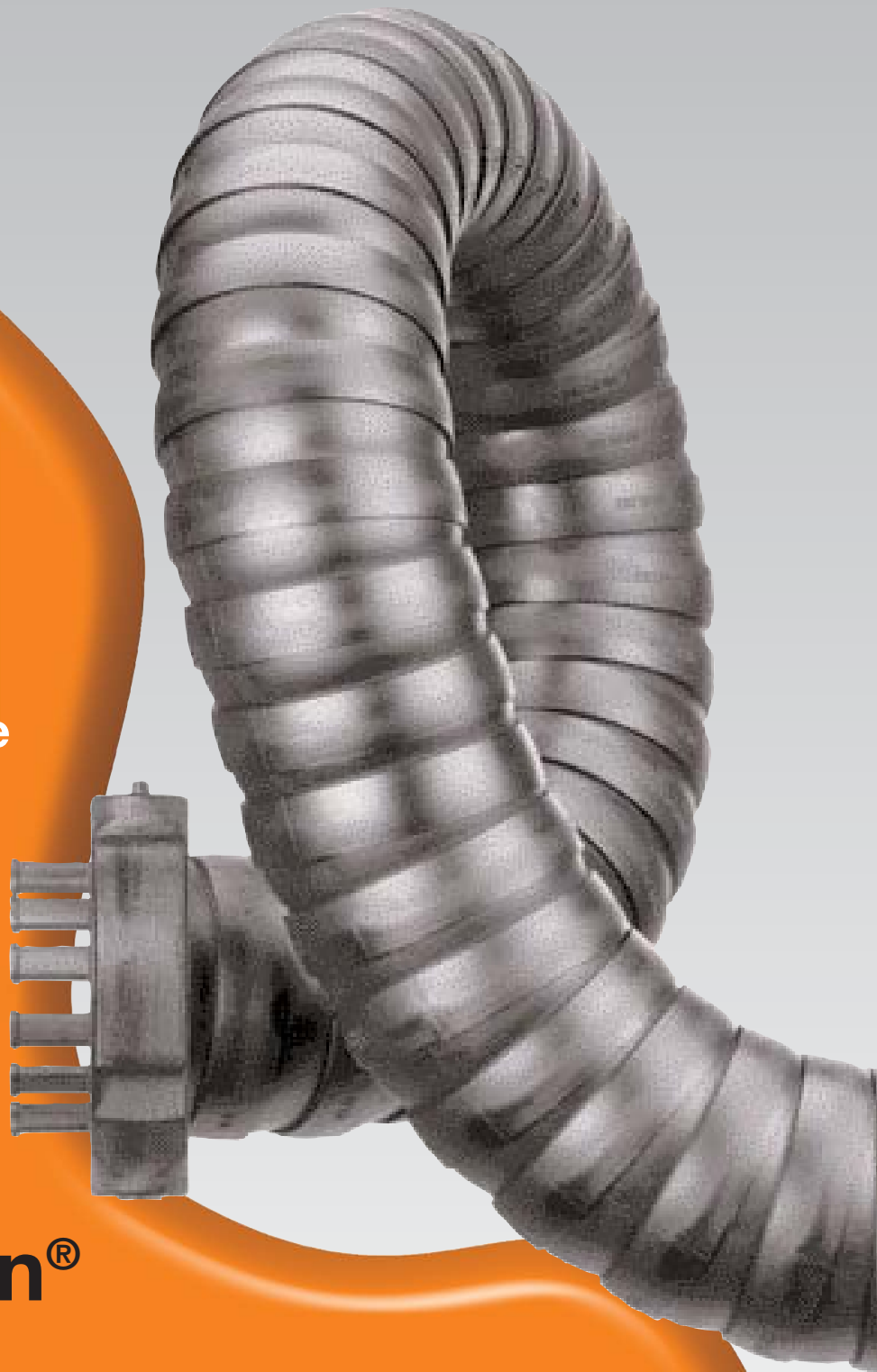


igus[®]

Plastics for Longer Life



**The NEW
Multi-Axis
Energy Chain[®]
for Robots**

Triflex[®] R

Triflex® R Features



iF-Design
2004

Modular energy supply for longer cable life on robots

3-D E-Chain® for robotic applications

This long-life, modular energy supply for scara robots can help to maintain uninterrupted production flow. With Triflex® R, igus® now offers robot manufacturers and users a whole new product family .

- Enclosed tube version now available in 4 sizes (40, 60, 70 and 100)
- New "E-Z" version, for fast assembly of cables and hoses - available in 4 sizes
- Complete range of strain relief components and mounting brackets available

More facts on igus® Triflex® R

- Built of one-piece links that require no additional items for support
- Can endure high tensile forces, due to its ball-and-socket or "trailer-hitch" design principle - Pull forces average 1000N
- High degree of flexibility, even on the 6th axis
- Handles lengthwise torsion of up to ± 380 degrees over 1 meter
- Smooth, rounded exterior enables it to glide over protruding edges
- Smooth interior increases cable life
- Easy attachment onto the robot / machine reduces setup time
- Lengthening and shortening is possible through modular design
- Outstanding test results in the igus® lab: Version TRC-70-110 has surpassed 1 million cycles without a problem (Cycle time is 50 sec.)



Triflex® R - TRC
Closed design



Triflex® R - TRE
"E-Z" design



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The Triflex® R Solution

- 1** Able to move multi-dimensionally - Twist up to approximately +/- 380° per meter possible in longitudinal axis. This aids in guiding the cables and lines around difficult configurations.
- 2** High tensile strength - Highly flexible due to ball-and-socket design, which enables movements in all axis. The force flux is routed optimally through the Triflex® R.
- 3** Easy opening mechanism - For easy installation and maintenance of cables and hoses.
- 4** Excellent mechanical features - Triflex® R is impact-resistant, dirt-repelling, rugged and abrasion-resistant. Round, smooth and closed outer/inner contour - The smooth exterior contour prevents Triflex® R from catching on other machine elements. This round design allows for extremely difficult travel paths of the robot and its energy supply.
- 5** Small bending radii and short pitch - For space-saving installation. Bending radius of Triflex® R Series 7 - 4.34" (110 mm).
- 6** Easy installation and dismantling - An injection molded component, therefore requiring minimal effort for assembly and installation. No other components (e.g. steel cables, spring mechanisms, etc.) required.
- 7** High stability - Due to outer stop dogs.
- 8** Self supporting operation - optional torsion fiber rods can be installed in predetermined bores.
- 9** Easy attachment to the robot/machine, reduces setup time.

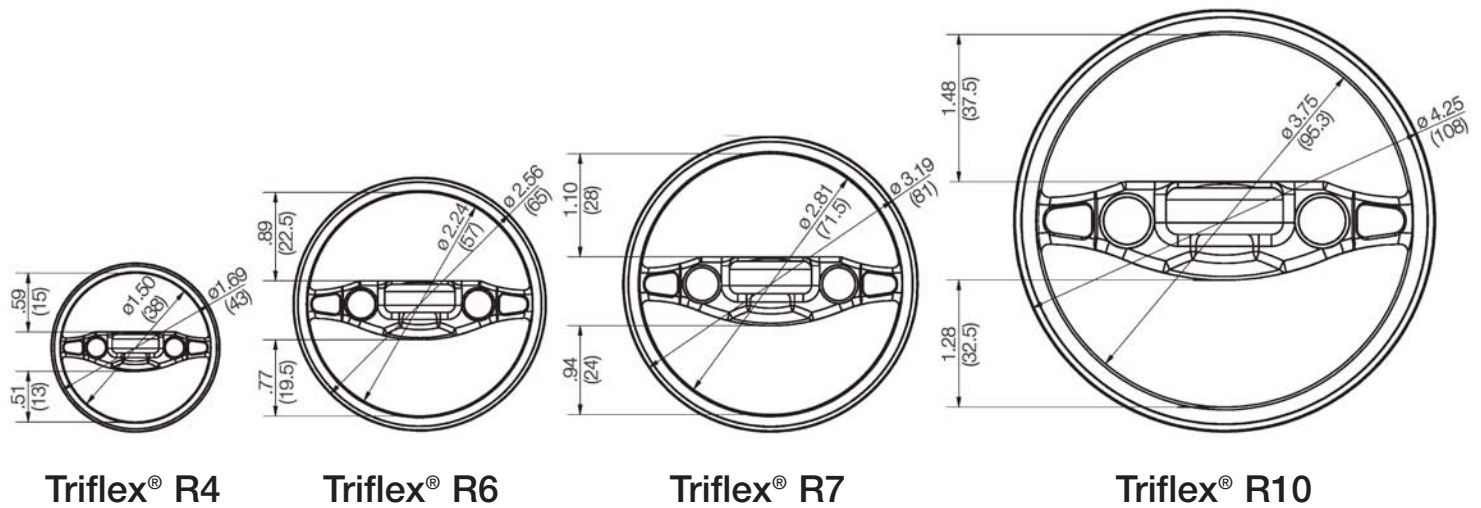


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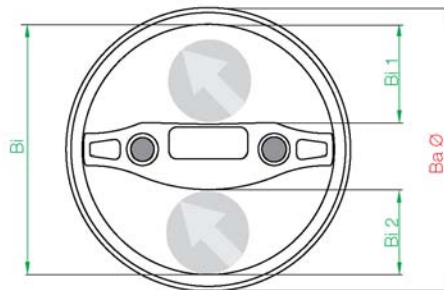
Triflex® R Sizes



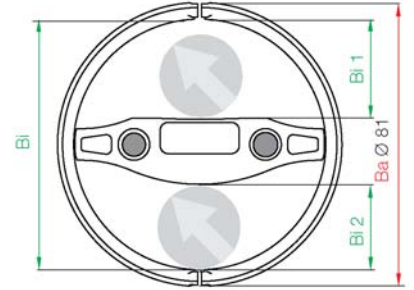
Series	Inner width Bi 1 in. (mm)	Inner width Bi 2 in. (mm)	Inner width Bi in. (mm)	Outer width Ba in. (mm)	Bending radii R in. (mm)	Links/ft (m)
TRE-/TRC-40	.59 (15.0)	.51 (13.0)	1.50 (38.0)	1.69 (43.0)	2.28 (58.0)	22 (70)
TRE-/TRC-60	.89 (22.5)	.77 (19.5)	2.24 (57.0)	2.55 (65.0)	3.43 (87.0)	15 (47)
TRE-/TRC-70	1.10 (28.0)	.94 (24.0)	2.81 (71.5)	3.19 (81.0)	4.33 (110.0)	12 (38)
TRE-/TRC-100	1.48 (37.5)	1.28 (32.5)	3.75 (95.3)	4.25 (108.0)	5.71 (145.0)	9 (29)



Triflex® R - TRC
Closed design



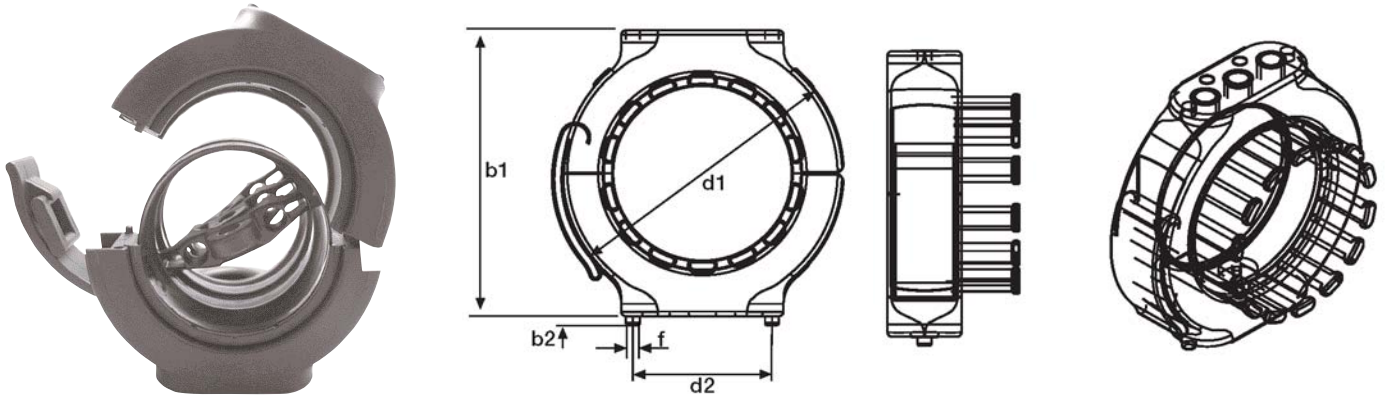
Triflex® R - TRE
"E-Z" design



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Triflex® R Mounting Brackets



Special mounting brackets with snap-lock mechanism allow for very quick maintenance when installing or replacing Triflex® R

- Quick assembly with snap-lock mechanism
- Adapter bores for standard robot styles
- Strain relief elements available
- Can be attached at the ends or anywhere in between

With Tiewraps	Without Tiewraps	d1 in. (mm)	d2 in. (mm)	b1 in. (mm)	b2 in. (mm)	f in. (mm)
TR-40-01	TR-40-02	3.22 (82)	1.57 (40)	3.35 (85)	.10 (2.5)	.19 (3)
TR-60-01	TR-60-02	4.80 (122)	2.36 (60)	4.96 (126)	.16 (4)	.24 (6)
TR-70-01	TR-70-02	4.80 (122)	2.36 (60)	4.96 (126)	.16 (4)	.24 (6)
TR-100-01	TR-100-02	5.98 (152)	2.36 (60)	6.02 (153)	.16 (4)	.24 (6)



Mounting bracket with strain relief elements for safe strain relief or attachment of Triflex® R to your machine or robot.

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Triflex® R Fiber Rods

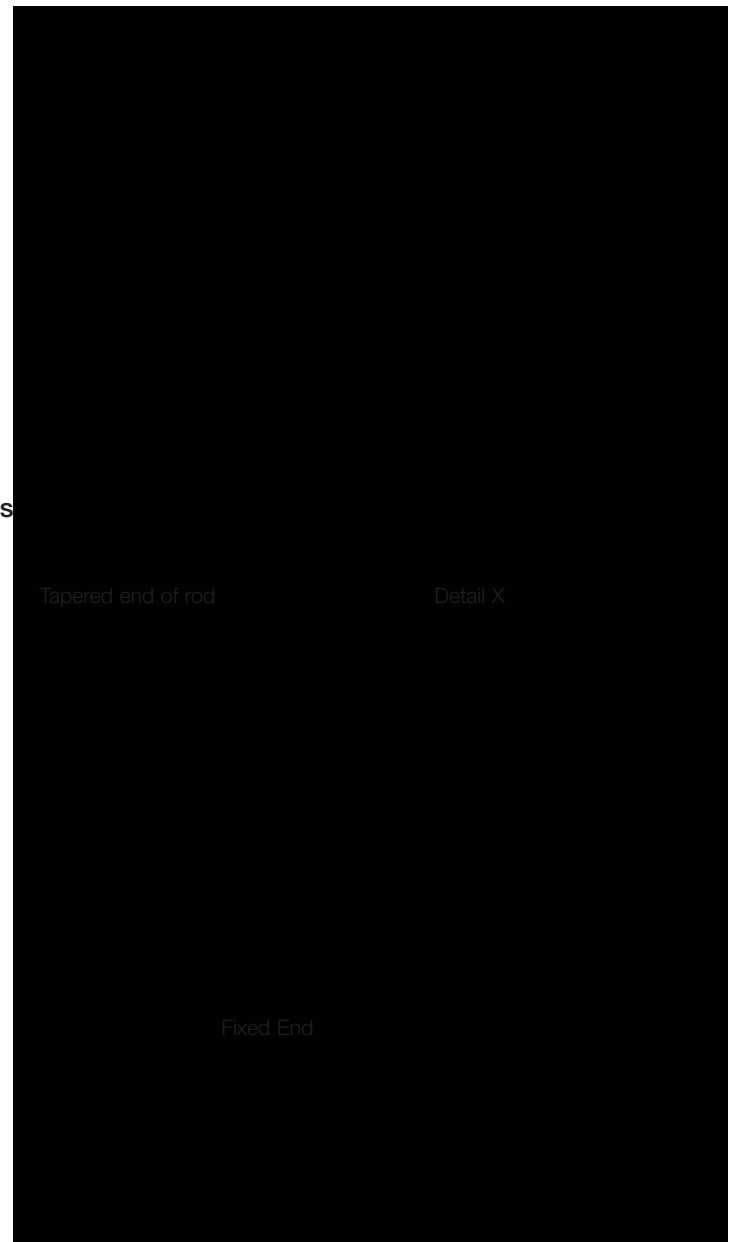
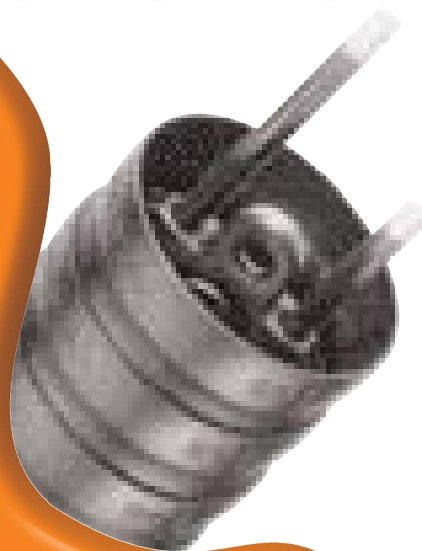
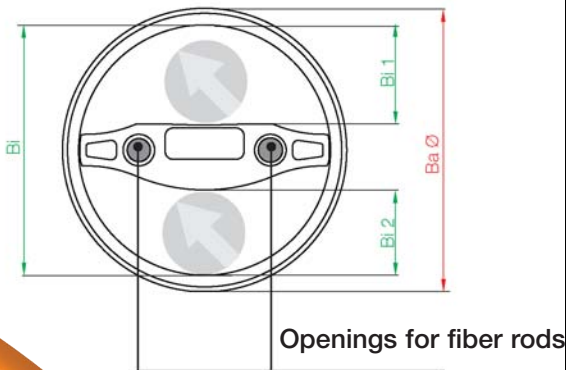


In some applications a high degree of flexibility is not required. In this case, fiber rods can be used to mount Triflex® R in a fixed position. This can reduce torsion or it can create pre-tension in specific target areas to keep Triflex® R out of work areas.

It's delivered as a preassembled unit, consisting of Triflex® R, installed fiber rods and assembled mounting brackets.

- Full or partial mounting
- Specific pre-tension possible
- Will not catch on the exterior of the robot and provides smooth movement of the Triflex® R in extreme applications.
- Automatic repositioning of Triflex® R to the starting position.

NOTE: Fiber rod segments will flex ONLY, not bend. Fiber rod will break if bent too much. Always use additional links after a fiber rod segment.



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Triflex® R Fill Package

Triflex® R Series Selection and Fill Package

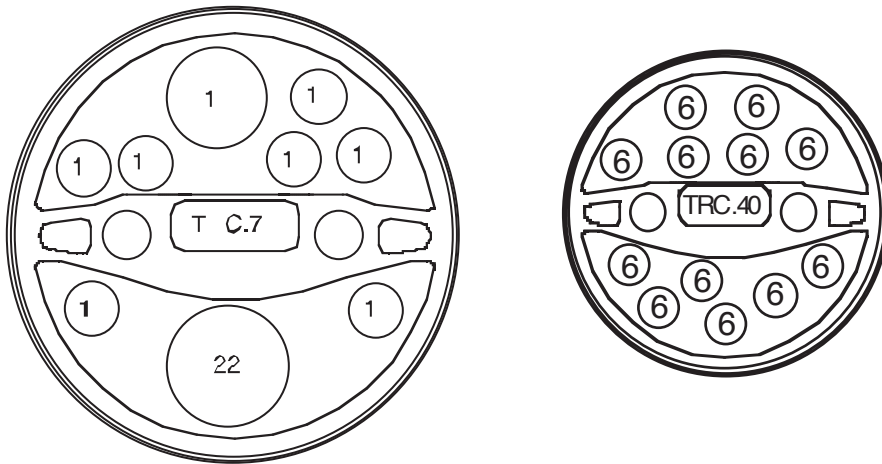
Note: When choosing cable for installation within the Triflex® R, sufficient clearance needs to be provided for all electric cables, pneumatic and media hoses, in order to compensate for forces from relative motion between them.

As a rule of thumb, the following values apply:
The total of cable/hose diameters must not exceed 60% of the available cross section of their Triflex® R component. A clearance of at least 10% (min. 1 mm) needs to be maintained between any two cables/hoses or the Triflex® R. Upon assembly, all cables/hoses need to be able to move freely inside the straightened Triflex® R. Please refer to the chart on this page for an overview of available cross sections for Triflex® R. The smaller the relation between usable cross section and the total of cable/hose diameters, the less the stress on the cables.

Example: Cross Section Calculation

$A_{\text{conduit}} = \frac{d^2 \times \pi}{4}$	
Examples:	
$A_1 = 10 \text{ mm} \times 10 \text{ mm} \times \pi/4$	
$= 78.5 \text{ mm}^2 \times 7 \text{ (number of conduits)}$	
$= 549.50 \text{ mm}^2$	
$A_2 = 18 \text{ mm} \times 18 \text{ mm} \times \pi/4$	
$= 254.34 \text{ mm}^2$	
$A_3 = 22 \text{ mm} \times 22 \text{ mm} \times \pi/4$	
$= 379.94 \text{ mm}^2$	
$A_{\text{conduit}} = A_1 + A_2 + A_3 = 1183.7 \text{ mm}^2$	

Fill Package Example



Series	Usable Cross Section
TRC40	.78 inch ² (508.0 mm ²)
TRC60	1.77 inch ² (1144.6 mm ²)
TRC70	2.77 inch ² (1788.0 mm ²)
TRC100	4.92 inch ² (3177.0 mm ²)

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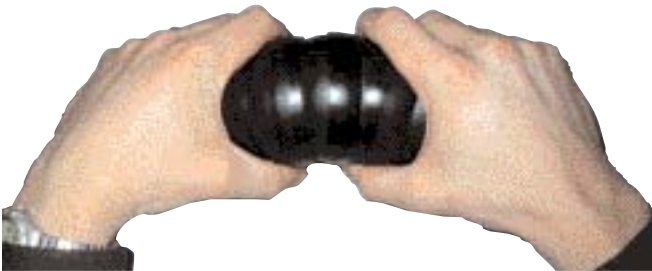
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Triflex[®] R Assembly

Assembling Triflex[®] R



Press outer contours opposed to socket against each other.



Push socket on top of ball and click together.

Disassembling Triflex[®] R

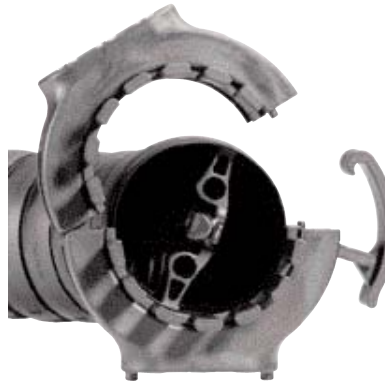


Push screwdriver through perforated window, moving chain links to the maximum bending position on the opposite side.

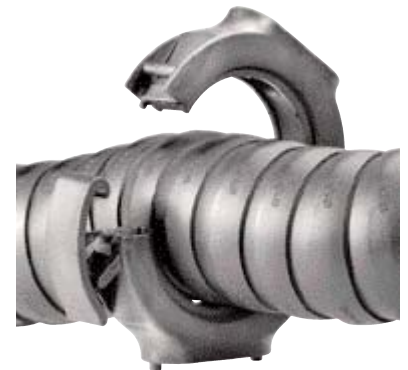


Remove socket from ball using the screwdriver as a lever.

Mounting Bracket Assembly



Mounting brackets can be installed on the ends, with or without strain relief elements.



Mounting brackets can also be installed at any intermediate point along the carrier for added support.

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Triflex® R Swivel Bracket

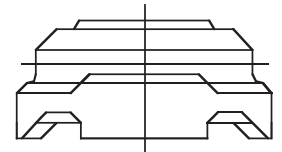


Very tight motions put undue stress on cable harnesses, leading to premature wear or wrong readings off very sensitive cables. Swivel brackets relieve stress on the cable harness and cable carrier alike. Swivel brackets are available with and without integrated strain reliefs.

Advantages:

- Swivel bracket utilizes igubal® self-lubricating flange bearing
- Minimizes critical bends
- Smoother movement of the carrier

4.65 (118)
3.44 (87.5)



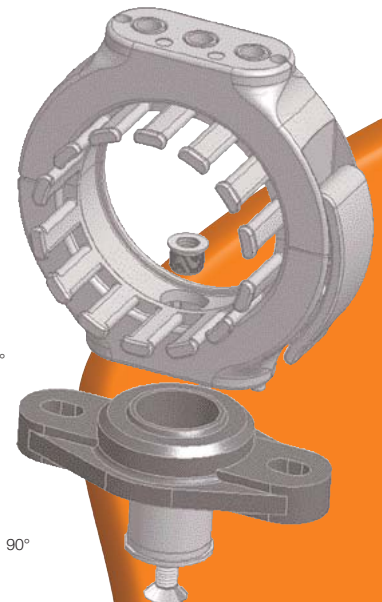
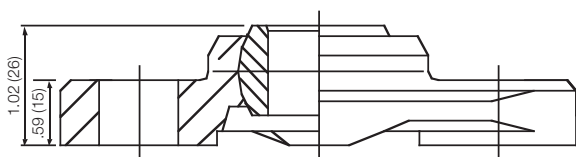
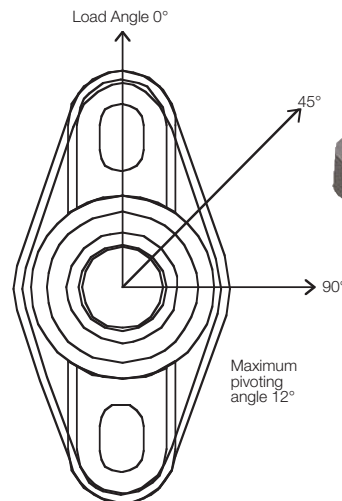
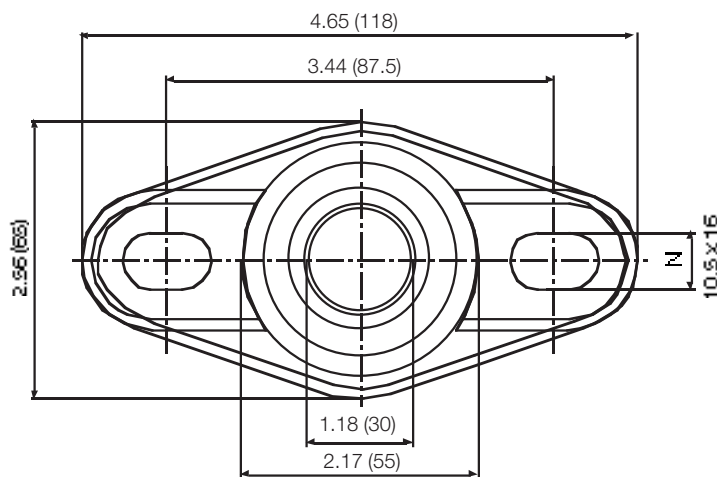
Pivoting Mounting Bracket with Strain Relief

Series	TRC/TRE 40	TRC/TRE 60	TRC/TRE 70	TRC/TRE 100
Part Number	TR-40-03	TR-60-03	TR-70-03	TR-1000-0

Pivoting Mounting Bracket without Strain Relief

Series	TRC/TRE 40	TRC/TRE 60	TRC/TRE 70	TRC/TRE 100
Part Number	TR-40-04	TR-60-04	TR-70-04	TR-1000-04

2.17 (55)



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Triflex® R ReadyChain

Triflex® R - Chainflex® robotic cable package

Robotic cables and other conduits are delivered as harnessed kits.

Triflex® R - ReadyChain - Chainflex® cable/hose Packages

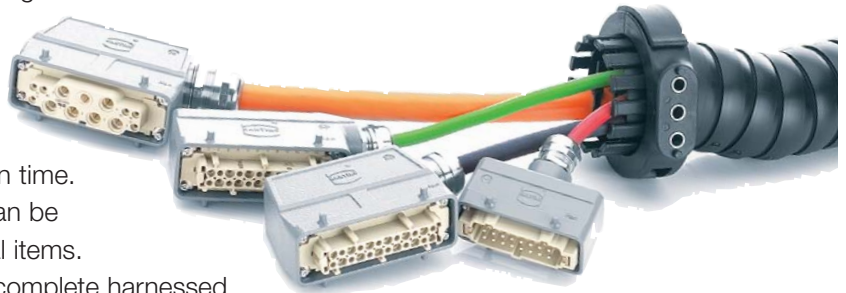
Turnkey harnessed ReadyChain cable and hose packages, equipped with Chainflex® cables for use on robots. Delivered complete with cables, hoses, connectors and accessories.

ReadyChain minimizes setup time and reduces down time.

Cable and hose packages for robotic applications can be customized with Chainflex® products or other special items.

Robotic cables and other conduits are delivered as complete harnessed systems.

Under the igus® CF Robot range, control, data, servo- and motor cables are available.



Chainflex® Cable Testing



Test 1: Triflex® with CF Robot; more than 900,000 torsional movements so far.



Test 2: CF Robot; more than 2,454,600 movements tested successfully in long term test.

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Triflex[®] R Testing

Tested more than 1 million cycles at the igus[®] test lab



Real world applications are simulated in the igus test lab. This example was tested for 1 million cycles.



Complex motions are run through high cycle tests.



Outstanding mechanical performance - glides safely over edges due to smooth and robust outer contour.



Space-saving assembly of fiber rods onto mounting brackets.

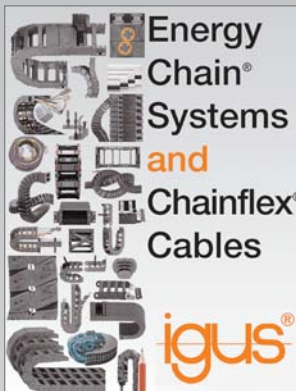
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igus[®] also offers...



The Energy Chain Systems[®] catalog features hundreds of all-plastic Energy Chain[®]/Tube cable carriers for guidance and protection of automated cables and hoses. The complete line of Chainflex[®] continuous-flex cables, and a broad range of strain relief, mounting brackets, shelving and separation accessories are also included.



igus[®] also offers the TwisterChain[®] Energy Chain[®] designed specifically for rotary applications. It can be used in conjunction with Triflex[®] R on articulating robots. TwisterChain is constructed with a wider variation of cable carrier and circle radii in mind, saving space while offering cable compartmentalization and accessibility.



The Chainflex[®] catalog contains our full range of Chainflex[®] continuous-flex cables as well as design information and strain relief elements.

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E-mail: webmaster@igus.com