette. Putting the cassette onto the rails requires keeping the master fixed rollershoe on the master fixed rail side. Adjustment of the slave adjustable rollershoe can then be made in order to achieve the desired cassette slide resistance. Once proper slide resistance is achieved, the slave adjustment side fasteners can be torqued to specification per paragraph 5.

12. Keyed butt-jointing of rail sections

12.1 Rail hole spacing

Butt-jointed rails over L = 4000 mm are sectioned together according to the GDL standard. See “GDL’s Keyed Butt-Jointed Rail Option” on page 18. Butt-jointed rails sections are cut so that the standard rail mounting hole spacing is maintained across all butt-joints.



Keyed butt-jointed rails are usually shipped completely assembled, but sometimes must be shipped partially assembled, due to shipping length limitations and shipping care. Partially assembled butt-jointed rails are supplied with a butt-jointing clamping fixture and the keyways and screws for fastening rail section together.

12.2 Mounting of butt-jointed rails

Clean mounting surfaces, then place rail sections loose on the guide path, one behind the other. Lay the rails in their correct sequence of the system design (i.e.: 1, 2, 3, 4…etc.). The orientation of the depth groove on the lower surface of the rail should always be on the same side for all rail sections being butt-jointed.

Any non-assembled rail sections should be aligned with the factory supplied butt-joint clamping fixture as displayed below.

See explanation of “GDL’s Keyed Butt-Jointed Rail Option” on page 18.

Once all rail sections are assembled, the complete guide path can be aligned and fastened. Alignment and fastening should be conducted according to the applicable guide arrangement and steps previously described in this technical information section.

Ordering Instructions

GDL Rail Part Numbering

1 2	3	4 5	6	7	8
Series	**Rail**	**Size**	**Guideway Material**	**Coatings**	**Mounting Holes**
F D Double Sided Rail Guide* (Standard)	R	1 2*	H High Performance Alloy Steel* (Standard)	0 Anodized Aluminum* (Standard)	0 Topside Thru Hole* (Standard)
E Single Sided Rail Guide*		1 5*	S Stainless Steel*	Z Custom (Consult Factory)	1 Underside Blind Thread
		2 0*	A Anti-magnetic Stainless Steel (size 25 only)		Z Custom (Consult Factory)
Note: FE Series Supplied in Pairs.		2 5*			
		3 5*			
*STOCKED ITEM		4 5*			

GDL Cassette Part Numbering

1 2	3	4 5	6 7	8	9	10
Series	**Cassette**	**Size**	**Bearing Options**	**-**	**Grease**	**Lubrication Options**
F D Double Sided Rail Cassette* (Standard)	C	1 2*	H P Axial Needle - High Performance - Alloy Steel* (Standard)		0 High Performance* (Standard)	0 None* (Standard)
E Single Sided Rail Roller Shoes*		1 5*	S P Single Row Radial Ball - Standard Performance - Alloy Steel*		Z Custom (Consult Factory)	1 Central Lubrication With Cupped Grease Nipple (Except Size 12)**
		2 0*	A M Axial Needle - Anti-magnetic Stainless Steel (Size 25 Only)			2 Central Lubrication With Tapped Ports (Except Size 12)**
		2 5*	V A Axial Needle - Vibration Dampening and Anti-Static (Except Size 12, 15 and 20)**			Z Custom (Consult Factory)**
Note: FE Series Supplied in Pairs		3 5*	H C Axial Needle - Stainless Steel* (Except Size 12)			
		4 5*	H D Double Row Radial Ball - High Dynamics - Alloy Steel (Except Sizes 12, 15 and 20) (Consult Factory)**			Note: Central Lubrication Only Available For Axial Needle Bearing Options.
			S C Single Row Radial Ball - Stainless Steel (Except Size 12)			
			R G Single Row Radial Ball - Glass (Consult Factory)			
			G F Axial Needle - Grease Free			
*STOCKED ITEM			Z Z Custom (Consult Factory)**			
**Minimum Order Quantity Required						

9 10

"L11" Dimension

0 0 Equal On Both Sides* (Standard)

? ? Actual Dimension (mm)**

**As Measured From Left Side While Viewing The Depth Groove Line.

11

Long Rail Joining Option

0 None* (Standard)

1 Keyed Butt Joint

2 Unkeyed Butt Joint

12

Screw Covers

0 None* (Standard)

1 Yes*

Note: Quantity Supplied To Cover All Rail Holes.

13 14 15 16 17 18

- Length (mm)

- 0 0 0 0 0

11

Coatings

0 Anodized and Standard Hardware* (Standard)

1 Anodized and Stainless Steel Hardware*

Z Custom (Consult Factory)

12

Locking Mechanism

0 None* (Standard)

1 "L" Ratchet Handle*

2 "Star Grip Handle*

Note: Locking Mechanism Only Available on FD Series Size 15 thru 45 with Axial Needle Bearing - High Performance - Alloy Steel.

13

Mounting Holes

0 Topside Threaded Thru* (Standard)

1 Underside Hole Thru (Unthreaded)

2 Underside Hole Thru (Threaded)

14

Wiper Options

0 With Felt Wipers* (Standard)

1 Without*

2 With Felt Wipers and Scrapers*

15

Cassette Length

0 Normal Length* (Standard)

Z Custom (Consult Factory)**

16

Adjustment

0 None* (Standard)

1 Adjusted to Specific Rail*

Note: Adjustment at Factory Only Available on FD Series.

GDL Application Sheet

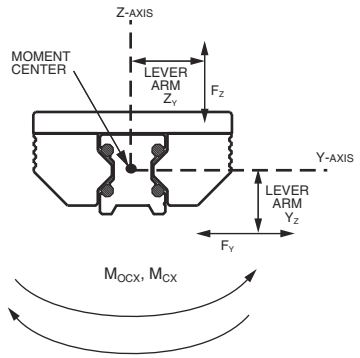
Distributor: _____ End-User: _____

Salesperson: _____

Phone: _____ Fax: _____ e-mail: _____

Other Information: _____

Roll

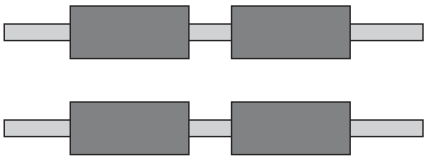


Roll load _____

X - Distance _____

Y - Distance _____

Z - Distance _____

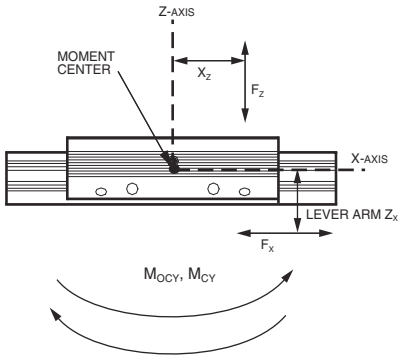


Lengh of rails _____

Distance between rails _____

Distance between cassettes on each rail _____

Pitch

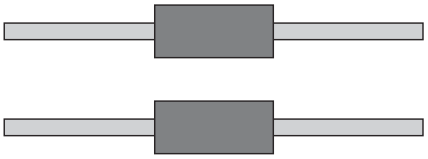


Pitch load _____

X - Distance _____

Y - Distance _____

Z - Distance _____



Technical Data:

Stroke _____

Horizontal _____

Vertical _____

Velocity / Speed _____

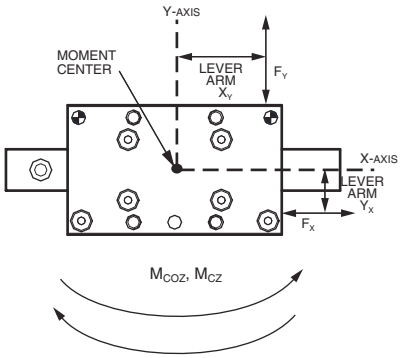
Acceleration _____

Load / Mass _____

Load Distances _____

Lifetime Desired _____

Yaw



Yaw load _____

X - Distance _____

Y - Distance _____

Z - Distance _____

Environment:
(Dirt, Humidity...)

Fax back to Technical Assistance Fax 630-871-1515 Phone 630-871-8300

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