



PHILLYSTRAN

THE PERFORMANCE LEADER



BROADCASTING.



WireCo®
WorldGroup

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PHILLYSTRAN... THE PERFORMANCE LEADER

Founded in 1972, Phillystran is 'the' specialist in high performance, synthetic fiber ropes for demanding applications. By combining cutting edge technical know-how with the industry's broadest range of advanced fibers, Phillystran has a reputation for excellence in the development of ropes that set the standard for performance, longevity and efficiency in demanding applications.

Phillystran has led the development of synthetic ropes for applications previously performed by steel wire ropes, with significant performance and business benefits. Our products are used worldwide in a broad range of marine, industrial and military rope applications including mooring lines, life lines and winch lines, boat rigging, structural support lines, power cables, broadcast tower guy cables and seismic cables.

Trusted Solutions Partner

Phillystran's knowledge and experience means we are a trusted solutions partner for companies looking for efficiency and productivity improvements – we help companies do it better. We specialize in producing custom designed strength members for specific applications. Over 50% of the products supplied by Phillystran are custom manufactured to exacting customer requirements.

Unlike other manufacturers that offer a limited range of yarns, Phillystran gives you access to the industry's broadest range of high tenacity fiber ropes, strands, braids and strength members from fibers such as Kevlar®, Twaron®, Technora®, Vectran®, Spectra®, Dyneema® and Zylon®, to develop products that maximize the unique properties of the high tenacity fibers currently available. Phillystran also manufactures polyester ropes for specialized applications.

Market Leading Innovation

In addition to access to the industry's widest range of high performance yarns, Phillystran is a leader in rope construction and engineering. Our proprietary four strand, wire lay construction around an independent synthetic core, where each strand is individually overbraided, offers outstanding levels of abrasion resistance and service life.

Phillystran is an active member of the Cordage Institute, and works on the development of international standards, guidelines, test methods and other technical documents for rope and cordage products. Phillystran product quality and customer service are second to none. Phillystran is fully certified according to ISO 9001:2015. Our commitment to innovation is matched by our drive to continually improve quality across the business by controlling product design, inspecting all raw materials, monitoring key elements of the manufacturing process, and conducting final product testing and inspection. Moreover, as a rope is only as strong as its termination, all Phillystran ropes are supplied fully terminated, using our proprietary socketing compound A-20 resin to ensure the strongest possible bond.

As a member of the WireCo Worldgroup, Phillystran also has access to a global network of research and development into high performance yarns and engineered ropes unmatched in the industry.

As continued research brings new and better fibers to market, Phillystran is able to develop new ropes to expand the scope for synthetic fiber rope applications. Our goal is to give your business a competitive edge with ropes that enhance application performance and streamline equipment functionality.

PHILLYSTRAN IN BROADCASTING

Phillystran has over 45 years' experience of supplying high performance fiber guying systems for AM, FM and communications towers up to 2,000 feet high, operating at powers as high as 2 megawatts. As broadcast towers and antennae technology has been deployed to ever more challenging environments, Phillystran's non-metallic guying systems provide a clear engineering advantage over traditional steel wire systems.

Phillystran High Performance Tower Guys (HPTG-I) are made from stranded aramid fibers with up to 1.7 million pounds breaking strength. They eliminate transmission problems associated with EHS (extra high strength) and bridge strand steel wire guying such as Electro Magnetic Interference (EMI), Radio Frequency Interference (RFI), Signal Suppression Array Directional Irregularities Zapping and White-Noise Arcing.

Phillystran HPTG-I guying systems are in use in every climate, from the deserts of Oman to the tundra regions of Greenland. On top of the One World Trade Center (Freedom Tower), HPTG-I guy assemblies are used to support the 400 ft transmission mast - the tallest in the Western Hemisphere and home to a wide variety of broadcast and communications antennas serving the greater New York City area.

Phillystran's HPTG-I aramid fiber guy lines are one component of the HPTG-I Guying System. The complete guying system includes the HPTG-I guylines with either the Corona, Big Grip Dead-Ends or standard end wire terminations, together with vibration dampers and steel tails, as required, Phillystran is able to handle the most demanding guying applications.

Phillystran guying systems are designed to last for many years. The aramid fiber guy line is protected by a co-polymer polyurethane extruded jacket with excellent weathering and dielectric properties and blended with carbon black pigmentation for maximum UV resistance. The outer jacket sheds moisture thus assuring consistent dielectric properties regardless of the season or climate. With an expected life of 25 years or more, many Phillystran guy line systems have been in place since the early 1970s.

Such is the resilience and strength of Phillystran guy lines that they have been used in a number of structural applications where the weight of steel wire is too great. Typically, HPTG-I aramid fiber guy lines are a fifth of the weight of comparable steel wire ropes with the same strength yet will last many years longer.

As broadcast tower and antennae projects reach ever higher, Phillystran HPTG-I guying systems provide broadcast companies and mast installers with the optimum mix of high strength guying, unhindered transmissions and installation longevity.



**HPTG-I ARAMID FIBER
GUY LINES ARE A
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LONGER**



NAVY

BROADCASTING

MINING

UTILITY



PHILLYSTRAN HIGH PERFORMANCE TOWER GUYS



ARAMID FIBER GUYING SYSTEMS FOR BROADCAST TOWERS AND ANTENNAS

Phillystran High Performance Tower Guys (HPTG-I) aramid fiber guying systems are the results of many years of experience with AM, FM, TV and communications towers up to 2,000 feet high, operating at powers as high as 2 megawatts. HPTG-I is in use in every climate from the deserts of Oman to the tundra regions of Greenland. Phillystran HPTG-I guy assemblies are installed atop One World Trade Center (Freedom Tower) to support the 400 ft mast. That structure is the tallest in the Western Hemisphere and will be home to a wide variety of broadcast and communications antennas serving the great New York City area.

HPTG-I aramid fiber guying systems eliminate problems associated with EHS(2) and BS(2) steel guy cables such as:

- ElectroMagnetic Interference (EMI)
- Radio Frequency Interference (RFI)
- Signal Suppression
- Array Directional Irregularities
- Zapping and White-Noise Arcing (associated with ceramic insulators)



What is a “guying system?”

Phillystran's HPTG-I aramid fiber guy lines are one component of the HPTG-I guying system. By offering a system, the user is assured that all details related to the HPTG-I guy line have been addressed. This is the unique factor which differentiates these products from other steel guy alternatives. The guying system consists of the following components:

1. The HPTG-I aramid fiber guyline
 - Made from high modulus (not standard modulus) aramid fibers such as Kevlar and Twaron® fibers
 - Designed/constructed in a unique wire-lay construction
 - Resin impregnated for enhanced performance
 - Protected with a thick polyurethane extrusion for maximum UV and environmental resistance and offering the longest life expectancy of any non-metallic guyline on the market.
2. The factory installed Corona sockets
 - HPTG-I aramid fiber guylines are supplied as guy assemblies fabricated to customer length specifications
 - Corona sockets are included to protect the guyline from RF burning
 - Suggested for all towers/antennas operating at powers of 10KW and above.
3. The optional Spiral Vibration Dampers (SVD) or Air Flow Spoilers (AFS). See description on page 10.
4. Factory / engineering assistance for tensioning and installation guidelines and suggestions.
5. The steel tail which is a design consideration recommended for all tower installations (actual steel tail materials not supplied by Phillystran). See description on page 11.

Each of these components are described in more detail throughout this product brochure.



“We chose the Phillystran HPTG-I products as an offering to the Sultanate of Oman's three medium wave AM broadcast sites and were very pleased with the results. Using the non-metallic HPTG-I prefabricated guy assemblies not only simplified the installation but also offered performance advantages for the Oman MOI's antenna systems. Phillystran was selected also to reduce the high static charge that develops on metal guys in the hot, arid climate of the Middle East. This serves to reduce transmitter shut backs.”

Tom King, President and CEO Kintronic Lab



How to determine what size HPTG-I is required

A certified structural engineer should be consulted to determine guy size.

Total Guying, where the HPTG-I assembly is greater than 50% of the total guy length:

Select the HPTG-I size equal to the EHS steel guy size (recommended by either a structural engineer or tower manufacturer) based on RBS or refer to TIA-222-G column in Table 1.

Partial Guying, where the HPTG-I assembly is 50% or less of the total guy length:

Partial guys of HPTG-I should not be less than 10% of the tower height (at the HPTG-I assembly attaching point) in length and should extend equally in all directions at a given guy level. Example is a 3-sided 1,000 ft. FM tower with 3 top level HPTG-I assemblies not less than 100 ft. in length. Refer to TIA-222-G column in table 1.

TABLE 1 - HIGH PERFORMANCE TOWER GUY (HPTG-I) SIZE SELECTION CHART

HPTG-I	EHS/BS EQUIVALENT ²	TIA-222-G EQUIVALENT	JACKETED DIAMETER	JACKETED WEIGHT	CORONA SOCKET	BIG GRIP	SVD or AFS VIBRATION DAMPERS
p/n and RBS ¹	inches	inches	inches	lb/1,000ft	p/n	p/n	
HPTG 1200I	-	-	0.17	11	-	-	-
HPTG 2100I	1/8 EHS	-	0.22	19	-	PLP-2738	SVD 0103
HPTG 4000I	3/16	-	0.30	36	-	PLP-2739	SVD 0103
HPTG 6700I	1/4	-	0.37	53	CS 15400	PLP-2755	SVD 0103
HPTG 11200I	5/16	1/4 EHS	0.44	75	CS 15400	PLP-2558	SVD 0104
HPTG 15400I	3/8	5/16	0.51	98	CS 15400	PLP-2756	SVD 0105
HPTG 20800I	7/16	3/8	0.57	120	CS 35000	PLP-2763	SVD 0106
HPTG 27000I	1/2	7/16	0.65	150	CS 35000	PLP-2765	SVD 0106
HPTG 35000I	9/16	1/2	0.69	170	CS 35000	-	SVD 0106
HPTG 42400I	5/8	9/16	0.84	230	CS 42400	-	AFS 5058104
HPTG 58300I	3/4	5/8	0.96	300	CS 58300	-	AFS 5058105
HPTG 85000I	7/8	11/16, 3/4 BS	1.26	420	CS 85000	-	AFS 50589317
HPTG 130000I	1 BS	7/8	1.51	740	CS 130000	-	contact Phillystran
HPTG 160000I	1 1/16	1	1.76	910	CS 200000	-	contact Phillystran
HPTG 200000I	1 1/4	1 1/16, 1 3/16	1.87	1,050	CS 200000	-	contact Phillystran
HPTG 252000I	1 3/8	1 1/4	2.08	1,290	contact Phillystran	-	contact Phillystran

¹ HPTG-I part number = the Rated Break Strength (RBS) in lbs

² Extra High Strength (EHS) / Bridge Strand (BS) steel guys on Rated Break Strength (RBS)

What is the purpose of the HPTG-I jacket?

The aramid fiber guy line core must be protected from the harmful effects of ultraviolet (UV) radiation. The HPTG-I thick extruded jacket is a co-polymer polyurethane with excellent weathering and dielectric properties, blended with carbon black pigmentation for maximum UV resistance. The outer jacket sheds moisture thus assuring consistent dielectric properties regardless of the season or climate.

TABLE 2 - HIGH PERFORMANCE TOWER GUY (HPTG-I) SIZE SELECTION CHART

PART NUMBER	LOAD BEARING AREA square inches	NOMINAL TENSILE MODULUS (million psi)		
		1st cycle	10th cycle	10th cycle ea (pounds)
HPTG 4000I	0.0168	14	15	252,000
HPTG 6700I	0.0280	14	15	421,000
HPTG 11200I	0.0467	14	15	701,000
HPTG 15400I	0.0609	14	15	913,000
HPTG 20800I	0.0862	14	15	1,290,000
HPTG 27000I	0.112	14	15	1,670,000
HPTG 35000I	0.142	14	15	2,130,000
HPTG 42400I	0.188	10.5	12	2,250,000
HPTG 58300I	0.247	10.5	12	2,960,000
HPTG 85000I	0.366	10.5	12	4,390,000
HPTG 130000I	0.675	10.5	12	8,100,000
HPTG 160000I	0.870	10.5	12	10,400,000
HPTG 200000I	1.03	10.5	12	12,400,000
HPTG 252000I	1.31	10.5	12	15,800,000

What are Corona sockets and when are they required?

Corona sockets are aluminum, resin-filled, potted end terminations and are factory installed. Phillystran recommends these potted end terminations for all commercial AM, FM and TV projects. Designed to protect HPTG-I from RF burning, Corona sockets are the first level of protection for HPTG-I products, with additional levels of protection required for high powered broadcasting stations. Contact Phillystran for recommendations above 10 kw. See table 3 for Corona socket dimensions.

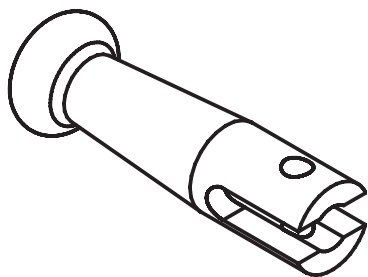


TABLE 3A - DIMENSIONS IN INCHES

CORONA SIZE	A	B	C	D	E	F	G	PIN DIAMETER	WT lb
CS 15400	10.00	2.38	.91	2.91	.48	1.68	7.21	.75	3
CS 35000	14.13	1.20	1.20	4.13	.75	2.50	10.00	1.13	8

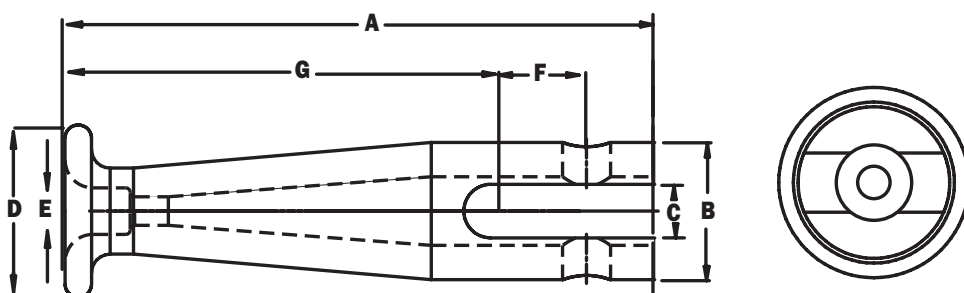
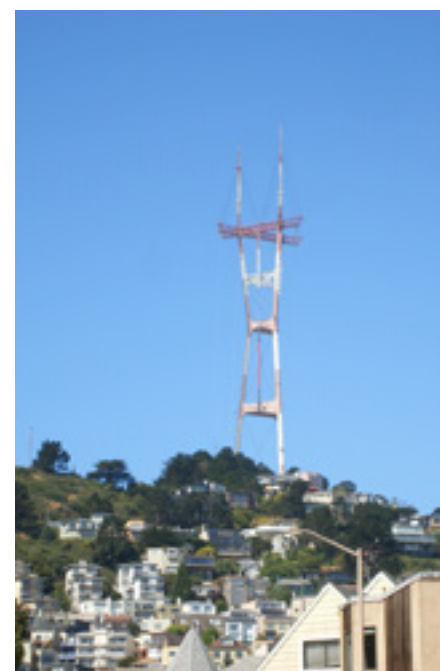
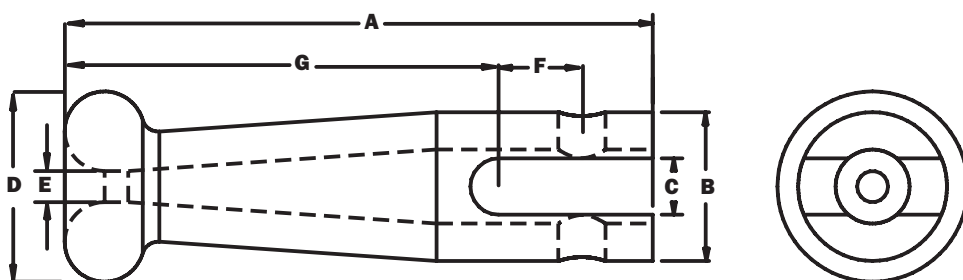


TABLE 3B - DIMENSIONS IN INCHES

CORONA SIZE	A	B	C	D	E	F	G	PIN DIAMETER	WT lb
CS 42400	14.88	3.75	1.32	4.75	0.80	2.20	10.88	1.13	11
CS 58300	17.63	4.55	1.60	4.88	1.00	2.50	13.00	1.38	18
CS 85000	20.00	5.31	1.88	5.13	1.25	2.88	14.63	1.50	25
CS 130000	25.65	7.50	2.75	7.88	1.53	4.38	16.69	2.50	68
CS 200000	27.00	7.94	2.75	9.25	2.00	4.44	18.78	2.50	85



What is the life expectancy of HPTG-I?

HPTG-I differs from other non-metallic guy lines or rods because of the thick protective outer polyurethane extruded jacket (see table 4) which protects the HPTG-I for many years. Phillystran guy line systems have been in place since the early 1970s, with an expected life of 25 years or more; perhaps the life of the tower(s). Retirement criteria is based on the condition of the jacket, especially near the base of the corona socket. It is recommended that HPTG-I guy systems be inspected at least annually, and more frequently as the guy system ages.

When are vibration dampers required?

Guy lines, whether steel or non-metallic, may exhibit aeolian (high frequency) or galloping (low frequency) vibration. HPTG-I is effectively dampened using preform line products' Spiral Vibration Dampers (SVD) or Air Flow Spoilers (AFS); see table 1 on page 8. The SVDs are installed in pairs with one pair installed within 6 inches of each end of the HPTG-I Corona socket, using four AFSs per assembly. Vibration dampers are recommended for any HPTG-I assemblies greater than 100 ft. in length, and greater than 50% of the total guy length.

TABLE 4 - TYPICAL VALUES

HPTG-I POLYURETHANE JACKETING COMPOUND

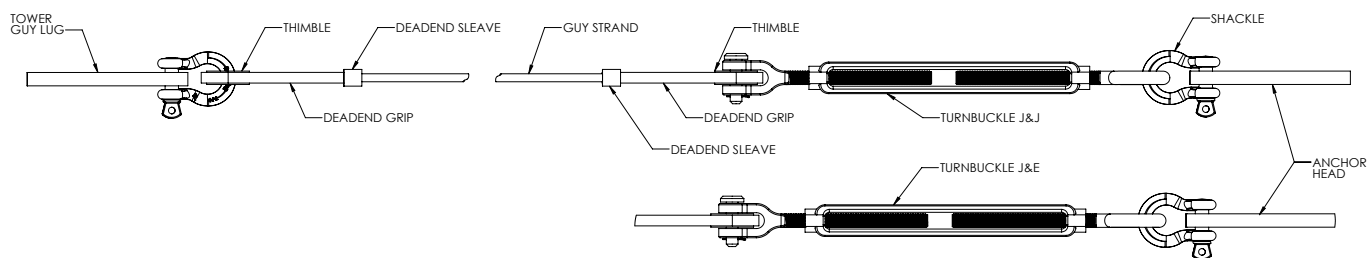
	ASTM	SAMPLE*	SI UNITS	USCS UNITS
Shore hardness	D 2240	2	90 A	90 A
Tensile strength	D 412	1	38.2 MPa	5550 psi
Tensile stress @ 100% elongation	D 412	1	9.0 MPa	1300 psi
Tensile stress @ 300 % elongation	D 412	1	17.2 MPa	2500 psi
Ultimate elongation	D 412	1	525%	525%
Tensile set @ 200 % elongation	D 412	1	25%	25%
Vicat softening point	D 1525	2	110 °C	230 °F
Compression set	D 395			
22 hrs @ 23 °C		2	25%	25%
22 hrs @ 70 °C		2	60%	60%
Glass transition temperature	DSC**	3	- 44 °C	- 47 °F
Tear resistance	D 624	2	74.4 kN/m	425 lb/in
Tear resistance	Die C	1	23.6 kN/m	135 lb/in
Specific gravity	D 470	2	1.13	1.13
Low temperature stiffness	D 792			
Modulus of rigidity @ 23 °C	D 1053	2	11.1 MPa	1609 psi
Modulus of rigidity @ 0 °C		2	17.2 MPa	2500 psi
Modulus of rigidity @ -20 °C		2	55 MPa	8000 psi
Modulus of rigidity @ -40 °C		2	331 MPa	28000 psi

* (1) 25 mil, extruded (2) 75 mil, milled and pressed (3) granules

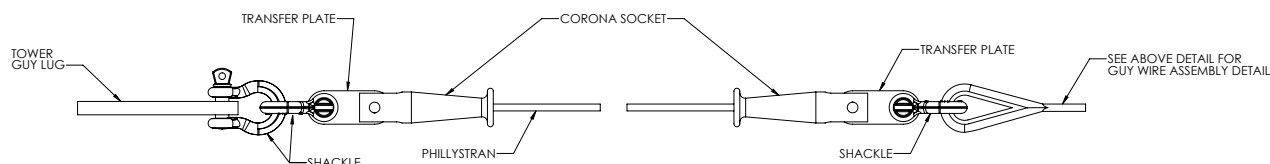
** Different scanning calorimeter, 10 °C/min. temperature program



ARTICULATED HARDWARE RECOMMENDED FOR USE WITH BOTH CORONA SOCKETS AND BIG GRIP DEAD-ENDS



TYPICAL GUY WIRE ASSEMBLY DETAIL



TYPICAL PHILLYSTRAN ASSEMBLY DETAIL

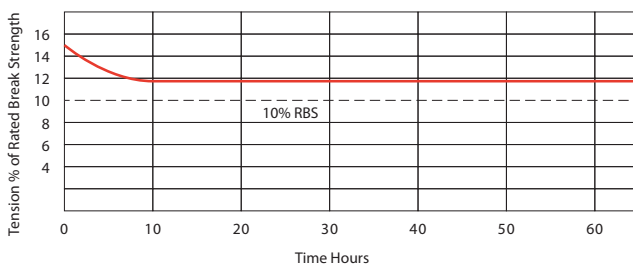
What is the function of the steel tail?

A steel tail is a length of EHS steel guy line connecting the HPTG-I assemblies to the turnbuckle or guy anchor. The steel tail protects the HPTG-I assemblies from damage due to brush fires, lawn maintenance equipment or vandals. The steel tail length should be sufficient to get the bottom end of the HPTG-I assembly above arm reach, or above brush tops (if located in a marsh or tall brush area). The HPTG-I should never pass through tree limbs or be allowed to rub against poles or trees. The steel tail allows for easier guy length calculations and serves as a guy tension monitoring point, as well as a safer area to attach guy grips during guy line installation and tensioning.

Grounding of tower and anchors

Grounding will decrease the chances of damage to the HPTG-I caused by RF flashover or lightning. Improper grounding can expose the guy system to damage at both the tower attaching point, as well as at the bottom end connection (where the HPTG-I attaches to the steel tail). Most electrical and broadcasting consultants can advise on proper grounding techniques.

Stress/Relaxation Phillystran High Performance Tower Guys



TENSIONING PROCEDURE FOR HPTG-I

IT IS IMPORTANT THAT THE PLUMB OF THE TOWER BE MAINTAINED THROUGHOUT THIS PROCEDURE. EXAMPLE: TENSION HPTG-I ASSEMBLIES TO APPROXIMATELY 15% OF ITS RBS. GUY TENSION WILL RELAX TO APPROX. 10% RBS. CONSULT A TOWER STRUCTURAL ENGINEER BEFORE TENSIONING HPTG-I ASSEMBLIES.





PHILLYSTRAN PLP BIG GRIP DEAD-ENDS FOR TOWER GUY SYSTEMS

Phillystran Big Grip dead-ends' unique features include:

BIG GRIP P/N HPTG-I P/N

- Grip designed to match rope twist direction
- Special sized wires for ease of application
- Galvanized steel and "C" coat construction
- Color coded for ease of identification
- Longer length to match Phillystran's high performance
- Designed to develop the rated strength of the Phillystran products.

Color coded cross-over marks: indicate starting point for application.

PHILLYSTRAN BIG GRIP p/n	HPTG-I p/n	LENGTH inch	BIG GRIP WEIGHT lb	COLOR CODE	RECOMMENDED HEAVY DUTY THIMBLE inch
PLP-2738	HPTG 2100I	31.0	0.53	blue	3/8
PLP-2739	HPTG 4000I	37.5	0.87	yellow	7/16
PLP-2755	HPTG 6700I	45.5	1.26	red	1/2
PLP-2558	HPTG 11200I	51.0	1.65	black	1/2
PLP-2756	HPTG 15400I	59.5	2.72	yellow	5/8
PLP-2763	HPTG 20800I	66.0	3.04	red	3/4
PLP-2765	HPTG 27000I	76.0	4.02	green	7/8

Weights and dimensions can vary

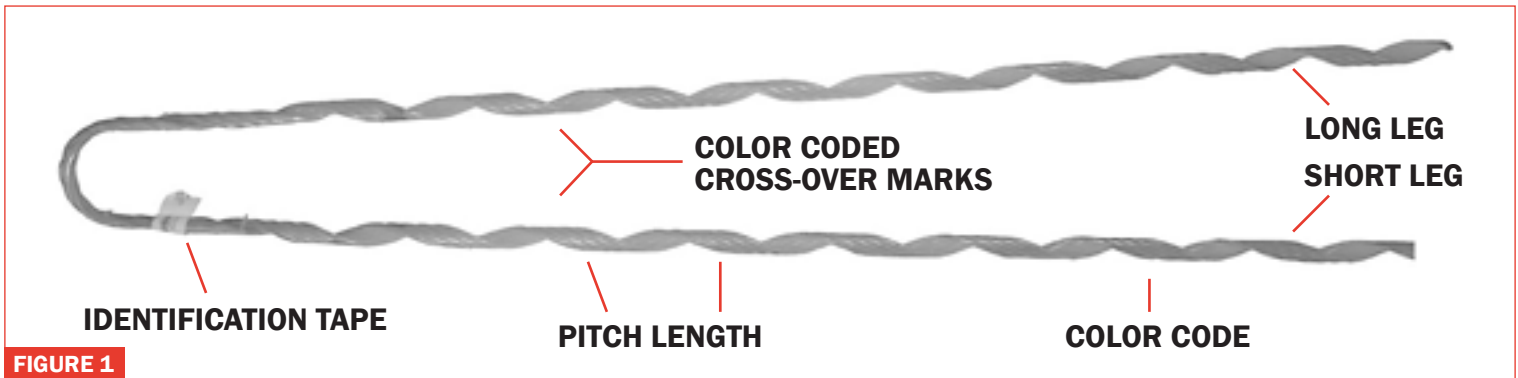


FIGURE 1

Installation procedure

- Pretension the guy for easier Big Grip installation.
- Insert thimble into eye of Big Grip following "Installation Guidelines". Install Big Grip with thimble through attaching hardware. Begin the installation for the grip at the cross-over marks (figure 2).
- Wrap on the first leg (either leg) with two complete wraps. Align the cross-over marks, then wrap the second leg with two complete wraps, ending opposite the first leg.
- Complete the installation by wrapping both legs simultaneously (keeping legs opposite each other) or alternating legs half a wrap at a time (figure 3).

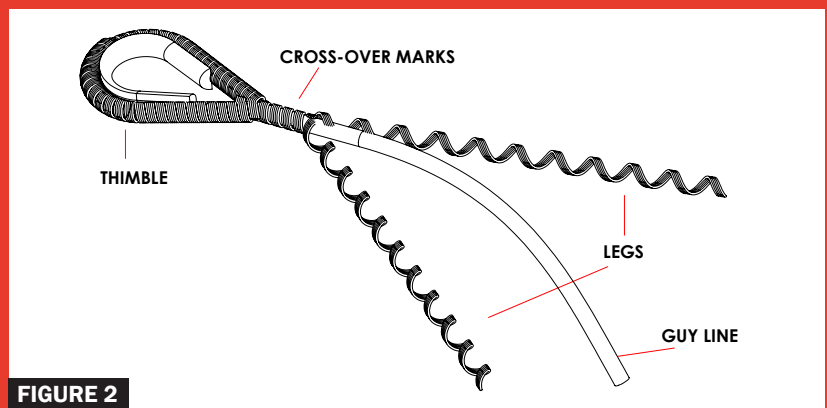


FIGURE 2

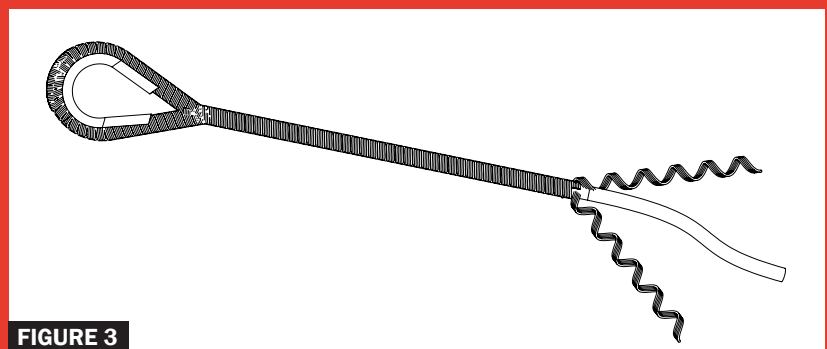


FIGURE 3

NOTE: DO NOT completely wrap one leg at a time as is common with steel guy strand. The second leg will not install properly due to HPTG-I rope distortion.

- It may be necessary to split a leg to complete installation of the grip. Be sure that all wire ends are snapped into place. A gap will be present between the wrapped legs when installation is completed (figure 4).

- Trim back rope end as required and install end cap by applying silicone adhesive or similar compound inside cap and pushing cap completely onto end of rope.

- Secure black tie wrap around grip at wire ends to secure ends. Tie wrap should be positioned to within one (1) inch of wire ends of short leg.

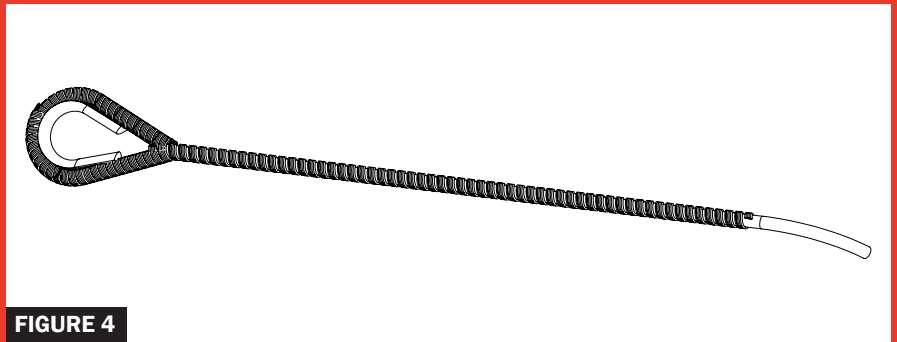


FIGURE 4

BIG GRIP ATTACHMENT GUIDELINES

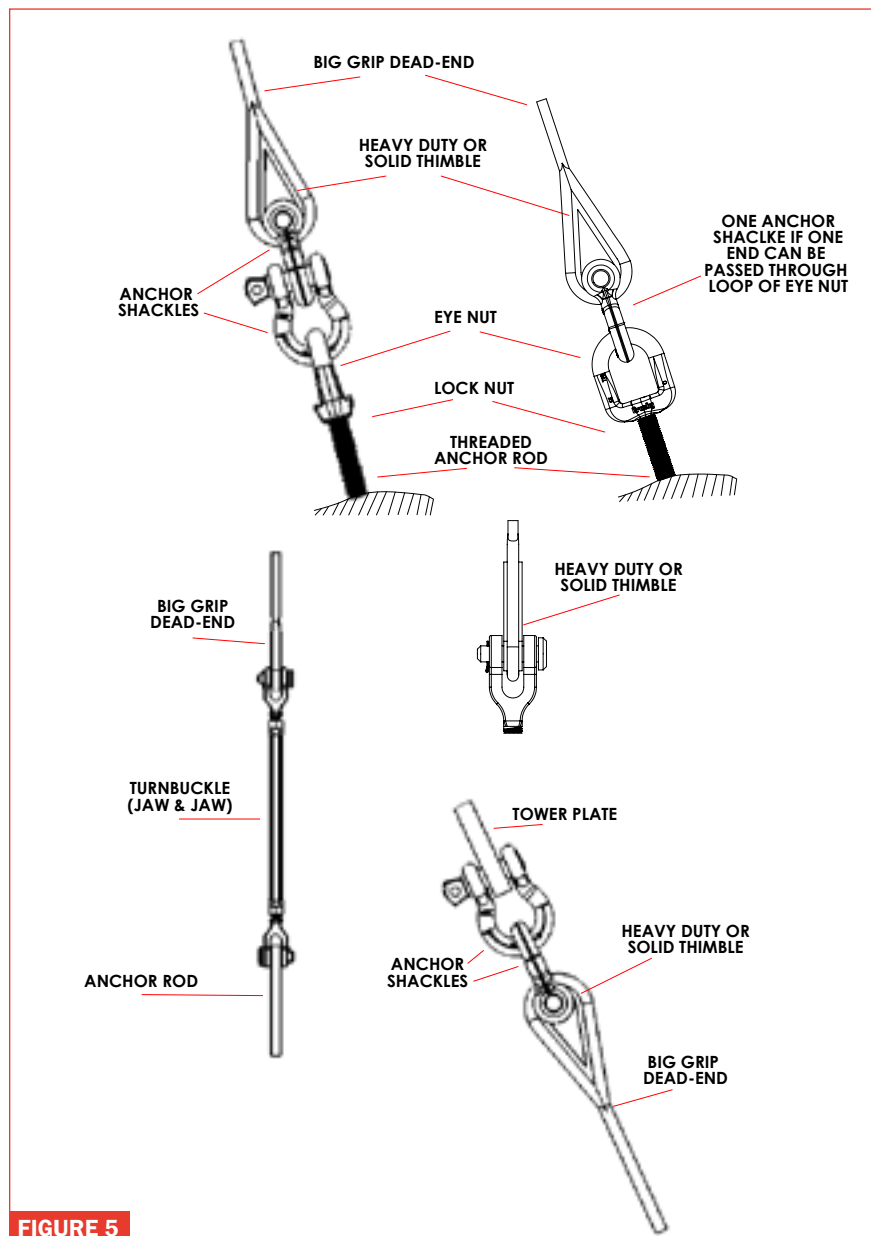


FIGURE 5



Installation procedure

- Big Grip dead-ends should be used only on the size for which they are designed. When ordering Big Grip dead-ends, make sure to specify the size on which it is to be used.

- Big Grip dead-ends are precision devices that should be handled carefully. To prevent distortion and damage they should be stored in cartons until used and should be installed under the guidelines in this section.

- During installation and at all times, care should be taken to avoid gouging or damaging the corrosion preventative material of the Big Grip dead-end and of the jacketing on the Phillystran.

- Big Grip dead-ends may be removed and reapplied two times, if necessary, for the purpose of retensioning guys.

- If removal is necessary after a Big Grip dead-end has been installed for a period greater than three months, it must be replaced with a new Big Grip dead-end.

- Big Grip dead-ends should not be applied with tools. They should be applied by hand. However, a screwdriver may be used as an aid in splitting the legs.

- Big Grip dead-ends should not be used on hardware which allows the strand to rotate or spin about its axis uncontrolled. Adjustable hardware, such as a turnbuckle, may be used as long as rotational movement of the strand is restricted.

- Hardware used in conjunction with Big Grip dead-ends should have smooth contours, ample groove clearances, acceptable diameters and sufficient strength to minimize abrasion and fatigue of the loop area. Only heavy-duty type wire rope thimbles are recommended for use with Big Grip dead-ends. To prevent collapse of the thimble, either a solid (hawser) type thimble, a large pin inside the thimble or where a smaller pin is used, extra strong weight pipe or equivalent is necessary.

- When in doubt about installations, hardware or applications, contact Phillystran.



"The folks at Phillystran offer unique products and engineering expertise matching the extremely challenging requirements for the 1WTC mast guys."

Phil Lalande, DCM project manager 1WTC

CAUTION

Break Strength: The breaking strength of a rope is the load at which a new rope will break when tested under laboratory conditions. Break strength should not be mistaken for safe working load.

Safe Working Load: Because of the wide range of rope use, rope condition and the degree of risk of life or property, it is not possible to make a blanket recommendation for the safe working load. It is ultimately dependent on the rope user to determine the safe working load as a percentage of break strength.

Wear: Ropes wear out with use; the more severe the usage, the greater the wear. It is often not possible to detect wear on a rope by visible signs alone. Therefore it is recommended that the rope user determine a retirement criteria for ropes in their application. For assistance in developing safe working load and retirement criteria for each application please call or write Phillystran.

All printed statements, data and recommendations are based on reliable information and tests, and are presented without any guarantee or warranty. Statements regarding the use of Phillystran's products and processes are not to be construed as recommendations for use in violation of any applicable laws, regulations or patent rights.

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