



MKIV HYDRAULIC JIB REEFING & FURLING

Unit 5

Installation Manual – Intended for specialized personnel or expert users

4389 11/19



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Please read these instructions carefully before installing, servicing, or operating the equipment.

This manual may be modified without notice. See: www.harken.com/manuals for updated versions.

PLEASE SAVE THESE INSTRUCTIONS

Introduction

This manual gives technical information on installation and service. This information is **destined exclusively** for specialized personnel or expert users. Installation, disassembling, and reassembling by personnel who are not experts may cause serious damage to property or injury to users and those in the vicinity of the product. If you do not understand an instruction contact Harken.

The user must have appropriate training in order to use this product.

Harken accepts no responsibility for damage or harm caused by not observing the safety requirements and instructions in this manual. See limited warranty, general warnings, and instructions in www.harken.com/manuals.

Purpose

Harken® Jib Reefing and Furling is designed for rolling sails on sailboats to reduce sail size or to completely roll the sail so wind has little effect. Use of this product for other than normal sailboat applications is not covered by the limited warranty.

Safety precautions



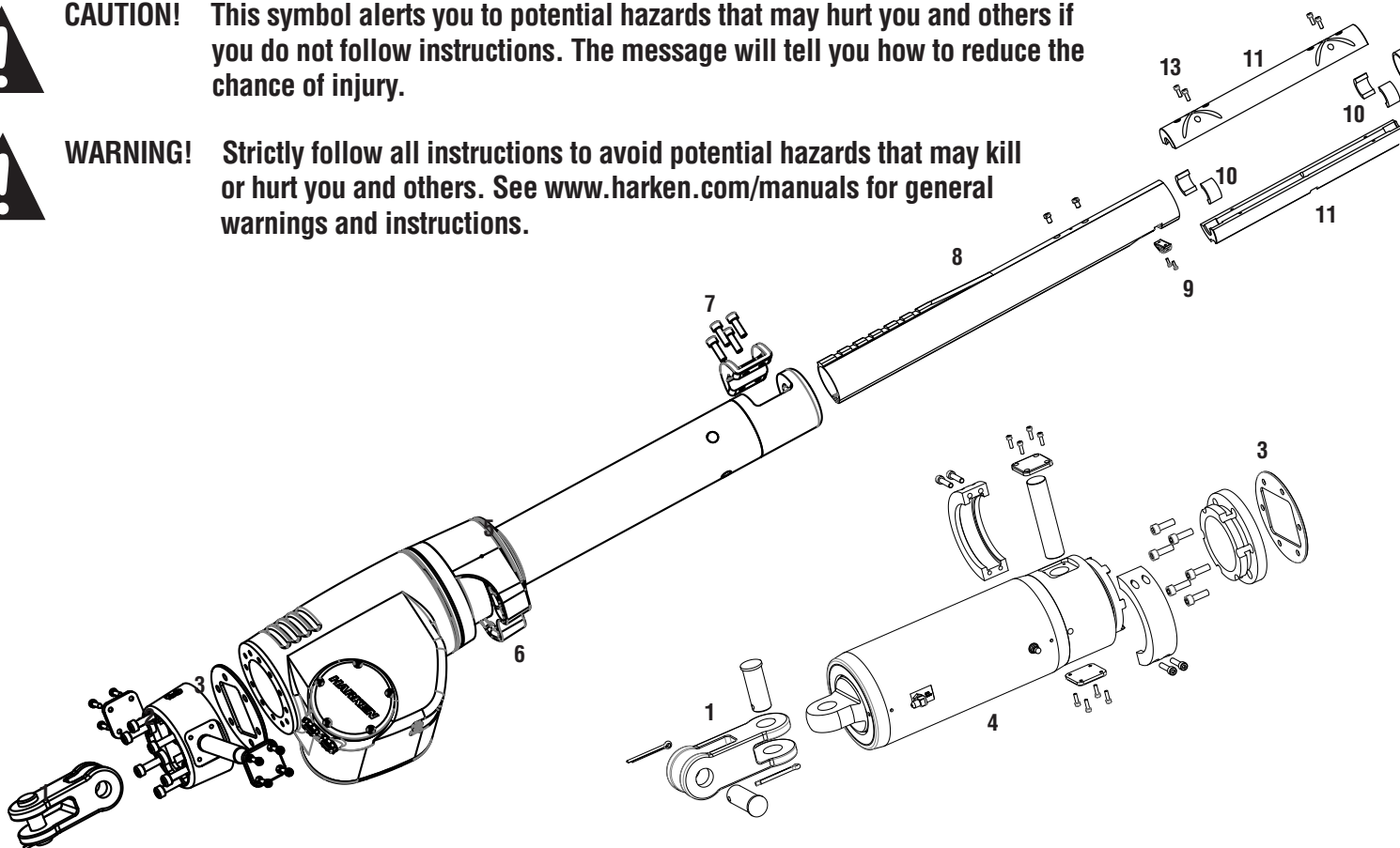
WARNING! This symbol alerts you to potential hazards that may kill or hurt you and others if you don't follow instructions. The message will tell you how to reduce the chance of injury.



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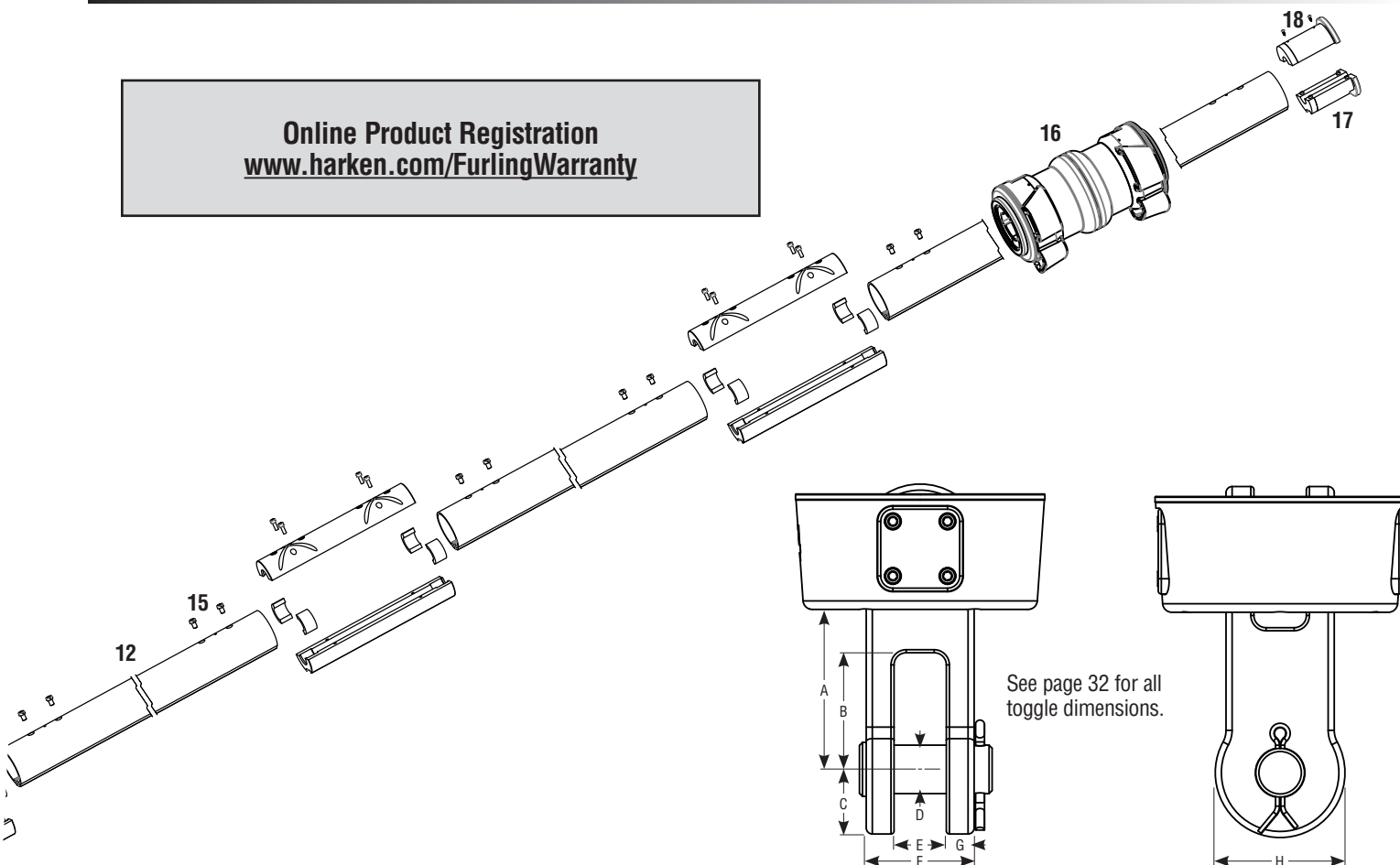
WARNING! Strictly follow all instructions to avoid potential hazards that may kill or hurt you and others. See www.harken.com/manuals for general warnings and instructions.



Part descriptions

- | | | | | |
|-----------------------------|------------------------------|-----------------------|----------------------|---------------------|
| 1) Jaw/jaw toggle | 5) Lower unit | 9) Feeder | 13) Connector screws | 17) Trim cap |
| 2) Toggle housing | 6) Lashing guides | 10) Connector bushing | 14) Connector | 18) Trim cap screws |
| 3) Toggle housing insulator | 7) Foil clamp | 11) Bottom connector | 15) Foil screws | |
| 4) Hydraulic cylinder | 8) 762 mm (2.5') bottom foil | 12) 3.35 m (11') foil | 16) Halyard swivel | |

Online Product Registration
www.harken.com/FurlingWarranty



Sizing check

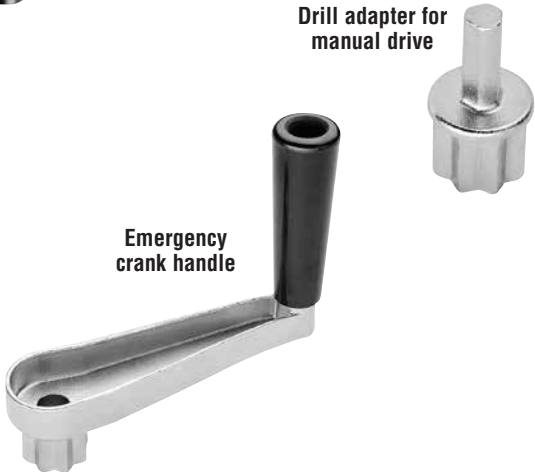
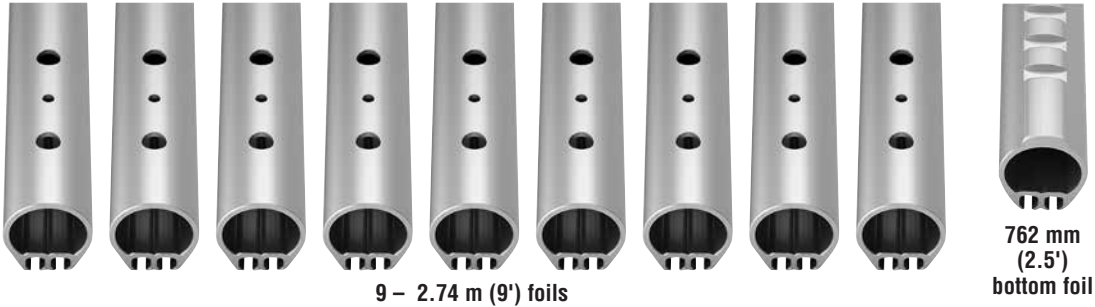
1. Check headstay and clevis pin dimensions in chart below.
2. Harken does not recommend drilling boat's chainplate or toggle. Bushings may be required to fit boats with smaller clevis pin sizes.



WARNING! Do not drill boat's chainplate or toggle. This may result in rig failure. Use the correct size toggle and clevis pin.

3. If rod rigging is used, check foil inside dimensions to make sure rod splices fit inside foils.
4. Will lower unit fit on bow? See page 33. If necessary, use an additional toggle to slightly raise unit.

UNIT 5	Unit part no.	Description	Rod Ø	Wire Ø
	7415.15S	MKIV hydraulic unit 5 (small bushings)	-48, -60, -76‡ (14.3, 16.8, 17.9 mm)	5/8" (16 mm)
	7415.15L	MKIV hydraulic unit 5 (large bushings)	—	3/4", 7/8" (19, 22 mm)
	Toggle part no.	Description	Toggle clevis Ø	
	7415.25 11/8	Toggle assembly	1 1/8"	28.6 mm
	7415.25 11/4	Toggle assembly	1 1/4"	31.8 mm
	7415.26 11/8	Hydraulic cylinder/toggle	1 1/8"	28.6 mm
	7415.26 11/4	Hydraulic cylinder/toggle	1 1/4"	31.8 mm
‡Continuous rod only. If rod is sectional, order unit 6.				

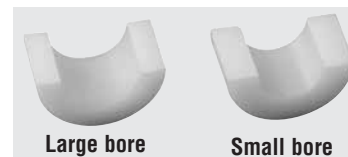


Main components		
Description	Part no.	Qty
Lower unit	See parts list	1
2.5'(762 mm) bottom foil	7415.30	1
9'(2.74 m) foil	7415.31	9*
Halyard swivel	H-56965	1
Emergency crank handle	7430	1
Drill adapter for manual drive	7431	1

*Standard package



Connector bushing set



Large bore

Small bore



Bottom connector

Connectors



Connector fastener set



Trim cap halves



Trim cap screws



Feeder



Feeder screws



Prefeeder

Other components

Description	Part no.	Qty
SMALL BORE		
Connector bushing set/Sm (38)	HFG962	1
Trim cap half A/Sm	H-56617	1
Trim cap half B/Sm	H-56618	1
Extra connector set/Sm	7415.31S	1
LARGE BORE		
Connector bushing set/Lg (38)	HFG963	1
Trim cap half A/Lg	H-56619	1
Trim cap half B/Lg	H-56620	1
Extra connector set/Lg	7415.31L	1
ALL UNITS		
Connector 15.5" (398 mm) bottom A side	H-56606	1
Connector 15.5" (398 mm) bottom B side	H-56607	1
Connector 12" (305 mm) A side	H-55547	8*
Connector 12" (305 mm) B side	H-55548	8*
Connector fastener set (50)	HFG964	1
Foil fastener set (50)	HFG965	1
Trim cap screw	HFS1127	2
Prefeeder	947	1
Feeder	H-55869	1
Feeder screws	HFS1102	2
M6 allen (hex key) wrench	HFG644	1
M8 allen (hex key) wrench	HFG646	1
Injector, 1 oz. 5200 adhesive	HFG725	1
Adhesive-5200 marine white 1 oz	HFG722	2
Red Loctite	HFG739	3
Blue Loctite	833	1



Foil screws



Extra connector set



Red Loctite® adhesive



Blue Loctite adhesive



6, 8 mm



Injector

5200 adhesive

*Standard package

Loctite is a registered trademark of Henkel AG & Company KGaA.

Toggle Assembly

- 1. Harken toggle assembly or hydraulic cylinder required. **Sold separately.**
- 2. Mating turnbuckle components with eye at lower end must be purchased separately. See page 9. Contact Harken for toggle housing dimensions to fit eye fitting.
- 3. On retrofits, headstay will require cutting and shortening to fit Harken toggle. Unit is designed to fit over most turnbuckles. Contact Harken for questions on interior housing for turnbuckle.
- 4. Rod rigging requires a terminal to allow rod to pass through foils. Generally this will require a split collet design.

 **WARNING! A stay that is old or damaged may break suddenly. Always use a new stay when installing a furler or have condition checked by a professional rigger before reusing.**

Hydraulic hoses and adapters

Hoses and adapters are not supplied with furler. See next page for specifications.

Hydraulic length-adjusting cylinder (sold separately)



Harken toggle assembly housing (sold separately)



Unit	Part no.
5H	7415.26 1 1/8
	7415.26 1 1/4

Unit	Part no.
5H	7415.25 1 1/8
	7415.25 1 1/4

Tools required



1. Long tape measure	6. Side cutters	11. Center punch
2. Short tape measure	7. Rat-tail file	12. Rigging or black tape
3. Power drill	8. Allen wrenches (provided)	13. Scissors
4. Drill bits	9. Slotted/Phillips screwdrivers	14. Metal straight edge
5. Crosscut table saw for metal	10. Needle-nose pliers	15. Hammer
16. Metric ball-end Allen wrench (recommended but not required)		

Adhesive alert

MKIV furlers are shipped with 3M 5200 adhesive. Use adhesives on dry connectors and foils using the special injection system described in the assembly section. Parts may immediately be exposed to rain. Cure is best at 70 F (22 C) with 50% humidity. Do not apply at temperatures below 40 F (5 C) and above 100 F (38 C).

Although adhesive has not cured it will remain in place on foil joints whether they are left on the ground or raised up on boat. Foils can be raised immediately after assembly and sails fitted.

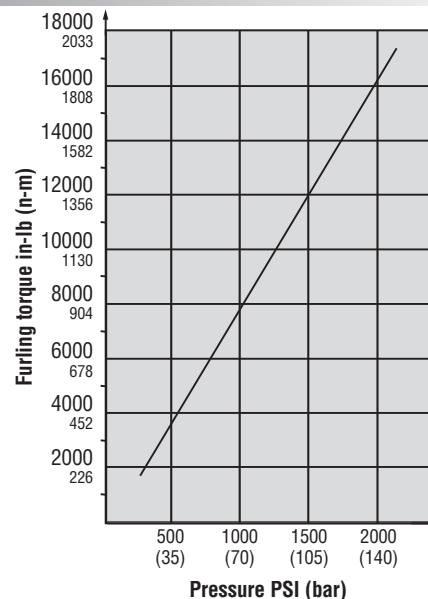
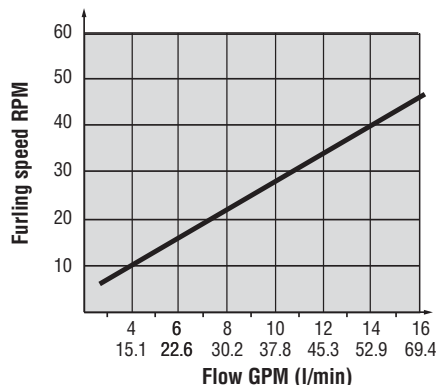
Note: A small amount of adhesive may bulge out of injection ports. If possible, let system sit for a couple days before sailing. If adhesive gets on sails, remove using acetone. For faster-curing adhesive, purchase 4200 fast cure.

Note: Damaged foils can be repaired. Use a hand-held propane torch to heat joints until foils can be pulled apart.

Furler power requirements

The furling unit and hydraulic tensioning cylinder will work with current Harken hydraulic power plants.

Unit	Recommended flow rate
5	10 g/m 37.8 l/m



Maximum operating pressure

Set relief valve on power plant at 140 bar or 2000 PSI. Harken powerpacks ship with valves set at 140 bar.

Valves on power unit

Furler can be used with open or closed center, 4-way, 3-position control valves.

Gear oil specifications

Unit is sealed with a light bath of ISO 68 gear oil.

IMPORTANT! The only parts of furler to be disassembled by installer are the torque tube clamp and toggle housing. All other work should be performed by factory-authorized personnel. Work performed by unauthorized personnel may void the Harken limited warranty.

Hose and fitting selection recommendation

Hose type - SAE 100 R8 hose. Alternatively SAE 100 R2 may be used.

Hose size - Use -10 hose (5/8" ID). Long runs may require larger hoses.

Hose end fitting, furler end - Female swivel hose end to mate with adapter.

Note: See *hydraulic connection to furling unit*, next page.

Measure hydraulic hose runs

Remember these important points when measuring runs.

- 1) Short straight runs between HPU and function are best.
- 2) Avoid sharp edges which may chafe the hose.
- 3) Minimize fittings/connections throughout the run to avoid possible leak points.
- 4) Minimize 90° bends, which increase system losses and decrease performance.
If unavoidable, use a 90° swept fitting. Do not use a 90° elbow fitting.



CAUTION! Do not exceed the manufacturer specified minimum bend radius.

When ordering, specify that all hoses are flushed, filled with clean oil, and capped at point of purchase. HARKEN recommends ISO 46 grade oil. If hoses are shipped, they may not contain oil.



CAUTION! Always ensure pressure rating for selected hose is equal to or greater than 2000 psi/140 bar.

Note: Hose shortening - hydraulic hoses typically shorten 2% to 4% of total length when pressurized. When routing and measuring hose lines, ensure extra hose length is added to compensate for the hose shortening under pressure.

Hydraulic connection to furling unit

The furling unit has SAE female straight thread ports to accept -10 ORB fittings. Use male to male adapters into the furler so you can use female swivel hose ends. Use -10 JIC X -10 ORB adapters - stainless steel

Important: Do not use PTFE tape or sealant on threaded connections to Harken ports. Using PTFE tape can damage threads.

Hydraulic oil

Use only hydraulic oil ISO 46 grade or equivalent.



CAUTION! Hydraulic oil may cause skin irritation.

Important: Hydraulic oil may damage paint and some surfaces.

Leak check

To perform leak check, run furler in a single direction for 5 – 10 seconds. If installation was completed with empty hoses, increase the run time to 10 – 30 seconds. Perform the following:

- 1) Confirm hose run is correct by verifying operation of intended function.
- 2) Inspect each fitting for leakage.
- 3) Tighten fitting as necessary.
- 4) Repeat procedure for all functions.

IMPORTANT: If installation was completed with empty hoses, check the oil level indicator after, and add oil as necessary.

One-way function flush

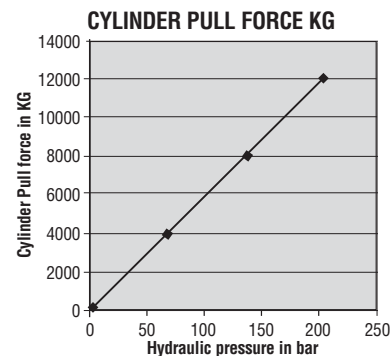
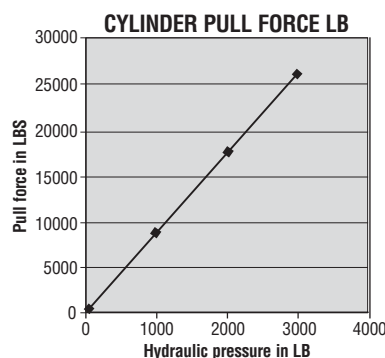
Flush the pump motor through the power unit system filter by running furler in a single direction. Run in same direction as previous step. This process helps ensure system cleanliness by depositing any contaminants into the power unit system filter.

Hydraulic length adjusting cylinder (optional)

Specifications:

Stroke: Unit 5: 152 mm (6")

Performance:



Pressure requirements

The hydraulic length adjusting cylinder requires a pressure of Max. 3,000 psi (200 bar) to develop rated pull force on the headstay. A pressure relief valve must be used to ensure this pressure is not exceeded. The hydraulic pressure for the cylinder can be provided by a high pressure manual system or the boats power unit. If the cylinder is used with a power unit providing substantially less than 3,000 psi (200 bar), a hydraulic intensifier is required to step up the pressure. Either power source requires the use of a zero leak control valve so the pressure to the cylinder doesn't bleed down over time.



WARNING! Relieve all pressure prior to disconnecting. Only work on cylinder and connections if you are a hydraulic technician.

Hydraulic cylinder hose connection

The cylinder has a -4 JIC fitting. Choose appropriate hose and end fitting.

Cylinder Gas

Cylinder is shipped without gas. Fill fitting is a Schroeder type. For best clean performance use nitrogen or argon gas pressurized to 50 - 60 psi (3.45 - 4.48 bar).

Use dimensions of Harken toggles or cylinders shown below to build stay to correct length.

Toggle assembly

Turnbuckles should be one-half (1/2) to two-thirds (2/3) open to allow shortening for new wire stretch and for fine-tuning mast rake and to help connect the stay.

Hydraulic cylinder

Length for hydraulic cylinder can be determined at one-half (1/2) to two-thirds (2/3) open to allow to allow shortening for new wire stretch and for fine-tuning mast rake and to help connect the stay. Stroke length for unit 5 cylinder is 152 mm (6").

Deductions to determine stay length



Toggle part no.	Clevis pin Ø	Pin-to-pin length
7415.25 1 1/8 std	1 1/8" (28.6 mm)	5" (126.72 mm)
7415.25 1 1/4 std	1 1/4" (31.8 mm)	5 11/16" (143.91 mm)

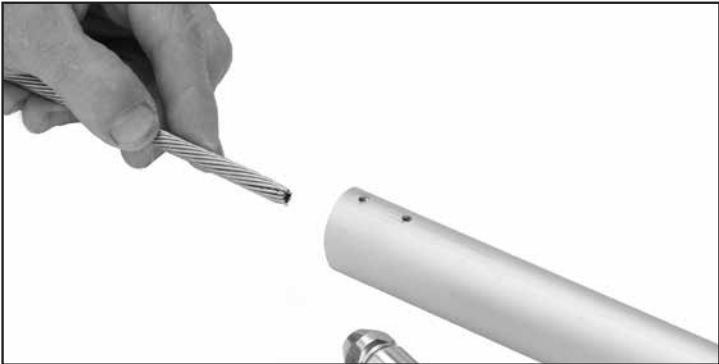


Hydraulic cylinder part no.	Clevis pin Ø	Max. pin-to-pin length	Min. pin-to-pin length
7415.26 1 1/8	1 1/8" (28.6 mm)	27 11/16" (703 mm)	21 11/16" (550.29 mm)
7415.26 1 1/4	1 1/4" (31.8 mm)	28 5/16" (720 mm)	22 5/16" (567 mm)

Options for snaking stay into foils

- 1. Swage stud at end of wire.
- 2. Open end of wire and install Norseman or Sta-Lok® stud after foil is assembled.
- 3. Rod adapter fitting (not supplied by Harken).

! WARNING! Using a threaded nosepiece with only adhesive at the upper rod eye terminal may result in headstay failure. Always use terminals with mechanical locks as specified by rod manufacturer.

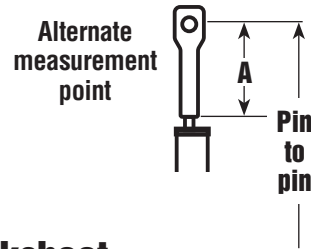


STA-LOK is a registered trademark of STA-LOK terminals.

Preassembly

Measure A and add to this chart and length chart below		
	Inches	mm
A		
B	3	76
E	30	762
F	28.5	723
G		
Total A+B+E+F+G		

Make sure upper measurement points of A and pin-to-pin are the same.



Top Foil Length Worksheet

1	Pin-to-pin length																	
2	Subtract ABEFG	—																
3	Result (pin-to-pin – ABEFG)																	
4	Subtract D	—																
To find D pick number from chart below that is closest to, but not greater than total from step 3.																		
<table><thead><tr><th>Inches</th><th>mm</th></tr></thead><tbody><tr><td>7 x 108 = 756</td><td>7 x 2743.2 = 19202</td></tr><tr><td>8 x 108 = 864</td><td>8 x 2743.2 = 21946</td></tr><tr><td>9 x 108 = 972</td><td>9 x 2743.2 = 24689</td></tr><tr><td>10 x 108 = 1080</td><td>10 x 2743.2 = 27432</td></tr><tr><td>11 x 108 = 1188</td><td>11 x 2743.2 = 30175</td></tr><tr><td>12 x 108 = 1296</td><td>12 x 2743.2 = 32918</td></tr><tr><td>13 x 108 = 1404</td><td>13 x 2743.2 = 35662</td></tr></tbody></table>			Inches	mm	7 x 108 = 756	7 x 2743.2 = 19202	8 x 108 = 864	8 x 2743.2 = 21946	9 x 108 = 972	9 x 2743.2 = 24689	10 x 108 = 1080	10 x 2743.2 = 27432	11 x 108 = 1188	11 x 2743.2 = 30175	12 x 108 = 1296	12 x 2743.2 = 32918	13 x 108 = 1404	13 x 2743.2 = 35662
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12 x 108 = 1296	12 x 2743.2 = 32918																	
13 x 108 = 1404	13 x 2743.2 = 35662																	
Example—if result from Step 3 is:																		
1200 inches D = 1180 inches 32,000 mm D = 30,175 mm																		
5	Result (C) top foil length																	

UNIT 5H

Length check

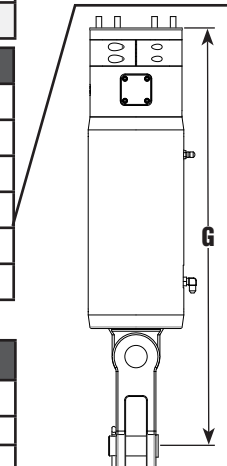
After completing worksheet above fill in A, C, D and G below. Add A through G to confirm total equals your pin-to-pin measurement.

Length chart			
Dimensions		in	mm
A	Center of pin to bottom of terminal		
B	Bottom of terminal to top of foil	3	76
C	Top foil length		
D	Number of foils _____ x 108" (2743.2 mm)		
E	Bottom foil	30	762
F	Bottom of foil to top of toggle housing insulator	28	723
G	Top of toggle housing insulator to clevis pin		
Pin-to-pin length			

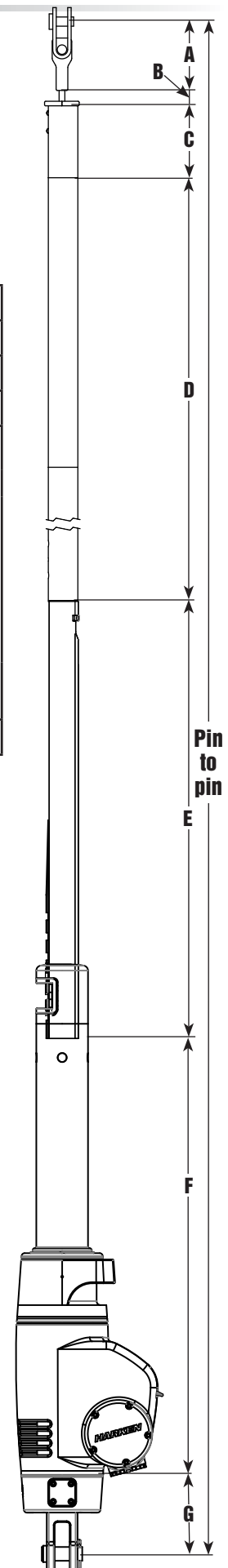
G top of toggle housing insulator to clevis pin					
Toggle part no.	Type	Clevis pin		G distance	
		in	mm	in	mm
7415.25 1 1/8	Toggle assembly	1 1/8	28.6	6 3/8	162
7415.25 1 1/4	Toggle assembly	1 1/4	31.8	7 1/16	179
7415.26 1 1/8	Hydraulic cylinder/toggle	1 1/8	28.6	28 15/16*	735*
7415.26 1 1/4	Hydraulic cylinder/toggle	1 1/4	31.8	29 5/8*	752*

*Dimensions with cylinder 58% open

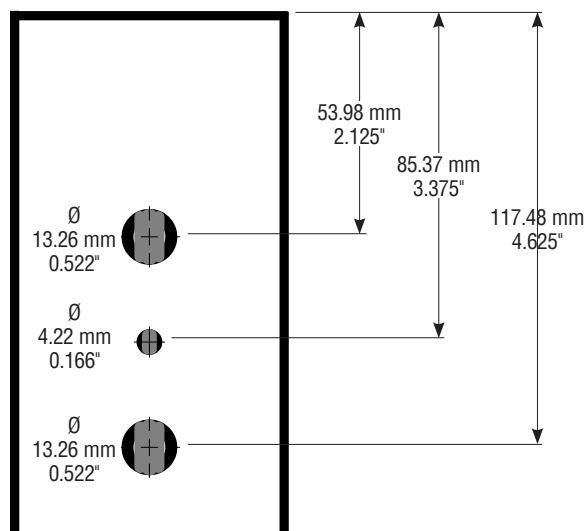
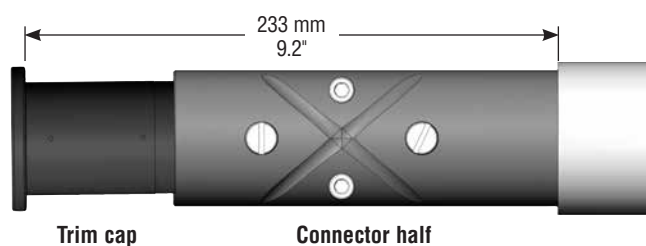
Cylinder pin Ø	G distance (closed)		G distance (open)	
	in	mm	in	mm
1 1/8	25 7/16	647	31 7/16	799
1 1/4	26 1/8	664	32 1/8	816



Top Foil Length



If top foil is shorter than 233 mm (9 1/4") shorten one of the lower foils and redrill the three (3) holes.

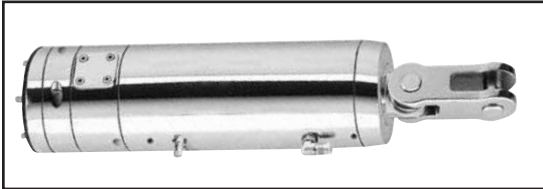


Tip: Mark top foil to distinguish from cutoff piece.

Scribe line on top of foil to mark drill holes. Lay top foil alongside cutoff piece and use a flat metal object (i.e. metal ruler) to scribe top line of foil.



Confirm foil length by laying foils alongside stay with turnbuckle components. Pull stay out so it is straight. Attach Harken toggle to bottom of stay using cross pin. Adjust turnbuckle so that length of stay with Harken toggle will fit boat. Ideally, turnbuckle will be one-half ($1/2$) to two-thirds ($2/3$) open to allow for rig adjustment. Line up lower unit so base of unit lines up with toggle housing. Attach one (1) link plate to lower unit. Line up lower unit so link plate hole lines up with cross pin in Harken toggle. Make sure toggle is tensioned when measuring.



Determine where cylinder will ride when sailing. Shown fully closed.



Line up bottom foil so foil clamp is centered or just below center of notches in bottom foil.



Note: Position top foil so that with top cap the foil will ride about 76 mm (3") below terminal. If wire fitting at top of stay is swage, foil must ride just below shoulder of swage. Mark cut line on foil. Wrap tape around foil as a guide so cut is straight.



Cut foil to length using hacksaw.



Deburr inside edge using rat-tail file.



Prepare top foil for drilling.

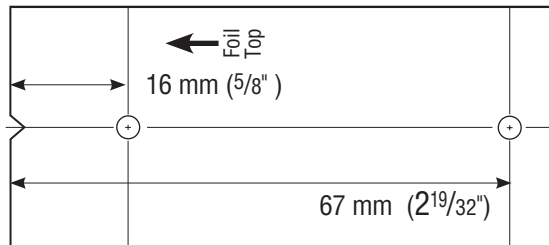
Tip: Mark top foil to distinguish from cutoff piece.

Scribe line on top of foil to mark drill holes. Lay top foil alongside cutoff piece and use a flat metal object (i.e. metal ruler) to scribe top line of foil.



Cut out template at right. Line up template with top of foil and scribed line. Tape in place. Use center punch to mark holes.

Check center punch marks to confirm they are 16 mm ($\frac{5}{8}$ ") and 76 mm ($2\frac{19}{32}$ ") from top of foil.



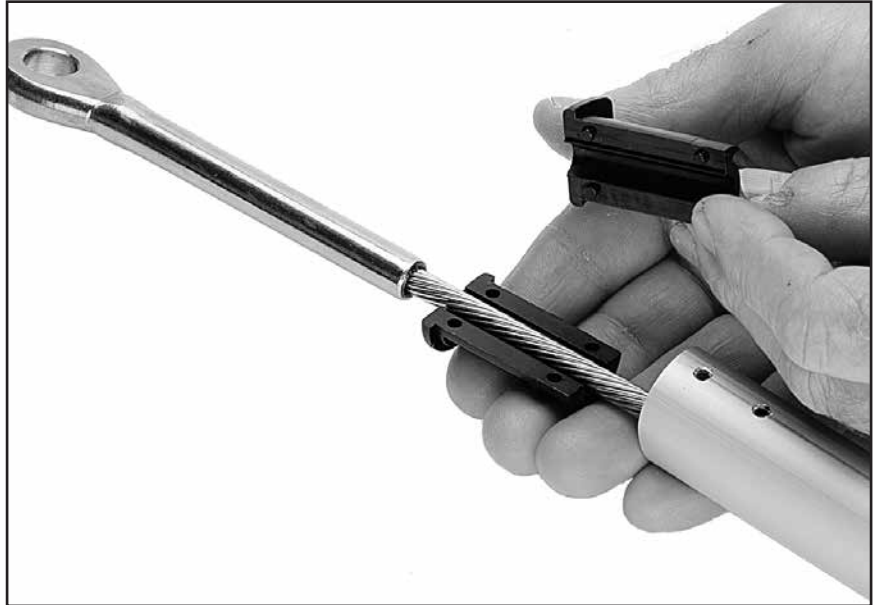
Drill two (2) 4 mm ($\frac{5}{32}$ ") holes for trim cap.



Lay top foil in line with others. Slide stay into top foil and down line of foils or slide each foil up stay.



Install trim cap. Place each side over wire.



Push trim cap into foil to start, then tap in using hammer.

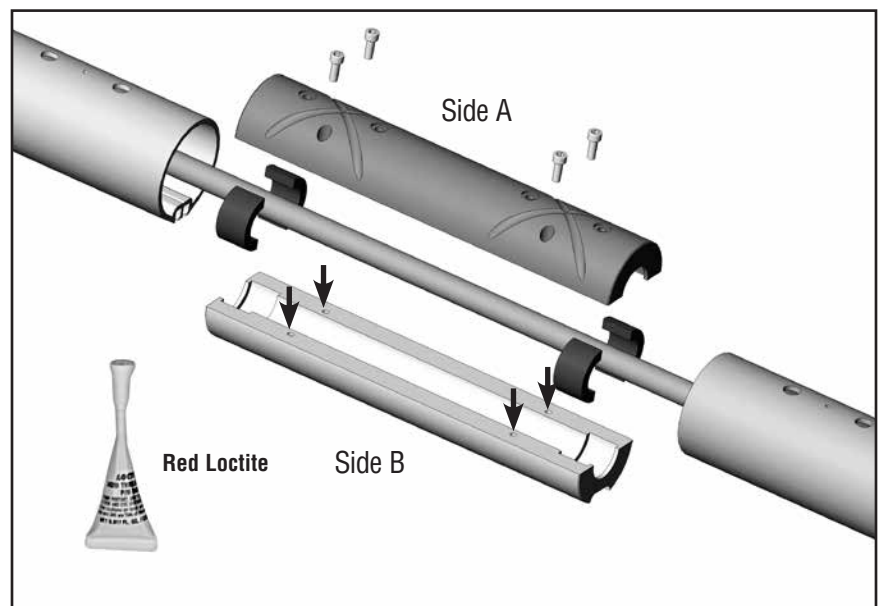
Install trim cap screws.



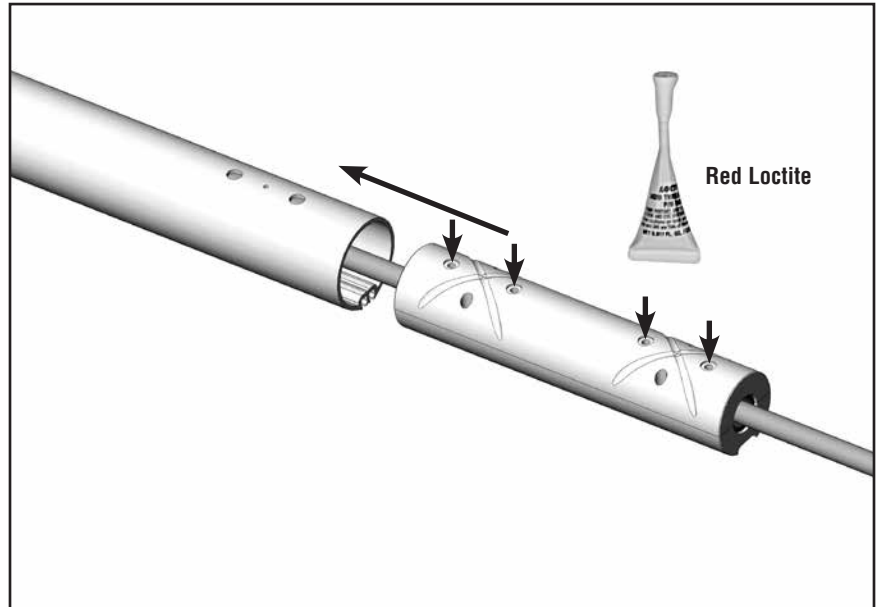
Locate 305 mm (12") connector side A and B. Put red Loctite® adhesive on screw holes in side B.

Place halves of bushings onto stay and capture in connector sides A and B.

Assemble using connector screws.



Insert connector into foil and put red Loctite® adhesive on foil screw holes.

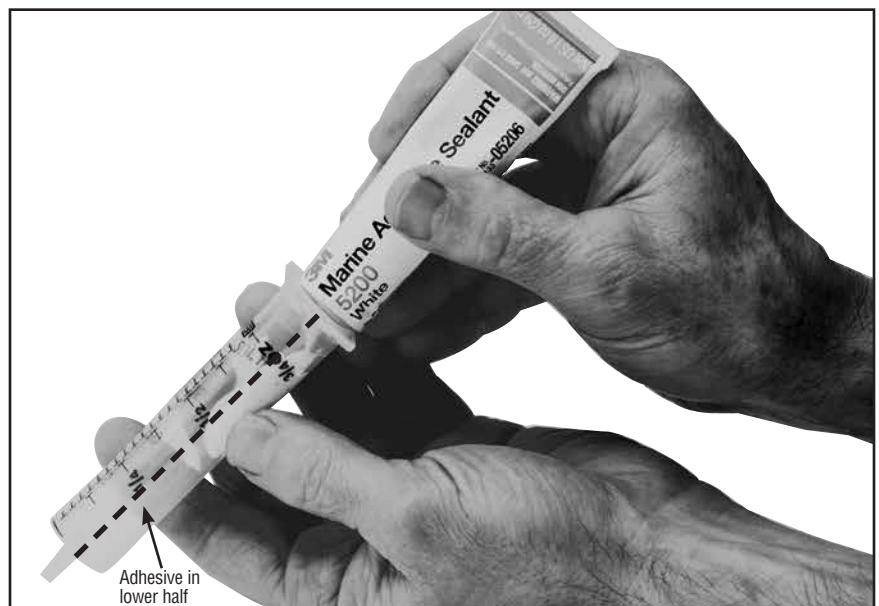


Assembly

Loading injector with adhesive

Tip: In cooler weather, keep sealed adhesive in pocket to keep warm. Use instructions below to fill injector less than half way; you will only use a small amount of adhesive. Refill if needed, but do not keep open sealant for long periods. Use adhesive within three (3) hours.

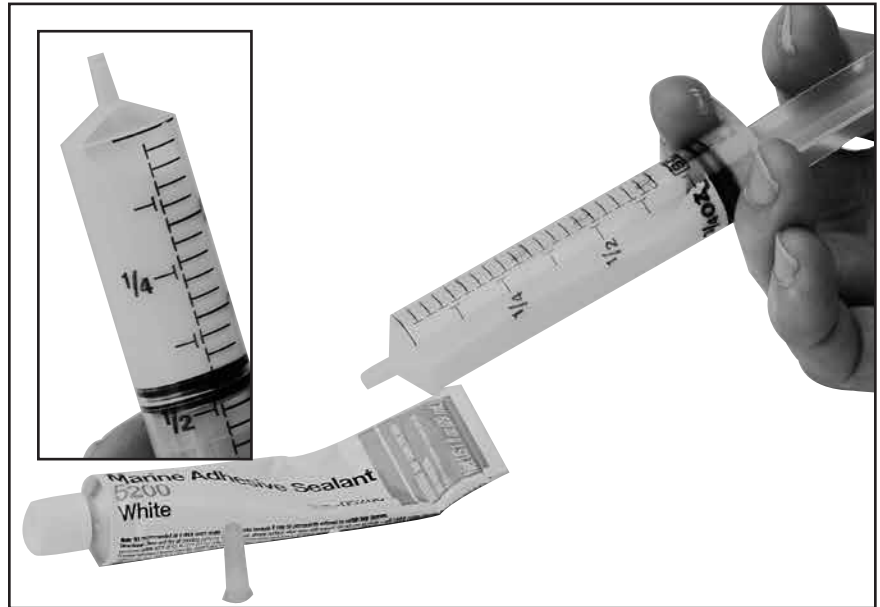
Use cap of adhesive to break seal. Remove injector tip cap and plunger. Hold injector at an angle with applicator tip facing down. Squeeze adhesive into tube so lower half of injector is full as shown. Keep tip free of sealant to let air inside.



Loctite is a registered trademark of Henkel AG & Company KGaA.

Start plunger into injector and immediately hold upright so plunger is down and applicator tip is up.

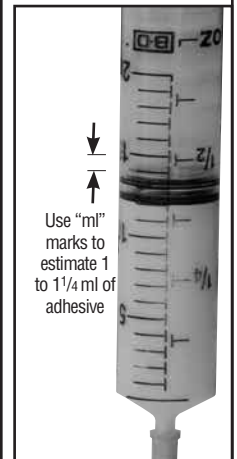
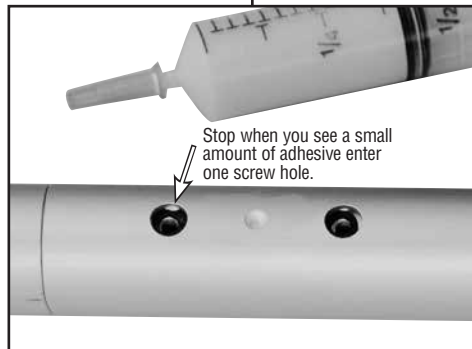
As sealant runs down toward plunger an air pocket will form near tip. Push plunger to evacuate air. You are now ready to begin injecting adhesive.



Inject only a small amount of adhesive into middle hole.

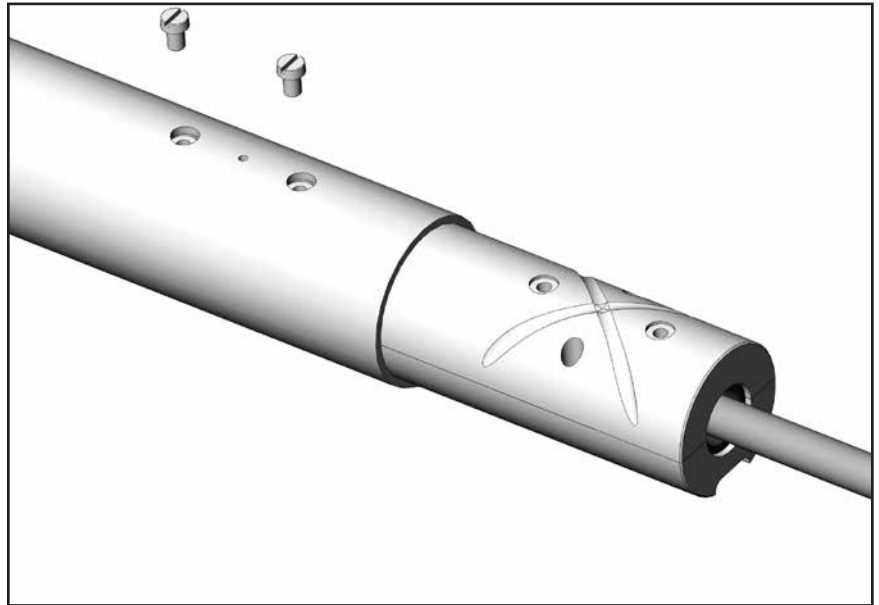
Unit	Adhesive
5	1 1/2 ml

Tip: When you see a small amount of adhesive enter one screw hole, stop. You have applied enough adhesive.

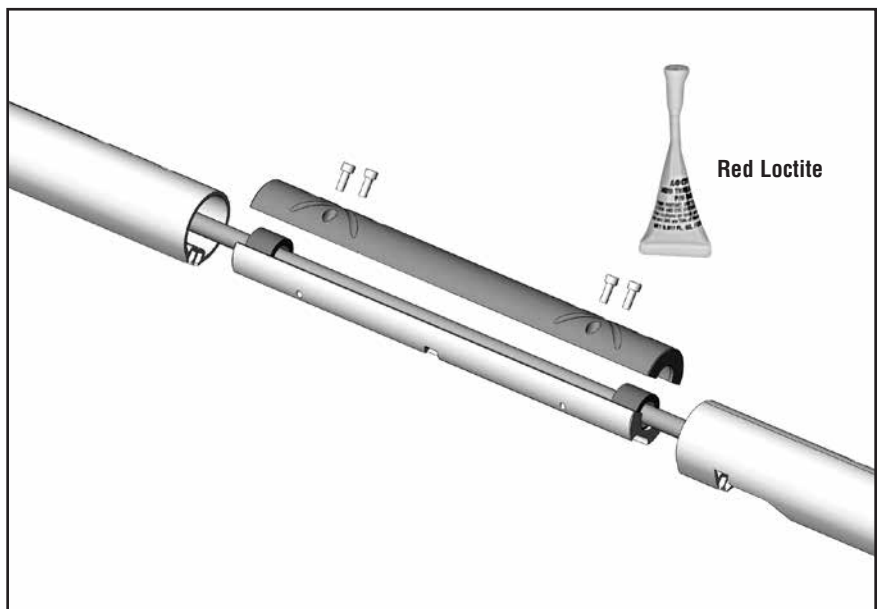


Secure foil to connector using foil screws.
Make sure red Loctite® adhesive is in screw holes.
If not, apply to screws.

Secure foil to connector using foil screws. Make sure red Loctite® adhesive is in screw holes. If not, apply to screws.



Assemble the 394 mm (15 1/2") bottom connector. Feeder notch is centered so there is no connector top/bottom.



Assemble using red Loctite on screws.



Loctite is a registered trademark of Henkel AG & Company KGaA.

Slide halyard swivel onto foil above feeder window. The halyard swivel is symmetrical.



Loosen foil clamp screws at top of lower unit assembly.



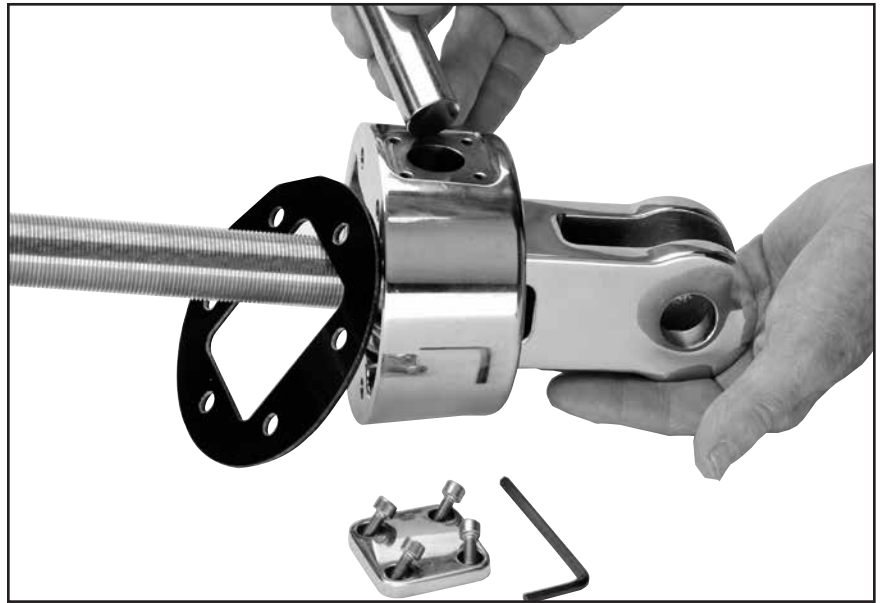
Slide assembly onto foils.

Tip: Face clamp downward so it clears foil notches during installation.

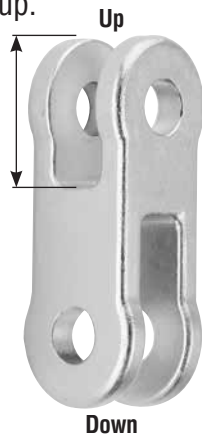


Assemble turnbuckle. Slip toggle housing insulator onto threaded eye. Remove toggle plate. Use cross pin to capture eye and toggle in toggle housing.

Note: If using Sta-Lok® or Norseman stud, you must use a washer above stud as shown below.



Make sure shallow jaw is up.

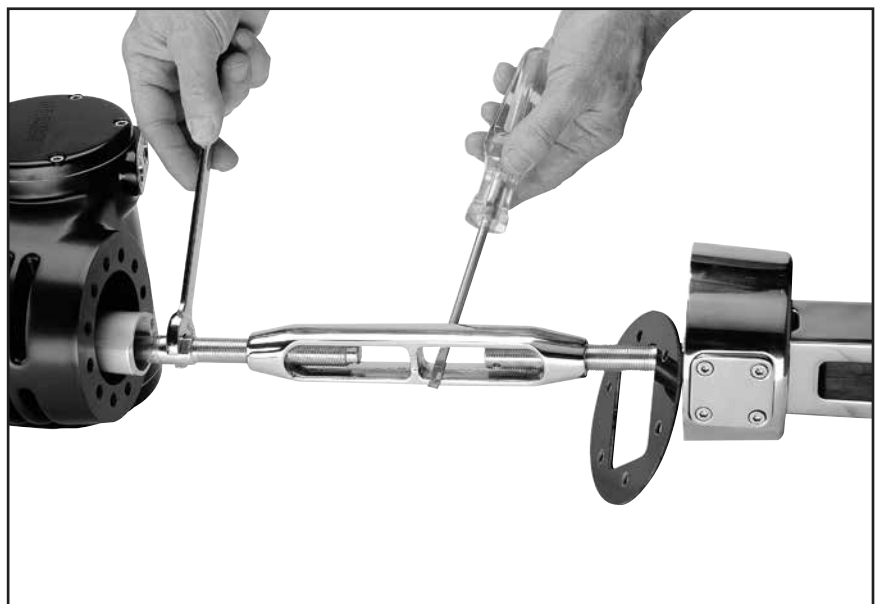


Install cover plate using blue Loctite® adhesive on screws.

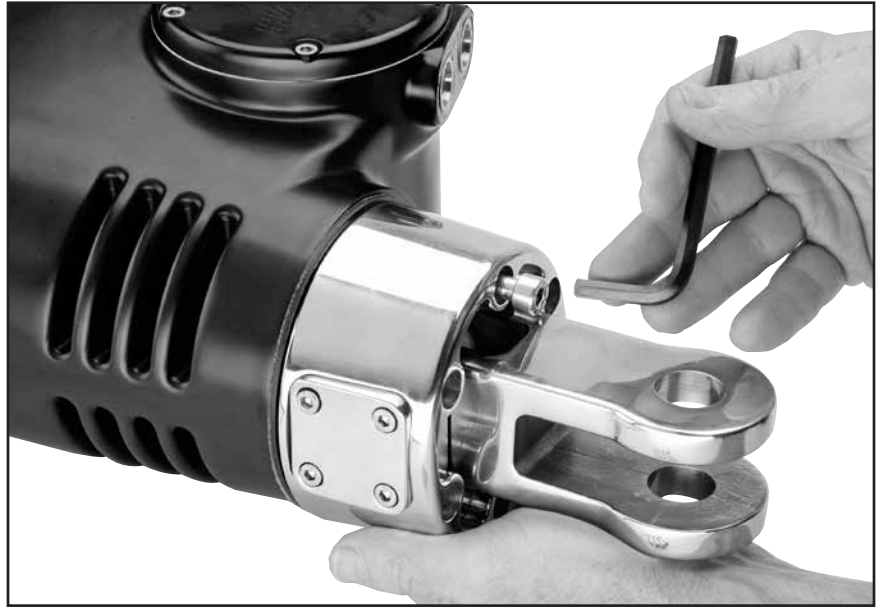


If stay length is set use side cutters or needle-nose pliers to bend cotter pin to secure turnbuckle.

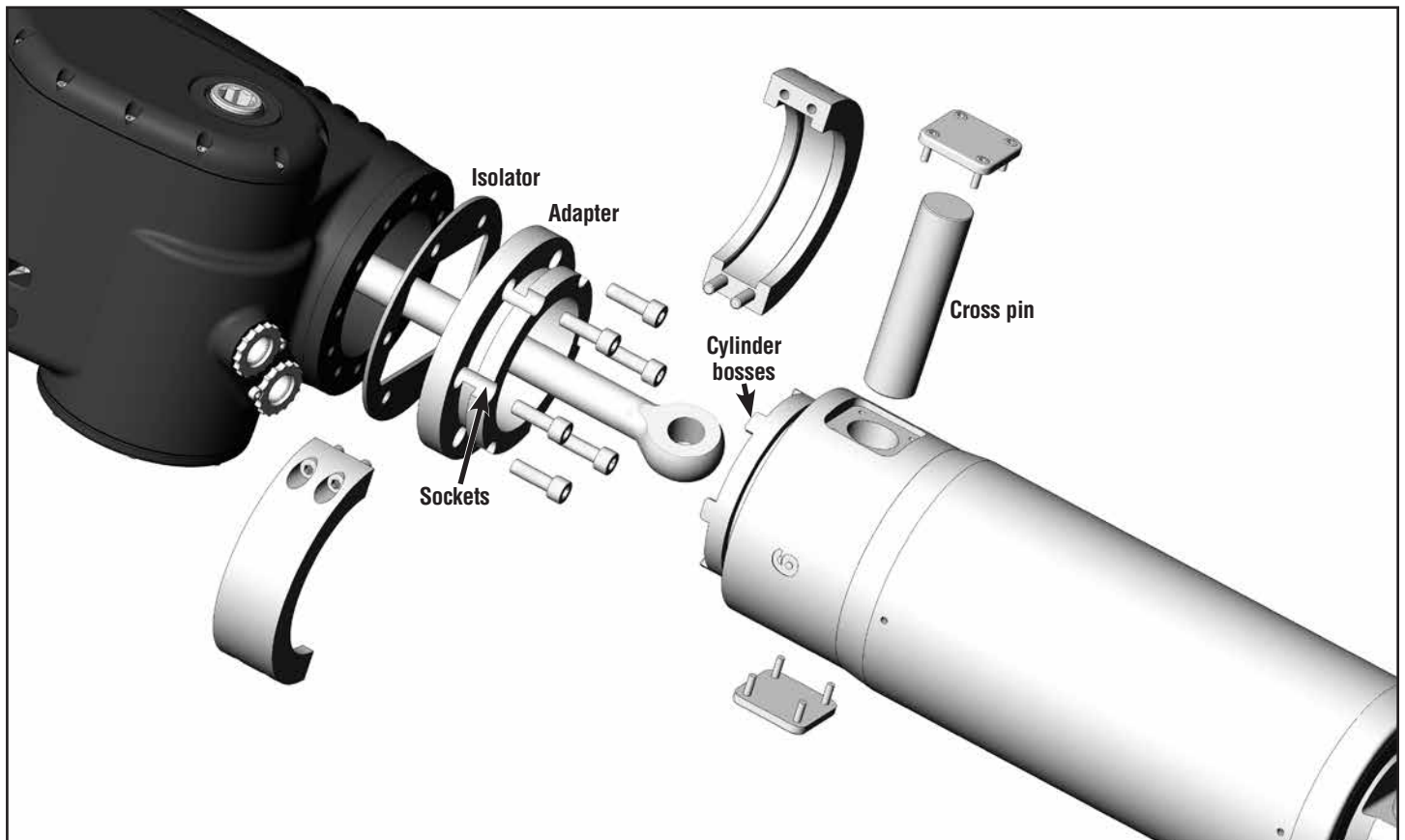
STA-LOK is a registered trademark of STA-LOK terminals.
Loctite is a registered trademark of Henkel AG & Company KGaA.



Choose toggle orientation to match chainplate—fore/aft or athwartships. Line up insulator and secure toggle assembly to lower unit using blue Loctite® adhesive on screws.



Attach hydraulic cylinder



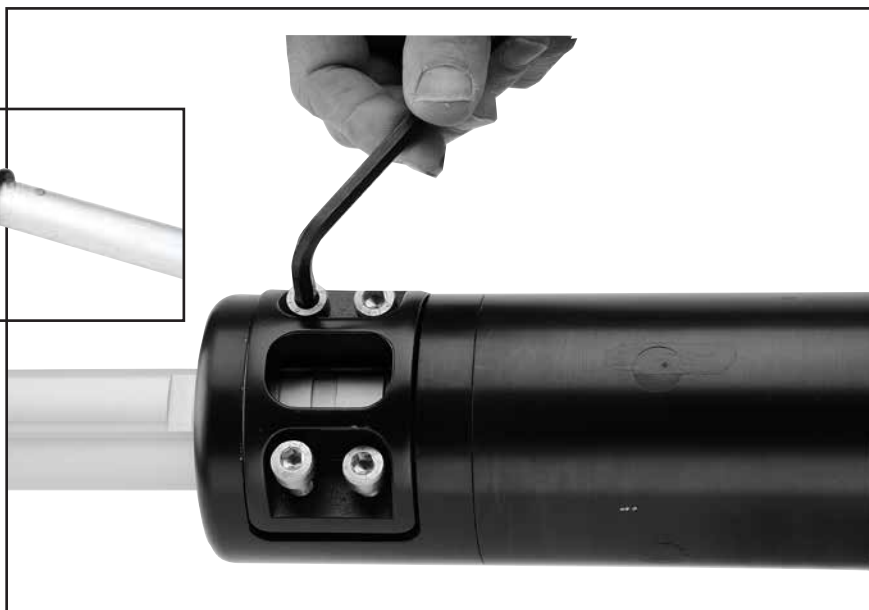
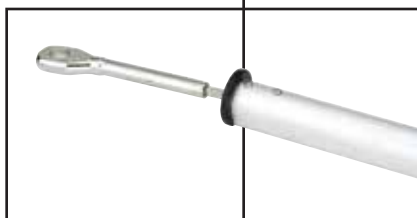
Install isolator and adapter to lower unit using six (6) socket head cap screws. Use Tef-Gel® lubricant on screws.

Insert eye into cylinder. Use stay eye terminal or threaded turnbuckle eye. Insert cross pin and secure by fastening toggle plate on each side of cylinder. Use Tef-Gel on screws.

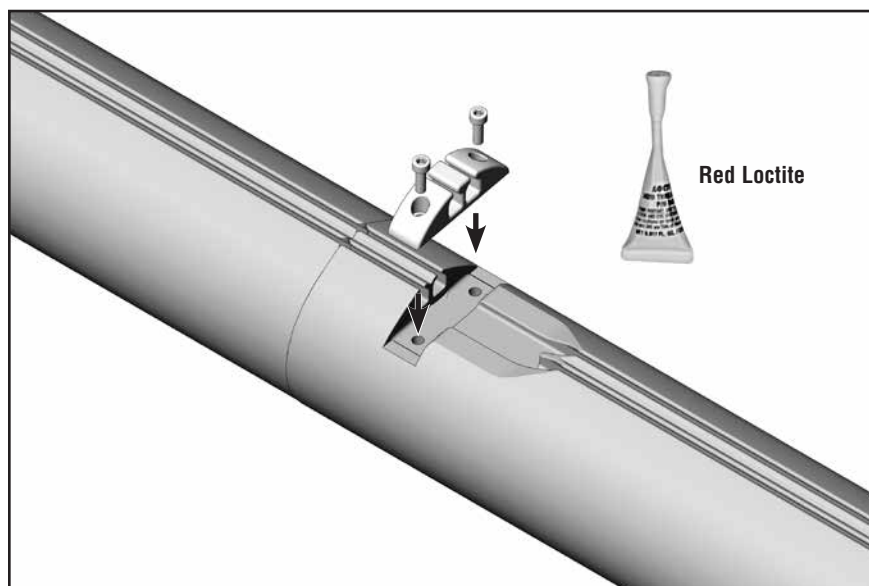
Fit cylinder bosses to one (1) of six (6) socket positions. Determine position based upon desired orientation of main unit and cylinder hydraulic port.

Secure cylinder to lower unit using clamp. Use Tef-Gel on screws.

Check foil height at top, set and secure using Allen wrench.



Fasten feeder to foil gap using red Loctite® adhesive on screws.



Commissioning

Lash halyard swivel

Lash halyard, head of sail and tack. One very useful knot is a triple fisherman's knot. See: www.harken.com/knot-tying-resources.



Have extra cotter pins and lock nuts on hand to replace used ones at base of unit and for turnbuckle.

Hold foils and loosen foil clamp screws until you can pull clamp out to lower foils.

Lower foils.

Remove six (6) toggle housing screws. Use halyards to securely lift and hold foils and lower unit.



WARNING! Foils are heavy and can drop suddenly on fingers. Only do this work at the dock, not underway.

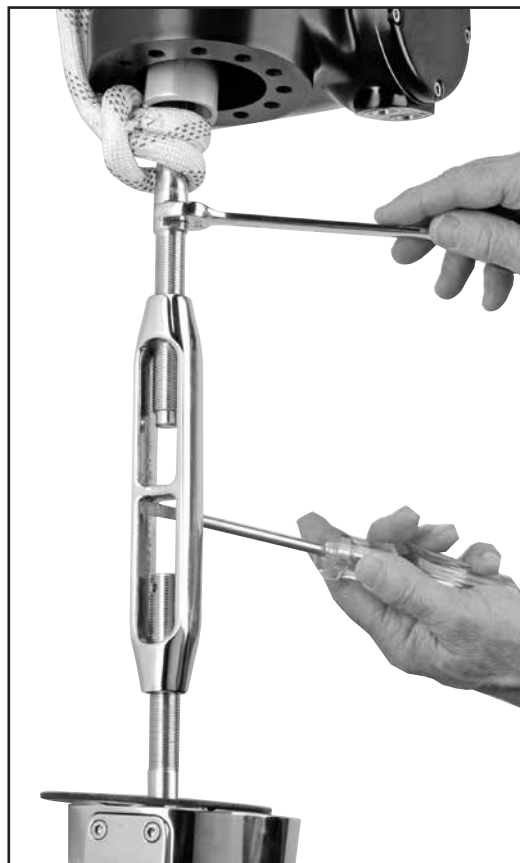
Adjust turnbuckle.

Replace used cotter pins and lock nuts. Lower unit and install clevis pin and new cotter pin.

Lift foils so top is 75 mm (3") below upper terminal.



Raise lower unit and use halyard to lift and hold it about 1.5 m (5'). Raise foils using second halyard and secure. **Allow room above for turnbuckle take up.**



Halyard wrap

The most serious problem with furling systems occurs when the jib halyard wraps around the headstay foil. Halyard wraps will keep you from furling or unfurling and may cause serious damage to the unit and the halyard.



WARNING! In severe cases, a halyard wrap can cause loss of control of boat and/or headstay can break suddenly.

To prevent wraps, the halyard must exert a slight pull to the rear. This allows the foils to turn while halyard remains stationary.

Prevent halyard wraps

1. Halyard swivel should be within 150 - 120 mm (6 - 8") of foil unless a halyard restrainer is used.
2. Halyard must pull slightly to rear (8 - 10°).
3. Halyard must be snug, but not too tight.

If halyard wraps, do not force unit to turn. Attempt to open sail by carefully furling in and out a little at a time. If sail will unfurl, lower it by releasing jib halyard. Severe halyard wraps can only be cleared by going aloft and freeing halyard.

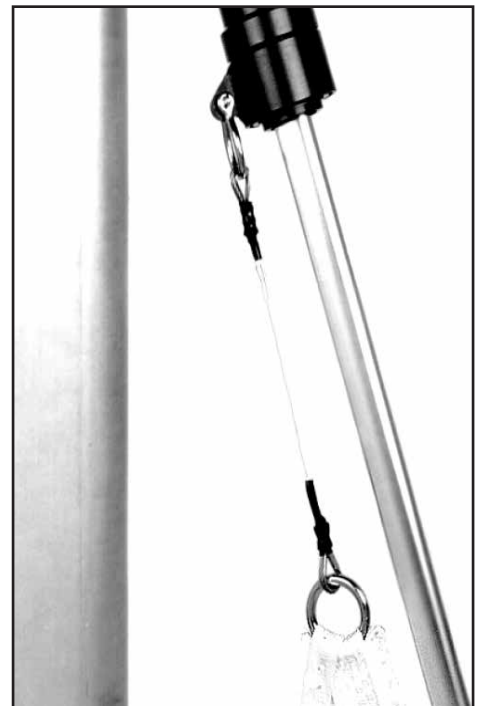
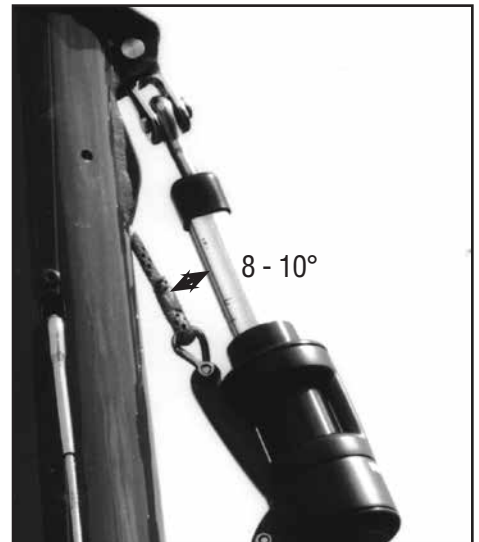
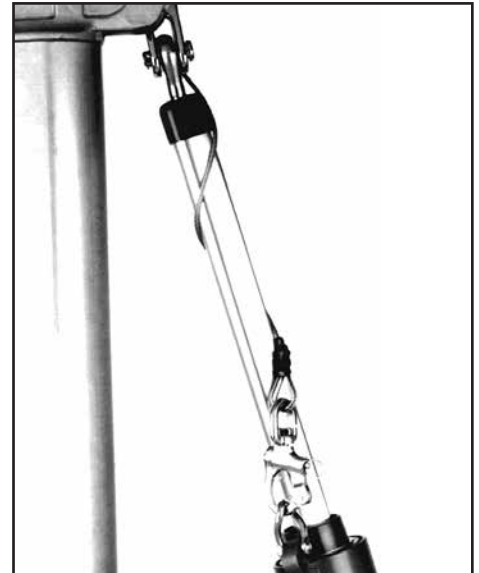
If sail will not furl or unfurl, try to remove jib sheets and manually wrap sail around headstay.

Testing at dock does not indicate halyard angle is correct. In wave action, halyard may wrap if lead angle is not correct. The 8-10° diverging angle shown at right is critical.

Pendants

If the sail luff is not long enough to position halyard swivel properly, you must add a pendant. Pendants should be made of plastic-coated wire and be permanently attached so sail height will be correct. Adjustable-length pendants are not acceptable, as they might not adjust correctly during a sail change.

1. Raise sail, but do not attach tack shackle.
2. Position halyard swivel correctly near top of headstay.
3. Secure halyard.
4. Tie a piece of rope to sail tack.
5. Lead line through tack shackle on lower unit.
6. Tension sail.
7. Measure distance from tack shackle to sail tack and permanently attach pendant of this length to head of sail.
8. Repeat procedure for every jib in your sail inventory.



To prevent wraps, jib halyard must pull slightly to rear. On most boats, halyard lead angle is acceptable if halyard swivel is raised to top of foil. On some boats halyard sheaves are located too close to headstay and a halyard restrainer must be used.

Halyard restrainers should be used only when required by masthead geometry. Restrainers tend to limit sail luff length and may cause problems if not installed properly.

Restrainer should be mounted as high as possible on face of mast. Position restrainer so that foils will not hit it when under load.

The restrainer should deflect halyard as little as possible or you may experience difficulty in tensioning sail luff as well as friction when furling, resulting in possible damage to foils. To decrease deflection angles, shorten sail luff.

Tip: Boats used in charter service should have a halyard restrainer, regardless of masthead geometry.

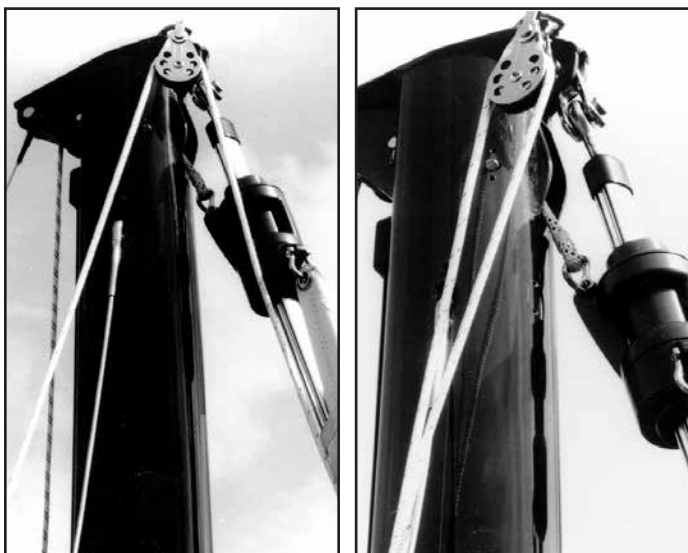


Halyard tension

The jib halyard should be firm, but not too tight.

Tip: The luff foil system supports sail along its length so halyard tension is used only to shape sails, not to support them. Use enough halyard tension to remove some wrinkles along luff of sail. Do not tension halyard enough to cause vertical wrinkles in luff of sail. Tension to adjust position of draft in sail to suit sailing conditions. Halyard should be firm but not tight. If in doubt, release halyard tension. To protect sail, ease halyard when boat is not in use.





Using hydraulic length adjuster

Use reference lines on guide rod to help repeat settings. Make sure mainsheet and vang are eased. Use adjuster to set length (especially when using two furlers) to make sure the desired furler is tensioned when the backstay is tensioned.

Backstay adjusters

Backstay adjusters allow headstay tension to be varied to change sail shape to match conditions. They permit a very tight headstay to be eased when boat is not in use.

Remember to keep headstay tight for best performance when furling or reefing.

IMPORTANT! If your boat is fitted with an adjuster, be sure that it is tensioned before the halyard is tensioned. If not, backstay adjuster may increase halyard tension and could damage the sail or furling system.

Racing boats often slack the headstay completely when sailing downwind. Check to be sure that foil does not jam against upper headstay terminal when backstay is released. To prevent this, it may be necessary to shorten foil slightly.

Spinnaker halyards

Spinnaker halyards occasionally cause problems with furling.



WARNING!: In severe cases, spinnaker halyards can jam furler causing loss of control of boat. Make sure all halyards are clear of furling unit action.

On many boats, it is not possible to attach the spinnaker halyard to bow pulpit because it may be "sucked" into the jib when furling.

On some boats the spinnaker halyard lays across headstay and will catch on halyard swivel, foils or jib halyard. To prevent problems, it may be necessary to install a masthead bail to move spinnaker halyard block forward and to one side.

Boats with external halyards may find it necessary to flip both ends of spinnaker halyard behind spreaders to prevent fouling with furling system.

Headstay tension

A furling system will work best if headstay is tight.

A loose headstay is difficult to rotate and can cause unusual wear on foil joints.

To adjust headstay tension, remove sail and follow instructions on page 23.

Tip: Before adjusting headstay tension, slack mainsheet and vang.



Furl and reef

To furl or reef, ease jib sheets and press correct switch to furl sail.

In very light air, it may be necessary to place some tension on jib sheet to insure a tight furl.

To furl in a breeze, ease sheets gradually and furl sail in smaller increments until sail is furled or reefed.

When furling or reefing, make sure that nothing is jammed. Review swivel height, lead angle, halyard restrainer information. Make sure operator has a good view of sail and stops furling when sail is rolled and sheets have a wrap or two on the furled sail. Stop immediately if sheets jam or halyard wraps. If operator does not have a good view, station a crew member with good visibility and communicate to operator. If motor is laboring, stop and check for reason. Consult "Troubleshoot" on page 30.



WARNING! A hydraulic furling system is very powerful and jammed parts can break suddenly at high load. Stop furling immediately and correct problem.

Reefing tips

A sail may be partially furled before you resume sailing. This is known as reefing.

Many sailors find it helpful to place marks on foot of sail so that they can reef to a variety of predetermined jib sizes. This allows marks to be placed on jib lead tracks or toe rail so that lead block position can be changed to correspond to reefed jib.

Sails are generally reefed to balance boat and to reduce heeling moment. Sails may also be reefed to improve visibility or to slow boat while sailing in congested areas or entering or leaving harbors.

Secure sail

When furling prior to leaving your boat in slip or on mooring, be sure that you get a tight furl and continue furling system until sheets wrap around rolled sail two (2) or three (3) times. Some people secure sail with shock cord or sail ties.

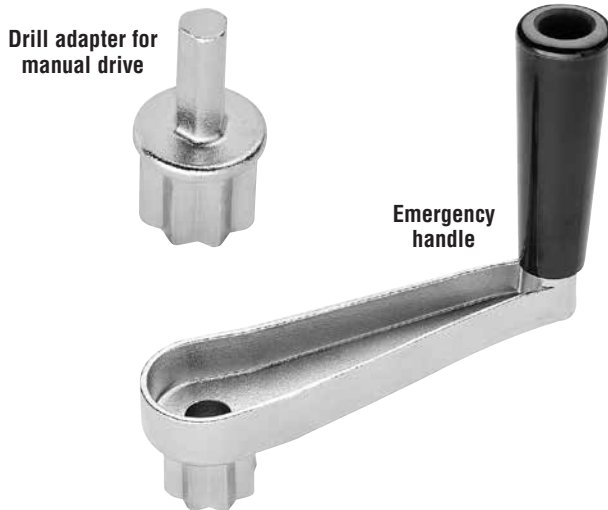


Before using the system, practice manual operation in case there is a loss of power. Make sure that the emergency handle can rotate and not hit the bow pulpit.

Cordless drill adapters work well, but there must be a fully-charged cordless drill on hand at all times. Because a cordless drill may lose power, always have an emergency handle onboard in a secure, easy-to-find location. Communicate location as part of safety equipment orientation for all crew members.



WARNING! You must have a reliable manual drive procedure in place before using the system.



Furling or reefing with manual power

In the event of power failure, go forward and lower sail or furl by hand.



WARNING! You must observe all personal safety precautions including using a harness and secure tether and personal flotation device (PFD) when going forward.

1. Communicate to all crew members that you are going to manually rotate the furler. Practice this emergency procedure in controlled conditions so you and your crew are prepared in the event of a power failure. Explain procedure for controlling the boat and have someone ease sheets as you rotate the handle.
2. Have an emergency handle available.
3. Using all personal safety precautions including PFD, harness, and tether, before going forward.
4. Position shift lever on right side as shown in photo.
5. Use the emergency handle or a cordless drill to turn the foil until the sail is reefed or furled.





Clean

Keep unit clean. When you wash boat, flush unit with soap and fresh water. Occasionally lower sail and flush halyard swivel with soap and fresh water.

Clean Foils by washing with soap and water.

A scrap of luff tape may be run up foil to scrub inside grooves. Sail luff tapes may be sprayed with McLube to reduce friction during sail changes.



WARNING! Decks sprayed with McLube® SailKote will be very slippery which can lead to slipping and falling overboard. Spray sails off boat so McLube does not contact deck.



WARNING! Worn, damaged or corroded parts may break suddenly. Periodically inspect items listed below and any others as necessary.

Inspect

Inspect unit for signs of chafe, wear or damage.

Inspect clevis and cotter pins below and inside lower unit for signs of loosening. Check headstay tension for signs of loosening.

Inspect swage fitting and lower toggle for signs of stress corrosion.

Inspect Norseman or Sta-Lok® terminal or rod terminal for signs of loosening.

Inspect all screws on unit to be sure they have not loosened.

Inspect foil to make sure that it has not dropped into lower unit.

Periodically inspect wire for signs of wear or unraveling.



Storage – mast down

In areas where it freezes, do not store system where water can accumulate in foils. When water freezes it will rupture aluminum. Store foils under cover, with grooves facing down or on an angle so water will run out.

Storage/transporting

Do not store or transport system with lower unit extending beyond mast. Remove lower unit and halyard swivel for storage and transport.

After storage or transport

After storing or transporting unit, clean thoroughly including tack and halyard swivel ball bearings. See instructions above.

Loosen foil clamp before slacking backstay

In order to prevent foils from locking against upper stay terminal when backstay is released, loosen foil clamp screws and lower foil before loosening backstay.

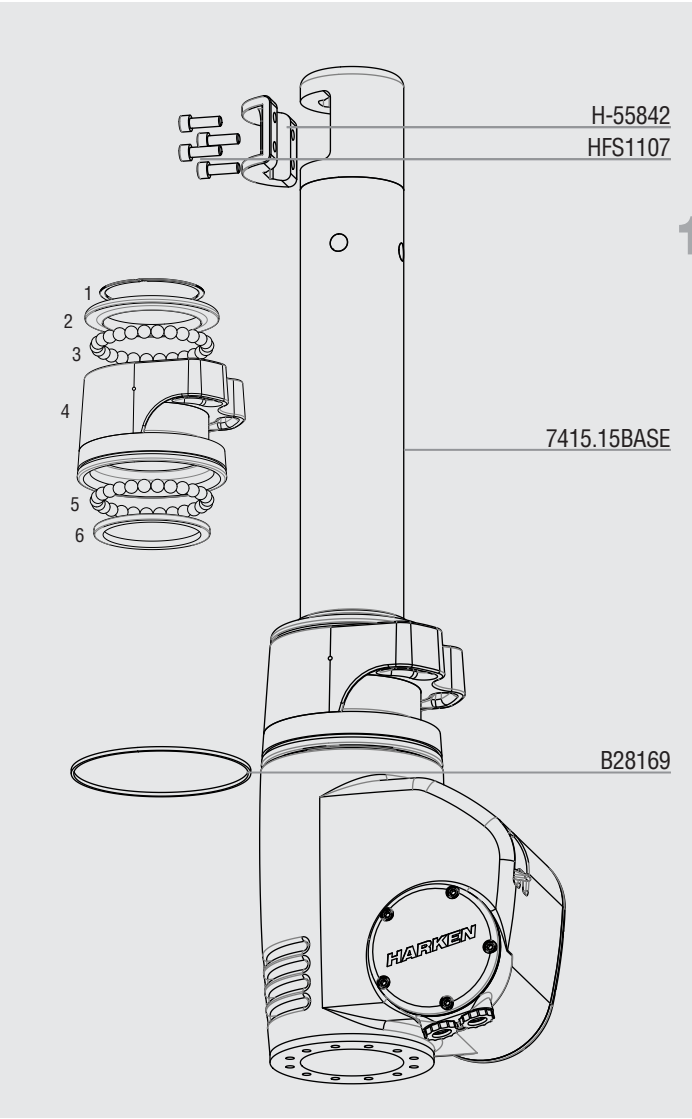
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McLube™ is a registered trademark of McGee Industries, Inc.

Problem	Probable cause	Solution
Sail will not furl or is difficult to furl	Jib halyard is wrapping around headstay because angle between mast and halyard is too shallow	See installation instructions regarding optimal halyard angle. It may be necessary to mount a halyard restrainer on front of your mast to hold halyard to rear
	Jib halyard is wrapping around the headstay because halyard swivel is too low	See installation instructions regarding optimal halyard swivel height. A wire pendant may be needed at head of sail to raise halyard swivel to proper height
	Jib halyard is too tight	Ease jib halyard
	Foils riding on turnbuckle	Raise foils. See adjusting turnbuckle on page 23
	Foils too high, binding on swage eye	Lower foils until clear. See adjusting turnbuckle on page 23
	Spare halyard is wrapping in sail as it furls	Secure spare halyards away from furling headstay by flipping them behind spreaders
	Salt or dirt in bearings	Flush bearings with freshwater and lubricate with dry spray lubricant such as McLube® lubricant
	Sail full of wind	Luff completely before furling or reefing
	Sail flogging too much	Release a short length of sheet, furl a small amount and repeat
	Foil out of clamp	Reinstall foil in lower unit and tighten clamp screws
	Halyard swivel installed upside down	Remount swivel correctly
Sail will not unfurl or will not unfurl completely	Jib halyard is wrapping around headstay because angle between mast and halyard is too shallow	See installation instructions regarding optimal halyard angle. It may be necessary to mount a halyard restrainer on front of your mast to hold halyard to rear
	Jib halyard is wrapping around the headstay because the halyard swivel is too low	See installation instructions regarding optimal halyard angle
	Foils riding on turnbuckle	Raise foils. See adjusting turnbuckle on page 23
	Foils too high, binding on swage eye	Lower foils. See adjusting turnbuckle on page 23
	Jib halyard is too tight	Ease jib halyard, especially when tightening backstay
	Spare halyard is wrapping in sail as it furls	Secure spare halyards away from furling headstay by flipping them behind spreaders
	Salt or dirt in bearings	Flush bearings with freshwater and lubricate with dry spray lubricant such as McLube
Sail will not furl completely	Spare halyard catching in sail as it furls	Move halyards away from furling headsail as above
Headstay rotates in jerks or elliptically	Insufficient tension on headstay	Tighten headstay and/or backstay to eliminate sag in headstay
Sail does not stay furled	Sail not furled tightly on stay	Keep some tension on sheets when furling in light air to get a tight, secure wrap
Sail will not go up	Luff tape will not go into groove	Check luff tape for fraying Check luff tape size
	Sail catching at prefeeder	Flake sail more loosely on deck
	Dirt in groove	Attach a halyard and downhaul to a small section of luff tape and clean groove by raising and lowering
Sail will not raise completely or luff will not tension	Halyard swivel is hitting end stop	Luff of sail is too long and must be recut
	Angle between halyard and mast is too sharp and halyard is pulling too much to the rear	Halyard must be routed from a point higher on mast. This may require that halyard turning block aloft be replaced or sail shortened
Sail will not come down	Halyard is wrapping on headstay	Angle between headstay and halyard is too shallow and must be optimized per installation instructions
	Halyard swivel off foil	Sail luff too long or foil is too short or low and must be lengthened or raised
Ultraviolet cover rolls up inside of sail	Wrong switch used to furl sail	Unroll sail and use other switch to furl. Alternatively, rewire switch if preferred. Once correct one is determined, label switch "furl" and the other "unfurl"

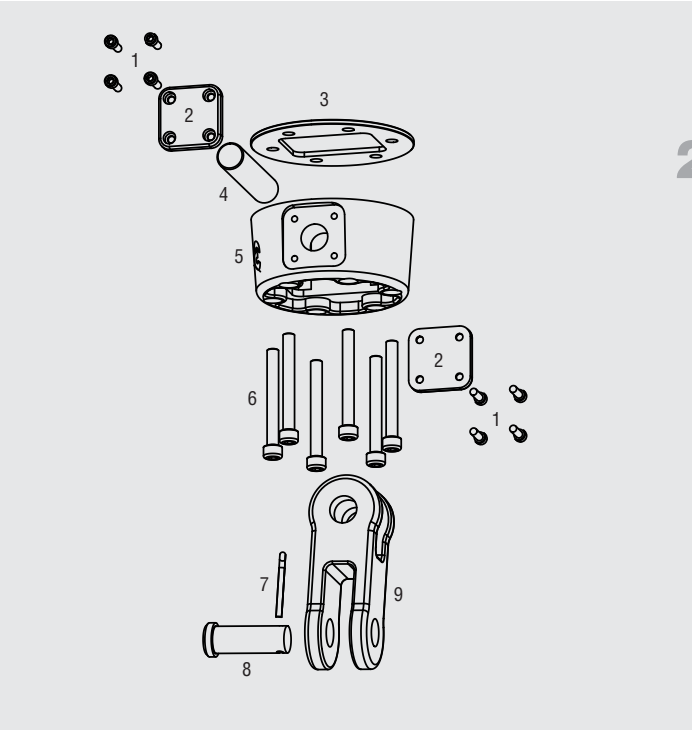
McLube is a registered trademark of McGee Industries, Inc.

Warranty
www.harken.com/manuals
or call, write, email or fax Harken, Inc.,
Pewaukee, WI USA

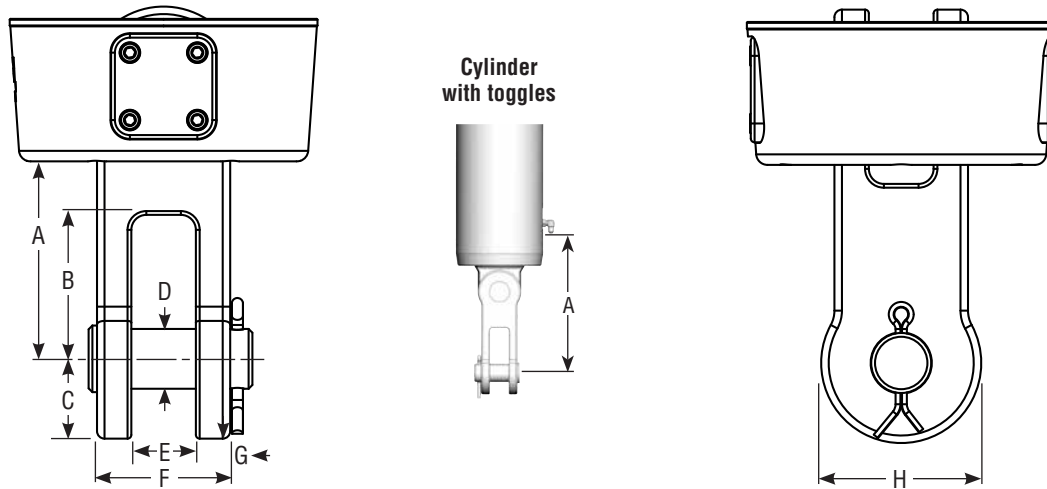


No.	Description	Order	Part no.
	Torque tube foil clamp	1	H-55842
	Torque tube screws M8 X 125 mm SHCS	4	HFS1107
	Red ring	1	B28169
Lower unit		1	7415.15BASE
1	Smalley ring	1	H-53073
2	Tack swivel top washer	1	H-53072
3	1/2" Torlon® ball bearings	28	HBB21
4	Tack swivel body	1	H-53069
5	1/2" Delrin® ball bearings	28	HBB22
6	Tack swivel lower washer	1	H-53071

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Delrin is a registered trademark of E. I. du Pont de Nemours and Company or its affiliates.

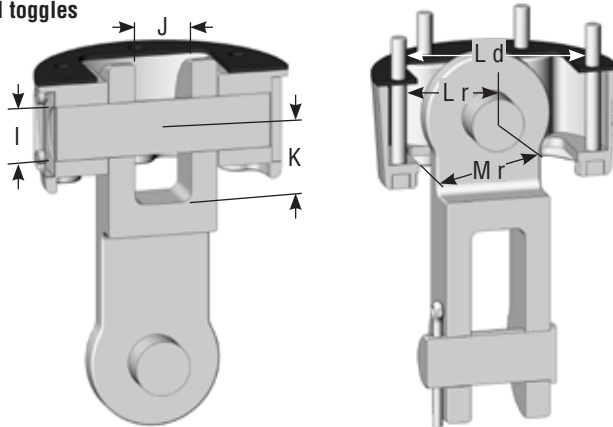


No.	Description	Order	Part no.
Toggle assembly 1 1/8"		1	7415.25 1 1/8
1	Toggle plate screws M5 X 16 mm SHCS	8	HFS982
2	Toggle plate	2	H-51261
3	Toggle housing insulator	1	H-53089
4	Cross pin 1 1/8"	1	H-51605
5	Toggle housing 1 1/8"	1	H-53087
6	Toggle housing screws M10 X 90 mm SHCS	6	HFS1259
7	Cotter pin 3/16" X 2"	1	HFG743
8	Clevis pin 1 1/8"	1	H-45436
9	Jaw/jaw toggle 1 1/8"	1	H-45428
Toggle assembly 1 1/4"		1	7415.25 1 1/4
1	Toggle plate screws M5 X 16 mm SHCS	8	HFS982
2	Toggle plate	2	H-51261
3	Toggle housing insulator	1	H-53089
4	Cross pin 1 1/4"	1	H-53094
5	Toggle housing 1 1/4"	1	H-53088
6	Toggle housing screws M10 X 90 mm SHCS	6	HFS1259
7	Cotter pin 1/4" X 2.5"	1	H-46623
8	Clevis pin 1 1/4"	1	H-52870
9	Jaw/jaw toggle 1 1/4"	1	H-52864

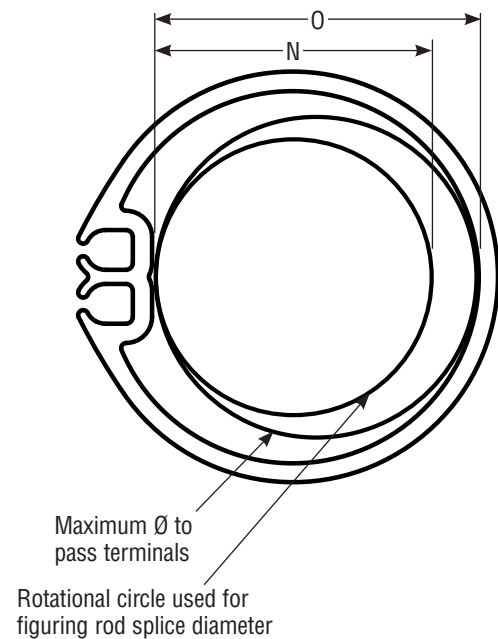
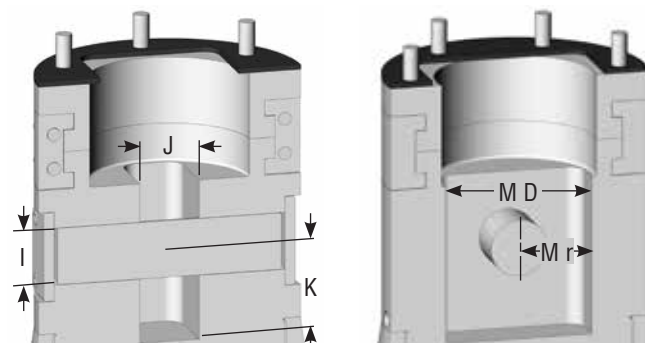


Toggle	A		B		C		D		E		F		G		H	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Standard toggles																
7415.25 1 1/8	3.614	91.8	2.700	68.6	1.507	38.3	1.122	28.5	1.210	30.7	2.524	64.1	0.657	16.7	3.014	76.6
7415.25 1 1/4	4.291	109.0	3.134	79.6	1.507	38.3	1.248	31.7	1.312	33.3	2.528	64.2	0.608	15.4	3.014	76.6
Cylinders with toggles																
7415.26 1 1/8	6.677	169.6	2.700	68.6	1.507	38.3	1.122	28.5	1.210	30.7	2.524	64.1	0.657	16.7	3.014	76.6
7415.26 1 1/4	7.354	186.8	3.134	79.6	1.507	38.3	1.248	31.7	1.312	33.3	2.528	64.2	0.608	15.4	3.014	76.6

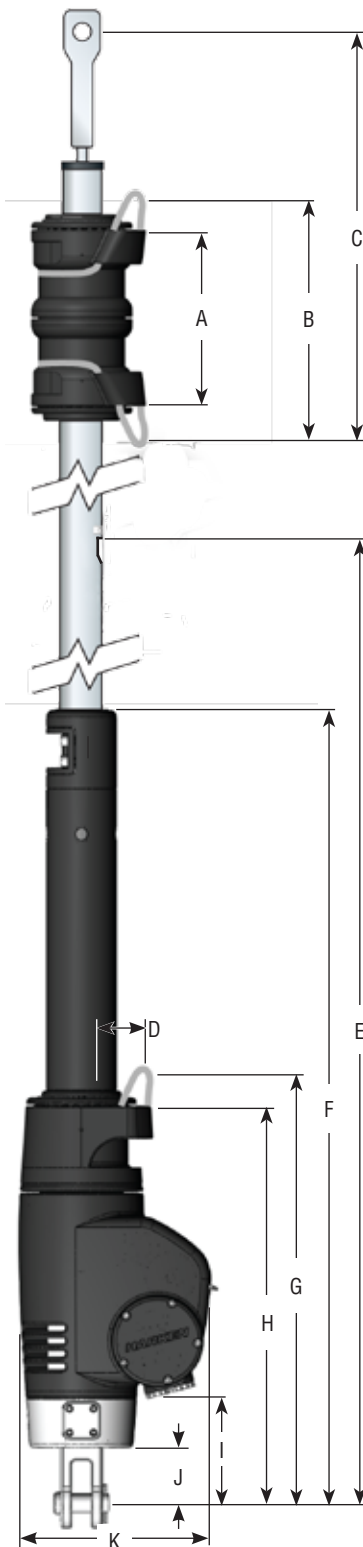
Standard toggles



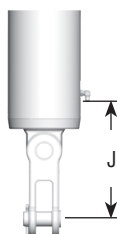
Cylinders with toggles



Toggle	I		J		K		L Radius		L Diameter		M Radius		M Diameter		N		O	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Standard toggles																		
7415.25 1 1/8	1.125	28.6	1.210	30.7	1.639	41.6	1.891	48.0	3.781	96.0	1.838	46.7	3.676	93.4				
7415.25 1 1/4	1.248	31.7	1.312	33.3	1.796	45.6	1.891	48.0	3.781	96.0	1.838	46.7	3.676	93.4				
Cylinders with toggles																		
7415.26 1 1/8	1.125	28.6	1.188	30.2	1.653	39.7	—	—	—	—	1.45	36.8	2.9	73.7	1.412	35.9	1.77	45.0
7415.26 1 1/4	1.248	31.7	1.312	33.3	1.688	42.9	—	—	—	—	1.45	36.8	2.9	73.7				



See page 32
for all toggle
dimensions.



Luff length

Note offsets above and below sail.

A shorter luff may be required if a halyard restrainer is used or an additional toggle assembly is used to raise unit.

If luff of sail is not long enough to put halyard swivel near top of headstay foil, a pendant must be added. See page 24.

Tack setback

Note setback for tack shackle and cut sail accordingly.

Luff tape size

Unit 5H requires #6 5 mm ($\frac{3}{16}$ ") luff tape.

Luff tape length

Cut off top of luff tape so it is 600 to 1000 mm (24 to 36") below head of sail. This allows head to lag behind rest of sail to help flatten sail. It will also help head to roll more smoothly.

Note feeder height and extend bottom of luff tape downward so it is below feeder. This will prevent luff tape from catching in feeder as sail is lowered.

Tack and head lashing

Choose high strength low stretch line to lash head and tack to fittings. Use specialty knots such as a triple fisherman's knot. See knot tying resources at www.harken.com/knots.

Sun cover

Sun covers may be installed on either side of sail. Be sure to match other sails in the customer's inventory.

Toggle assembly	A		B		C*		D**		E Max		E Min	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
7415.25 1 $\frac{1}{8}$ std	10 $\frac{1}{2}$	267	16 $\frac{3}{4}$	425	31 $\frac{1}{2}$	800	6	150	62 $\frac{13}{16}$	1596.19	—	—
7415.25 1 $\frac{1}{4}$ std	10 $\frac{1}{2}$	267	16 $\frac{3}{4}$	425	31 $\frac{1}{2}$	800	6	150	63 $\frac{9}{16}$	1613	—	—
7415.26 1 $\frac{1}{8}$ cylinder	10 $\frac{1}{2}$	267	16 $\frac{3}{4}$	425	31 $\frac{1}{2}$	800	6	150	87 $\frac{15}{16}$	2234	81 $\frac{15}{16}$	2081
7415.26 1 $\frac{1}{4}$ cylinder	10 $\frac{1}{2}$	267	16 $\frac{3}{4}$	425	31 $\frac{1}{2}$	800	6	150	88 $\frac{5}{8}$	2251	82 $\frac{5}{8}$	2098

* Approximate, will vary according to rigging used. Assumes about a 80 mm offset for each lashing.

** Approximate measurement from boltrope to lashing bearing point.

Toggle assembly	F Max		F Min		G Max***		G Min***		H Max		H Min	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
7415.25 1 $\frac{1}{8}$ std	41	1042	—	—	26 $\frac{1}{16}$	662	—	—	23 $\frac{11}{16}$	602	—	—
7415.25 1 $\frac{1}{4}$ std	41 $\frac{11}{16}$	1059	—	—	26 $\frac{3}{4}$	679	—	—	24 $\frac{1}{2}$	619	—	—
7415.26 1 $\frac{1}{8}$ cylinder	66 $\frac{1}{8}$	1679	60 $\frac{1}{8}$	1527	51 $\frac{15}{16}$	1319	45 $\frac{15}{16}$	1167	48 $\frac{13}{16}$	1239	42 $\frac{13}{16}$	1087
7415.26 1 $\frac{1}{4}$ cylinder	66 $\frac{13}{16}$	1697	60 $\frac{13}{16}$	1544	52 $\frac{9}{8}$	1337	46 $\frac{5}{8}$	1184	49 $\frac{1}{2}$	1257	43 $\frac{1}{2}$	1104

*** Assumes a 80 mm offset for lashing.

Toggle assembly	I Max		I Min		J Max		J Min		K	
	in	mm	in	mm	in	mm	in	mm	in	mm
7415.25 1 $\frac{1}{8}$ std	6 $\frac{5}{8}$	168	—	—	3 $\frac{5}{8}$	91.8	—	—	10 $\frac{3}{8}$	263.67
7415.25 1 $\frac{1}{4}$ std	7 $\frac{1}{4}$	185	—	—	4 $\frac{5}{16}$	108.99	—	—	10 $\frac{3}{8}$	263.67
7415.26 1 $\frac{1}{8}$ cylinder	31 $\frac{7}{16}$	799	25 $\frac{1}{2}$	647	15 $\frac{1}{8}$ #	384#	9 $\frac{1}{8}$	232	10 $\frac{3}{8}$	263.67
7415.26 1 $\frac{1}{4}$ cylinder	32 $\frac{1}{8}$	816	26 $\frac{1}{8}$	663	15 $\frac{13}{16}$ #	402#	9 $\frac{13}{16}$	2496	10 $\frac{3}{8}$	263.67

Height of cylinder threaded hydraulic port.



Notes:

Notes:

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