

BRACER® BRACING WASHER

BRACER® HILLSIDE STYLE WASHER

Designed to Improve the Stability of Your Building

The BRACER® with slip resistant knurls are designed to increase the load capacity of your bracing system by over three times more than a standard hillside washer.

Our patented slip resistance knurls minimizes slippage of the rod, keeping the bracing tight. It has been tested by an independent laboratory confirming that BRACER® achieves complete loading of the web and rod, eliminating backup plates and welding! This research provides the only certified load data by any supplier of hillside style washers.

US Patent # 6,217,270

New Elliptical Shape #1 BRACER distributes stress into web for better load distribution!



"The #1 BRACER ductile iron oval hillside washers for 1/2 - 5/8" rods surpass the design capacity of the rods and beam / column sections."

"Procedures and calculations in the literature for the design of x-bracing anchorage can be used with confidence when specifying and selecting ductile iron oval BRACER hillside washers."

"The oval shape is better than rectangular mainly because of two reasons: The base area is almost the same and the oval shape eliminated stress concentrations at the 90-degree corners and reduces the cantilever distance (from the corner of the base to the center of the rod). In addition, your oval shape is properly stiffened on it's back. This latest oval shape is a winner with STRESS-LOK!

90-degree corners and reduces the cantilever distance (from the corner of the base to the center of the rod). In addition, your oval shape is properly stiffened on it's back. This latest oval shape is a winner with STRESS-LOK!

Statement of certification by Dr. Ralph Sinno Ph.D. Professor of Civil Engineering Mississippi State University.

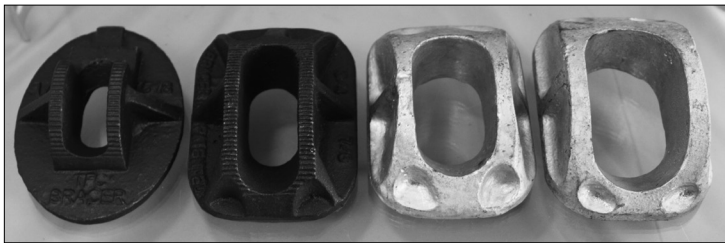
WHY BRACER® ?

Patented design provides optimal load transfer and easy installation.

- Patented knurls on the surface minimizes slippage of the rod.
- Eliminates back-up plates and welding.
- Special nipple is design to engage the web slot deeper, producing higher load capacity and easy installation!
- Made from high strength ductile iron to assure quality performance.
- Certified independent test data confirms load capacities.



SIZES AND ROD CAPABILITY



#1 BRACER Oval With Knurls (1/2" - 5/8" Rod)
#2 BRACER With Knurls (3/4"- 7/8" Rod)
#3 BRACER (1" - 1-1/4" Rod)
#4 BRACER (1-3/8" - 1-1/2" Rod)

Shown in standard red paint and optional HDG finish.

MATERIAL PROPERTIES

STANDARD MATERIAL (Import)

Ductile Iron
 ASTM 536-84 Grade 65-45-12
 Ultimate Tensile Strength: 65,000 PSI

OPTIONAL MATERIAL (Domestic)

ZAMAC 5 Zinc Aluminum Alloy
 ASTM B86-88 AC41A

FINISH

Red Enamel: BRACER #1,2,3
 Gray Enamel: BRACER #4
 Type: gloss enamel, 85 units minimum at 60°.
 Thickness: 1.6-2.0 mils
 Adhesion: ASTM 2794 Excellent. No Peeling or removal
 Impact Resistance: ASTM D 2794 Good > 10 in. lbs.
 Abrasion Resistance: ASTM D 4060 Good
 Corrosion Resistance: Salt Spray: 250 hrs. (<5% red rust)
 Kesternich: 5 cycles (<10% red rust)

OPTIONAL FINISH

Hot Dip Galvanized Per ASTM 153 Class A

For load data, please refer to page 208.

Bracer Base Dimensions

Need a standard hillside? Call about information on our BRACER LITE!

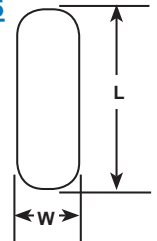
Bracer Size	Max Rod Size	"L"	"W"
#1 (Oval)	5/8"	4.000"	3.000"
#2	7/8"	4.000"	3.000"
#3	1-1/4"	4.000"	3.000"
#4	1-1/2"	4.250"	3.000"

SLOT SIZES AND ROD ANGLES

SLOT REQUIREMENTS - MINIMUM

Slots in the web must be sized to allow a rod angle of up to 52° and to allow the tab on the bottom of the BRACER to engage the web.

*Static load tests were conducted using the these dimensions.



ROD AND (BRACER SIZE)	ROD ANGLE (MAX)	FROM MSU TEST		SLOT WIDTH (W) MINIMUM	
		*SLOT LENGTH (L)	*SLOT WIDTH (W)	DUCTILE IRON (IMPORT)	ZINC ALLOY ZAMAC 5 (DOMESTIC)
1/2" Rod (#1 BRACER)	55°	1.065"	1.062"	.750"	1.000"
5/8" Rod (#1 BRACER)	52°	1.875"	1.062"	.750"	1.000"
3/4" Rod (#2 BRACER)	55°	2.000"	1.062"	1.000"	1.000"
7/8" Rod (#2 BRACER)	52°	2.125"	1.062"	1.000"	1.000"
1" Rod (#3 BRACER)	58°	2.500"	1.312"	1.250"	1.250"
1-1/4" Rod (#3 BRACER)	56°	2.625"	1.312"	1.312"	1.312"
1-3/8" Rod (#4 BRACER)	55°	3.060"	1.425"	1.425"	1.425"
1-1/2" Rod (#4 BRACER)	52°	3.125"	1.600"	1.600"	1.600"

BRACER[®] LITE

BRACING WASHER

BRACER[®] LITE HILLSIDE STYLE WASHER

Visit our website for the most up to date product and technical information!



**Looking to increase the stability of your building?
Specify BRACER[®] LITE.**

BRACER[®] LITE increases load capacities and performance compared to ordinary hillside washers. Included with BRACER[®] LITE is our STRESS-LOK[®] clamping washer. STRESS-LOK[®] helps increase the load carrying capacities and reduces slippage of the rod, keeping the bracing tight!

Available in 3 sizes!



See why BRACER[®] LITE provides better performance compared to standard hillside washers.



STRESS-LOK[®] WASHER
Our patented STRESS-LOK[®] clamping washer distributes the load across more area than a standard flat washer.

Tests conclude that this design increases the load capacity of the bracing assembly, keeping the rod from slipping across the surface which can cause loosening of the nut.



ANTI SLIP SERRATIONS
Our patented serrations reduce rod slippage, which keep the bracing from becoming loose.

Independent tests confirm that BRACER[®] LITE produced from ductile iron produces higher load capacities and better ductility. Hillside washers produced from Class 30 cast iron had unpredictable load capacities.



LARGER NIPPLE
Designed to engage the web slot deeper, making installation easy and producing greater loads in applications requiring steep rod angles.



INDEPENDENT TESTS
TFC is the only supplier of hillside style washers that can supply independent tests to confirm the load capacities.

Tests conclude that the patented BRACER[®] LITE with STRESS-LOK[®] were found to be superior to off the shelf hillside washers, and can carry higher loads.

TECHNICAL INFORMATION

Material: Ductile Iron ASTM 536-84 Grade 64-45-12
Finish: Plain

LOAD RESULTS

Independent tests were conducted at Mississippi State University under the direction of Dr. Ralph Sinno Ph.D. P.E. in accordance to test sponsored by the MBMA and published as part of the Journal of Structural Engineering Vol 119, No 11, November 1993, "X-Bracing Anchorage Connection" paper.

Comments by Dr. Ralph Sinno:

"Triangle Fasteners "Bracer Lite" hillside anchors having ridges, serration, on the curvature of the hillside washer with companion Stress-Lok washers were found to be superior to the standard off-the-shelf market available ductile steel hillside washers. They carry higher loads with no failure in any tests to neither the hillside anchor, "Bracer Lite", nor the Stress-Lok washers."

WEB	BRACER LITE SIZE	LOAD (Ultimate)
1/8"	1/2"	(1)10,750 lbs.
1/8"	5/8"	(1)15,850 lbs.
3/16"	3/4"	(2)23,500 lbs.
1/4"	3/4"	(2)26,600 lbs.

Rod Angle: (1) 30⁰ / (2) 45⁰

Failure Mode
Rod tensile failure.





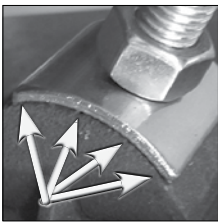
Specifically Designed for Use With Bracing Washers

STRESS-LOK[®] is the first washer designed to keep brace rods tight. It eliminates slippage of the rod caused by vibration due to wind load, earthquakes, cranes and other cyclic loads.

The concave bearing surface with a series of knurls, increases the contact area between the washer and hillside. The additional contact area distributes the load over a greater area, thereby keeping the connection tight. It also improves the overall strength of a standard hillside washer.

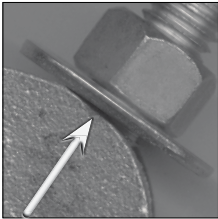
US Patent # 6,217,270

WHY STRESS-LOK[®]?



Patented washer distributes the bracing load across the hillside to increase strength and reduce slippage of the rod.

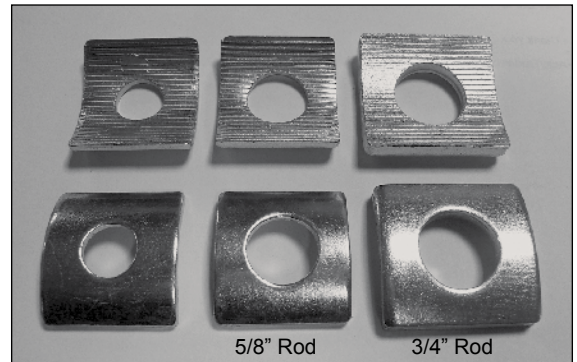
- The curved mating surface increases performance by distributing the load onto the hillside.
- The increased contact area eliminates slippage that can loosen the connection.
- Certified independent test data confirms load capacities.
- Can be used with standard hillside washers to improve their performance.



Flat washers provide minimal contact which can weaken the connection and cause loosening of the nut.

STRESS-LOK[®] distributes the load over a greater area which increases strength compared to standard flat washers.

SIZES AND DIMENSIONS



5/8" Rod 3/4" Rod

SIZES (Rod Size): 1/2", 5/8" and 3/4"
MATERIAL: Low Carbon Steel
FINISH: .0003" min. Zinc Plated

INDEPENDENT TESTS



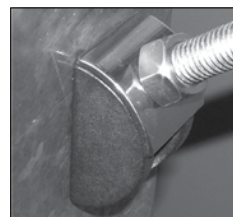
"...Triangle Fastener's hillside anchors having ridges, serration, on the curvature of the standard hillside washer with Stress-Lok washers were found to be superior to the standard off-the-self market available hillside washers."

Source: R. Ralph Sinno, Ph.D., P.E., F. ASCE
Professor of Civil & Environmental Engineering

Statement from independent laboratory tests conducted at Mississippi State University, August 26, 2008.



For optimal performance of your bracing system, use STRESS-LOK with BRACER Hillside Style Washers.



STRESS-LOK can be use with ordinary hillside washers to improve their performance.

Increase the stability of your building for less than \$0.50 per rod!

For load data, please refer to page 208.

LOAD DATA

BRACER, BRACER LITE LOAD CHART

REV 3 – 9.13.10

Tests were conducted at Mississippi State University by the direction of Professor R. Ralph Sinno Ph.D., P.E. in accordance to tests sponsored by the MBMA. "X-bracing Anchorage Connection," Journal of Structural Engineering, ASCE, Vol 119, No. 11, November 1993.
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WEB THICKNESS	ROD DIAMETER	² ROD TENSILE STRENGTH (Min - lbs)	SLOT SIZE Width x Length	BRACER SIZE AND WASHER SL = StressLok FW = Flat washer	LOAD (lbs) ULTIMATE 30° & 45° rod angles	FAILURE MODE
1/8" (TB-2)	5/8"	16,700	1.062" x 2.125"	#1 BRACER & FW	20,750 (30°)	4
				#1 BRACER & FW	19,500 (45°)	1 & 4
				#1 BRACER & SL	18,000 (45°)	1 & 4
				#1 Oval BRACER & SL	17,000 (45°)	1 & 4
	3/4"	24,700	1.062" x 2.125"	#2 BRACER & FW	29,500 (30°)	1 & 4
10ga (TB-1)	1/2"	10,500	1.062" x 2.125"	#1 BRACER & FW	12,600 (30°)	1
			.750" x 1.750"	#1 BRACER & SL	10,580 (45°)	1
	5/8"	16,700	.750" x 1.750"	1/2" BRACER LITE & SL	10,750 (45°)	1
	3/4"	24,700	1.062" x 2.125"	5/8" BRACER LITE & SL	15,580 (45°)	1
	7/8"	27,700	1.062" x 2.125"	#2 BRACER & FW	29,100 (30°)	1 & 4
9ga (Corle)	1"	36,400	1.062" x 2.125"	#2 BRACER & FW	33,500 (30°)	1 & 4
3/16 (TB-4)	1/2"	10,500	1.312" x 2.625"	#3 BRACER & FW	36,350 (30°)	1 & 4
			1.312" x 2.625"	#1 BRACER & FW	12,500 (30°)	1
	5/8"	16,700	1.312" x 2.625"	#1 BRACER & SL	16,600 (45°)	1
			1.312" x 2.625"	#1 BRACER & FW	22,600 (30°)	1
			1.250" x 2.625"	#1 BRACER & FW	19,760 (45°)	1
	3/4"	24,700	1.312" x 2.625"	#1 BRACER & SL	22,750 (45°)	1
				#1 Oval BRACER & SL	18,250 (45°)	1
				#2 BRACER & FW	28,800 (30°)	1
				#2 BRACER & SL	26,200 (45°)	1
				3/4" BRACER LITE & SL	25,800 (45°)	1
7/8"	27,700	1.312" x 2.625"	#2 BRACER & FW	23,250 (45°)	1	
1/4" (TB-7)	5/8"	16,700	1.312" x 2.625"	#2 BRACER & FW	37,300 (30°)	1
				#1 BRACER & SL	38,300 (45°)	4 & 7
	3/4"	24,700	1.312" x 2.625"	#2 BRACER & FW	18,400 (45°)	1
				#2 BRACER & SL	30,600 (30°)	1
				3/4" BRACER LITE & SL	29,300 (45°)	1
	7/8"	27,700	1.312" x 2.625"	#2 BRACER & SL	26,000 (45°)	1
	1"	36,400	1.312" x 2.625"	#2 BRACER & FW	26,000 (45°)	1
	1-1/4"	58,100	1.312" x 2.625"	#3 BRACER & FW	38,200 (30°)	1
#3 BRACER & FW				40,200 (45°)	1	
5/16"	7/8"	27,700	1.625" x 3.500"	#3 BRACER & FW	39,500 (30°)	4
				#3 BRACER & FW	70,000 (30°)	1 & 4 & 5
	1-1/4"	58,100	1.625" x 3.500"	#3 BRACER & FW	50,000 (45°)	1
				#3 BRACER & FW	40,500 (45°)	1
				#3 BRACER & FW	56,000 (45°)	7
1-1/2"	69,300	1.625" x 3.500"	#4 BRACER & FW	71,000 (30°)	3 & 4	
5/16" web with 1/4" backup plate: 4.875" x 5.500"	1-1/2"	69,300	1.625" x 3.500"	#4 BRACER & FW	52,500 (45°)	2 & 7
				#4 BRACER & FW	71,000 (30°)	4

TEST PHOTOS



Failure Modes

- Mode 1: Tensile fracture of the bracing rod
- Mode 2: Compression fracture of the BRACER
- Mode 3: Punching shear fracture of the web plate beneath the BRACER washer.
- Mode 4: Excessive flexure deflection of the web plate of the column section.
- Mode 5: Failure of the fillet weld between the web plate and flange of the section adjacent the BRACER.
- Mode 6: Nipple disengagement from the web slot.
- Mode 7: Nipple shear fracture.

Notes

1. The flange thickness was stiffened over previous tests with a 3/8" plate and welded to the outside of the existing flange.
2. Minimum Rod Strength based on Grade 2 bolt per SAE J429 .

Test at 45° rod angle – Report dated February 18, 2005

Test with STRESS-LOK and BRACER II at 45° rod angle – Report August 26 2008 (SL= StressLok)

Test with OVAL BRACER II. STRESSLOK at 45 rod angle – Report September 13, 2010

"Procedures and calculations in the literature for the design of x-bracing anchorage can be used with confidence when specifying and selecting ductile iron oval BRACER hillside washers."
Statement by Dr. Ralph Sinno Ph.D.