Product Data Guide

FIRST Robotics Competition 2012

Want to use igus® products in your robot design?

Look Inside!

Young Engineers Support Program
igus® says Y.E.S.!

(800) 521-2747

www.igus.com

e-mail Courtney Toomey at ctoomey@igus.com

All products listed are donated to every participating *FIRST* team courtesy of igus® Inc.

How to Use igus® Products on Your *FIRST* Robot

Hello FRC teams! Enclosed in this kit are a number of igus® products to help with the design of your *FIRST* robot. However, are you unsure about how to use igus®' products? Read on for product information and some insightful tips and suggestions!

If you have additional questions, please contact Courtney Toomey at ctoomey@igus.com.

In this kit, you will find:

Energy Chain® Cable Carrier
Energy Chains® are all-plastic cable carriers designed to guide and protect cables in moving applications. Although the cables on your *FIRST* robot won't be moving, Energy Chain® is perfect for preventing cables from snagging or getting caught on opponents robots.
➠ Looking for product specifications? See page 4.

DryLin® N Linear Guide Systems
DryLin® N low-profile linear guides are an oil-free alternative to bulky, messy ball bearings. DryLin® N has excellent wear resistance and a small mounting height and width, which is perfect when dealing with space constraints on your robot. Use DryLin® N to enable any linear movement your robot has to perform.
➠ Looking for product specifications? See page 5.

DryLin® S Aluminum Shafting
DryLin® S aluminum shafting is lightweight and highly wear-resistant. It also has a lower coefficient of friction and delivers three times the life of steel when running against the proper bearing material. DryLin® S is the perfect partner for the plain, clip and spherical bearings also included in your kit.
➠ Looking for product specifications? See page 6.

iglide® Clip Bearings
iglide® clip bearings are designed specifically for a variety of sheet metal applications. The bearings have flanges located on both ends so they can be secured in the sheet metal plate. After installation, the bearing opens and forms a lining for the borehole in the metal plate. The shafting prevents the clip bearing from detaching from the housing, even during axial movement.
➠ Looking for product specifications? See page 6.

iglide® J Plastic Plain Bearings
iglide® J plastic bearings are an ideal alternative to bronze, metal-backed and custom injection-molded bearings. They are perfect for reducing the weight of your robot. iglide® J bearings are also self-lubricating, which means they require no maintenance or messy oils.
➠ Looking for product specifications? See page 7.

iglide® M250 Plastic Plain Bearings
iglide® M250 plastic bearings are an ideal replacement for sintered-bronze bearings. They are impact-resistant and provide excellent vibration dampening. They are also dirt- and dust-resistant and are well suited for low to medium loads.
➠ Looking for product specifications? See page 8.

igubal® Rod Ends and Flange Bearings
igubal® rod-end and flange bearings are maintenance-free and weigh only a fifth of traditional metallic rod-end bearings. This is a very popular product among *FIRST* teams, as these bearings also compensate for misalignment errors.
➠ Looking for product specifications? See page 9.

Good luck in this year's competition!

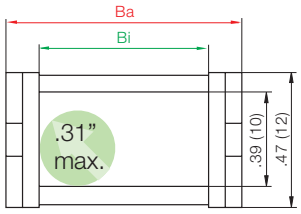
Visit www.igus.com to access free 3D CAD files, watch videos, access catalog pages, and more!

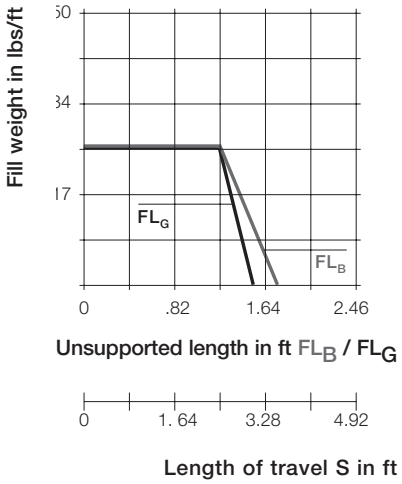
Energy Chain® Cable Carrier Overview

Series 05 E2 “micro” Data Sheet
Part Number: 05-4-038-0
Quantity: 1 meter

When to use:

- when cables are vulnerable to damage
- to prevent cables from snagging or catching on other robots
- to organize the different types of cables used on your robot





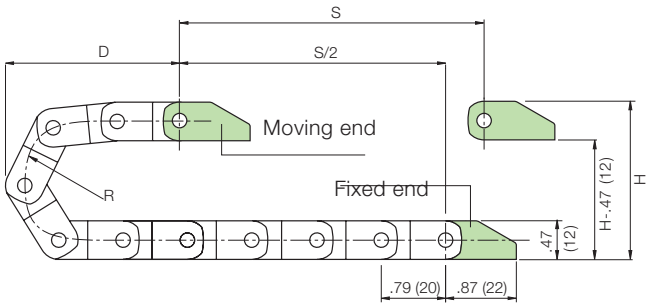
Product Range:

Inner Widths (Bi) inches (mm):	.79 (20)
Bending Radii (R) inches (mm):	1.50 (038)
Pitch:	.79 (20 mm/link) =
	15.24 links/ft (50 links/m)

Installation Dimensions

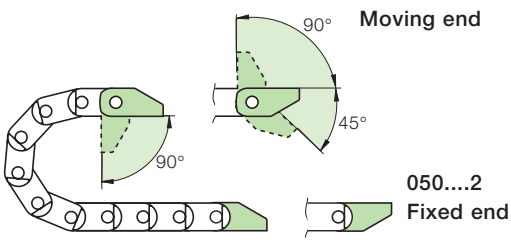
R	**1.50 (038)**
H*	3.54 (90)
D	2.36 (60)
K	6.30 (160)

*The required clearance height is HF = H + .39 (10) with .13 lbs/ft (0.2 kg/m) fill weight. Please consult igus® if space is particularly restricted.

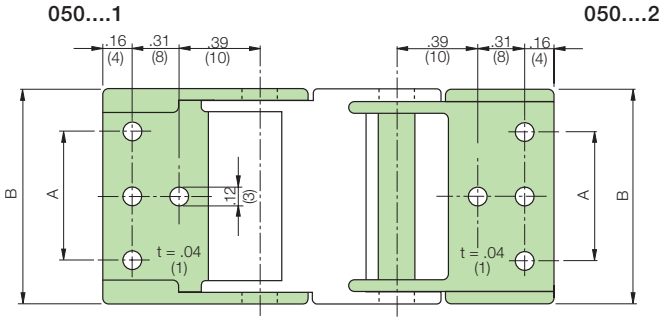


Mounting Brackets

050....1
Moving end

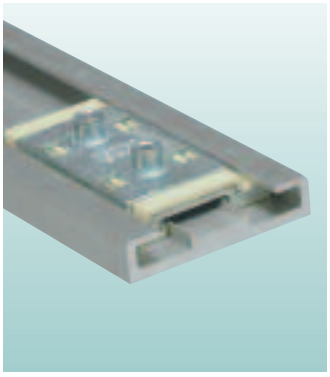


050....2
Fixed end



Chain Type	Part No. Full set	Dimension A in.	(mm)	Dimensions B in.	(mm)
05-20 (05-4)	**050-20-12**		–	.97	(24.7)

DryLin® N Linear Guide System Overview



DryLin® N Data Sheet

Part Number: NK02-40-2-610

(24 inches - 610 mm)

Quantity: 1 assembly

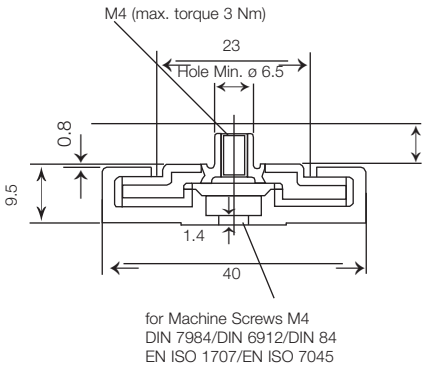
When to use:

- for linear motion
- to save space
- for high speeds and accelerations

Application pictured uses the larger size of the DryLin® N product line.

Special Characteristics of DryLin® N:

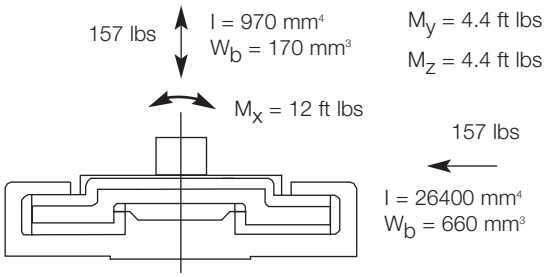
- maintenance-free and self-lubricating
- high resistance to dirt
- corrosion resistant
- lightweight due to aluminum/plastic combination
- very high speed and acceleration possible
- replaceable plastic sliding elements made of iglide® J



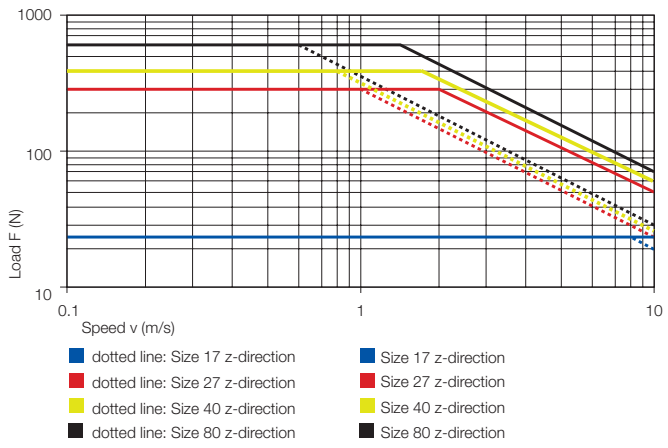
Data

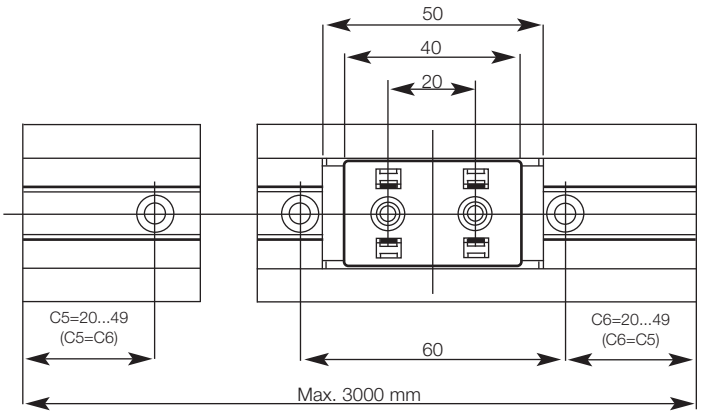
Rail weight	.025 lbs/inch (450 g/m)
Carriage weight	.066 lbs (30 g)
Maximum rail length	11.5 ft (3000 mm)
Standard bore scheme	symmetrical C5=C6
Maximum speed	49 ft/s

Load Data:

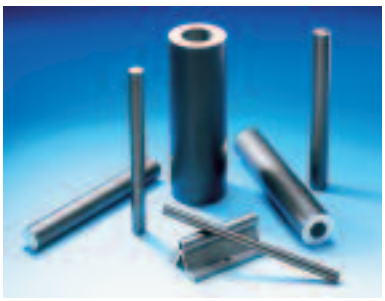


Carriages with mounting nuts





DryLin® S Aluminum Shafting Overview



DryLin® S Shafting Data Sheet
Part Number:
AWI-10 (24 inches)
Quantity: 2

When to use:
- in conjunction with igus®' plain, clip and spherical bearings
- to reduce the weight of your robot

Data:

Material:	AlMgSi 0.5 F22
Tolerance:	h9 - h11
Roundness:	DIN 1798
Straightness:	DIN 1798
Hardness:	75 HB
Surface:	hard-anodized/oxidation (wear-resistant Al - oxide)

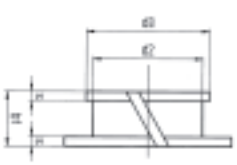
Layer Thickness:	> 40 µm
Surface Hardness:	450 - 550 HV
Roughness:	Ra < 0.5
Electrical Resistance:	$4*10^{11}$ Ohm mm^2/m
Chemical Resistance:	2 < ph < 9

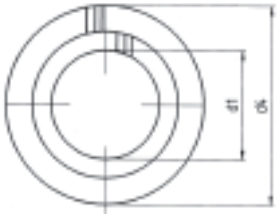
Part No.	Design	Diameter	Max. Length	Weight (lbs/ft)
AWI-10- L in mm	Solid	5/8	72	.361

iglide® Clip Bearing Overview

iglide® MCI Bearing Data Sheet
Part Number: MCI-06-02
Quantity: 6

When to use:
- for slow rotating, oscillating or axial motion
- to reduce friction
- for quick and easy installation





Part Number	Recommended Housing Bore		Recommended Shaft Size	
	Max.	Min.	Max.	Min.
MCI-06-02	0.4481	0.4269	0.3750	0.3740

Part Number	d1	d2	d3	d4	s	b1	ID of Bearing in Housing	Recommended Sheet Metal Thickness
MCI-06-02	3/8	0.4375	15/32	9/16	0.03	0.2000	.3760	.072/.135

iglide® J Plain Bearing Overview

iglide® J Bearing Data Sheet
Part Number: JSI-1012-08
Part Number: JFI-1012-08
Quantity: 4 of each

When to use:
- for rotational, oscillating and linear motion
- to reduce the weight of your robot
- for low wear against different shaft materials
- to eliminate the need for lubricants

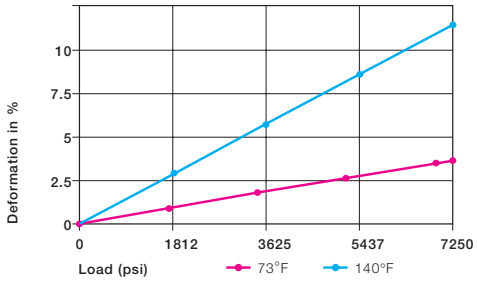
Special Characteristics:
- low coefficients of friction
- vibration dampening
- good chemical resistance

Part No.	d1	d2	b1	I.D. After Pressfit		Housing Bore		Shaft Size	
				Max.	Min.	Max.	Min.	Max.	Min.
JSI-1012-08	5/8	3/4	1/2	.6297	.6270	.7510	.7500	.6250	.6240

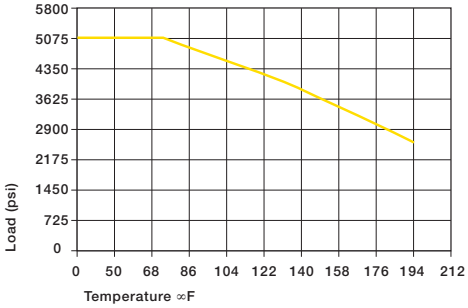
Part No.	d1	d2	b1	d3	b2	I.D. After Pressfit		Housing Bore		Shaft Size	
					-.0055	Max.	Min.	Max.	Min.	Max.	Min.
JFI-1012-08	5/8	3/4	1/2	1.000	.062	.6297	.6270	.7510	.7500	.6250	.6240

iglide® J Material Table

General Properties	Unit	iglide® J	Testing Method
Density	g/cm³	1.49	
Color		yellow	
Max. moisture absorption at 73°F/50% r.h.	% weight	0.3	DIN 53495
Max. moisture absorption	% weight	1.3	
Coefficient of friction, dynamic against steel	μ	0.06 - 0.18	
p x v value, max. (dry)	psi x fpm	9700	
Mechanical Properties			
Modulus of elasticity	psi	348,000	DIN 53457
Tensile strength at 68°F	psi	10,585	DIN 53452
Compressive strength	psi	8,700	
Permissible static surface pressure (68°F)	psi	5,075	
Shore D-hardness		74	DIN 53505
Physical and Thermal Properties			
Max. long-term application temperature	°F	194	
Max. application temperature, short-term	°F	248	
Min. application temperature	°F	-58	
Thermal conductivity	W/m x K	0.25	ASTM C 177
Coefficient of thermal expansion (at 73°F)	$K^{-1} \times 10^{-5}$	10	DIN 53752
Electrical Properties			
Specific volume resistance	Ωcm	$> 10^{13}$	DIN IEC 93
Surface resistance	Ω	$> 10^{12}$	DIN 53482



Deformation under load and temperature



Recommended maximum permissible static surface pressure of iglide® J as a result of the temperature

iglide® M250 Plain Bearing Overview

iglide® M250 Bearing Data Sheet
Part Number: MTI-10
Quantity: 4

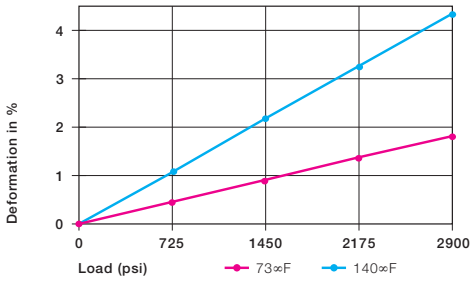
When to use:
- for rotational, oscillating motions
- in place of bronze bearings to save weight and eliminate lubrication
- for dirty environments
- to reduce vibration

Special Characteristics:
- dimensionally interchangeable with many sintered metal bearings
- excellent where high vibration dampening is necessary
- good for edge loads

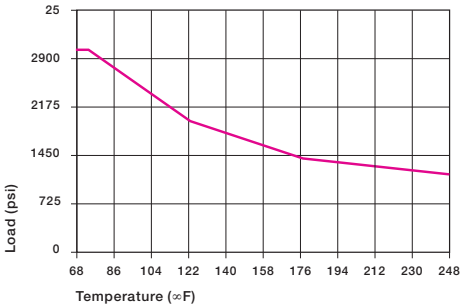
Part Number	d1(nominal)	d1		d2		s
		Max.	Min.	Max.	Min.	
MTI-10	5/8	.6371	.6300	1.0000	.9870	.0940

iglide® M250 Material Table

General Properties	Unit	iglide® M250	Testing Method
Density	g/cm³	1.14	
Color		charcoal	
Max. moisture absorption at 73°F / 50% r.h.	% weight	1.4	DIN 53495
Max. moisture absorption	% weight	7.6	
Coefficient of friction, dynamic against steel	μ	0.1 - 0.3	
p x v value, max. (dry)	psi x fpm	3,400	
Mechanical Properties			
Modulus of elasticity	psi	121,500	DIN 53457
Tensile strength at 68°F	psi	16,240	DIN 53452
Compressive strength	psi	7,540	
Permissible static surface pressure (68°F)	psi	2,610	
Shore D-hardness		79	DIN 53505
Physical and Thermal Properties			
Max. long-term application temperature	°F	176	
Max. application temperature, short-term	°F	338	
Min. application temperature	°F	-40	
Thermal conductivity	W/m x K	0.24	ASTM C 177
Coefficient of thermal expansion	$K^{-1} \times 10^{-5}$	10	DIN 53752
Electrical Properties			
Specific volume resistance	Ωcm	$> 10^{13}$	DIN IEC 93
Surface resistance	Ω	$> 10^{11}$	DIN 53482



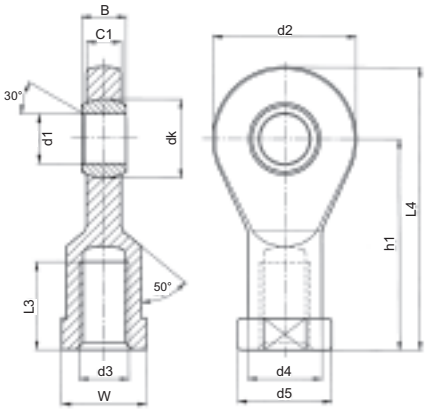
Deformation under load and temperature



Recommended maximum permissible static surface pressure of iglide® M250 as a result of the temperature

igubal® Rod Ends

igubal® Rod End Data Sheet
Part Number: EBRI-10R
Quantity: 2



When to use (both rod end and flange types):

- for rotational, oscillating and linear motions
- to compensate for misalilgnment and edge loads
- to reduce the weight of your robot — weighs 1/5 of metallic bearings

Special Characteristics of EBRI-10R:

- maintenance-free, self-lubricating
- high strength under impact loads
- very high tensile strength for varying loads
- resistant to dirt, dust and lint
- resistant to corrosion and chemicals
- high vibration dampening capacity

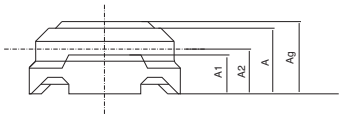
Load Data and Dimensions (inch)

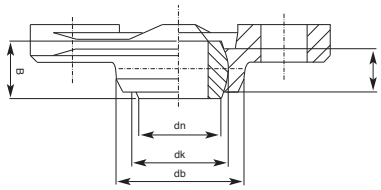
Right-Thread	Left-Thread	Max. static Tensile Strength Short-term lbs	Max. static Tensile Strength Long-term lbs	Max. Cross Force Short-term lbs	Max. Cross Force Long-term lbs	Min. Thread Depth (mm)	Max. Torque Strength Outer Threading ft lbs	Max. Torque Strength Through Ball ft lbs
EBRI-10R	EBLI-10R	1079	539	180	90	18	18.4	22.1

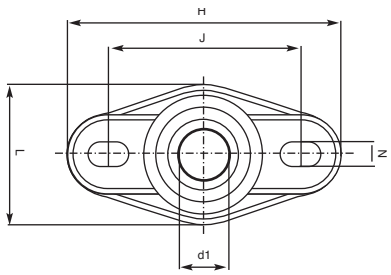
Right-Thread	Left Thread	d1 E10	d2	d3	d4	d5	C1	B	h1	l3	l4	W	Max. Angle of Pivot
EBRI-10R	EBLI-10R	0.6250	1.693	5/8	.827	1.023	0.4134	0.5000	2.5394	1.0433	3.3858	0.87	16°

igubal® Flange

igubal® Flange Bearing Data Sheet
Part Number: EFOI-10R
Quantity: 2







Load Data and Dimensions (inch)

Part Number	N d x l	B	C1	Max. Angle of Pivot	Max. Permissible Load on the Spherical Ball (lbs)	Max. Permissible Tensile Strength Force (lbs)
EFOI-10R	0.212 x 0.315	.500	0.374	24°	315	629

Part Number	d1	dn	dk	dB	H	L	J	A1	Ag	A	A2
EFOI-10R	.6250	.512	.630	1.260	2.858	1.496	2.087	.394	.683	.622	.433

igus®
Facts At A Glance

Corporate Mission igus® is committed to manufacturing plastic components which enhance the performance and prolong the life of automated machinery, and meet the needs of all of its customers, both professional and student alike.

Tag Line Plastics for longer life.

Founded 1985 US headquarters established in East Providence, R.I.
1964 Cologne, Germany

Innovation with Plastics

High-performance plastic bearings have emerged as a viable, cost-effective alternative to metal plain bearings as a standard choice for design engineers. Engineers are realizing that advanced synthetic compounds provide more design opportunities than traditional materials. For more than 40 years, igus® has been developing bearing materials based on modern plastics, which have predictable tribologic properties: fiber for reinforcement and strength, a lubricant and a base material.

Due to their plastic composition, all igus® bearings are lubrication-free and require no maintenance. The plastic-based construction also eliminates corrosion; delivers better vibration dampening than metal bearings; handles edge loading better than metal-backed; has high shock absorption; and emits low noise.

igus® plastics are also used throughout the Energy Chain® product line. By using only plastic, these cable carriers are lightweight, yet provide the same protection as steel or plastic/steel combination carriers.

Today igus® offers 28 high-performance plastic material blends. All have been developed through years of detailed research and rigorous testing. This commitment to quality has propelled the company to the forefront of the motion-control industry and will continue to lead igus® to success in the future.

Products

igus® develops an array of machinery components in addition to the products enclosed in your *FIRST* kit (see data sheets included in this brochure for details on those products), including:

- **Chainflex® cables -** specifically designed for use in Energy Chain Systems®, which can withstand the stress of tight bending radii and deliver longer extended life.
- **ReadyChain® -** preassembled cable-carrier systems complete with cables, Energy Chains®, connectors and accessories, which are custom-designed to the customers' specifications to deliver a ready-to-install, fully harnessed, out-of-the-box solution.

The Y.E.S. (Young Engineers Support) Program

igus® Inc., the leading developer of Energy Chain Systems®, Chainflex® continuous-flex cables and iglide® plastic bearings, offers free products through its Y.E.S. (Young Engineers Support) Program, which is designed to foster the mechanical design ideas of students who have a passion for engineering.

Through the Y.E.S. Program, igus:

- ❑ offers free product donations to students, engineers, teachers and professors for use in various design competitions, school projects and engineering curriculums;
- ❑ offers in-class seminars about igus, its products and the various ways students can take advantage of the Y.E.S. Program;
- ❑ educates students and engineers alike on the merits and benefits of plastic components;
- ❑ supports the visions of various engineering competitions by donating products, technical support and other resources;
- ❑ revitalizes students' interest in engineering;
- ❑ aids in making the unique design ideas of students and engineers a reality;
- ❑ encourages students to implement igus products into their projects in unique, interesting ways; and
- ❑ reaches students from across the United States, Canada and Mexico.

For information contact Courtney Toomey, Y.E.S. Program Administrator, at 800-521-2747 ext. 147 or visit www.igus.com/yesprogram.

Y.E.S. Facts

- ❍ The Y.E.S. Program is open to students of all ages and grade levels, as well as teams and engineers competing in robotic competitions.
- ❍ The Y.E.S. Program sponsors additional competitions such as BEST™ Robotics, MATE ROV, DARPA Grand Challenge, Challenge X, SAE Collegiate Design Series and Botball.
- ❍ The Y.E.S. Program offers lecture engagements presented by bearings and cable carrier experts at schools and universities across the United States, Canada and Mexico.
- ❍ Students have the opportunity to have their accomplishments featured on the Y.E.S. website by submitting information about the application, how they used igus products and pictures.