Component Change Notices

This page lists changes to system components that will affect installation plans or procedures.

Items listed here should be reviewed by builders or installers who may have expectations that the current system is identical to previously installed systems.

Date	ChangeAffects	Detail	Manual Vers.	Manual Page
Oct 2005	220 & 250 Actuator	Inboard Hull Flange - Mounting Bolt Diameter; Increased bolt diameter from 1/2” to 5/8”. Increased required bolt tightening torque.	5.03f	3a -8; 3a -12
Oct 2005	220 & 250 Actuator	Actuator Flange Mounting Bolt - Diameter change Increased bolt diameter from 1/2” to 5/8”. Increase platform clearance hole diameter to 21/32” Increase required flange bolt tightening torque.	5.03f	3b -7; 3b -10
Nov 2005	All Systems	System Cable Conductor color changes: Stabilizer Manifold wire color change.	5.03g	9-7
Apr 2006	220 Actuator	Actuator Yoke Clamping Bolts - Revised bolt size to 3/8” -16 & revised clamping torque.	5.03g	6 -6
Jul 2006	All Systems	Changed Actuator Shaft Position Sensor Coupler	5.03 j	Sect 10
Feb 2008	370 & 440 Actuator	Table 3a -B Hull Flange Bolt Drill Sizes	5.03 L	3a -8
Feb 2008	370 & 440 Actuator	Hydraulic Fluid Type Notice	5.03 L	Prefix

ARCTURUSMARINE™

TRAC®

THRUSTERS • DIGITAL STABILIZERS • INTEGRATED HYDRAULICS

Stabilizer Installation Manual
&
System Operation

Version 5.03 L

Table of contents:

Important Note about Hull Reinforcement

It is the responsibility of the installer to determine what reinforcement measures should be taken to properly strengthen the hull to withstand forces that may be encountered in the event that the fin, and thus the fin shaft, strikes an immovable object while the vessel is underway.

Recommendations made by American Bow Thruster are to be used as starting guidelines only. American Bow Thruster is **NOT** a naval architecture firm and is **NOT** qualified to advise on structural matters.

American Bow Thruster strongly recommends that you seek the advice of a naval architect familiar with the make of your vessel.

Installer Requirement

STAR™ Equipment Warning

When equipment is furnished for STAR™ (Stabilization at Rest), the installer must provide suitable durable signs for the sides of the hull to mark the location of stabilizer fins and to warn of danger of sudden fin movement.

STABILIZER FINS

EXTREME DANGER ! KEEP AWAY !

FINS MOVE WITHOUT WARNING

Installation Notice
Service Notice

System Hydraulic Fluid

ISO 32 and ISO 46 Hydraulic Fluids are the only fluids approved for use in Arcturus Marine hydraulic systems. The use of any other fluid will void the Arcturus Marine Warranty.

Warning!

Special Precautions must be taken when installing or removing the fin retaining nut.

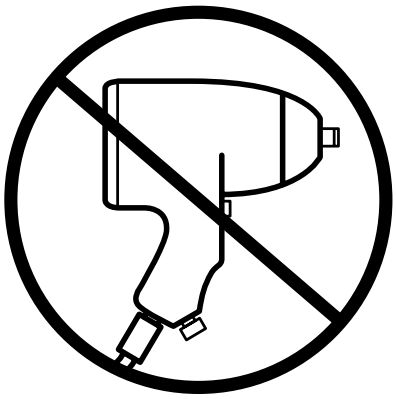
To avoid permanently seizing the nut on the shaft:

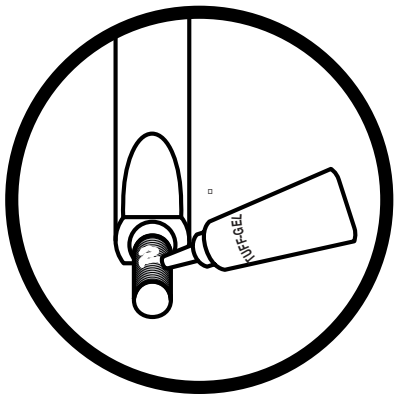
- Read section 5 for more information.
- Never use an air impact wrench to install or remove the nut.
- Always use a new nut supplied by American Bow Thruster only.
- Always completely drench the shaft threads with the appropriate thread locking compound before final installation of the fin nut.

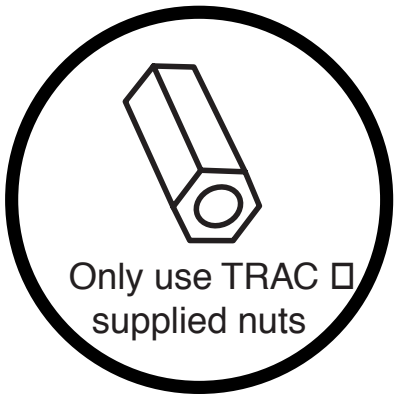
  The appropriate compound is engraved on the fin nut according to fin nut material:

  With Stainless Steel fin nuts - use only Tuff-Gel™

  With Nitronic 60 fin nuts - use only LOCTITE® 262







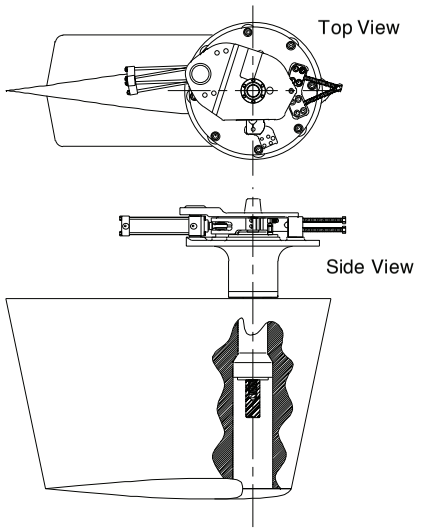
Section 1

System Documents

ACTUATOR – FIN SIZE COMPATIBILITY (1)

FIN	220	250	300	370	440	540	680
4.5	•	•					
6.0	•	•					
7.5	•	•	•				
9.0		•	•	•			
12.0			•	•			
16.0				•	•		
20.0				•	•		
26.0					•		
6.0X	•	•	•				
7.5X		•	•				
9.0X			•	•			
12.0X				•	•		
16.0X				•	•		
20.0X					•		
26.0X						•	
34.0X							•

ASSEMBLY OVERVIEW

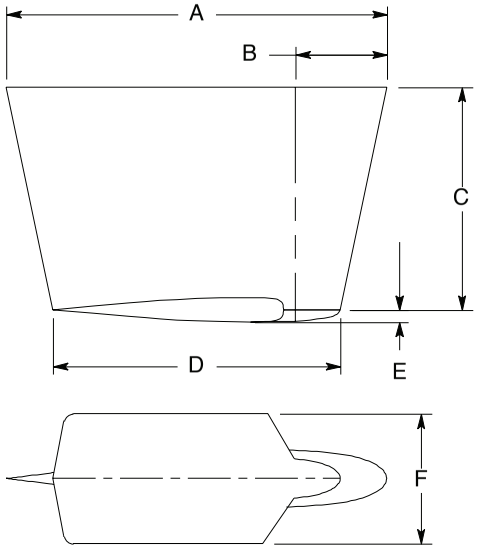


WINGLET FASTENERS (3)

Fastener Code	Fastener	Qty	Tighten to ft-lb / (Nm)	Required Thread Lock Coating
A	3/8" -16	4	24 / (33)	Medium Strength
B	1/2" -13	4	50 / (50)	Medium Strength
C	1/2" -13	6	50 / (50)	Medium Strength
D	1/2" -13	8	50 / (50)	Medium Strength

FIN DIMENSIONS (2)

FIN	A		B		C		D		E		F		WINGLET (3)
Size	Inch	(cm)	Inch	(cm)	Inch	(cm)	Inch	(cm)	Inch	(cm)	Inch	(cm)	Code
4.5	35.5	(90.2)	8.5	(21.6)	20.8	(52.8)	26.9	(68.3)	1.1	(2.9)	12.1	(30.7)	A
6.0	41.0	(104.1)	9.8	(24.9)	23.9	(60.7)	31.0	(78.7)	1.3	(3.3)	14.0	(35.6)	A
6.0X	53.6	(136.1)	11.7	(29.7)	23.9	(60.7)	43.8	(111.3)	1.9	(4.8)	19.8	(50.3)	A
7.5	45.8	(116.3)	11.0	(27.9)	26.7	(67.8)	34.7	(88.1)	1.5	(3.7)	15.7	(39.9)	A
7.5X	61.1	(155.2)	13.4	(34.0)	26.7	(67.8)	50.0	(127.0)	2.2	(5.6)	22.6	(57.4)	B
9.0	50.2	(127.5)	12.0	(30.5)	29.3	(74.4)	38.0	(96.5)	1.6	(4.1)	17.2	(43.7)	A
9.0X	69.8	(177.3)	15.3	(38.9)	29.3	(74.4)	57.0	(144.8)	2.5	(6.4)	25.7	(65.3)	B
12.0	58.0	(147.3)	13.9	(35.3)	33.9	(86.1)	43.8	(111.3)	1.9	(4.8)	19.8	(50.3)	A
12.0X	79.1	(200.9)	17.2	(43.7)	33.9	(86.1)	65.0	(165.1)	2.8	(7.1)	29.4	(74.7)	B
16.0	66.1	(167.9)	15.9	(40.4)	38.6	(98.0)	50.0	(127.0)	2.1	(5.3)	22.6	(57.4)	B
16.0X	87.8	(223.0)	19.9	(50.5)	38.5	(97.8)	71.9	(182.6)	3.8	(9.7)	22.6	(57.4)	C
20.0	75.4	(191.5)	18.1	(46.0)	44.0	(111.8)	57.0	(144.8)	2.4	(6.1)	25.7	(65.3)	B
20.0X	100.6	(255.5)	22.1	(56.1)	44.0	(111.8)	82.2	(208.8)	4.5	(11.4)	25.9	(65.8)	C
26.0	85.9	(218.2)	20.6	(52.3)	50.3	(127.8)	65.0	(165.1)	2.7	(6.9)	29.4	(74.7)	B
26.0X	118.5	(301.0)	28.4	(72.1)	50.3	(127.8)	97.6	(247.9)	5.9	(15.0)	29.1	(73.9)	D
34.0X	135.5	(344.2)	29.1	(73.9)	57.4	(145.8)	114.0	(289.6)	6.8	(17.4)	33.3	(84.5)	D



NOTES:

1. Compatibility shown here is for actuator torque, and for shaft size to fin socket size. This matrix shows the range of fin sizes that can be used with each actuator. Other considerations will determine which fin size will be installed on a given vessel
2. Fins designated with "X" suffix are extended chord fins for use in Stabilization At Rest (STAR®) systems.
3. Winglet column of Fin Dimension matrix shows fastener size code. Refer to Winglet Fastener Panel (page bottom left) for fastener details.

ARCTURUSMARINE™ TRAC®
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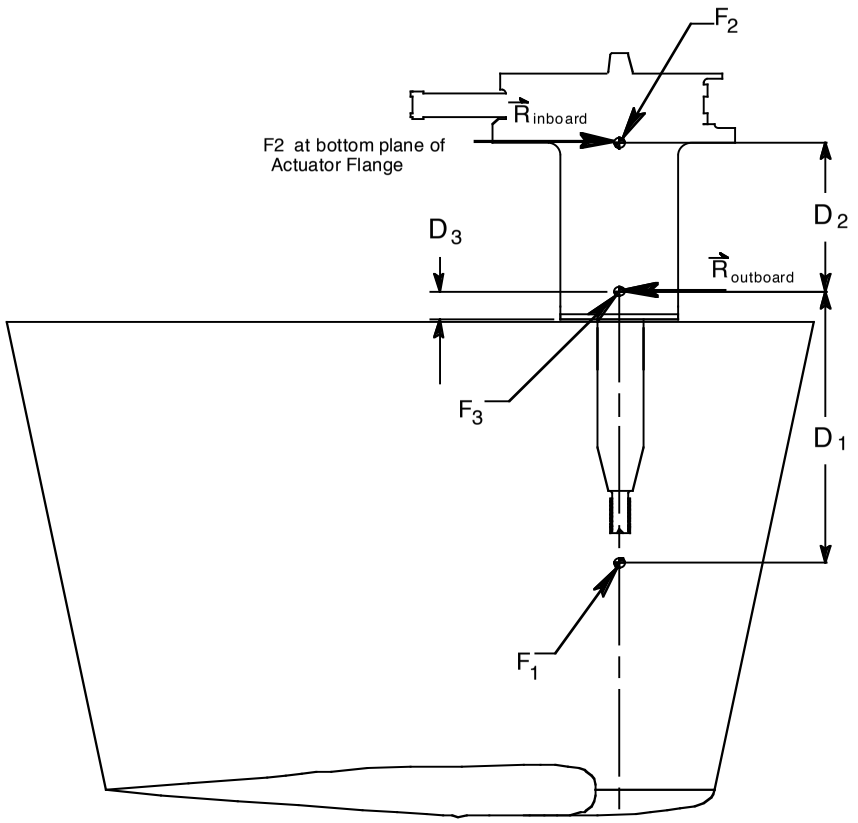
707.586.3159 Fax
http://www.thrusters.com

REVISED	3/21/2008	
DRAWN	RJP	
CHECKED		

TITLE: TRAC Stabilizer Fin Dimensions
SIZE: | DWG NO: | REV: C
SCALE: NONE | SHEET: 1 OF 1

Actuator Size	D1 Inches	D2 Inches	D3 Inches	F1 Lb	F2 Inboard Reaction Force Lb	F3 Outboard Reaction Force Lb	
220	14.71	3.82	1.75	3900	15,014	18,914	Nominal
	14.71	3.82	1.75	10800	41,578	52,378	Breakaway
250	16.39	4.41	2.06	5500	20,460	25,960	Nominal
	16.39	4.41	2.06	15400	57,288	72,688	Breakaway
300	17.96	5.69	1.94	8700	27,464	36,164	Nominal
	17.96	5.69	1.94	24100	76,077	100,177	Breakaway
370	20.86	6.82	2.25	14100	43,129	57,229	Nominal
	20.86	6.82	2.25	39100	119,599	158,699	Breakaway
440	35.25	8.05	2.93	15000	65,691	80,691	Nominal
	35.25	8.05	2.93	41700	182,622	224,322	Breakaway
440H	35.25	13.78	2.93	20000	51,169	71,169	Nominal
	35.25	13.78	2.93	55700	142,504	198,204	Breakaway
540	39.88	13.78	2.93	35500	102,741	138,241	Nominal
	39.88	13.78	2.93	98335	284,592	382,927	Breakaway
640	44.41	15.66	2.03	50000	141,749	191,749	Nominal
	44.41	15.66	2.03	139000	394,061	533,061	Breakaway



REV	DATE	DESCRIPTION	DRFT	APRV
B	03/01/07	ORIGINAL RELEASE		CC

REVISIONS

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ROHNERT PARK, CA 94928
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707.586.3159 Fax
http://www.thrusters.com

SALES ORDER		TITLE:	TRAC STABILIZER REACTION FORCES	
DRAWN	RJP	SIZE:	DWG NO: 35001	REV: B
CHECKED				
ENGINEER	CC	SCALE: N.T.S.	SHEET: 1 OF 1	

American Bow Thruster

A division of ***Arcturus***

517 Martin Avenue
Rohnert Park, CA 94928 U.S.A.
Tel: 707.586.3155
Fax: 707.586.3159

8/16/04

Standard Warranty

This warranty is offered by Arcturus Marine Systems, dba American Bow Thruster or ABT. ABT warrants all new products and systems to be free from defects in material and workmanship for a period of ONE YEAR from the date of system commissioning. Defective parts will be repaired or replaced at ABT's option. Customer is responsible for freight costs associated with returning parts to ABT. ABT will pay freight costs, including air freight, for the shipment of repaired or replacement parts back to customer.

This warranty does NOT cover failure of parts due to mis-installation, damage, accidents, improper storage, or mis-use. Labor for parts removal and reinstallation is NOT covered.

Arcturus Marine Systems (ABT) shall NOT be liable for special, incidental, or consequential damages of any kind including but not limited to vessel haulout costs or lost revenue.

The warranties described above shall be the sole and exclusive warranties granted by ABT and shall be the sole and exclusive remedy available to the purchaser.

Section 2

Selecting the Fin & Actuator Location

Longitudinal Fin Positioning

There are multiple considerations in choosing a location for the fins. There is an ideal location and, around this, there is a range of normally acceptable variations. Most often, practical considerations for clearances outside and inside the hull will restrict the possible choices. In all cases, the points discussed in this section will aid in selecting a better location.

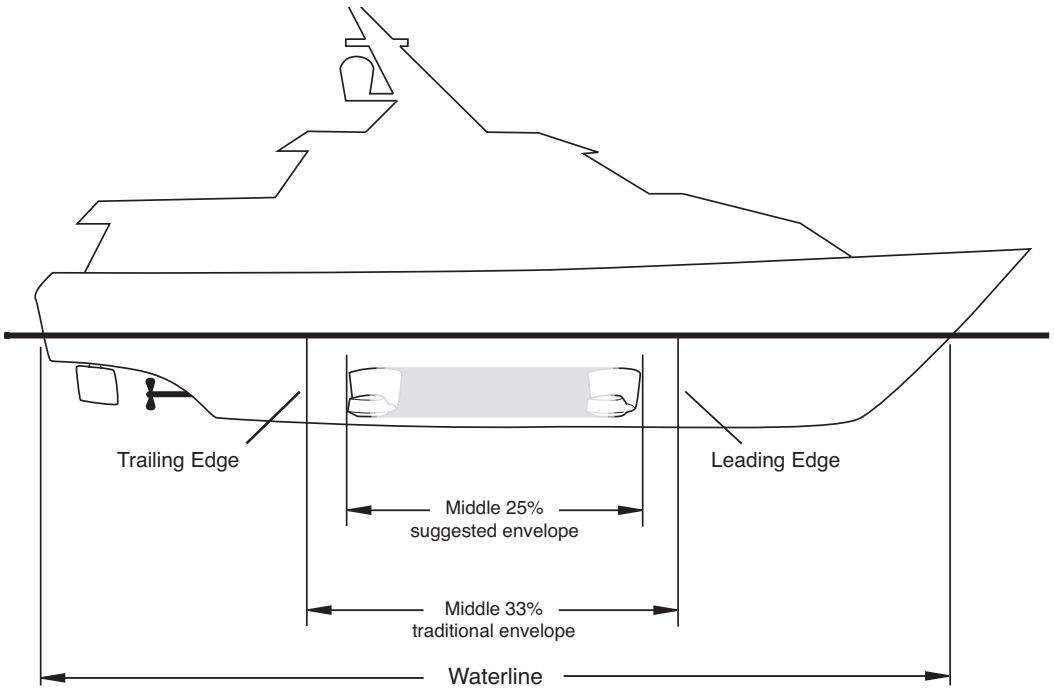
In some cases, the only possible location for fins and actuators may be outside the range established by normal guidelines. There are continuously increasing numbers of successful applications where fin location has not followed the general rules. Particularly in these cases, we strongly recommend that you contact us to discuss proposed fin position.

Like vessel comparisons

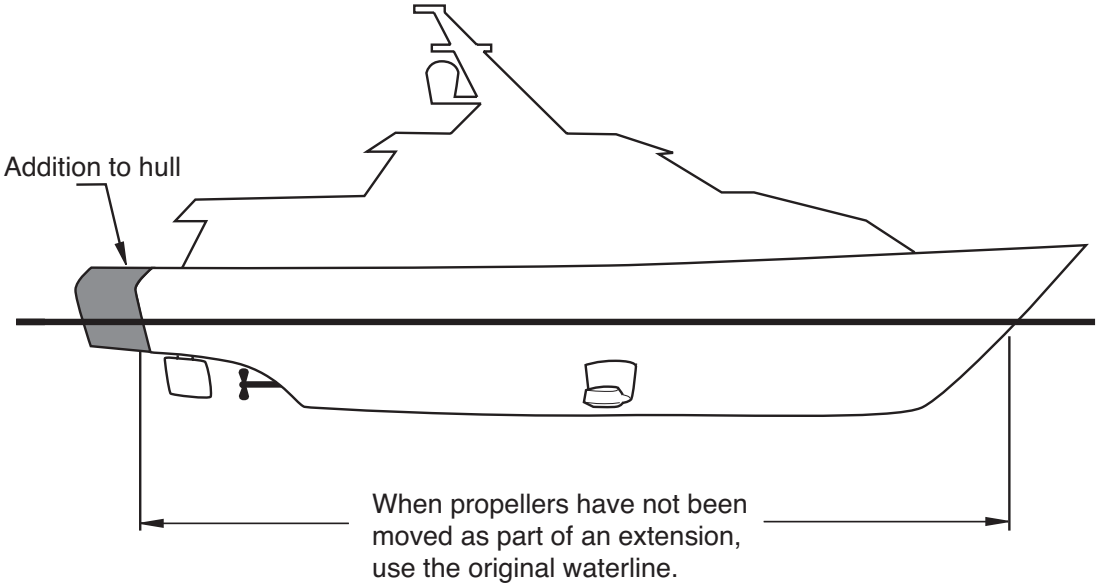
One of the most valuable considerations is the performance of stabilizer fins on other identical hulls. If you or your broker know other vessel owners who have stabilizers installed, inquire as to the location of the fins and whether or not any difficulties have been encountered. Ask specifically if propeller vibration has been experienced.

The general position envelope and the 1/3 rule

Traditionally the fin position envelope has been defined as the middle 1/3 of the waterline length with the trailing and leading edges of the fin within this margin. In general, this is a reasonable parameter, but it is our recommendation that a position within the middle 1/4 of the waterline length be chosen when possible.



Note: Only the waterline length of the vessel, not the overall length, is considered. Furthermore, if the vessel has been lengthened by an extension connected to the transom, and if the propellers and rudders have **not** been moved aft, then the position of the ORIGINAL transom should be used.

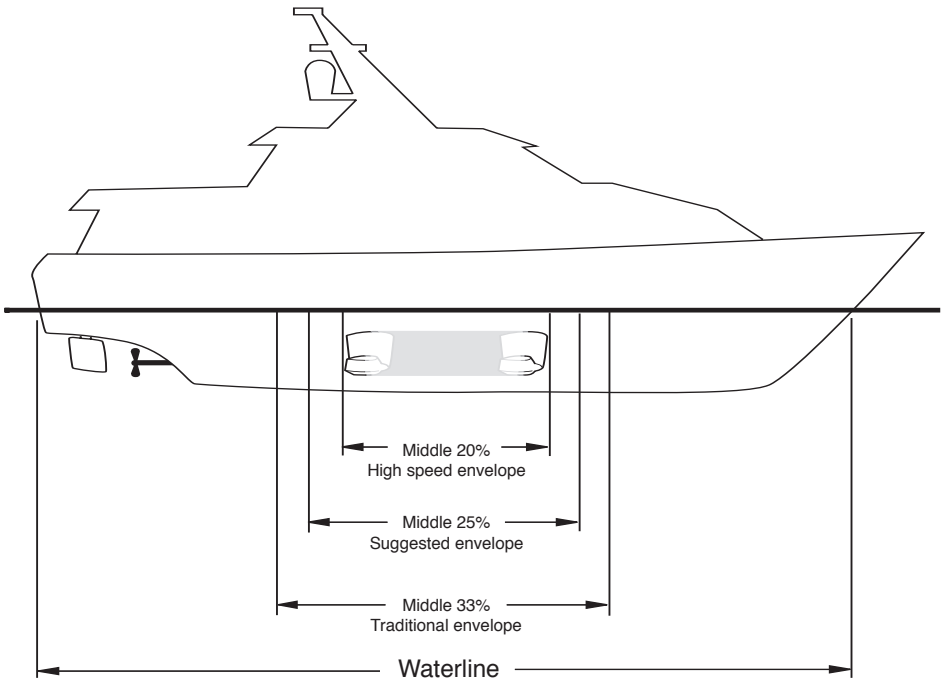


The ideal position

The ideal longitudinal location is usually at 50% of the waterline length.

High speed vessels

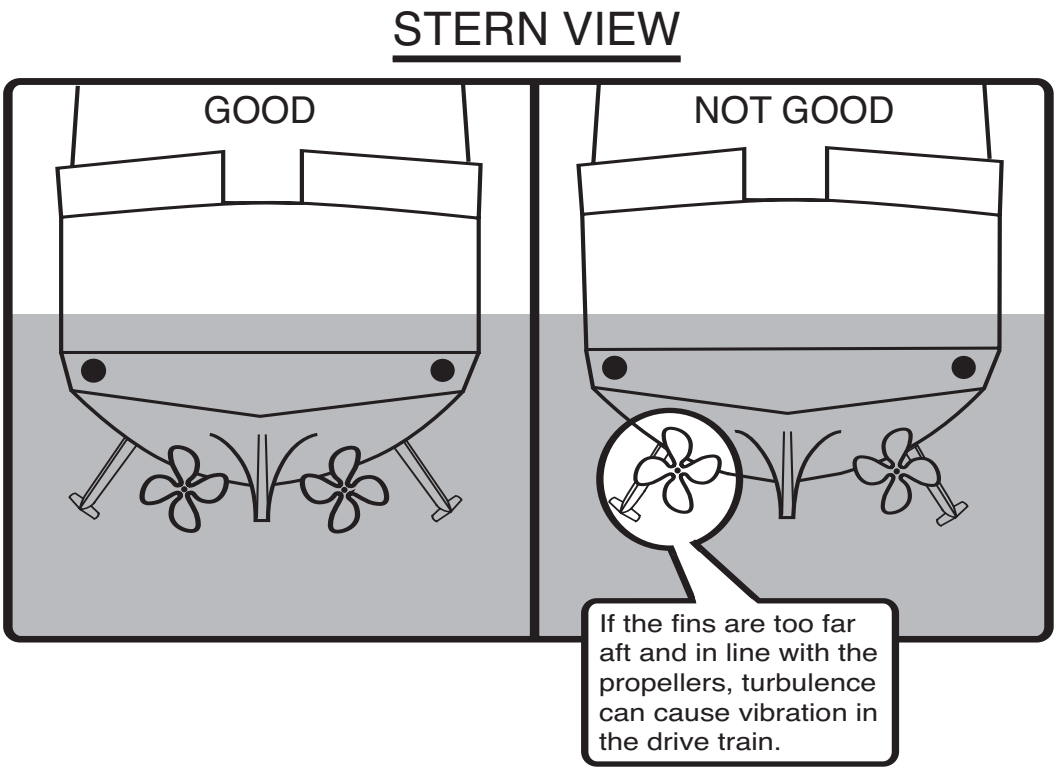
On vessels capable of speeds over 18 knots it is recommended that the fin position be within the middle 1/5 of the waterline length.



Positions too far aft

One of the greater concerns for choice of location relates to the possibility that fin discharge turbulence could affect water flow to the propellers and cause vibration that would transmit throughout the vessel. For locations further aft than the ideal, the athwartship position of the fins relative to the rudders and propellers should be evaluated. Experience has shown that aft locations may be vibration free when gear is at or close to the centerline, away from the path of disturbed water. However, when twin engines are set farther outboard, an aft fin location may lead to vibration problems.

Another concern with aft locations relates to the possibility for fins to produce steering effects. Particularly on hard chine boats, with low deadrise angles at aft locations, fins mounted perpendicular to the hull will behave as large rudders. For best overall compatibility of stabilizers, rudders, and auto-pilot, the fin location should be forward and outboard.



Propeller Vibration

On rare occasion, despite adherence to proper location guidelines, installed equipment has been found to cause detectable propeller vibration. The vibration may appear under infrequent operating conditions, and may disappear in a typical seaway, and it may be decided to take no further action. Beyond this, it is possible that removal of the fin winglets may reduce or eliminate turbulence effects.

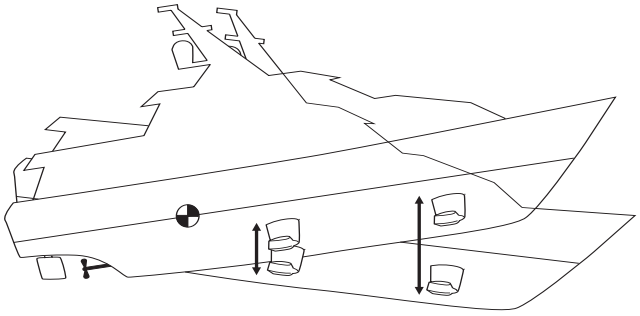
Positions too far forward

At any given forward speed, the stabilizer fins have maximum anti-roll lift potential when commanded to their greatest angle relative to the longitudinal axis of the hull. This maximum lift potential will occur when water flows past the fins along this same axis.

The pitching motion of the vessel distorts the relative direction of water flow past the hull. Flow direction becomes the vector of forward motion and vertical pitch motion. To the extent that the water flow direction across the fins is not along the longitudinal axis, anti-roll potential will be reduced.

Because pitching motion is lessened at the midship position, this is the preferred location for stabilizer fins. When the midship location is not possible, forward locations can be acceptable, especially with full displacement hulls. Some loss of potential from pitching motion may be preferable to possible consequences of aft locations described earlier.

Forward locations with high speed vessels should be evaluated carefully with respect to the possibility for fin surfaces to become exposed at top speeds.

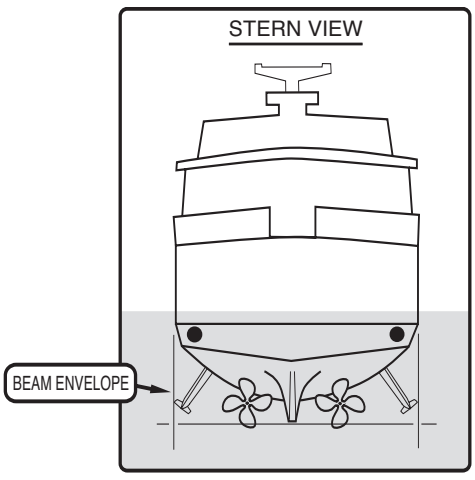


Fins placed far forward experience greater pitching motion which can reduce effectiveness.

Athwartship Fin Position

The fins should be as far outboard as possible without allowing any part of the fin or winglet to extend outside the vessel's beam. A position as far outboard as possible will create the largest lift moment.

A position as far outboard as possible will also minimize opportunity for the fins to send turbulent water toward the gear.

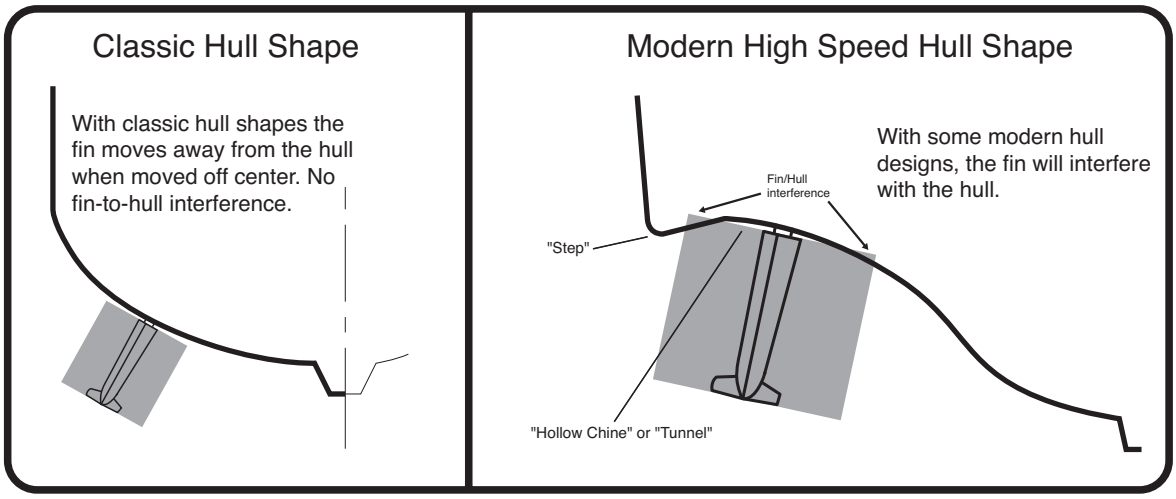


When parallel to the keel, fins should not extend outside the beam and should not extend below the keel.

Fin Clearance Considerations

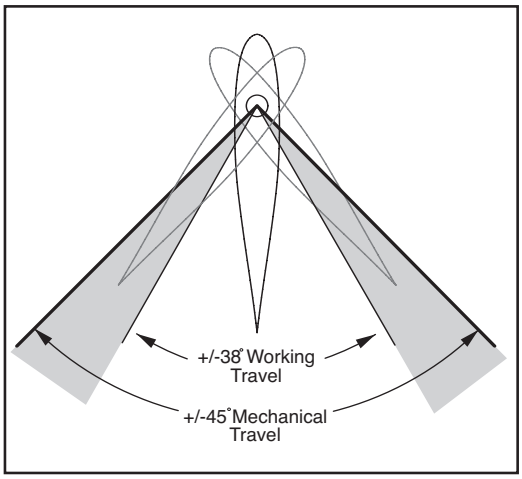
For dimensions, see the appropriate TRAC Digital Stabilizer Specification Sheet (located in Section 1 of this manual). Refer to the actuator size and hull mounting option that will be utilized in your system. In selecting a location for the actuator, consideration must be given to possible interference between the fin and hull at all points within the normal range of fin movement.

For most classic hull forms, the hull exterior will be slightly convex. Usually there will be no fin-to-hull interference in these installations. By contrast, many modern hull forms will have significant “steps” at the chine, or a “hollow chine”, or some other detail making the exterior hull surface concave in the area of fin mounting and movement. The fin may have clearance while centered but will collide with the hull when swept through its range of movement.



Where interference is anticipated, a fin model should be constructed from light plywood to facilitate analysis of the problem. Extra care and planning must be taken to optimize the clearance solution. Available options are illustrated on the following page, and some combination of these must be utilized.

The required free movement range for a fin, based on cylinder travel limits, is +/– 45º from a line parallel to the keel. The fin must be able to move through this range without contacting the hull. The possibility for the fin to wedge fast against the hull must be avoided. In any system, a minimum +/– 38º movement, is required to achieve rated performance.

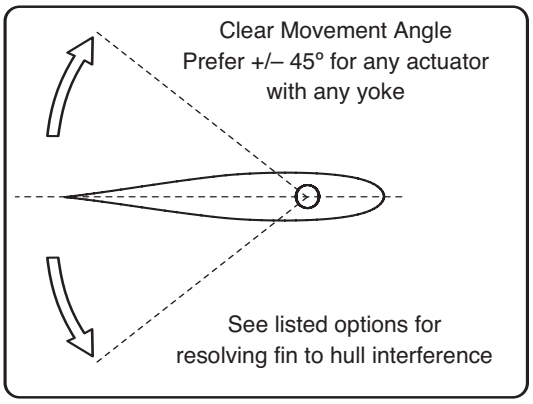


For systems with standard yokes (see Section 6), when +/–45º free range is not possible, the yoke jacking bolts may be set as more restrictive mechanical stops.

For systems with Notch-Lock Yokes, when +/– 45º free range is not possible, it may be possible to fit custom travel stops to the Yoke. Consult ABT to determine whether this is possible.

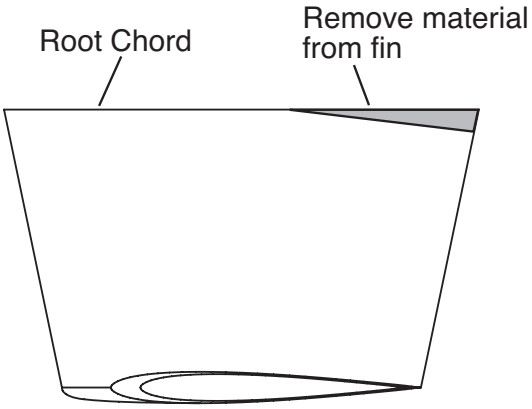
Options for resolving Fin to Hull Interference

When fin-to-hull interference occurs with less than the required +/– 45º free movement range, as measured by angular deflection from a line parallel to the keel, then one or more of the following steps must be taken.



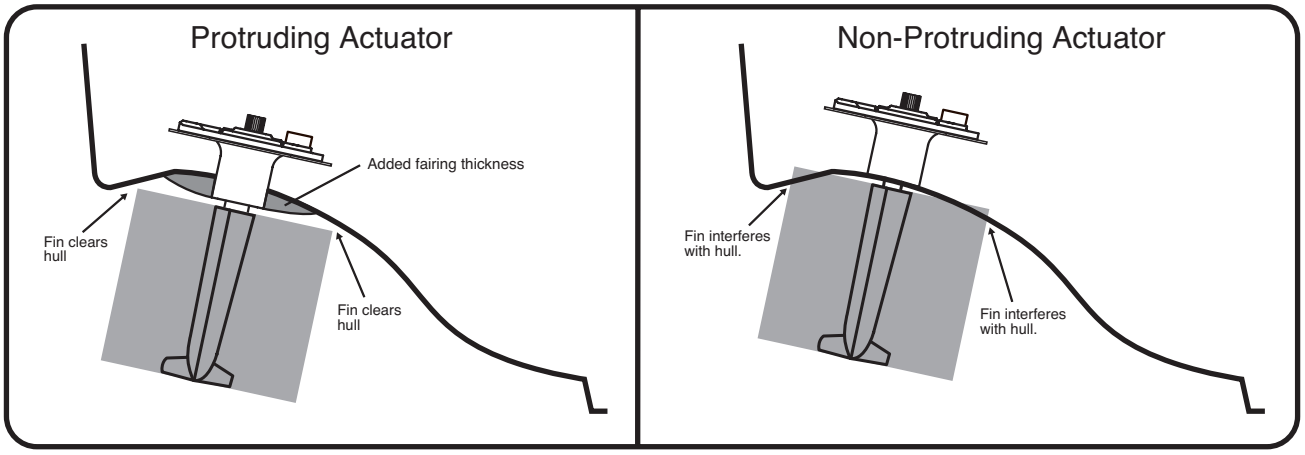
1. The top of the fin, toward the fin's trailing edge, may be trimmed as illustrated here. The extent of trimming should be kept to the minimum necessary to permit required clear movement

Contact the factory for trimming restrictions and for recommended trimming procedure.



2. Install custom mechanical stops on the Actuator Yoke (sizes 220, 300, 370, 640) or on the Actuator Cylinders (size 440). Every effort should be made to preserve at least +/– 38º of controlled fin travel. System performance will be degraded with lesser movement range. Contact factory to discuss mechanical stop options.

3**.** The actuator may be installed with greater than normal extension beyond the the hull. In this case it is imperative that structurally sound fairing be added to the outside of the hull to keep the fin-to-hull gap at normal limits, and to prevent hull induced turbulance from exerting pressure on the fin. These considerations are critically important with semi-planing and planing hull designs. When extension beyond the original hull plane will exceed 15% of actuator housing length. consult ABT to discuss housing support issues.



Inside the Hull – Actuator Clearance Considerations

Pre-Installation Clearances

Dimensions for the actuator with appropriate hull mounting details (for fiberglass or metal hull) are shown on the TRAC Digital Stabilizer Specification Sheet in Section 1 of this manual.

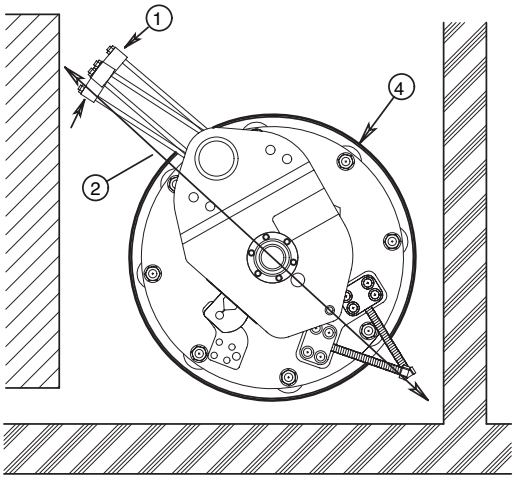
There are three general considerations for space clearances inside the hull.

1. First, there must be clearances for the fixed dimensions of the completely installed actuator assembly. This assembly includes the actuator housing with its integral top flange; equipment and fixtures attached to the top of the actuator flange, including jacking bolts, cylinders, and the top-plate; and the support platform (Inboard Hull Flange or installer's fabricated platform).

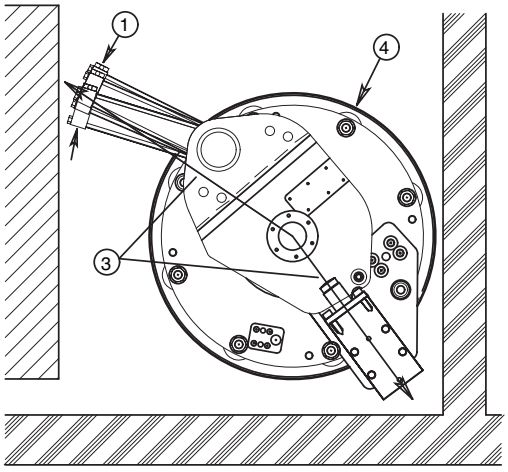
2. Second, there must be clear space for the full range of operating motion for movable parts. This will always include space for cylinder swing. It will also include space for wrench access to Yoke Jacking Bolts and for full retraction of these bolts (except for those systems with Notch-Lock Yokes).

For actuators with Standard Yokes, the cylinder(s) and the Yoke Jacking Bolts line-up roughly on a line through the center of the actuator. The cylinder(s) extends in one direction from center, and the backed-out Jacking Bolts extend in the opposite direction. The installation plan should allow for these extensions.

1. Plan Clearance space for cylinder movement.
2. With Standard Yokes, orient flange risers to position the actuator cylinder and the yoke jacking bolts.
3. With Notch-Lock Yokes, orient flange risers to position the actuator cylinder and the locking cylinder.
4. When riser orientation has been determined, mark the hull flange perimeter and one riser position.



STANDARD YOKE



NOTCH-LOCK YOKE

For actuators with Notch-Lock Yokes, there are no jacking bolts. However, the Locking Cylinder profile extends outside the perimeter of the actuator flange, and the installation plan must provide for this as well as for the body and swing of the Actuator Cylinder.

3. Third, there must be room to lift the actuator vertically above the installed supporting platform in order to insert the actuator's shaft and housing into the center bore of the Hull Flange. There must also be clearance for all other installation steps, including the drilling of fastener holes and wrench motion on actuator fasteners.

The need for this working space will be obvious during initial installation. The need to preserve this working space, for service access to the actuators should not be ignored.

Post-Installation Clearances

After TRAC Actuator installation is completed, it will be important to preserve clearance for service work on the actuators. Good accessibility should be maintained for routine inspection of this through-hull equipment. Actuator hydraulic cylinders and seals will require periodic replacement. Access for Top Plate removal is essential.

In extreme circumstances, complete removal of the actuator from the hull flange could be necessary. The difficulty of this operation will be greatly compounded if permanent structures and heavy equipment are installed in the required service space.

Section 3a

Actuator Installation

Fiberglass Hull
with
Inboard Hull Flange

Important Note:

It is the responsibility of the installer to determine what reinforcement measures should be taken to properly strengthen the hull to withstand forces that may be encountered in the event that the fin, and thus the fin shaft, strike an immovable object while the vessel is under way.

Recommendations made by American Bow Thruster are to be used as starting guidelines only. American Bow Thruster is NOT a naval architecture firm and is NOT qualified to advise on structural matters.

American Bow Thruster strongly recommends that you seek the advice of a naval architect familiar with your make of vessel.

Hull Reinforcement:

Hull reinforcement will be made at a location determined by considerations discussed in Section 2 of this Installation Manual.

As indicated there, the exact location and boundaries of the reinforced area will depend on dimensional factors outside as well as inside the hull. It is important to refer to all relevant dimensional and orientation details for the specific actuator and fin that will be installed.

Outside the hull, the selected location must permit the neutrally positioned fin (fin root chord parallel to the keel) to fit within the beam and keel boundaries of the vessel. Inside the hull, there must be clear space for installation and service procedures as well as for the obvious dimensional limits of the actuator, cylinder and jacking bolt.

The actuator requires periodic maintanance and service.
Provide for adequate access to the actuator.

Hull reinforcement may include increasing the thickness of the hull. It is important to recognize that while reinforcement is usually inside the hull, there may be instances where reinforcement thickening is added outside the hull. In either case, there are limits to total hull thicknesses that can be accommodated by the inboard hull flange and actuator housing. These limits are shown below for each actuator. It is very important to note that these limiting thicknesses apply to measurements made at the center of the actuator shaft, perpendicular to the outside hull and through all layers of reinforcement, hull leveling, and final bedding build-up. See page 3a-3 for measurement illustration.

The forces produced by an active fin and those which may be produced if the fin strikes an object must not be underestimated. The addition of new and significant hull strengthening structure may be required. This strengthening may include, but may not be limited to, new transverse or longitudinal ribs or frames. All existing nearby structural members should be tied into the actuator mounting.

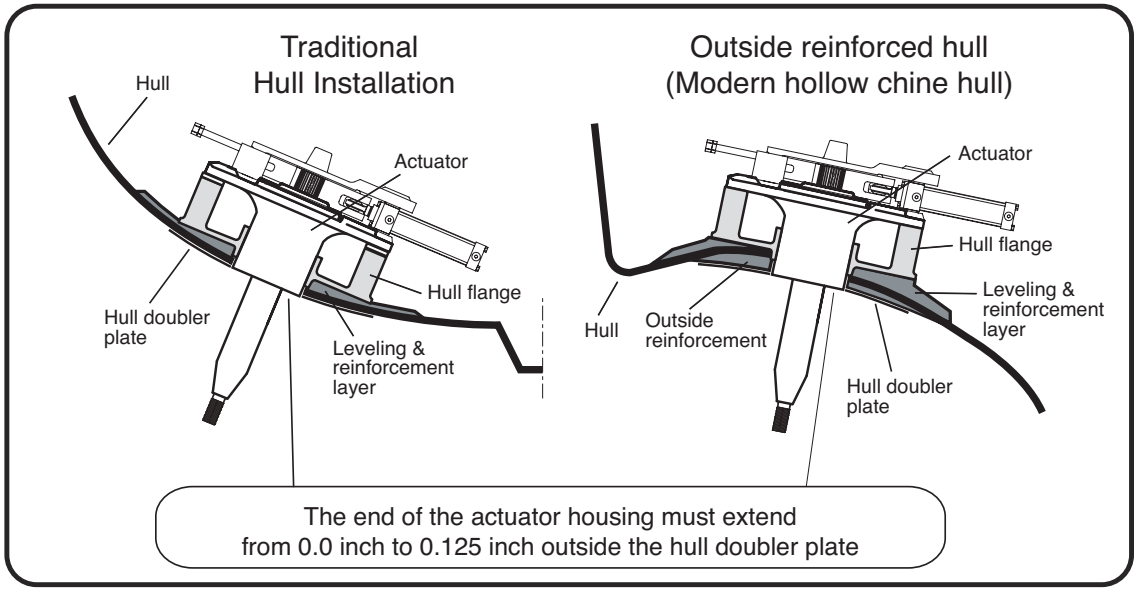
See Section 1 of this manual for operating and breakaway reaction forces.

⚠ WARNING! ⚠

HULL MUST BE REINFORCED TO WITHSTAND GROUNDING OF FIN

Reinforcement Outside the Hull:

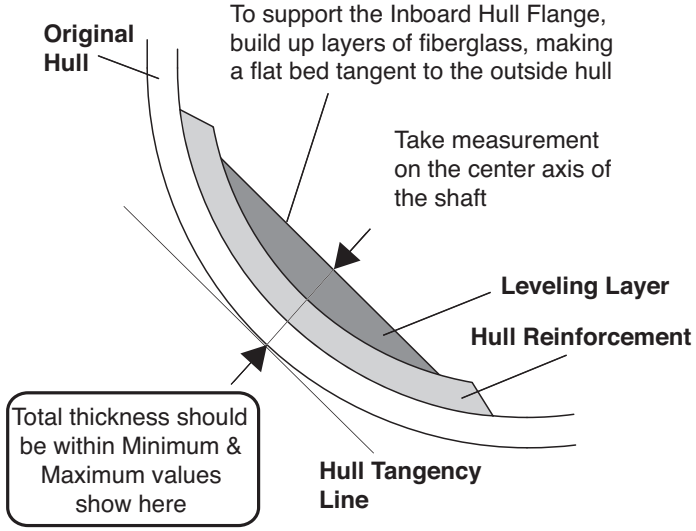
In some cases where fin-to-hull interference is expected, it may be preferred to add structural reinforcement to the outside of the hull. The resulting increased penetration of the actuator housing through the original hull may help to resolve the interference problem. Care must be taken to prevent added structure from causing turbulence in the area of the fin.



Reinforcement and Leveling inside the Hull:

The hull must be built up to provide a flat surface under the Inboard Hull Flange. Make sure the plane of the mounting surface is kept parallel to the plane that is tangent to the outside of the hull. The total final thickness of the hull in this mounting area, measured along the center axis of the actuator shaft, should be within the limits shown below.

When the engineer or naval architect plans for greater hull thickness then shown here, consult with your American Bow Thruster engineer concerning required modification of Inboard Hull Flange riser dimensions. Other installation modifications may also be required.



HULL THICKNESS

SIZE	MINIMUM	MAXIMUM
220	0.75	2.25
250	1.00	2.75
300	1.50	3.00
370	2.00	3.50
440	2.50	4.00

Installation Preview:

The step-by-step sequence for installing TRAC Actuators into fiberglass hulls is presented in this section. Preparatory steps 1 to 30 describe installation of the Inboard Hull Flange. Final steps 31 to 40 describe installation of the actuator into the hull flange.

Actuator size determines one procedural difference at step 20 of the installation sequence. This is related to the use of a companion flange for size 370 and 440 actuators. Except at this one step, the installation sequence will be the same for all actuators.

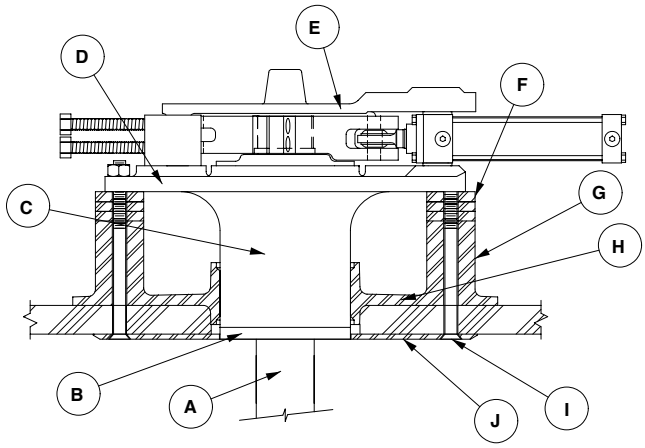
The additional parts for assemblies with actuators larger than size 300 are shown in these illustrations which list major components featured in this installation section.

Labeled assembly components are:

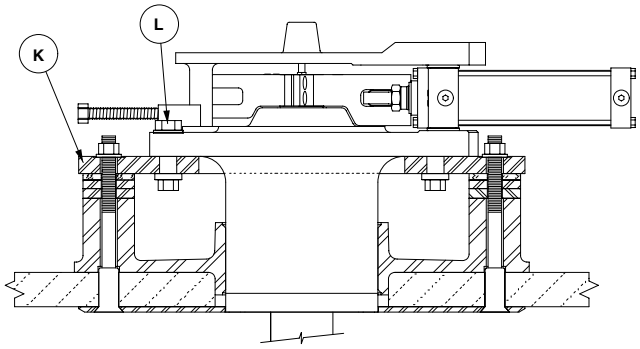
A. Actuator shaft
B. Actuator outboard seal housing
C. Actuator housing
D. Actuator flange
E. Top Plate
F. Hull flange spacer
G. Hull flange riser
H. Inboard Hull Flange
I. Actuator Mounting Bolt
J. Hull Doubler Plate
K. Companion Flange
L. Companion Flange Bolt

With size 370 and 440 actuators, the companion flange will be joined to the actuator flange at step 20 of the installation sequence. In all other respects, installation procedures for the Inboard Hull Flange and Actuators are the same regardless of size.

Size 220 to 300 Assembly Parts



Size 370 to 440 Assembly Parts



Preparing for Actuator Installation:

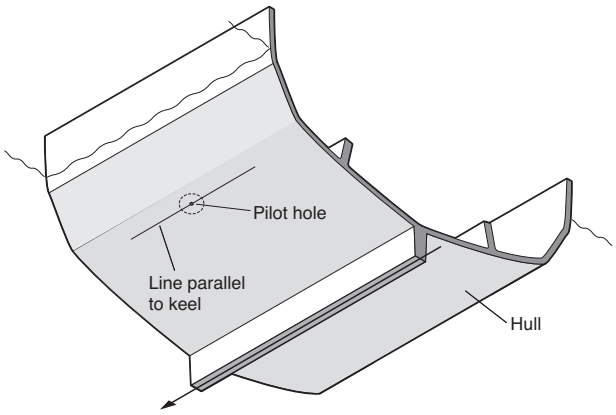
1. Inside the hull, mark the position for the center of the actuator shaft at its intended location.

2. Confirm again that this location allows for clearances described in Section 2 of this manual.

3. Drill a pilot hole at the confirmed location.

4. Inside the hull, measure hull thickness through the hole to the bottom of a straight edge that spans the hull flange mounting diameter. Orient the straight edge to produce maximum gap to the pilot hole opening. Check this thickness against the range shown on page 3a –3.

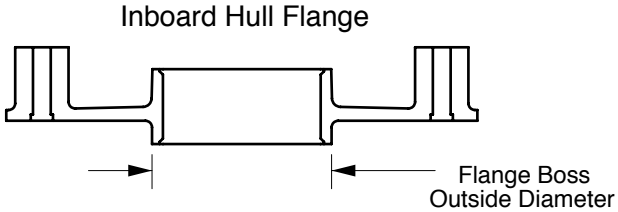
5. Outside the hull, mark a line parallel to the keel, intersecting the pilot hole and extending slightly beyond the forward and trailing limits of the fin. For a fin oriented along this line, and held perpendicular to the hull, the span of the fin must fit above the keel and inside the beam of the boat.



6. Cut the Hull Flange opening. Refer to Table 3a –A for the flange boss diameter and the hole diameter range. Carbide tipped hole saws or blade saws are recommended.

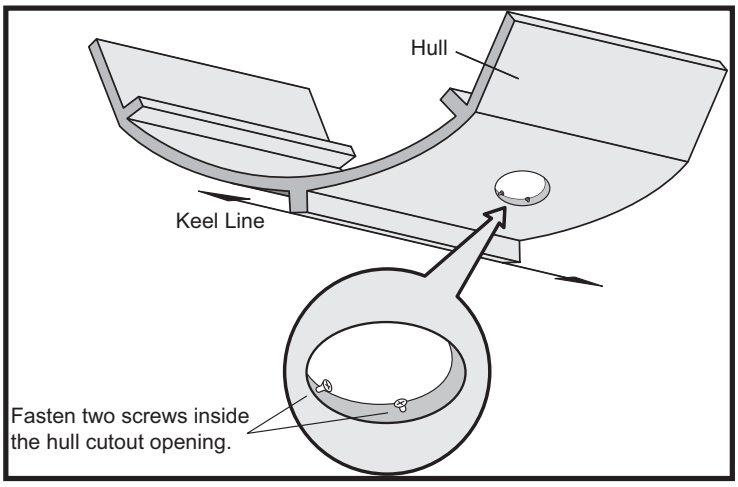
TABLE 3a –A
Inboard Hull Flange - Cutout Diameter

Actuator Size	Flange Boss O.D.	Recommended Cutout Diameter
220	5.42"	5.75 – 6.00
250	7.05"	7.25 – 7.50
300	7.93"	8.25 – 8.50
370	10.10	10.25 –10.50
440	12.60	12.75 – 13.00
440H	12.60	12.75 – 13.00

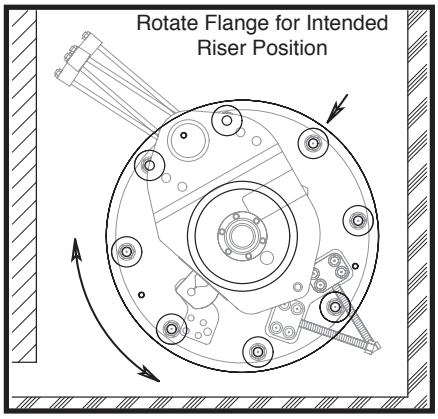


7. Test fit and shim the Inboard Hull Flange into the hull opening. Use two stainless steel screws on the lower side of the cutout opening to shim the boss of the flange into the center of the opening. As shown below, install these shim screws near the inside surface of the hull to allow the perimeter of the flange boss to nest securely between them.

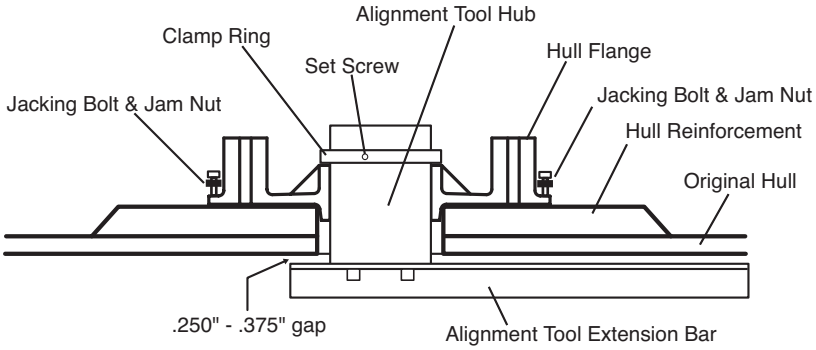
The flange boss must stay in this nested position throughout steps 8 and 9.

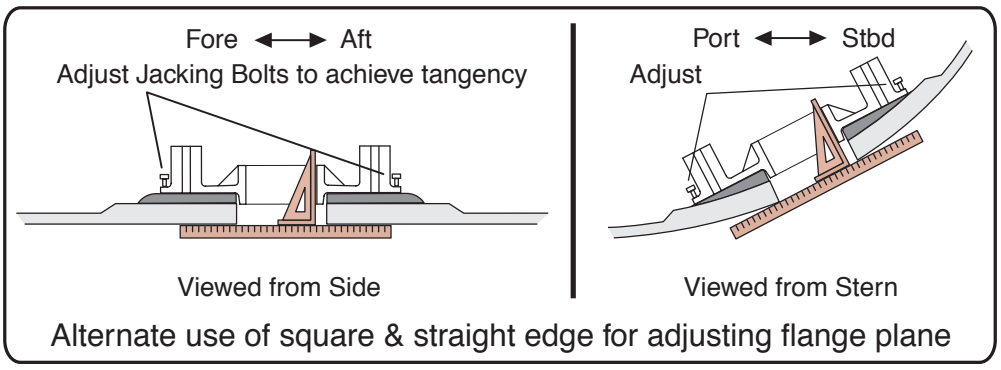


8. Rotate the Inboard Hull Flange to obtain a correct riser position. The correct position will allow the intended orientation of cylinder and jacking bolt extensions from the actuator flange. Make a riser mark on the hull mounting area. As installation of the hull flange proceeds, one of the eight risers must be at the marked location.



9. Adjust the Inboard Hull Flange for tangency to the hull. Use the TRAC Alignment Tool, consisting of a cylindrical hub with an attachable extension bar. Extension bars are factory cut to the length of the fin. Check the length of the supplied bar against the dimension shown on the Specification Sheet.





Alternate use of square & straight edge for adjusting flange plane

9.1. With the tool hub inserted into the flange bore, press the extension bar against the hull and adjust the flange jacking bolts to achieve tangency for both longitudinal and athwartship direction of the bar.

9.2. Next, with the extension bar 0.375 inches from the surface of the hull, rotate the bar +/– 45º from the marked neutral line to confirm required clear movement for the top of the fin. Make slight jacking bolt adjustments as needed to achieve fin clearance for this range of movement.

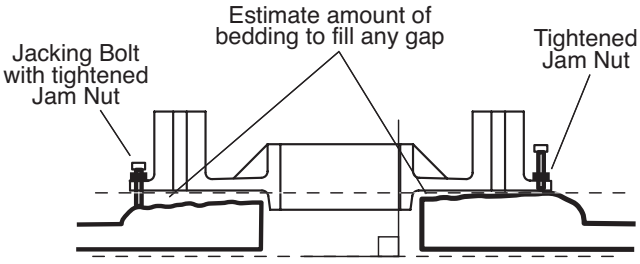
9.3. Finally, make sure that all three jacking bolts are contacting the hull (no rocking with slight pressure) then tighten the jacking bolt jam nuts, and make multiple hull and flange marks to register this install position for the flange. One of the flange risers should be aligned with the riser mark from step 8 above. Also, mark the flange as belonging on port or starboard side of the vessel.

9.4. The registration marks made here must allow the flange to be returned to this exact rotation position, with jacking bolts securely against the hull and with the flange boss properly nested against the bore shim screws.

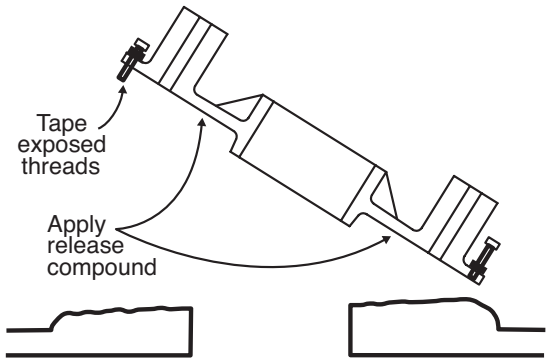
9.5. The jacking bolts must not be turned until final bedding has been added and hardened.

9.6. The hull and flange registration marks must remain distinct until final installation is completed.

10. Make note of the gap between the hull and hull flange for estimation of the amount of final bedding fill that will be needed. Don't underestimate the amount needed if the final bedding is to be completed with one filler application.



Final adjustment for Hull Flange tangency is made with the Hull Flange Jacking Bolts

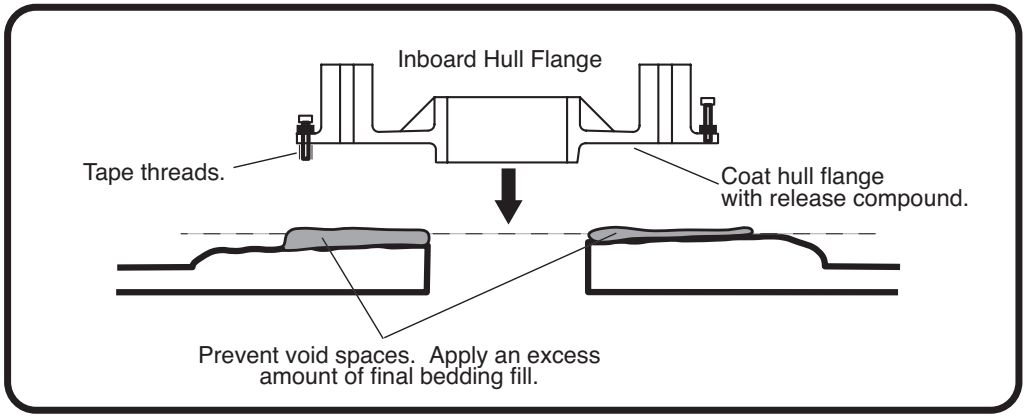


11. Remove the hull flange from its registered position and apply masking tape to cover the eight mounting bolt hole. Also mask the jacking bolt threads when possible, but carefully trim away any masking that would extend beyond the end of the bolt.

12. Thoroughly coat the hull side of the flange and flange boss with mold release compound.

13. Apply the final bedding layer of epoxy compound (resin with high compression strength filler). It is best to use an excessive amount of fill. There must be no significant voids in this layer. Excess fill will squeeze out from beneath the flange.

14. Hold the hull flange above bedding fill with the flange rotated to its proper position.



15. Lower the flange boss into the hull bore, making sure the flange and hull registration marks are properly aligned as the hull flange is pressed into the bedding material.

16. Continue with pressure on the flange until all jacking bolts contact the hull, taking care to nest the boss securely against the shim screws (not on top of the screws).

17. The final bedding epoxy must harden sufficiently for drilling before proceeding. Then, before loosening the flange, complete steps 18 through 26.

18. Thoroughly clean the flange bore, then insert the TRAC Alignment Tool Hub into the bore to retest tangency and clearance of the extension bar through +/– 45 degree displacement from the neutral line.

19. Drill all eight mounting holes from inside the hull using the hull flange risers as drilling guides. See the table below for fasteners, flange hole sizes, and recommended drill sizes. Do not use drill bits larger than the recommended size. For 370 and 440 actuators, drill first at the “Pilot Diameter”; then after completion of installation step 27, after the Inboard Flange is released from the bedding, enlarge the holes through the fiberglass hull to the “Final Drill Diameter”.

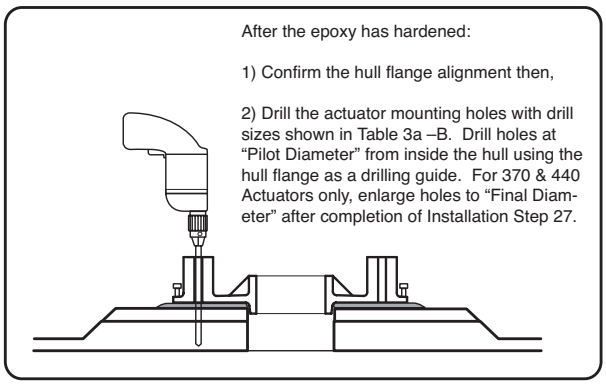
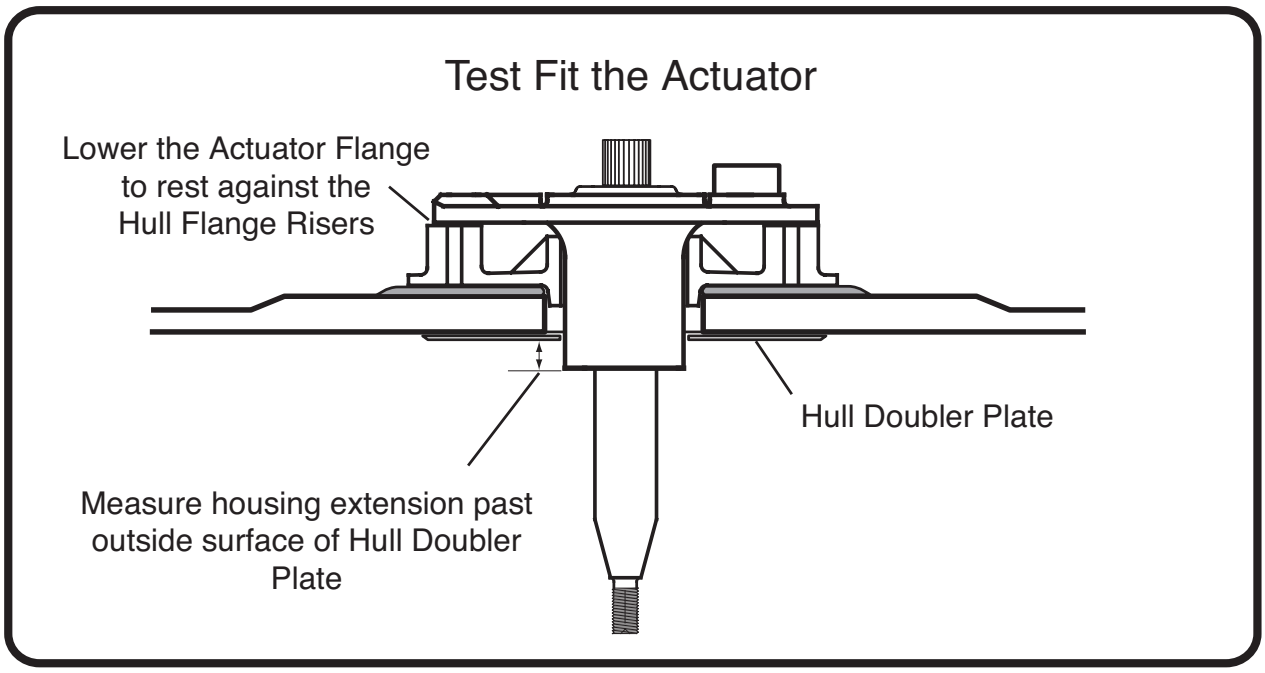


TABLE 3a - B
Drill Diameter for Hull Flange Bolts

Actuator Size	Bolt Size	Flange Hole Dia	Pilot Drill Dia	Final Drill Dia
220	5/8" -11 x 7"	3/4"	11/16"	11/16"
250	5/8" -11 x 8"	3/4"	11/16"	11/16"
300	5/8" -11 x 9.5"	3/4"	11/16"	11/16"
370	M20 -2.5 x 248	1.0"	15/16"	M33
440	M24 -3.0 x 286	1.185"	1-1/8"	M38
440H	M24 -3.0 x 422	1.185"	1-1/8"	M38

• Pilot Diameter is for drilling from inside with Inboard hull flange as drilling guide.
• Final Diameter is for enlarging holes through hull (370 & 440 actuators only) after completion of Install Step 27.

20. Test fit the actuator into the bore of the Internal Hull Flange in order to determine the required height of spacer stacks for the riser columns. Do this by lowering the actuator flange to rest on the top of the hull flange risers. The exact details for this step will depend on the size of the actuator.



20.1. For actuator sizes 220 through 300, simply lower the actuator assembly through the hull flange bore until the bottom of the actuator flange rests against the hull flange risers.

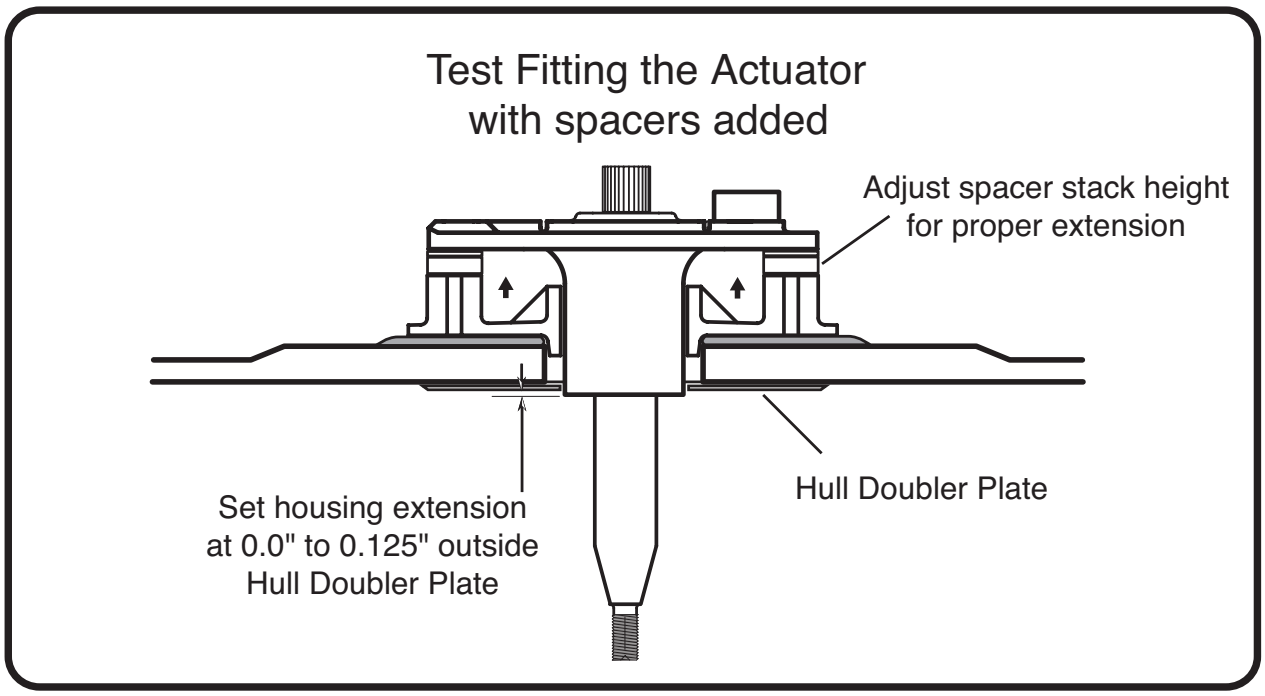
20.2. For actuator sizes 370 and 440, first loosely install the companion flange on top of the hull flange risers. Temporarily install fasteners in at least 4 locations; bolting through the companion flange, hull flange and hull. Use anti-seize compound on the bolt threads.

20.2.1. Now lower the 370 or 440 actuator assembly through the hull flange bore until the actuator flange rests against the companion flange.

20.2.2. Rotate the actuator to its intended position and then install all fasteners for attaching the actuator flange to the companion flange.

20.2.3. The actuator flange bolts are M24 –3.0 x 110 mm. Use high strength locking compound on the fastener threads. Assemble each fastener with a nut and flat washer, and tighten each fastener to 400 ft-lb.

21. For sizes 220 to 300, measure extension of the actuator housing beyond the outside plane of a hull doubler plate when the plate is pressed over the housing into contact with the hull. Measure to 1/32 inch accuracy. This is the estimated maximum spacer stack height. Stacks can be built in increments of 0.125 inches, and should approach but not exceed the measured value.



22. For 370 and 440 actuators, measure extension of the actuator housing beyond the outside plane of the hull. Measure from the hull side of a straight edge held against the housing and pressed to the hull. Take this measure (with 1/32 inch accuracy) at several locations around the perimeter of the housing and use the smallest result. From this smallest result, subtract 0.313 inches to arrive at estimated spacer stack height.

23. Build at least 4 identical stacks of spacers (by securely taping the circumference of each stack).

24. Insert these stacks between the risers and the flange at 90º separation, and check the actuator housing for proper extension beyond the Hull Doubler plate (220 to 300 actuator) or beyond the hull (370 or 440 actuator).

24.1. For 220 to 300 actuators, the correct extension is 0.000 to 0.125" beyond the Hull Doubler Plate.

24.2. For the 370 or 440, the correct extension is 0.313 to 0.438 inch beyond the plane of the hull.

25. Adjust spacer stacks as needed to get the correct housing extension as noted above, then build eight identical stacks for the tested side and mark each final stack for its port or stbd installation.

26. Test fit each actuator with its paired flange on that pair's assigned side of the vessel. Make sure that each actuator and flange is marked for port or stbd side.

27. Separate the Inboard Hull Flange from the flange bedding by turning jacking bolts CW just enough to break the Hull Flange free. Remove and discard the flange jacking bolts. They will not be used again.

28. Completely clean release material and tape from thebottom surface of the Inboard Hull Flange and also from the hull. Use solvents and use mechanical abrasion. These surfaces must be clean, degreased and dry for adhesion of 3M 5200 Sealant.

Also, completely clean and degrease the unpainted surface of the actuator housing; the hull doubler plate; and all actuator hull fasteners.

29. On the outside surface of the hull prepare for mounting the Hull Doubler Plate by grinding away coatings or surface wax from the hull for a diameter slightly greater than the doubler plate.

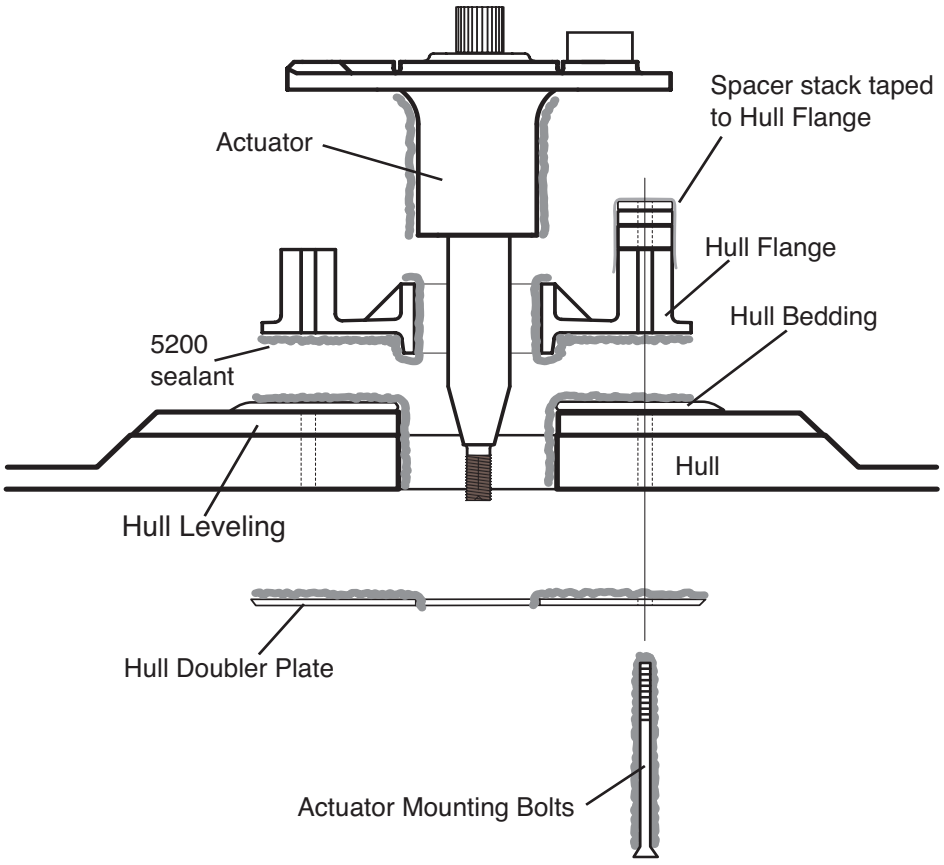
30. Wrap the cleaned actuator shaft with protective sheathing. This wrap can stay in place until the fin is ready for mounting.

Final Steps for Actuator Installation:

31. Secure a prepared spacer stack to the top of each Inboard Hull Flange riser.

32. Apply 3M 5200 Sealant to entirely coat the bottom of the Inboard Hull Flange including the outside perimeter of the flange boss.

33. Now place the Inboard Hull Flange, with its properly registered rotation, into position against the hull. Drilled holes should align with flange riser holes.



34. Apply 3M 5200 Sealant to:

34.1. The hull side of the Hull Doubler Plate, around its outside perimeter, around all bolt holes, and around the center opening. Lay down a 3/16 inch bead of sealant in all locations, except with larger actuator sizes, increase the amount of sealant around the center opening to match a larger pocket between the housing and hull cutout edge.

34.2. The entire shank area of all eight actuator fasteners; obtaining complete coverage with sealant.

34.3. The entire bare metal outside surface of the actuator housing, from the outboard end of the housing to the inboard end, where the radius turns toward the flange.

34.4. The inside walls of the Inboard Hull Flange Bore.

35. Now position the properly rotated actuator above the Inboard Hull Flange bore and lower the actuator flange onto the tape-secured spacer stacks.

36. Outside the hull, fill the void between the actuator housing and the hull cutout surface with 3M 5200 sealant, then immediately press the Hull Doubler Plate into position.

37. Pump 5200 Sealant into two bolt holes (at 180º separation) then insert bolts at these locations and tighten nuts just enough to retain the doubler plate against the hull. Do not cause the doubler plate to bend to hull curvature until all bolts have been inserted.

IMPORTANT: When tightening mounting bolts, don't allow the bolt shanks to twist. Insert the coated bolt into a sealant filled hole, then hold the bolt against rotation while the nut is tightened from inside.

38. Install the remaining fasteners, one by one. First pump 5200 Sealant into the hole from outside. Work the sealant onto the hole surface with an appropriately long rod. Next insert a sealant coated bolt, then while hold the bolt head with a hex wrench, the nut should be loosely tightenen to capture the bolt.

39. After all fasteners have been loosely installed, proceed with a repeated crossing sequence, bring all fasteners to medium tight; then to tight; and finally to full tight. At all times, prevent rotation of the bolts as nuts are progressively tightened. Tighten to final torque values shown below in Table 3a –C. The Hull Doubler Plate will bend to conform to the hull curvature and excess sealant will be extruded from beneath the plate.

TABLE 3a –C
Hull Flange Bolts
Tightening Torque Values

Size	Fastener	Ft-lb	N-m
220	5/8 –11	100	136
250	5/8 –11	100	136
300	5/8 –11	100	136
370	M20	150	203
440	M24	250	339

40. Clean up excess 5200 Sealant inside and outside the hull.

IMPORTANT: Do not use alcohol to clean-up 3M 5200 Sealant at any hull-to-actuator, hull-to-flange, or hull-to-doubler plate area. Alcohol will migrate into the sealant and prevent proper cure. Use ONLY Acetone or Mineral Spirits at these locations.

Section 3b

Actuator Mounting

Steel or Aluminum Hulls

Important Note:

It is the responsibility of the installer to determine what reinforcement measures should be taken to properly strengthen the hull to withstand forces that may be encountered in the event that the fin, and thus the fin shaft, strike an immovable object while the vessel is under way.

Recommendations made by American Bow Thruster are to be used as starting guidelines only. American Bow Thruster is NOT a naval architecture firm and is NOT qualified to advise on structural matters.

American Bow Thruster strongly recommends that you seek the advice of a naval architect familiar with your make of vessel.

Hull Reinforcement:

Hull reinforcement will be made at a location determined by considerations discussed in Section 2 of this Installation Manual.

As indicated there, the exact location and boundaries of the reinforced area will depend on dimensional factors outside as well as inside the hull. It is important to refer to all relevant dimensional and orientation details for the specific actuator and fin that will be installed.

Outside the hull, the selected location must permit the neutrally positioned fin (fin root chord parallel to the keel) to fit within the beam and keel boundaries of the vessel. Inside the hull, there must be clear space for installation and service procedures as well as for the obvious dimensional limits of the actuator, cylinder and jacking bolt.

The actuator requires periodic maintanance and service.
Provide for adequate access to the actuator.

Hull reinforcement may include increasing the thickness of the hull. While reinforcement is usually inside the hull, there may be instances where reinforcement thickening is added outside the hull. In either case, there are limits to total hull thicknesses that can be accommodated by the actuator housing and supporting platform. These limits will depend on the size actuator and the design plan the support platform. For dimensions, consult the appropriate TRAC Specification Sheet in Section 1 of this manual.

The forces produced by an active fin, and those which may be produced if the fin strikes an object, must not be underestimated. The addition of new and significant hull strengthening structure may be required. This strengthening may include, but may not be limited to, new transverse or longitudinal ribs or frames. All existing nearby structural members should be tied into the actuator mounting.

See Section 1 for stabilizer operating an break away reaction forces.

⚠ WARNING! ⚠

HULL MUST BE REINFORCED TO WITHSTAND GROUNDING OF FIN

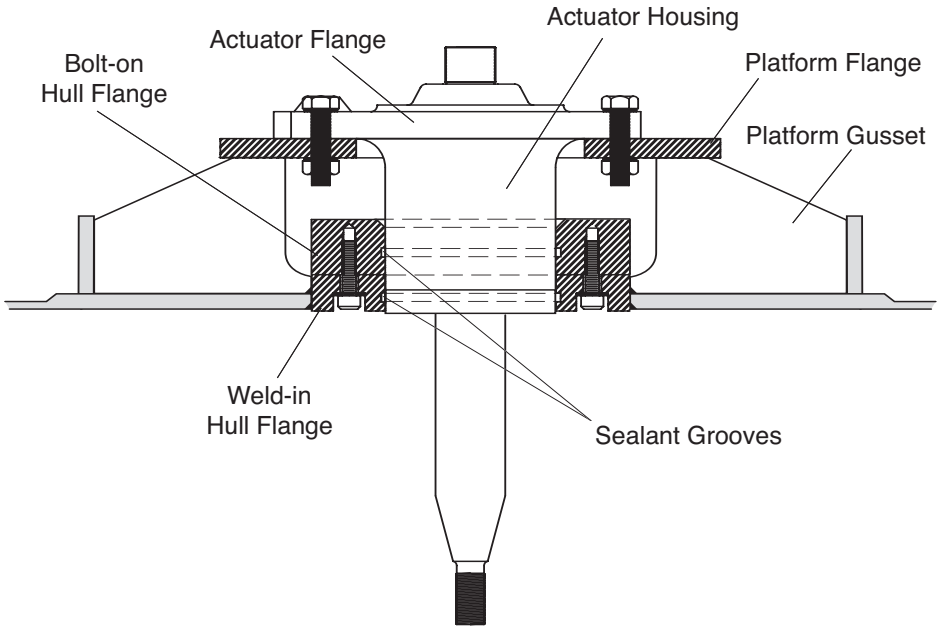
Actuator Installation for Metal Hulls

Actuator installation will follow a sequence of four basic steps:

1. Reinforce the hull.
2. Install the Hull Flange Assembly.
3. Design, fabricate and install the Platform Flange.
4. Install the Actuator.

An overview of the Actuator, Hull Flange Assembly and Platform Flange components, with the relationship between these major components and hull structures, is shown in Figure 1.

Fig. 1 Installed Actuator – Partial cutaway View

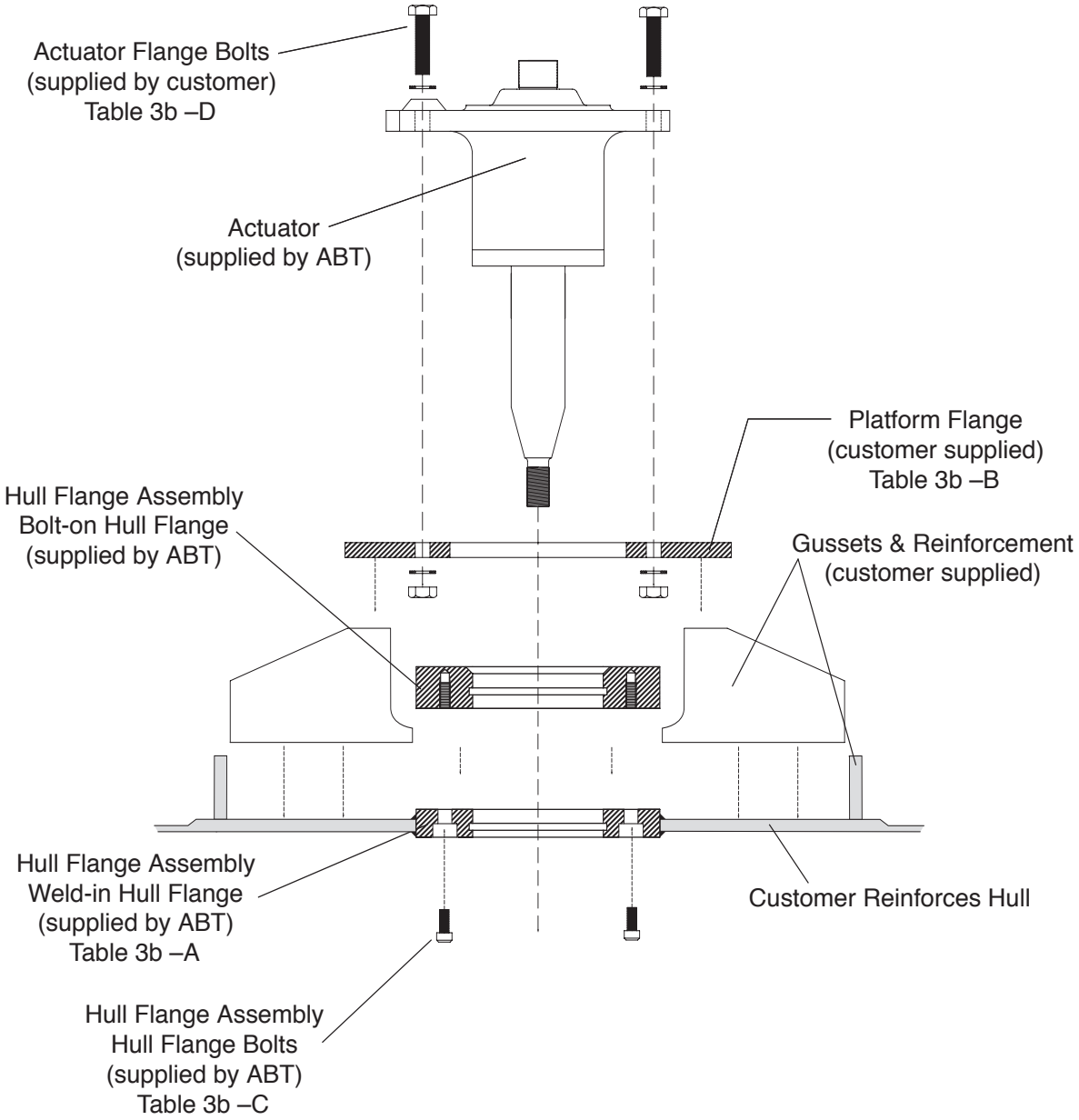


The Hull Flange Assembly consists of an exterior Weld-in flange and an interior Bolt-on flange which together capture and seal around the perimeter of the actuator housing. The Hull Flange assembly supports the end of the housing and transfers some lifting forces into the hull.

The Platform Flange supports the actuator at the correct height, and together with its gusset assembly, transmits most of the fins lifting forces to the hull.

Another view of major components is shown in Figure 2. This illustration indicates indicates which system parts are supplied by ABT and which parts must be designed and provided by the boat builder or system installer.

Fig. 2 Actuator Installation Parts – Exploded View



One suggested general plan would call for the upper flange platform surface to be supported by and connected to the hull through an assembly of eight gussets. The overall size of the platform and gusset structure would be a function actuator size and hull strength. Lighter hulls would have larger platforms to distribute lifting and breakaway forces to a larger hull area.

Dimensions for all parts provided by ABT are found on the TRAC Stabilizer Specification Sheet in Section 0 of this manual. Platform Flange and gusset dimensions shown on the Specification Sheet are initial recommendations only, and should be modified appropriately by the installer's naval architect. Some required dimensions of the Platform Flange are also presented later in this section in Table 3b –B.

Hull Reinforcement

Hull reinforcement will be done in the area chosen for the actuator by consideration of details presented in Section 2 of this manual. Those considerations, which apply to any installation, relate to stabilizer performance,fin and actuator dimensions, and equipment clearances.

Other dimensions, especially the length of the actuator housing, will be important in fixing the location of the platform flange (fabricated by installer) at the proper distance from the exterior side of the hull flange assembly (provided by ABT).

The operating and break-away reaction forces, for the actuator shaft, are provided in Section 0 of this manual for reference in planning hull reinforcement details.

Hull reinforcement may include increasing the thickness of the hull with additional plating on interior or exterior surfaces as determined appropriate by the naval architect.

In the planning stages for reinforcement, it would be useful to initially determine whether there will be external fin-to-hull clearance problems, and then detemine how resolution of these problems will fit with the overall plan.

Whenever the exterior hull shape is altered, special care should be taken to fair any added structure in a manner that will minimize water turbulence at the leading edge of the fin.

Install the Hull Flange Assembly

1. At the selected shaft location, mark an actuator shaft center point on the hull, and scribe a line through this point, parallel to the keel, and extending beyond the fore and aft edges of the fin.

2. Cut a hole through the hull to accept the Weld-in Flange.

The Flange diameter is given in Table 3b -A. Be careful to make hull cutout with a diameter that will allow a proper fillet weld to the perimeter of the Weld-in Flange.

3. Shim the Weld-in Flange into the cutout hole with the outside surface of the flange extending outside the surface of the hull by 0.25 inch at the longitudinal centerline.

TABLE 3b –A
Hull Flange Outside Diameter

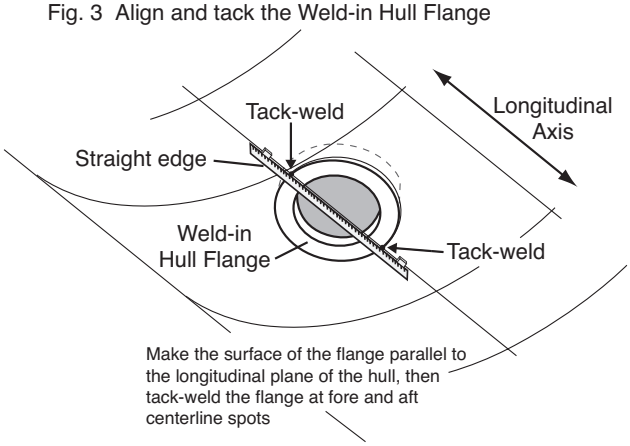
Actuator Size	Weld-in Flange o.d.	
	Inches	(mm)
440	15.900	(404)
370	13.125	(334)
300	11.250	(286)
250	10.300	(262)
220	8.750	(223)

Do this, as shown in Fig. 3, by holding a 4ft long straight edge parallel to the keel and across the center of the flange, with the ends of the straight edge shimed 0.25" from the hull.

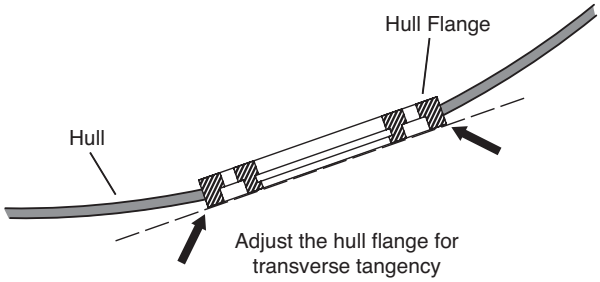
4. Bring the fore and aft faces of the flange into contact with the straight edge, and make the inboard and outboard centers of the flange have near equal extension outside the hull.

5. Tack weld the flange to the hull at forward and aft centerline spots.

Fig. 3 Align and tack the Weld-in Hull Flange



6. Adjust the athwartship plane of the flange by tapping the flange with a dead blow hammer to make this plane tangent to the ships hull; then tack weld inboard and outboard spots at the flange centerline.

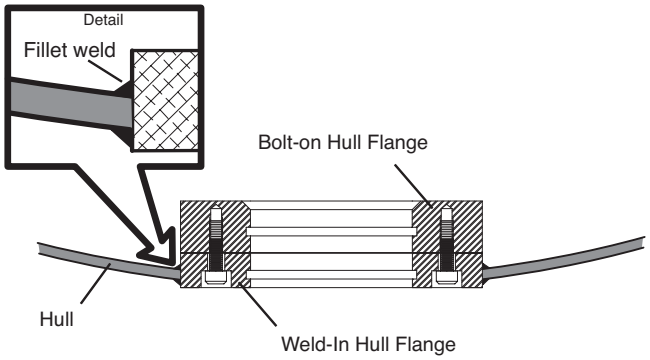


7. Re-evaluate the plane of the Weld-in Flange for tangency to the hull. Use a straight edge that will extend the full length of the top chord of the fin. Hold the straight edge flush with the flange and check for clearance from the hull for +/– 45º fin movement from the centerline.

When fin-to-hull interference will occur within +/–45º, resolve this clearance problem with options listed in Section 2 of this manual before proceeding with final welding.

8. Fasten the Bolt-on Inboard Flange to the Weld-in Hull Flange. Install and tighten all bolts. The Bolt-on Flange must be attached during final welding in order to minimize distortion of the Weld-in Flange.

9. Weld the hull flange to the hull plating with a fillet weld around the entire perimeter of the Weld-in Flange at both outboard and inboard surfaces. The welds must have full joint penetration. Consult with the project naval architect for proper welding procedure.



Design, fabricate and install the Platform Flange

10. Fabricate Platform Flanges according to the naval architects specifications.

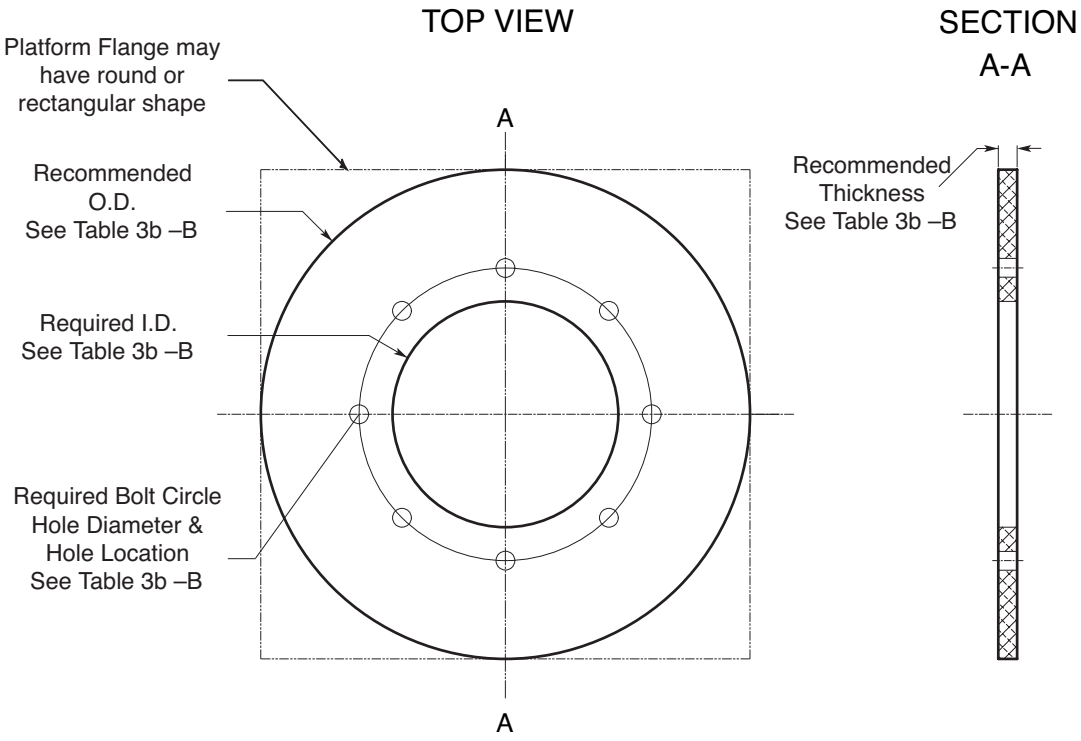


Table 3b –B

Platform Flange - Provided by Installer (dimensions are inches except **)

Actuator	Required I.D.	Required Bolt Circle	Required Drilling 8 places @ 45°	Recommend O.D.	Recommend Thickness	Flange Bolt Diameter
220	9.00	13.106	21/32" (0.656)	18.30	0.50	0.625
250	10.5	15.438	21/32" (0.656)	22.00	0.75	0.625
300	11.50	17.156	21/32" (0.656)	24.00	1.00	0.625
370	13.25	15.551	1.0"	26.00	1.25	M24**
440	16.25	18.769	1.0"	32.75	1.25	M24**
440H	16.25	18.769	1.0"	32.75	1.25	M24**

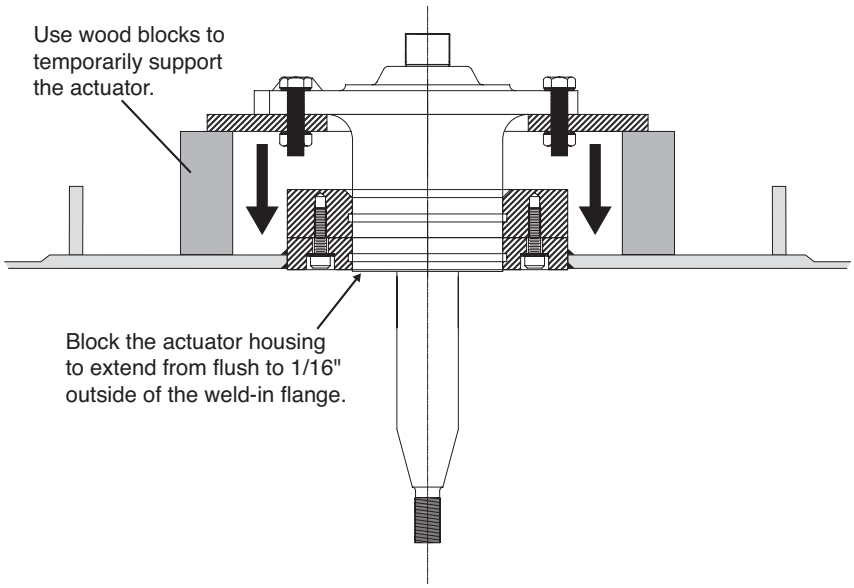
11. Bolt the Platform Flange securely to the bottom of the TRAC Actuator Flange. All fasteners should be installed with anti-seize compound and moderately tightened. Fasteners will be re-installed during final installation of the actuator.

12. Thoroughly clean and then lightly grease the outside of the actuator housing. Also clean-up and grease the bore of the hull flange assembly. Keep the Bolt-on Flange securely attached to the Weld-in Flange.

13. Using suitable equipment for lifting and holding, carefully lower the actuator shaft and housing through the bore of the hull flange until the end of the actuator housing is flush with the exterior plane of the flange.

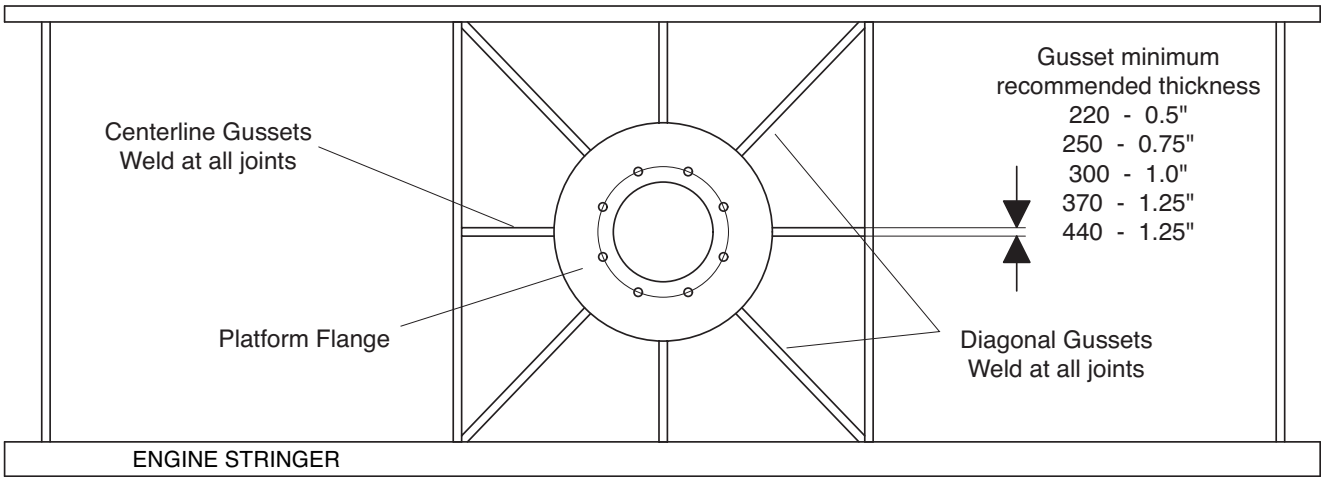
14. The actuator and Platform Flange unit should be rotated to a position that allows intended extension of the actuator cylinder, and the yoke jacking bolts or locking cylinder (Section 2 of this manual).

15. Block the Platform Flange securely at four locations, with the end of the actuator housing extending 0" to 1/16" outside the hull flange. Do not allow the end of the actuator housing to be recessed into the hull flange assembly.



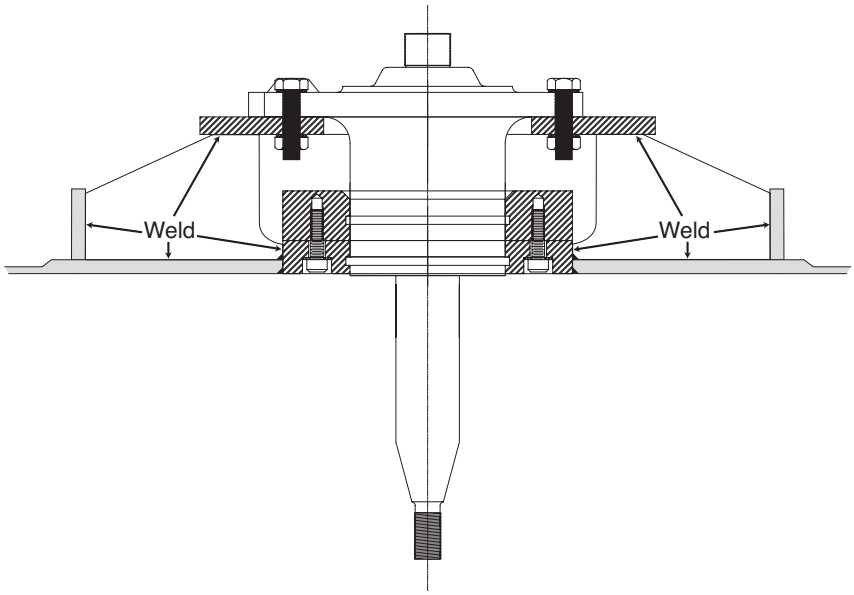
16. Fabricate, test fit, and weld the supporting gussets into place. It is suggested that four gussets should first be placed and partially welded. Then the temporary blocks can be removed, and the remaining gussets can be installed and partially welded.

Typical Gusset Pattern for Platform Flange



17. Final welding should be completed with fillet welds at all gusset joints to the platform flange, to the hull plating, and to any other contacting surfaces including the perimeter of the Weld-in Flange and hull stringers or ribs.

Do not weld to the Bolt-on Hull Flange.



18. Remove the actuator flange fasteners and remove the actuator assembly from the Hull Platform.

19. Remove the Bolt-on Inboard Flange from the Weld-in Flange.

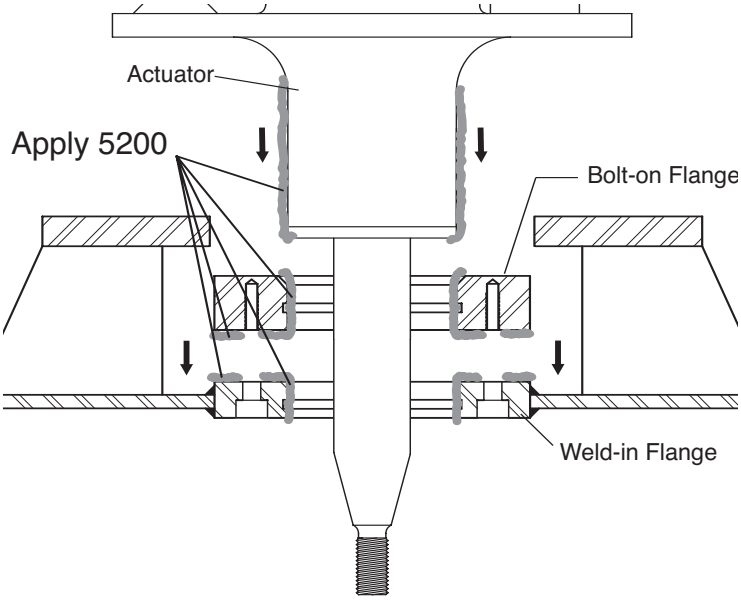
20. Thoroughly cleanup and degrease all surfaces of the actuator housing, the hull flanges, the actuator-to-platform fasteners, and the hull flange fasters.

21. Coat the entire bare metal housing of the actuator with 3M 5200 Sealant.

22. Apply sealant to the sealant groove of the Weld-in and the Bolt-on Hull Flanges. Run this bead entirely around the inner circumference of the flanges.

Next coat the rest of the inside bore of both flange pieces, and also coat the mating surfaces of the flanges. Take care to keep sealant out of the fastener holes.

The inside bore of the flanges must have 100% sealant coverage.



23. Shim the Bolt-on Flange just slightly above the welded flange to avoid pressing sealant into fastener holes.
Then thread fasteners, coated with medium strength locking compound, into all fastener holes.

24. Remove the shims to mate the flange surfaces, then loosely tighten the flange fasteners, leaving the ability to slightly slip the mating flange faces during actuator installation.

25. Lift the actuator, rotated to its correct position, and lower the shaft and housing through the hull flange bore. Slip the hull flanges as necessary for insertion of the housing.

26. Tighten the hull flange fasteners to the torque values shown in Table 3b –C.

Table 3b –C
Hull Flange Screw Installation Torque (note 1)

Actuator Size	Flange Fastener	Installation Torque (ft-lb)	(Nm)
440	M20 -2.5 X 60	140	190
370	5/8 -11 X 1.5	70	95
300	1/2 -13 X 1.5	50	68
250	1/2 -13 X 1.75	50	68
220	3/8 -16 X 1.25	14	19

notes: 1. Use medium strength thread locking compound.

27. Install the actuator flange fasteners with lock washers and high strength locking compound on fastener threads. Tighten to torque values shown in Table 3b –D.

TABLE 3b –D
Actuator Flange Bolts (note 1)
Installation Torque (note 2)

Size	Fastener	Ft-lb	N-m
220	5/8 –11	140	190
250	5/8 –11	140	190
300	5/8 –11	170	230
370	M24	400	542
440	M24	400	542

Note 1 - Grade 8 steel bolts, nuts & washers
Note 2 - Loctite®262 on threads & under nut

28. Cleanup 3M 5200 Sealant with acetone or mineral spirits. Do not use alcohol solvents. Alcohol will migrate into and interfere with proper setting of this sealant.

Section 4

Test Fitting the Fin

Decide about Test Fitting the Fin -

Occasionally, the decision may be made to proceed directly to final installation of the fin instead of test fitting the fin. This decision rests entirely with the installer but may be guided by considerations listed here.

(1) where the exterior hull shape is flat or convex, and
(2) where the alignment tool was used to confirm absence of fin-to-hull interference through +/– 45º displacement from the neutral line (line parallel to the keel), and
(3) where there is confidence that the alignment tool was properly assembled, and that the tool extension had proper length and that the extension bar was not bent,

then it may be decided to proceed directly with final installation of the fin (see Section 5 of this manual).

For complete confidence, test fit the fin even if the test fit procedure is simplified by holding and rotating the fin on the shaft without installing the fin nut.

Test fitting should be done when any of the following apply:

(1) Whenever the exterior hull shape is concave.
(2) Whenever the fins have been trimmed for fit.
(3) Whenever (with Standard Yokes only) it is expected that special adjustment of yoke jacking bolts will be required as mechanical stops, and close analysis is important.
(4) Whenever a proper alignment tool was not used to confirm absence of fin-to-hull interference.

Test Fitting vs Final Installation of Fin -

Test installation will differ from final installation in three respects:

1. For simple checks that do not require measurements or adjustments, and when fins are small size, it may be un-necessary to install the fin nut. It may be sufficient to check rotation clearances while holding the fin fully lifted onto the shaft.

2. For checks involving heavy fins, or where measurements or adjustments will be required, the fin nut will be installed but not tightened to final torque values.

3. Fin nuts must be engraved “LOCTITE ® 262”. These nuts are machined from Nitronic 60 material and, for test fitting, may be installed dry or with grease onthe shaft threads.

For any nut installation, the precautions listed immediately below must be observed.

Precautions for Test Fitting the Fin -

WARNING !!! There is risk of seizing a fin nut on the actuator shaft if these precautions are not followed. Remedial steps for a seized nut may include changing the actuator shaft! Avoid this potential problem by observing the points listed below:

1. Use only the fin nut that was shipped with the system. This nut must be engraved with "LOCTITE 262".

2. Inspect the shaft threads according to whichever of the following applies:

2.1. When a nut is found installed on the shaft and is found to turn smoothly off the shaft threads, then the newly exposed threads may be considered to be free of defects.

2.2. When shaft threads have not been continuously protected by a nut, then the threads must be inspected, repaired as needed, and tested with hand threading of the nut.

During hand threading, at any sign of resistance, stop!!; remove the nut; correct the thread repair; clean the threads; and re-test the nut.

3. Fin nuts engraved "LOCTITE 262" are machined from Nitronic 60 material and may be installed onto dry or greased shaft threads during test fitting.

4. Always hand tighten the nut while removing all fin slack. Lift and hold the fin fully engaged onto the shaft. Don't use the nut to hoist the fin onto the shaft. Do not use seating force, except to overcome the weight of the fin, until the fin is fully lifted onto the shaft (top of fin less than 1/2" from end of actuator seal housing).

Maintain maximum hand "feel" for proper threading of the nut, and If resistance is felt when the fin is still slack, then stop, reverse, and inspect the shaft threads.

5. Warning! Never use an air impact wrench to install or remove the fin retaining nut.

6. Do not allow the fin socket to contact the shaft threads when hoisting the fin onto the shaft. If any contact occurs, repeat from thread inspection.

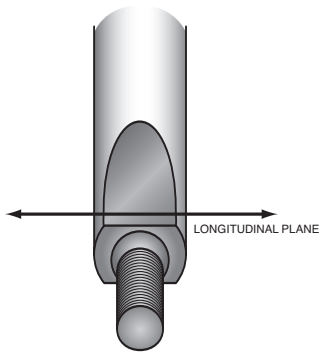
Test Installation Procedure

1. Thoroughly clean the actuator shaft. Check and remove any burrs or roughness.

2. Rotate the shaft until the end flats are horizontal, then coat the shaft with grease.

3. Thoroughly clean the fin socket. Check and remove any burrs or roughness, then lightly grease the upper rim of the socket.

The flats on the shafts should sit horizontal to the longitudinal plane of the vessel.

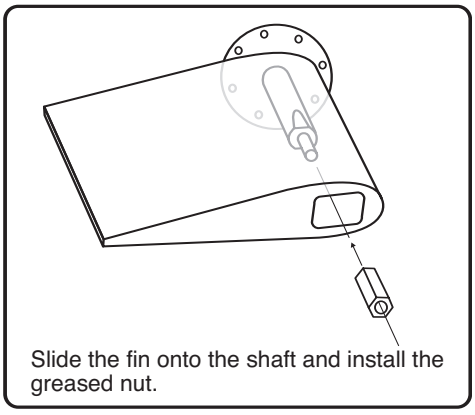


4. Remove the fin nut from the shaft threads. Important!! If the nut was found off the shaft such that the shaft threads have not been continuously protected by the nut, then revert to item 2.2 under **PRECAUTIONS** earlier in this section.

5. Make sure the nut is engraved “LOCTITE 262” and that shaft and nut threads are clean.

6. Lift the fin socket onto the shaft, taking extreme care to avoid touching the shaft threads. If thread contact occurs, and if the fin nut is to be installed then STOP, and repeat steps from step 4.

7. Fully lift the fin onto the shaft. If the fin nut is to be installed, hold the fin fully lifted onto the shaft to allow the nut to be turned by hand into contact with the socket. Don’t use the nut to jack the fin upward onto the shaft.

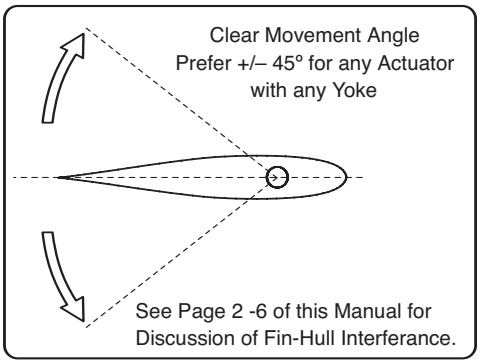


Slide the fin onto the shaft and install the greased nut.

The fin must be guided onto the shaft with force only as required to overcome gravity until the top of the fin is within 0.5 inches of the actuator seal housing. If resistance is felt before this approximate position is acheived, then the flats on the shaft are not properly aligned with the flats in the fin socket. This alignment must be corrected before proceeding.

8. Install the fin nut if needed for the test, but make the nut just snug. Do not tighten.

9. Test the fin motion for full required range as discussed earlier in Section 2 of this manual.



Required range of motion was discussed in Section 2 and is shown again in the adjacent illustration. The fin must have +/- 38º travel for full system performance.

If contact with the hull occurs within +/– 45º travel, the fin must not be able to wedge fast to the hull surface. With Standard Yokes, jacking bolt stops may be set to restrict fin motion to +/– 38º. This will be done after final installation of the fins (Section 5) and after installation of the yokes (Section 6).

10. If the requirements of step 9 are met, then test fitting is complete and the fins may be removed. If the requirements of step 9 are not met then additional steps must be taken to resolve the clearance problem before proceeding.

11. If re-testing is required, repeat from step 1 of this procedure.

12. After test fitting is completed, remove the fin nut (if installed) and then carefully lower the fin off the shaft.

Hold the fin fully engaged until the nut is off the threads, then take extreme care to support the fin as the socket clears the shaft end. Avoid contact with shaft threads.

13. After the fin is removed, re-install and hand turn the fin nut onto the shaft to protect the shaft threads. At any sign of resistance, STOP, inspect for damage & repair as needed. Then leave the nut fully installed for protection of the shaft threads.

Section 5

Fin – Final Installation

Final Installation of Fins

Prior to final installation of the fins, all fin clearance issues must be resolved.

Also, since anti-fouling paint will be applied to fins and winglets, it may be best to coat the top of each fin prior to final installation. Since fins are constructed with epoxy resin, water barrier primer is not required.

Before proceeding with final installation steps, carefully read the following precautions.

Precautions:

WARNING !!! There is risk of seizing the fin nut on the actuator shaft if these precautions are not followed. Remedial steps for a seized nut may include changing the actuator shaft! Avoid this potential problem by carefully observing the points listed below:

1. Use only a factory supplied fin nut that is engraved “LOCTITE® 262”. These nuts are machined from Nitronic 60 material. When necessary, request this fin nut from the factory.

2. Inspect the shaft threads according to whichever of the following applies:

   2.1. When a nut is found installed on the shaft and is found to turn smoothly off the shaft threads, then the newly exposed threads may be considered to be free of defects.

   2.2. When shaft threads have not been continuously protected by a nut, then the shaft threads must be inspected, repaired as needed, and tested by hand threading the nut.

   During hand threading, at any sign of resistance, stop!!; remove the nut; correct the thread repair; clean the threads; and re-test the nut.

3. For shipment, Nitronic 60 fin nuts are loosely installed onto actuator shaft threads. For test fitting, if done as in Section 4 of this manual, nuts may have been installed onto dry or greased shaft threads.

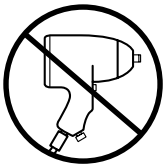
For final installation, always use LOCTITE 262. This thread locking compound is provided with the system. Omission or use of any other locking compound voids the warranty.

LOCTITE® 262 Must be used for Final Installation of the Fin Nut

4. To install the fin, always hand tighten the nut during initial turning onto the shaft. Hold the fin fully engaged onto the shaft while hand turning the nut. Don’t use the nut to hoist the fin onto the shaft. Maintain maximum hand “feel” for proper threading of the nut, and If resistance is felt when the fin is still slack, then stop, reverse, and inspect the shaft threads.

5. For final tightening, use an appropriate torque wrench and tighten the nut to the torque value engraved on the nut.

6. Warning! Never use an air impact wrench to install or remove the fin retaining nut.

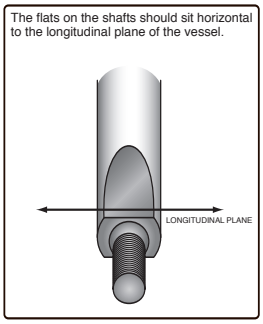


7. Never allow the fin socket to contact the shaft threads when the fin is hoisted onto the shaft. If contact occurs, repeat from thread inspection.

Final Mounting Procedure

1. Thoroughly clean the actuator shaft. Check and remove any burrs or roughness.

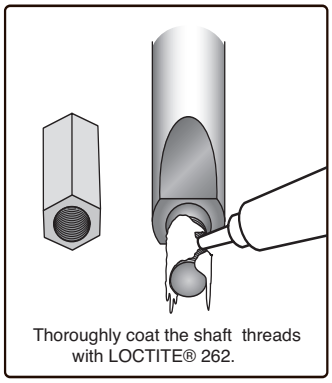
2. Rotate the shaft until the end flats are horizontal, then coat the shaft with grease.



3. Thoroughly clean the fin socket. Check and remove any burrs or roughness, then lightly grease the upper rim of the socket.

4. Remove the fin nut from the shaft threads. Important!! If the nut was found off the shaft such that the shaft threads have not been continuously protected, then revert to item 2.2 on the preceding page (5- 1) before continuing.

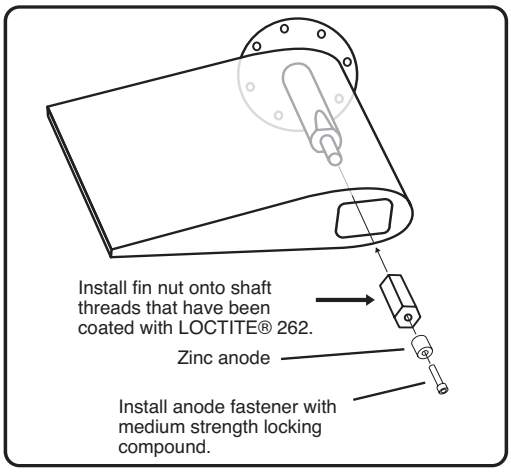
5. Thoroughly clean the shaft threads and the fin nut threads with acetone and then alchohol to remove any films, greases or contaminants.



6. Let the threads dry then thoroughly drench the shaft and nut threads with LOCTITE® 262..

7. Lift and position the fin socket onto the shaft, taking extreme care to avoid touching the shaft threads. If thread contact occurs, then Stop, repair threads, test and repeat from step 4 above.

Don't use lifting forces beyond those required to overcome gravity until the top of the fin is less than 0.5 inches from the actuator seal housing. If resistance is felt before this approximation is reached, then the flats on the fin shaft are not properly aligned with the flats in the fin socket. Alignment must be corrected before proceeding.



8. Hold the fin fully hoisted onto the shaft to allow the fin nut to be turned freely by hand into contact with the

socket. Don't use the nut to jack the fin upward onto the shaft.

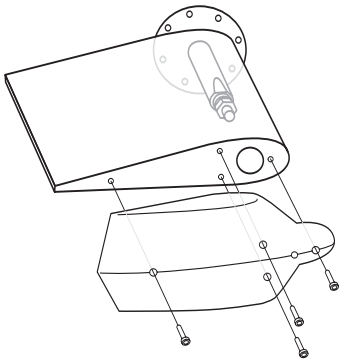
9. Tighten the fin nut to the torque value engraved on the nut. These torque values are repeated here for reference.

Fin Nut Torque Value		
Actuator	ft-lb	Nm
220	220	298
250	320	434
300	610	827
370	800	1085
440	1000	1356

10. Install the shaft zinc to the end of the fin nut using medium strength locking compound on the threads of the retaining socket head cap screw.

11. Install the winglet with fasteners coated with medium strength locking compound. The winglet screws have different lengths, and must be located according to the following rule:

When there are four winglet screws, install the two longest at the mid-position off-centerline holes. When there are six winglet screws, install the four longest at the mid position off-centerline holes. Next, install the shorter of the remaining fasteners at the nose centerline location (select either fastener if they are equal length). Then install the remaining fastener at the trailing centerline location.



Fasten winglet. Use high strength locking compound.

Tighten winglet fasteners to the torque values shown here:

Fin Type*	Size	Screw	Torque (Ft-lb)	Torque (N-m)
Std	4.0 to 12.0	3/8 -16	20	27
Std	16.0 to 26.0	1/2 -13	40	54
X	4X to 6X	3/8 -16	20	27
X	7X to 20X	1/2 -13	40	54

* Fin types are Standard (Std) or Extended (X) for TRAC-STAR© Systems

12. Rotate the fin to the reference line that was scribed on the hull during actuator installation. This line is parallel to the keel. If the line has been lost then it should be re-established before continuing.

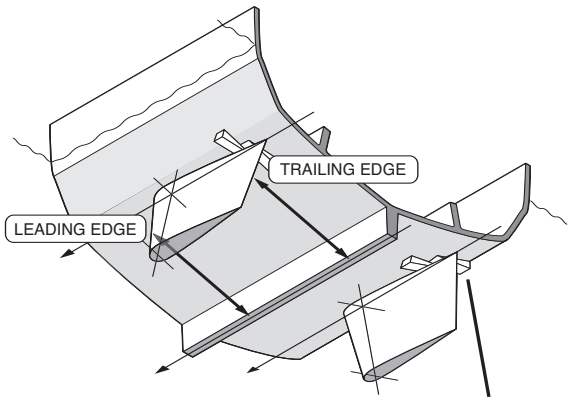
Wedge the fin securely on this line, parallel to the keel.

These wedges should stay in place until yokes have been installed onto the actuator shafts and jacking bolts have been set to retain the centerline position.

Wedges must be removed before the vessel is launched.

13. Anti-fouling bottom paint will be applied to fins and winglets. Since these parts are constructed with epoxy resin, the use of water barrier primers is not necessary.

Measure from the keel to the leading and trailing edges of the fin. This will assure that fins are parallel to keel.



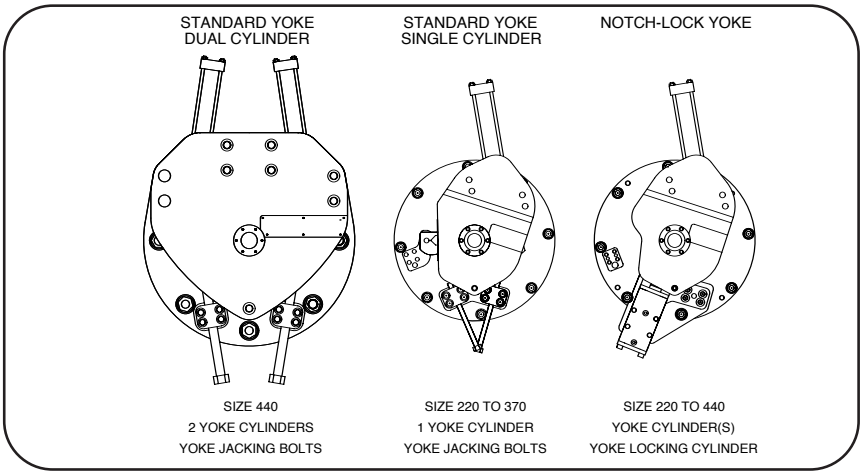
Use wood wedges to lock fins into position.

Section 6

Installing the
Yoke, Cylinder, & Top Plate

Installing the Yoke and Top Plate

The set of parts to be installed on the actuator shaft and the actuator flange will depend on the size and style of the TRAC Actuator assembly. Three figures below show two different yoke styles. Depending on the yoke style for your system, a specific installation procedure will be followed below.

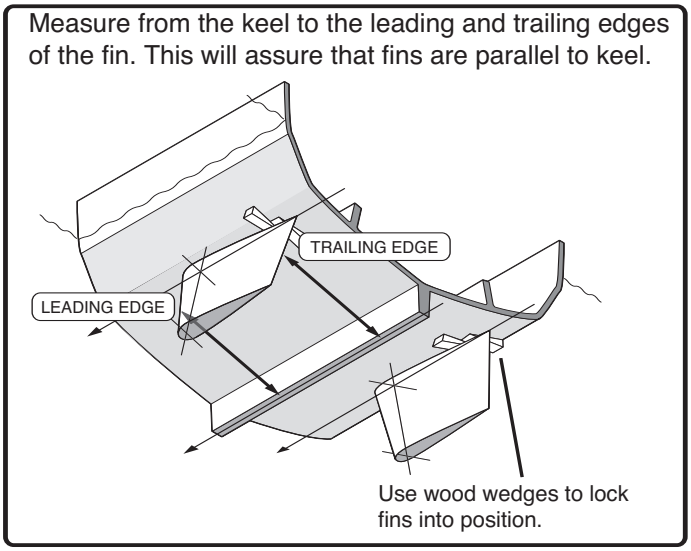


Systems with Standard Yokes have Yoke Jacking Bolts to move and secure a non-powered fin. Actuator sizes 220 to 370 will connect at one end to a single yoke cylinder. The free end of the yoke aligns with a Locking Plate when the yoke is near fin "centered". Actuator sizes 440 or larger have dual yoke cylinders and do not have a Locking Plate.

Systems with Notch-Lock Yokes have an hydraulic Locking Cylinder to secure a non-powered fin. These systems do not have Yoke Jacking bolts or Locking Plates.

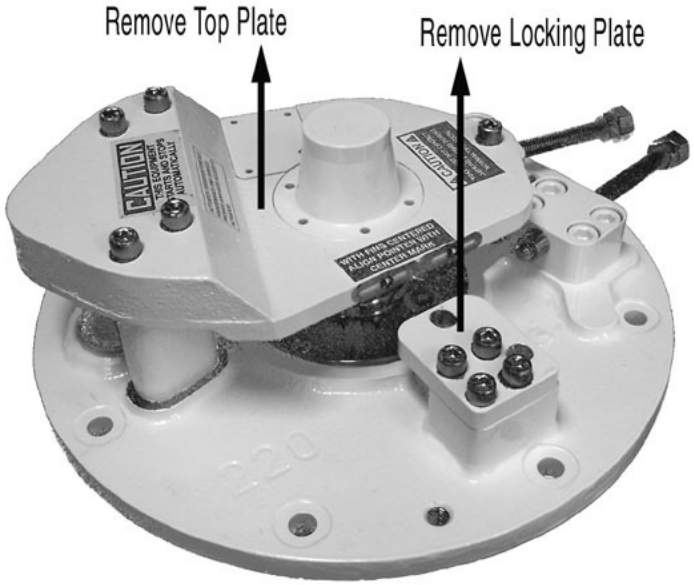
Starting Point for Any System

With either type of system, the initial requirement for yoke installation is that the fin be mounted to the shaft and then wedged securely on a line parallel to the keel. When this has been done, continue with the appropriated installation section below.



Yoke installation - System with Jacking Bolts

1. Remove the Top Plate (5 bolts) and set the top plate aside. The two larger legs of the top plate have locating pins which insert into the actuator flange. The top plate should be lifted by grasping near the large legs to avoid binding these pins during removal.

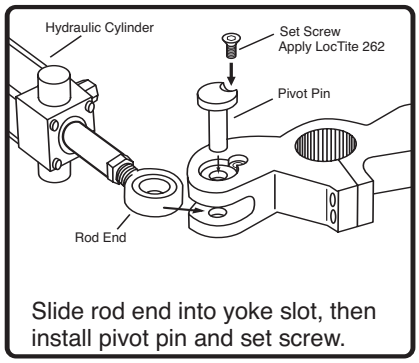


2. Remove the Locking Plate (4 bolts) from its mounting to the top of the actuator flange. The locking plate has two locating pins. Lift the plate in a manner that avoids binding the pins.

3. Inspect the factory assembled Yoke and Cylinder Assembly to confirm that the unit is ready for installation.

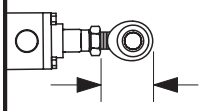
3.1. A spherical bearing rod end has been threaded into the end of the cylinder rod and tightened with a jam nut and high strength locking compound on all threads.

3.2. A removable plastic sleeve gage has been snapped onto the cylinder rod for conveniently setting the rod to mid-length extension during yoke installation.



Slide rod end into yoke slot, then install pivot pin and set screw.

Table 6 –A
Rod-end



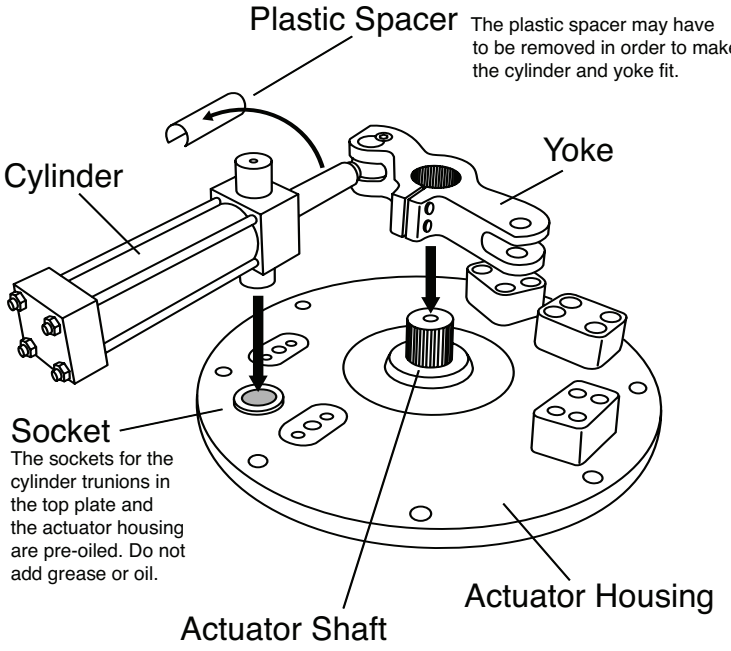
220 - 1.4"
250 - 2.2"
300 - 2.2"
370 - 2.5"

3.3. A pivot pin has been inserted through the yoke clevis and rod end to secure the cylinder to the yoke. The pivot pin is retained with a hex inset screw.

3.4. If the yoke and cylinder(s) are assembled as described above then proceed with the next step. Otherwise assemble the yoke and cylinder(s) as described before proceeding. Refer to Table 6 –A for rod end fixing distance. Use high strength thread locking compound. Note that 440 rod ends are not listed: These should be set up for equal cylinder rod

extension.

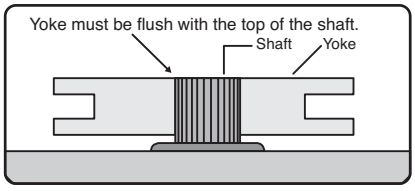
4. Position the yoke and cylinder by holding the yoke center hole above the actuator shaft and the cylinder trunion pin above the flange bushing cup. Direct the yoke's open clevis end toward the locking plate riser; direct the yoke clamp bolts toward the cylinder; and direct the



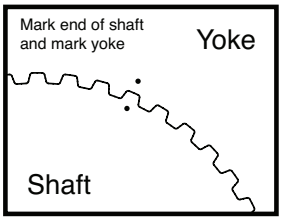
cylinder oil ports away from the actuator shaft.

5. With the cylinder shaft at mid-extension (sleeve tight between cylinder body and jam nut) press the yoke onto the splined shaft and also start inserting the cylinder trunion pin into its bushing cup.

While the objective is to install the yoke onto the shaft with the cylinder as close as possible to mid-extension, this precise position may not be possible. Instead, slightly extend or compress the cylinder (removing the gage if necessary), making an installation closest to the cylinder mid-extension point.



6. With the cylinder trunion pin fully seated into the actuator bushing, set the top of the yoke exactly even with the top of the shaft then tighten the yoke clamping bolts. Use high strength locking compound on the bolt threads and tighten to torque values shown in Table 6 –B.



7. With a fine center punch, mark the location of one yoke slot and then mark the location of the mating shaft spline. These are important reference marks for any future removal and re-installation of the yoke.

TABLE 6 –B

Standard Yoke - Clamping Bolts Tightening Torque Values

Size	Fastener	Ft-lb	N-m
220	5/16 –18	25	34
250	3/8 –16	25	34
300	1/2 –13	60	82
370	1 –14	400	542
440	1 –14	400	542

8. Install the Top Plate onto the actuator flange, checking first that the trunion bushing cup is seated in the top plate. Use medium strength thread locking compound and tighten bolts to

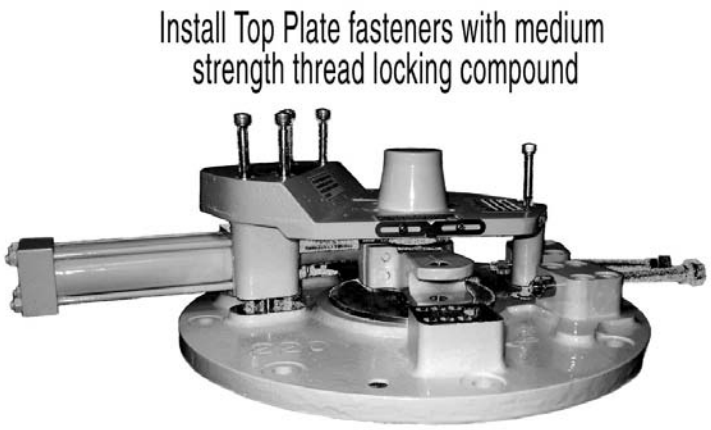
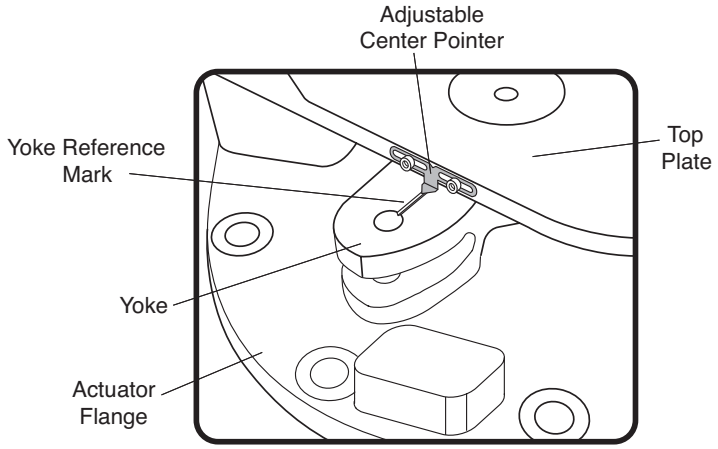


TABLE 6 –C
Top Plate Screws - Tightening Torque
Apply locking compound to threads and also as lubricant underscrew head

Size	Fastener	Ft-lb	Nm
220	4 @ 3/8" –16 x 3 3/4"	14	19
	1 @ 3/8" –16 x 3"	14	19
250	4 @ 3/8" –16 x 4"	14	19
	1 @ 3/8" –16 x 3 1/4"	14	19
300	4 @ 1/2" –13 x 4"	34	46
	1 @ 1/2" –13 x 3 1/2"	34	46
370	4 @ M20 –2.5 x 130	95	129
	1 @ M12 –1.75 x 120	30	41
440	8 @ M20 –2.5 x 130	95	129
	1 @ M16 –2.0 x 140	70	95

torque values shown in Table 6 –C.

9. Adjust and tighten the movable center-pointer on the side of the top plate to align with the



center of the machined scribe line on the top of the yoke arm.

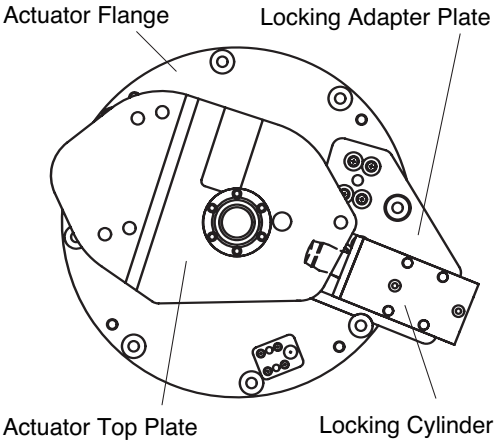
10. Turn in the yoke jacking bolts until both are slightly tightened against the yoke.

11. Stow the Locking Plate, with its fastener bolts and locking pin, for later installation when the fin has been moved from the center position. The fin should stay on center position until the shaft position feedback sensor has been installed. The actuator shaft extension for connection to the feedback sensor will be installed later.

12. Remove the wedges between the fin and the hull that were set to hold the fin parallel to the keel. The fin position is held by the yoke jacking bolts. These bolts must not be disturbed until the shaft position sensor has been installed.

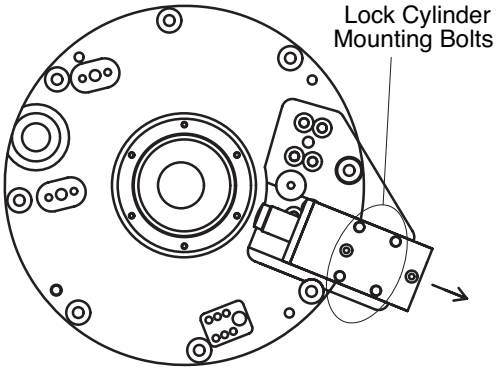
Yoke installation - Systems with Notch-Lock Yokes

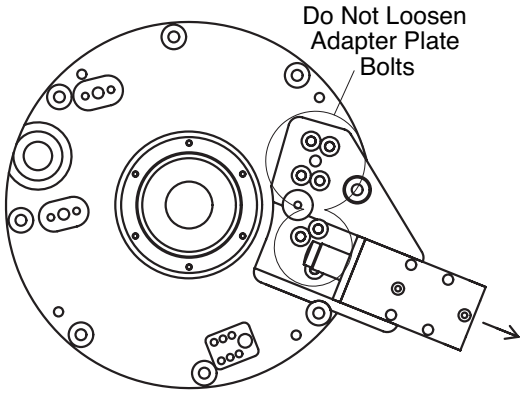
For new installations, the TRAC Actuator normally ships from the factory with the Top Plate installed to protect the actuator shaft splines; with the Locking Adapter Plate attached to the actuator flange; and with the Locking Cylinder temporarily bolted to the Adapter Plate.



1. Remove the Top Plate.

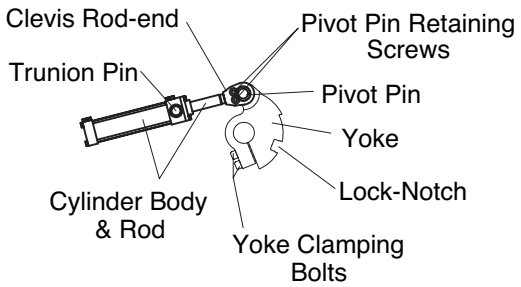
2. Release the Locking Cylinder (4 Bolts) and set the cylinder assembly aside. But, do not loosen the Locking Adapter Plate fasteners.





3. Inspect the factory assembled Notch–Lock Yoke and Cylinder Assembly to confirm that the unit is ready for installation.

Notch–Lock Yoke & Cylinder Assembly



3.1. A clevis rod end has been tightened against the end of the cylinder rod with high strength locking compound on the coupling threads.

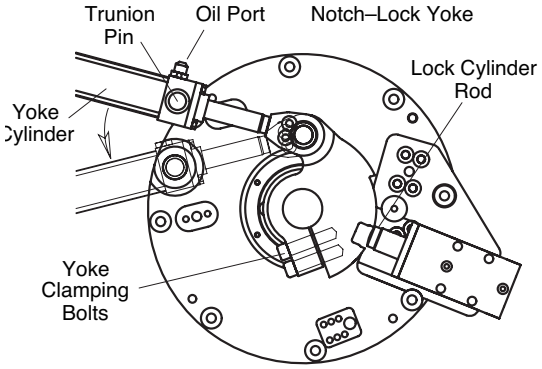
3.2. A pivot pin has been inserted through the rod-end clevis and the yoke spherical ball to secure the cylinder to the yoke. The pivot pin is retained with two hex inset screws.

3.3. If the yoke and cylinder is assembled as described above then proceed with the next step. Otherwise assemble the yoke and cylinder as described before proceeding. Use high strength locking compound on all rod-end coupler threads.

4. Position the yoke and cylinder for assembly onto the actuator splined shaft.

Hold the yoke above the actuator shaft with the yoke's locking slot aligned as close as possible to the Locking Cylinder's rod. The yoke cylinder can initially be cocked aside.

When slight misalignment will not allow the locking rod to enter the locking slot, simply install the yoke with alignment as close as possible.



5. With this close alignment, start insertion of the yoke onto the actuator shaft, then swing the cylinder trunion pin into alignment with the actuator flange's trunion bushing.
Continue to lower the yoke onto the shaft as the cylinder trunion pin is inserted into the bushing.

6. With the top of the yoke exactly flush with the top of the actuator shaft, apply high strength thread locking compound to the yoke clamping bolts and tighten as shown in Table 6D.

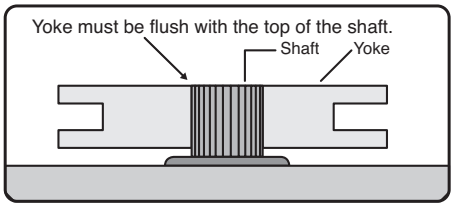
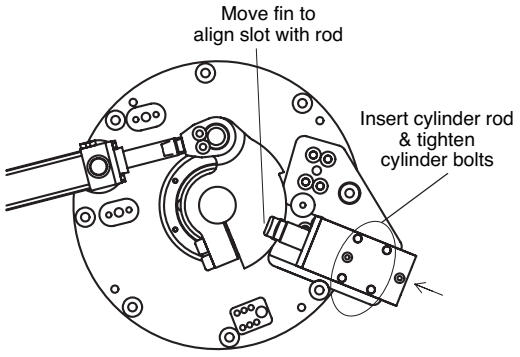


TABLE 6 –D
Notch-Lock Yoke Clamping Bolts Tightening Torque Values

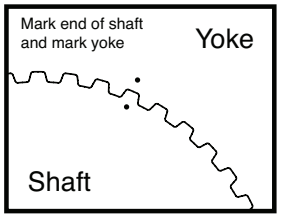
Size	Fastener	Ft-lb	N-m
220	3/8 –16	30	41
250	5/8 –18	175	237
300	1/2 –13	75	102
370	M12 –1.75	75	102
440	1" –14	500	678

7. If necessary, remove the fin wedges and slightly move the fin as needed to allow insertion of the locking rod into the locking slot. Arrange for lever pressure against the rear of the assembly to slightly compress the rod extension spring. The Locking Cylinder rod is spring extended and hydraulically retracted.



8. With the cylinder rod slightly compressed to align the Locking Cylinder fasteners to the Locking Adapter Plate, re-install four bolts with medium strength thread locking compound.

9. With a fine center punch, mark the location of one yoke slot and then mark the location of the mating shaft spline. These are important reference marks for any future removal and re-installation of the yoke.



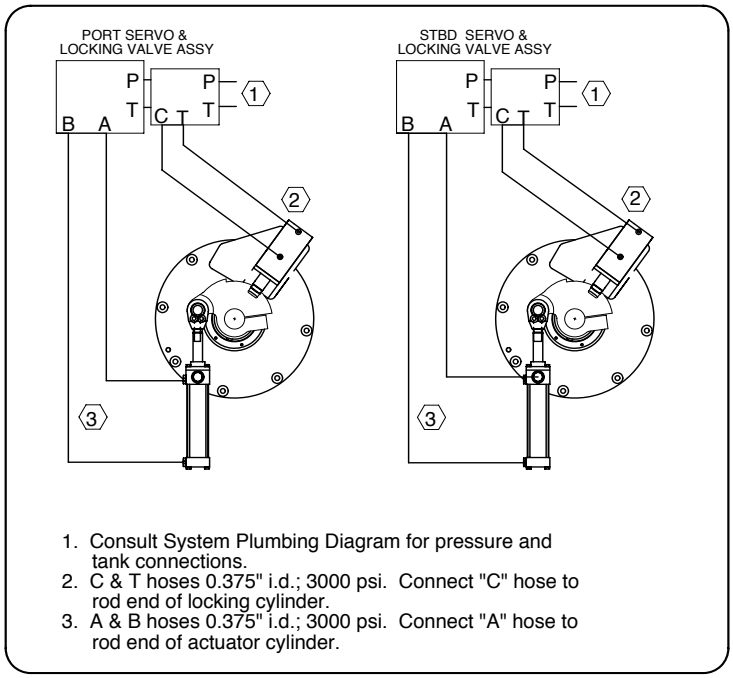
10. Install the Top Plate onto the actuator flange, checking first that the trunion bushing cup is seated in the top plate. Use medium strength thread locking compound and tighten bolts to torque values shown in Table 6 –C on page 4 of this section.

11. Remove wedges between the fin and the hull (if not removed in step 7 above). The fin position will be held by the Yoke Locking Cylinder, and the installation of the shaft position sensor (Section 10 of this manual) will be done with the yoke in the locked position.

Locking Cylinders – Hydraulic Plumbing Connections

Consult the System Plumbing Diagram for connection of hydraulic lines other than those shown here.

Depending on type of Servovalve Assembly, the locking cylinder's control valve will either be appended, or alternatively will be integrated into the Servovalve Assembly. The appended style is illustrated (right) with markings for the lockin cylinder ports being "C" and "T". Connect the "C" port of the locking valve to the front (pin) end of the locking cylinder body.

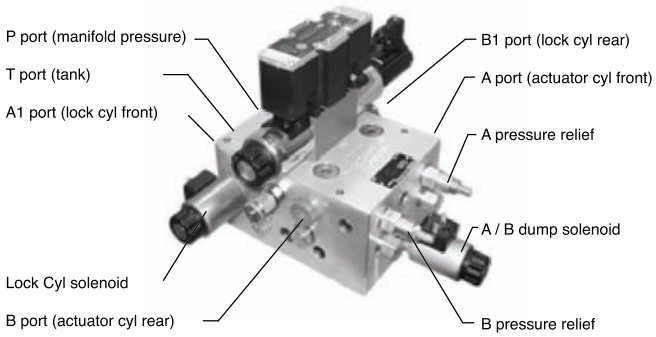


1. Consult System Plumbing Diagram for pressure and tank connections.
2. C & T hoses 0.375" i.d.; 3000 psi. Connect "C" hose to rod end of locking cylinder.
3. A & B hoses 0.375" i.d.; 3000 psi. Connect "A" hose to rod end of actuator cylinder.

The integrated style is illustrated below. Ports for locking cylinder hoses are marked "A1" and "B1". Connect the "A1" port to the front (pin)end of the locking cylinder.

Electrical connections to the locking cylinder control valve solenoid are shown on the following page 6 -8. Note that the integrated style Locking/Servovalve assembly has only one dump valve which simultaneously releases both A and B actuator cylinder ports to tank. The non-integrated Servovalve assembly has separate A and B dump valve solenoids.

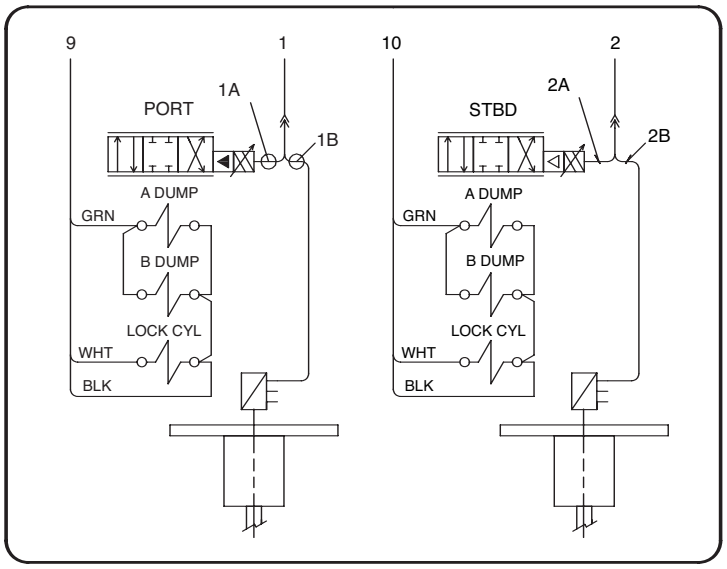
31908 Servo Valve Assembly
Port and Component Location



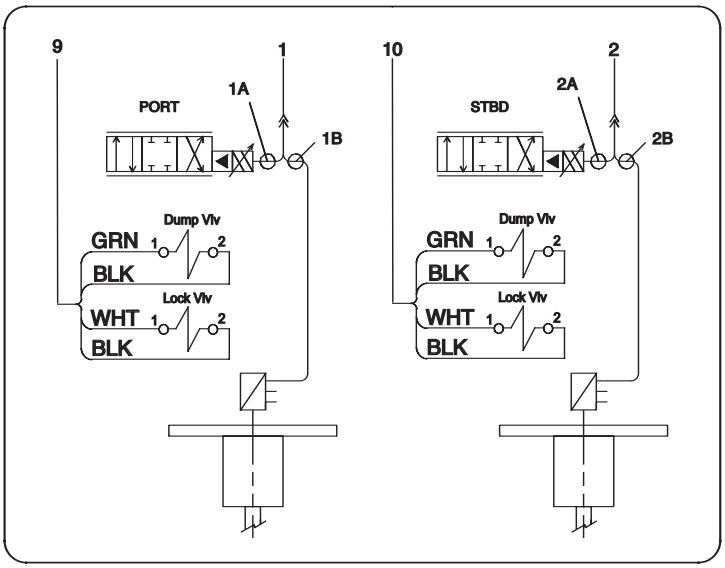
Electrical Connections to the Servovalve Assembly Solenoids

Electrical connection to the locking cylinder control valve as well as to the servo dump valves is made with conductors in cable 9 (port side) or cable 10 (stbd side). These cables have 3 conductors where black is common to dump and locking solenoids; white is the signal wire to the locking valve; and green is the signal wire to the servoassembly dump valves.

Non-integrated (locking cylinder appended to Servovalve Assembly):



Integrated (locking cylinder integrated with Servovalve Assembly):

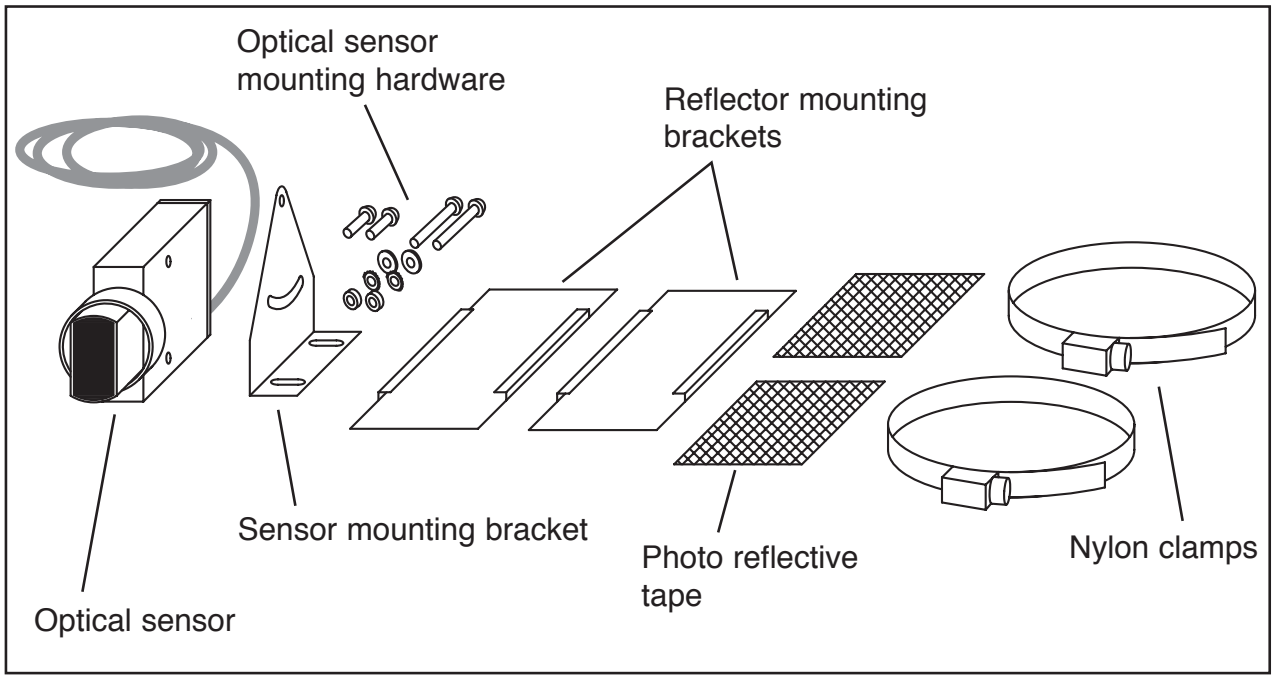


Section 7

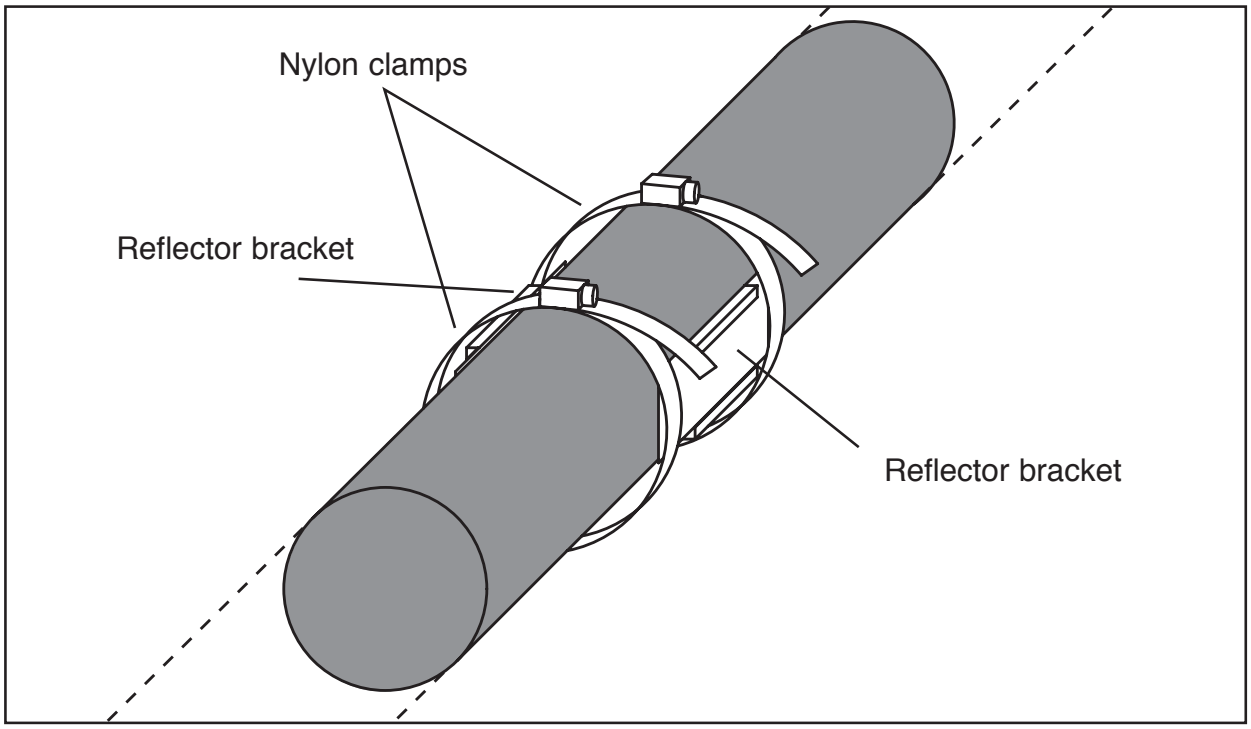
Optional Speed Sensor Installation

Photoelectric Type

The parts furnished for optical speed sensor installation are shown below. Any additional brackets needed for mounting the optical sensors must be supplied by the installer.

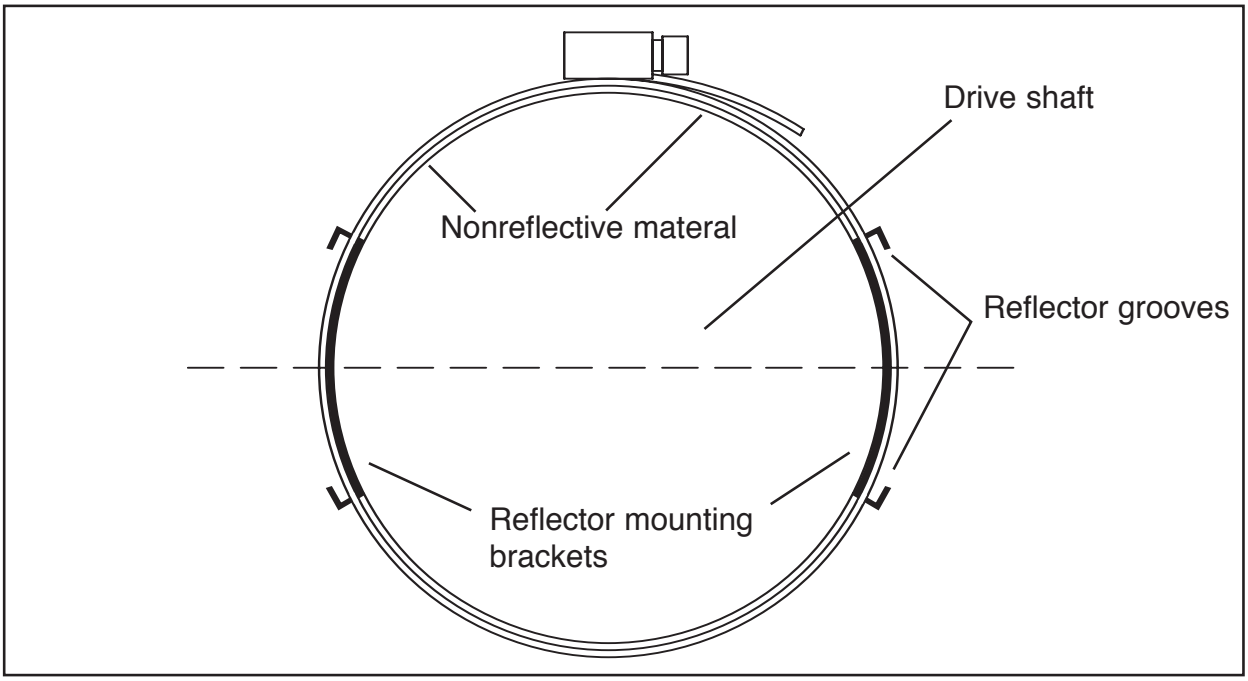


NOTE: In addition to the parts shown above, there is also a strip of non reflective materal, which is to be wrapped around the shaft under the reflector brackets. Using the clamps supplied attach one pair of reflector brackets opposite each other on the shaft as shown below.

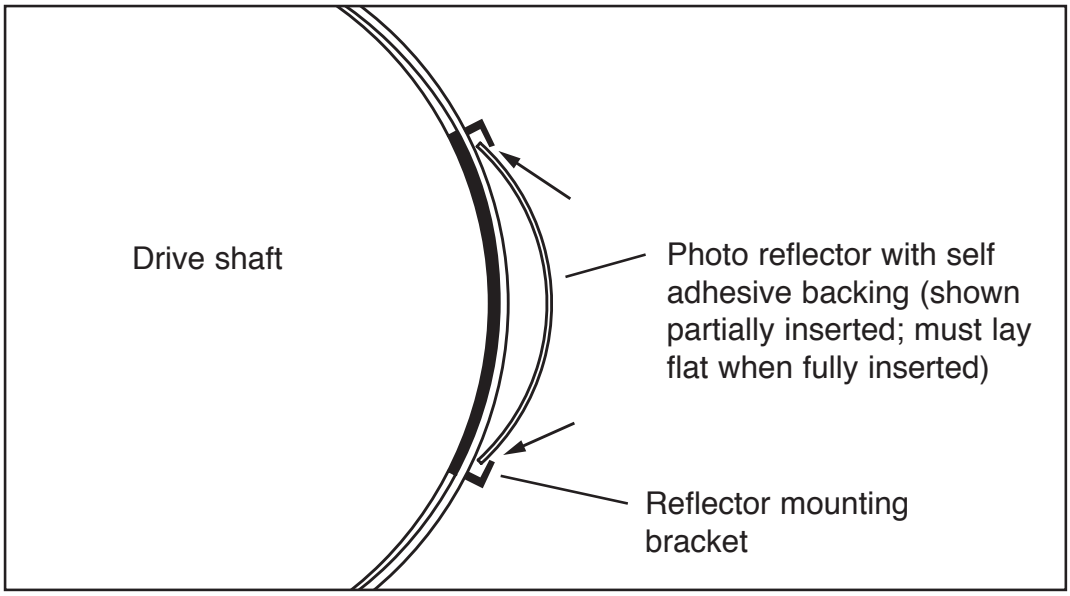


When the nylon clamps are tight the reflector brackets will conform to the curvature of the shaft.

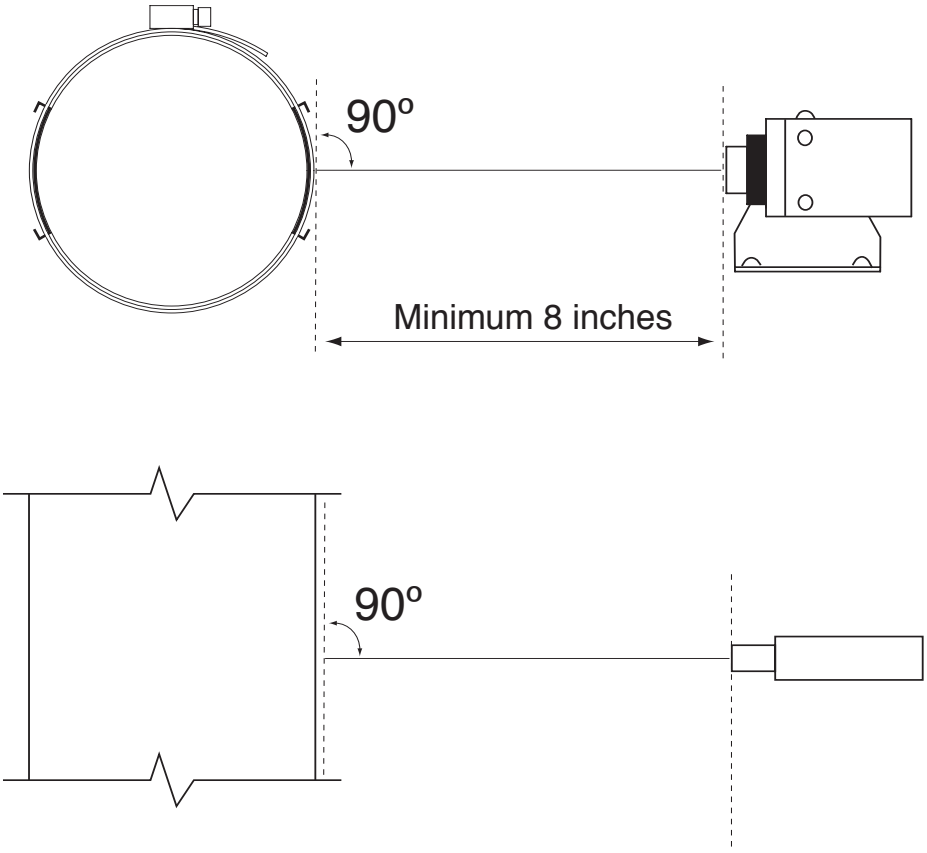
Front view of drive shaft



When the brackets are mounted on the shaft, remove the protective skin from the reflector's adhesive backing and install reflective tape into the brackets. Make sure that the top and bottom edges of the reflective tape are captured under the bracket's reflector grooves.



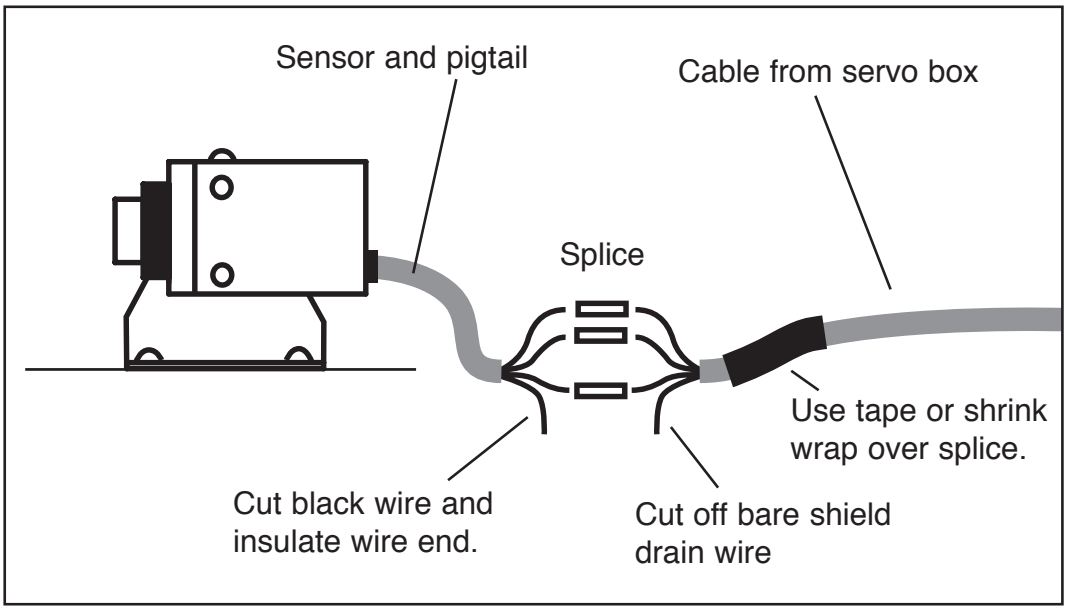
The face of the photo sensor should be mounted 8 inches or more from the reflector target, and the sensor must be oriented for its emitted beam to strike the target at right angles in all planes as shown below. Final alignment should be done after electrical connections have been completed in order to allow use of the photo sensor's built-in alignment indicator.



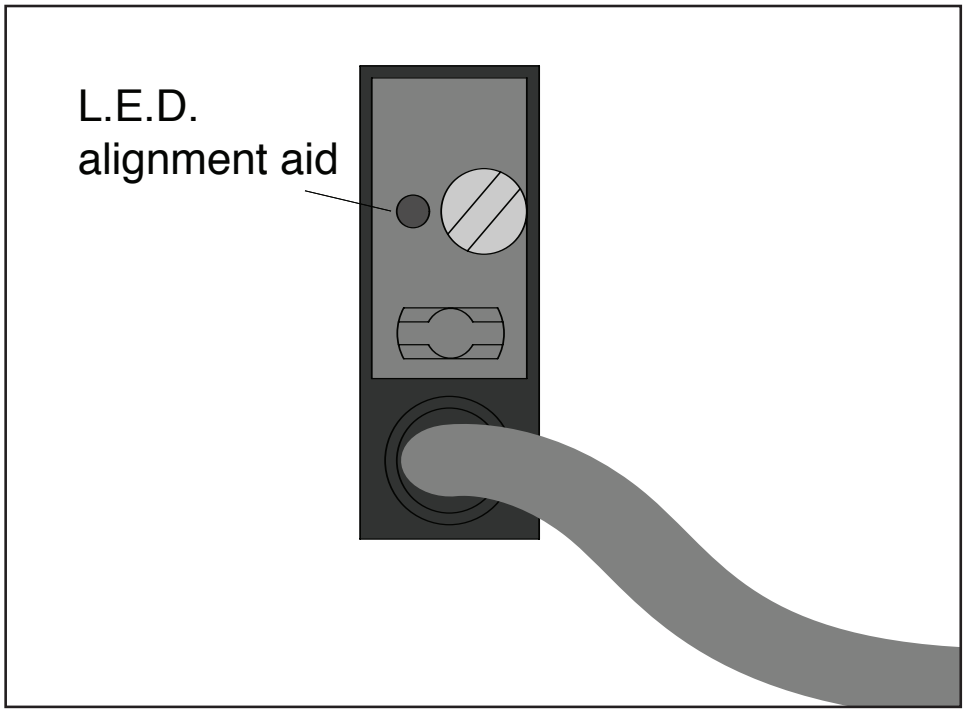
Once the approximate position is found for the sensor, make electrical connection according to the style of sensor supplied. If Quick connect cables are supplied then simply make plug-in connection. If cable splice connections must be made, then follow the diagram and table below for wire to wire connection.

SERVO CONTROL BOX CABLE # 7 & # 8
Port Engine Speed Cable (#7) -- Stbd Engine Speed Cable (#8)

CPC PIN #	CABLE # 7 & # 8	SENSOR WIRE COLOR	DESCRIPTION
1	WHITE	WHITE	SPEED SENSOR SIGNAL
2	RED	BROWN	SPEED SENSOR 24VDC (+)
3	BLACK	BLUE	SPEED SENSOR DC (-)
4	SHIELD	NONE	CABLE SHIELD
		BLACK	SENSOR SIGNAL (NOT USED)



When the optical sensor is connected and power is applied to the sensor, a small LED alignment aid will blink. The time between blinks is an indicator of alignment accuracy. A fast blink indicates accurate alignment. A fast blink appears to be continuously on. Fix the final sensor position to achieve fast blink.



Section 8

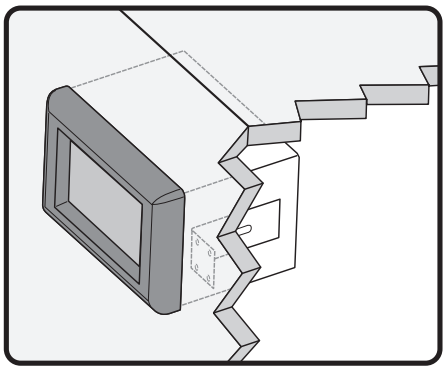
Supporting Equipment Installation

Pilothouse Panel

The Pilothouse Panel is intended to be mounted in the pilothouse where the environment is protected. It is **NOT** intended for open air installation such as on the flybridge.

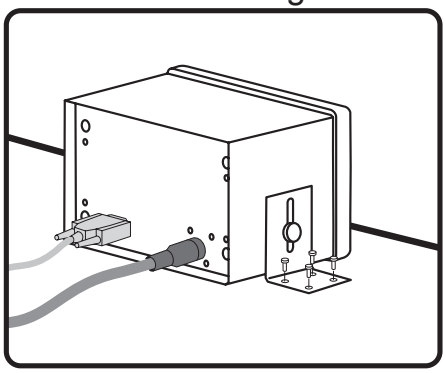
•The pilothouse may be flush mounted in a pilothouse console.

Flush Mount



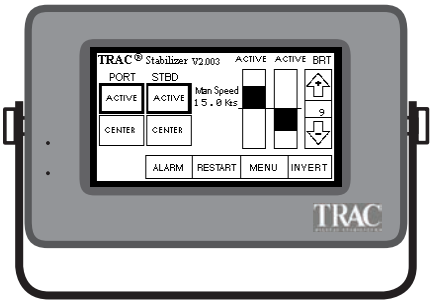
•The pilothouse may be mounted externally with the standard mounting brackets.

Standard Mounting Bracket



•Or mounted externally with a swivel bracket.

Swivel Bracket



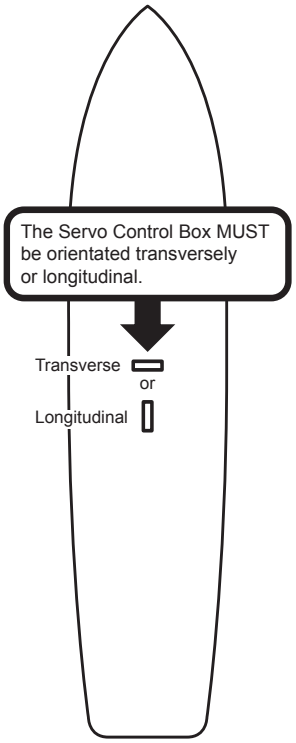
Servo Box

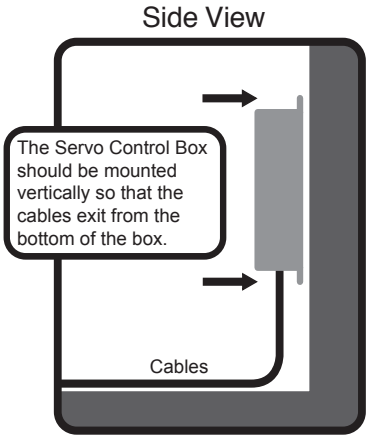
The Servo box is the heart of the system. Nearly all control cables run to the servo box. Pick a central location in the vessel with good wire run access.

The Servo Box must be mounted where:

•There is no excess vibration
•There is no excessive heat.
•There is NO moisture.

The servo box **MUST** be mounted vertically on either the longitudinal axis or the transverse axis of the vessel. It is intended that the servo box be mounted so that the cables plug into the bottom of the box. This provides protection for the box should any fluid be sprayed or spilled on top of the box. However, if the servo box is mounted in a truly fluid free environment, it may be mounted so that the cable receptacles are on the top of the box. The best place for the servo box is under the wheelhouse console.



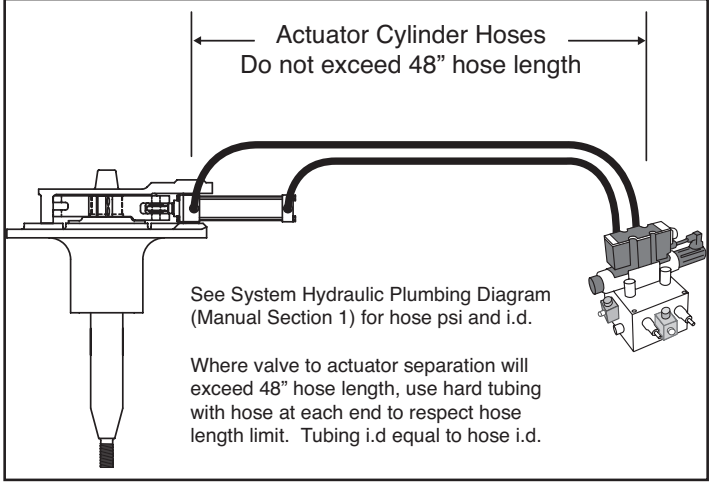


Power Converter

The 12-24v power converter, when used, should be mounted in a dry, well ventilated location between the power source and the servo box.

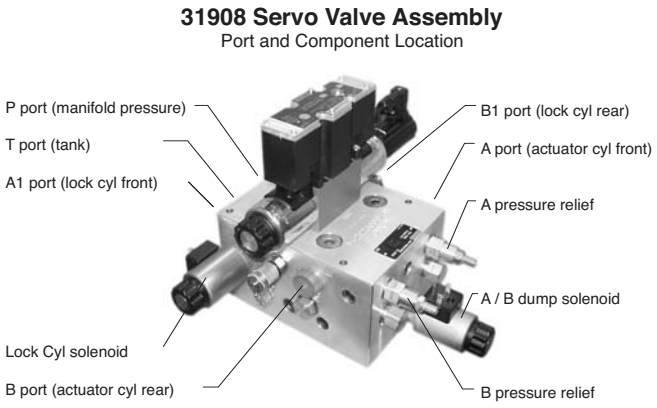
Servovalve hoses

The servo control valves should be located near the actuators to permit minimal length A & B cylinder hose length. Maximum length for A & B hoses should be 36” to 48”.



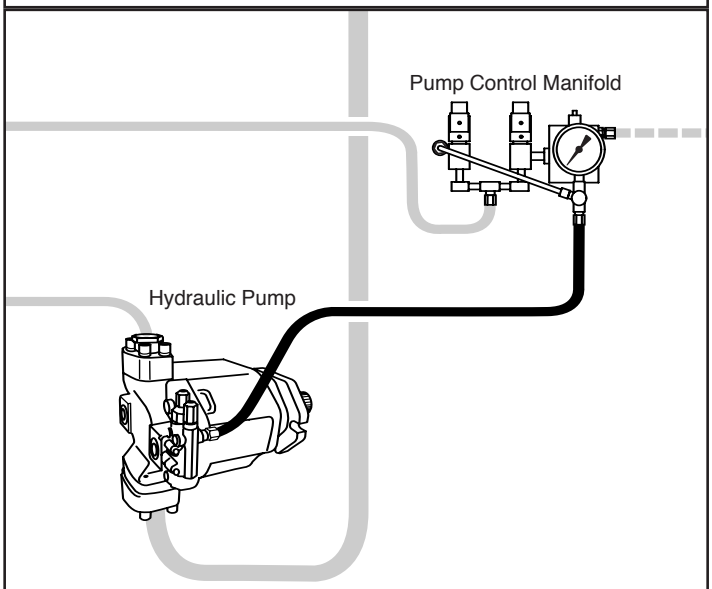
Servovalve assembly A/B dump valve and Locking cylinder control.

Electrical connections for the Servo assembly A/B dump valve and for the Yoke Locking Valve is shown in Section 6 of this Installation Manual (page 6-8). Hydraulic connections between the Locking Valve and Locking Cylinder are shown on page 6-7.



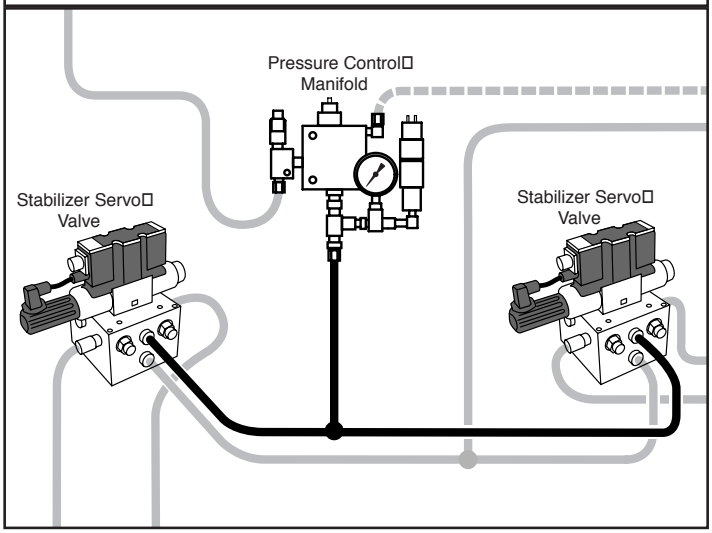
Variable Displacement Pump Pressure Control Manifolds

Variable Displacement Pump Pressure Control Manifolds, when used, should be mounted reasonably close to the hydraulic pumps they serve.



Pressure control manifolds

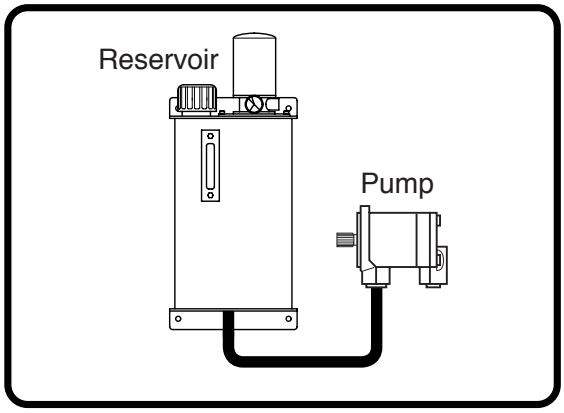
Pressure control manifolds are best mounted centrally in the system. If a pressure control manifold is mounted on one side of the boat near an actuator, the size of the hoses serving the opposite actuator should be increased by one hose size.



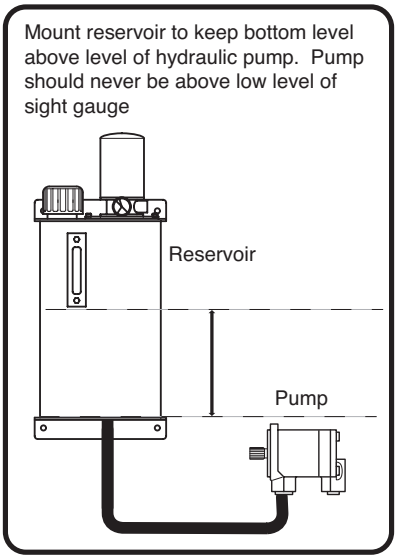
Reservoir Placement

When locating the reservoir some considerations should be taken into account. A location that puts the pump and reservoir in close approximation to each other is desirable. Ninety degree bends should be minimized to ensure that the oil has as little resistance through the lines as possible.

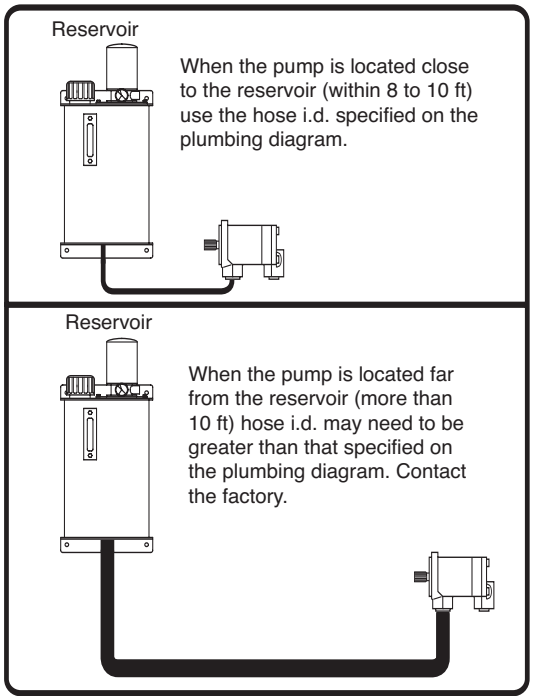
Reservoir should be located closer rather than farther from the pump.



The pump should also be located even or below the oil level. A location below the oil level is desired.



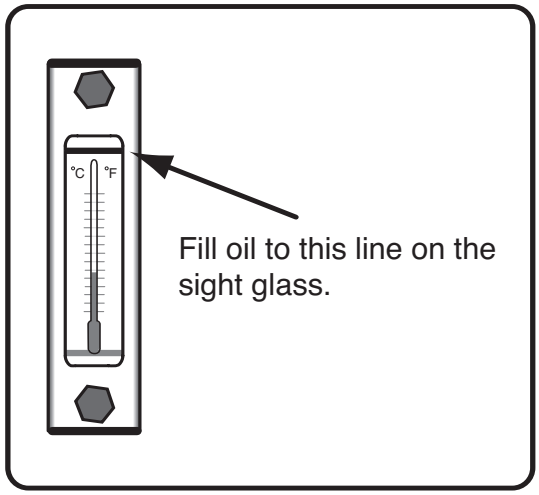
When running supply hose to the pump consideration should be taken when choosing hose size. If the pump is located in close proximity to the reservoir the normal recommended hose diameter should be used. If the pump is lower and farther away from the reservoir a larger hose diameter should be used.



When mounting the reservoir be sure that the fasteners used to attach the tank to the vessel are able to hold the weight of the filled reservoir.

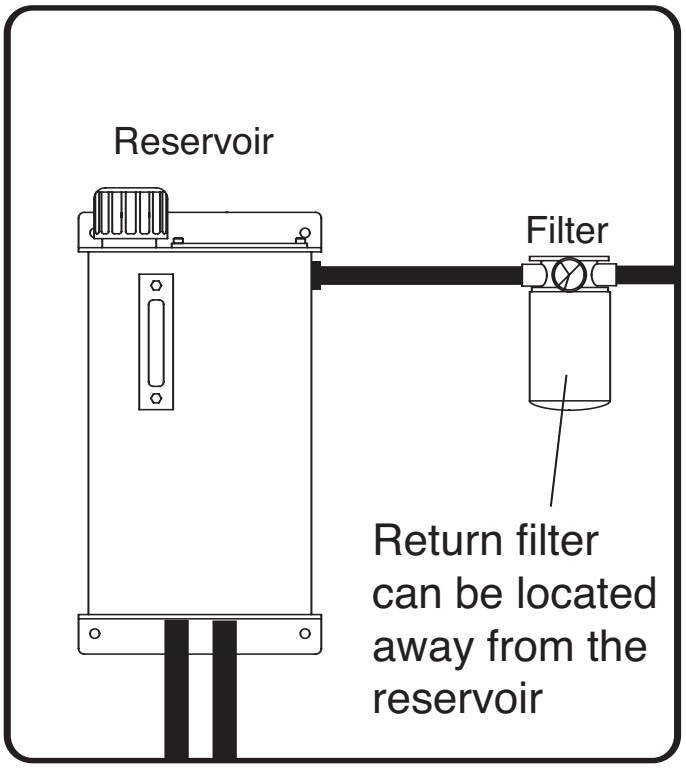
Hydraulic Oil

The reservoir tank should be filled to the top line on the sight glass. ISO46 oil is recommended for this hydraulic system. ISO 32 is acceptable.



Filter mounting

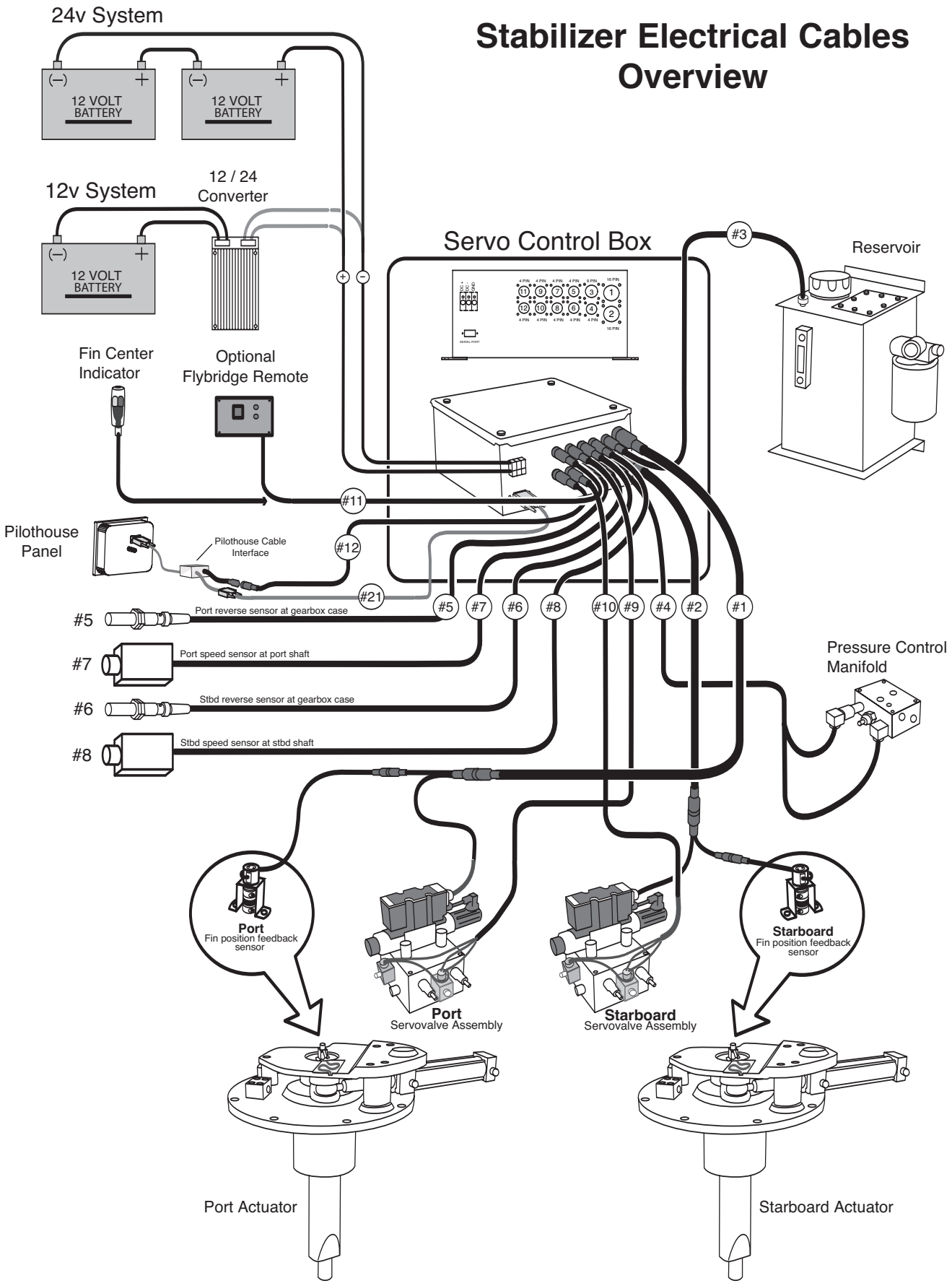
The filter can be remotely mounted if space restrictions are encountered.



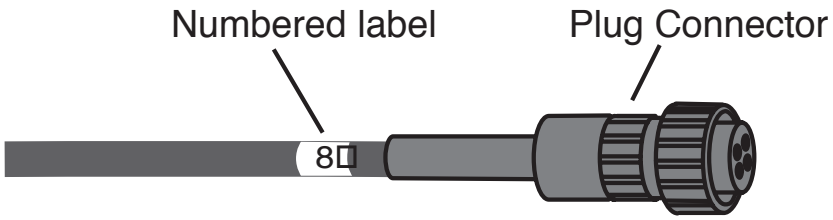
Section 9

Electrical Cable Installation

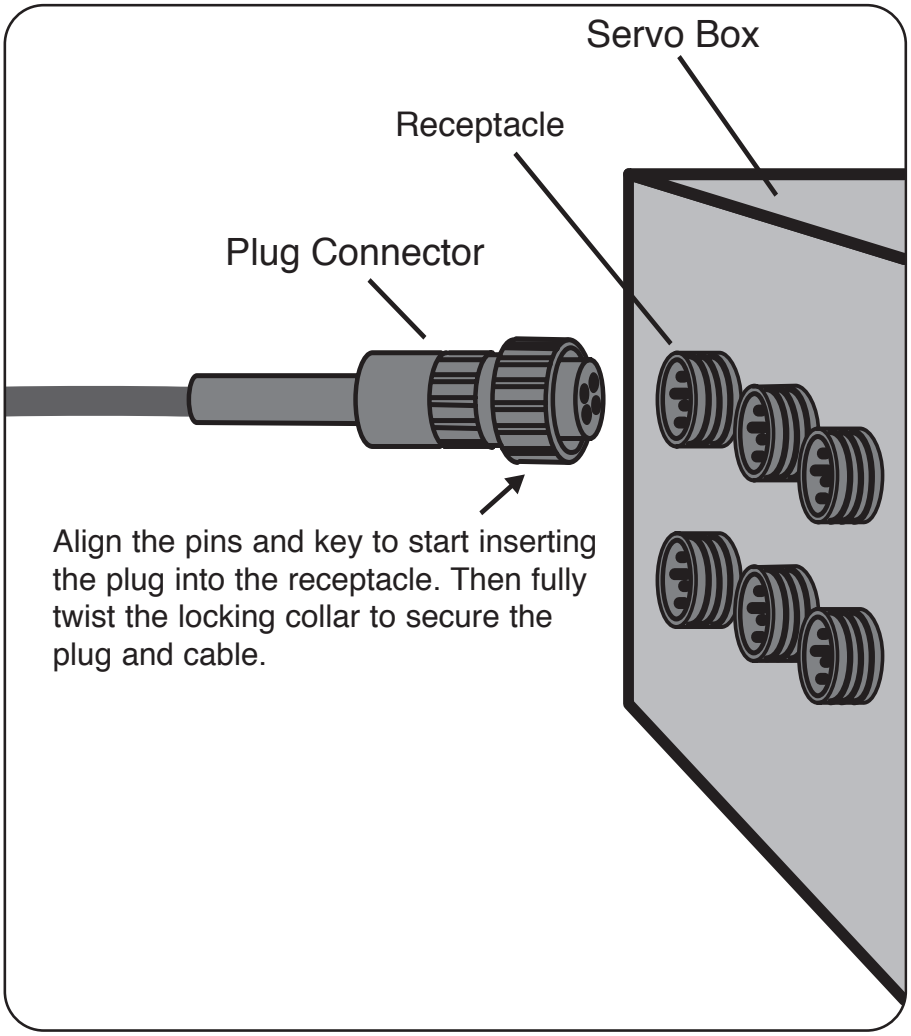
Stabilizer Electrical Cables Overview



Most system electrical components connect to the Servobox with cables of custom length which have factory installed plugs. Each cable is numbered and marked. The diagrams on the following pages illustrate component connections to the Servobox.



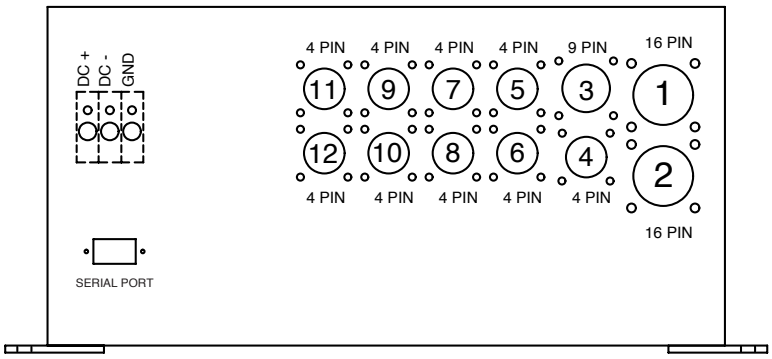
To connect a cable, the plug end should be lightly pressed against the designated receptacle and rotated until the plug key aligns with the receptacle slot. With the key properly aligned, start insertion while rotating the twist-lock collar clockwise to seat and lock the plug. Do NOT over-tighten.



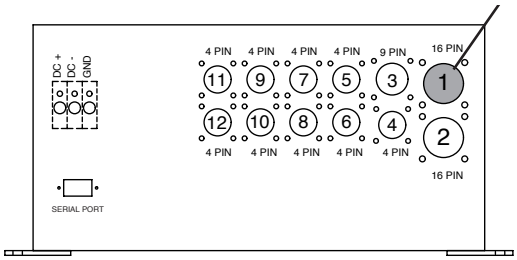
Receptacle Layout for the Servobox

The receptacles on the Servobox are numbered and marked to correspond to system cables. There are 12 twist-lock receptacles, 3 screw-clamp power terminals, and 1 serial connector receptacle. Each diagram in this section will use the convention illustrated below where the connector under consideration is shaded “gray”.

Bottom View of Servobox
Location of Connector Receptacles

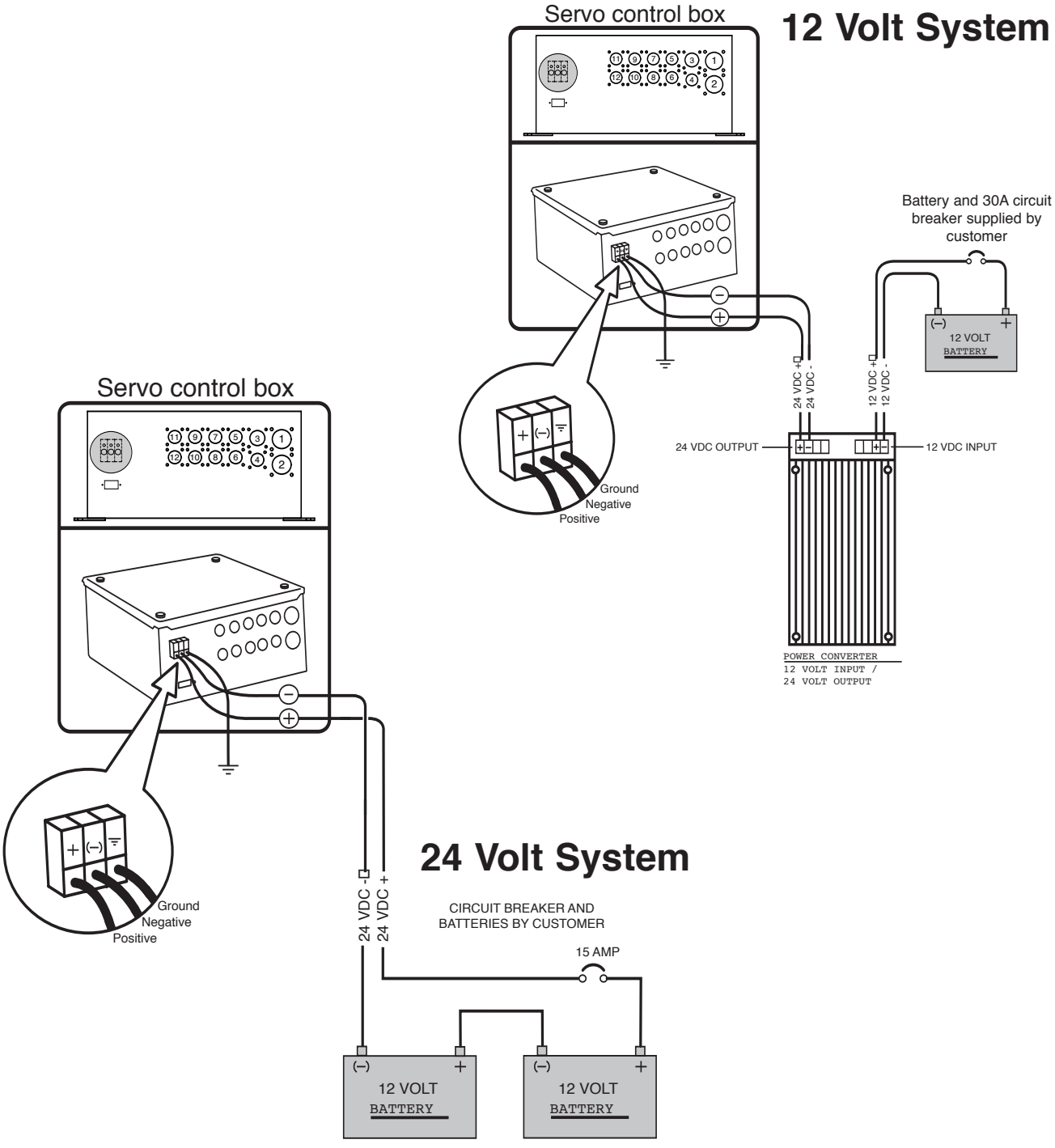


In connection illustrations, a shaded circle indicates the appropriate receptacle for the cable under consideration.



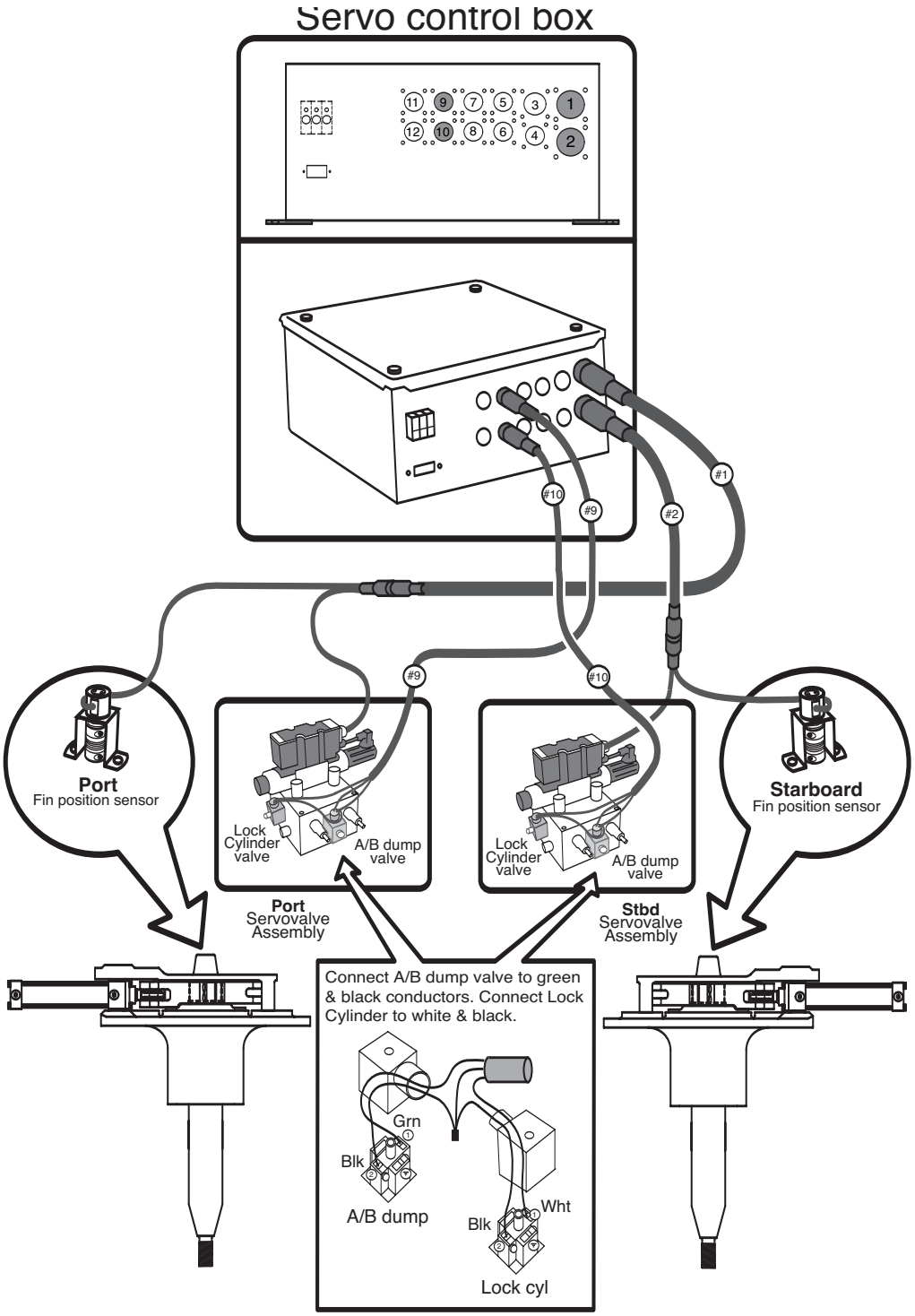
Power Connection

The Servobox power requirement is 15 Amperes at 24 Vdc. Boats with 12V systems must provide 30 Amperes at 12 Vdc to a voltage converter obtained from American Bow Thruster. Power wiring for both systems is shown below. The Servobox GND terminal must connect to supply negative, preferably through a conductor that does not carry normal supply current. The installers wire gauge should be selected for maximum 3% voltage drop from the supply source to the Servobox power terminals.



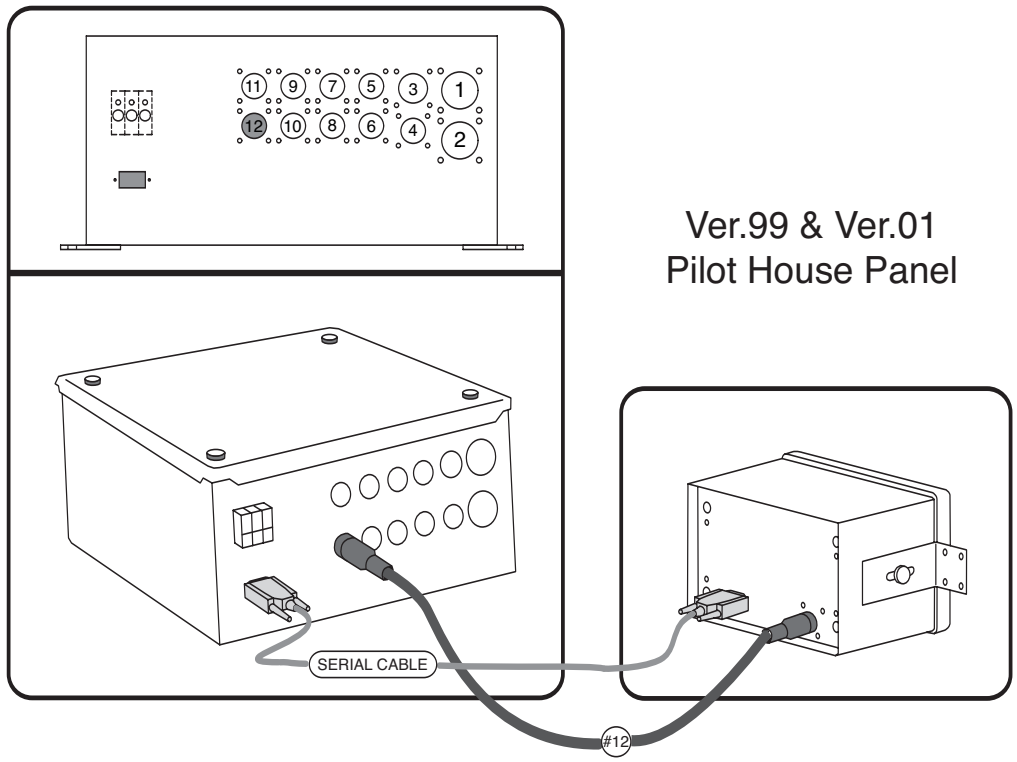
Servovalve Assembly Cables:

Cables #1 & #2 - Main trunk with Y branch to servo and to position sensor.
Cables #9 & #10 - To A/B dump & yoke locking valves.

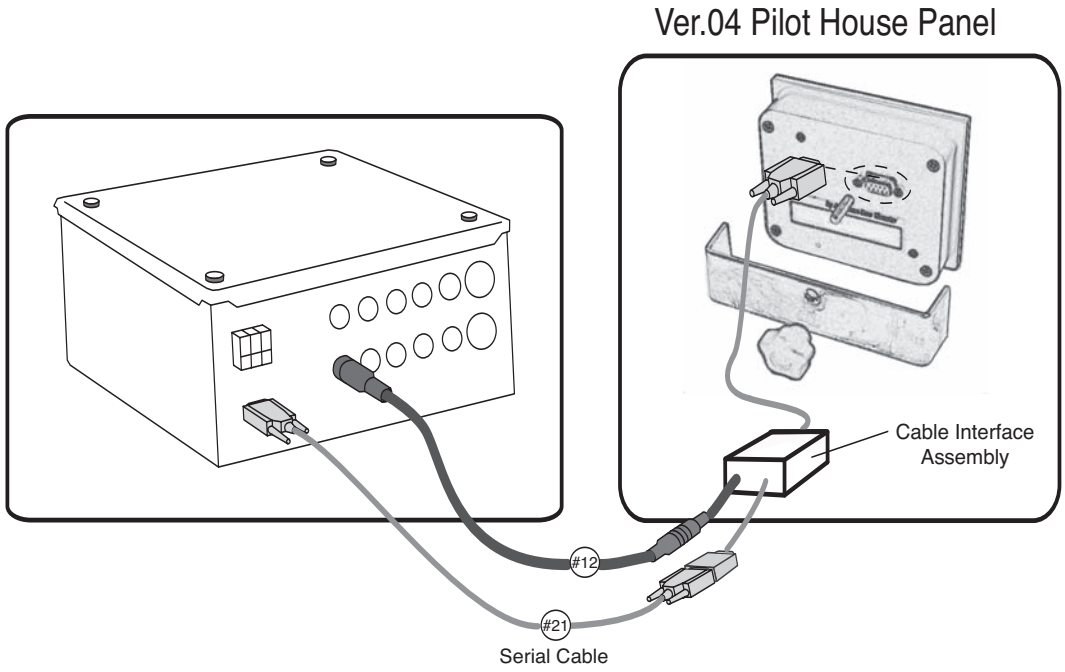


Pilothouse Panel Connections:

Cable #12 (power) and Cable #21 (serial communication)



Ver.99 & Ver.01
Pilot House Panel

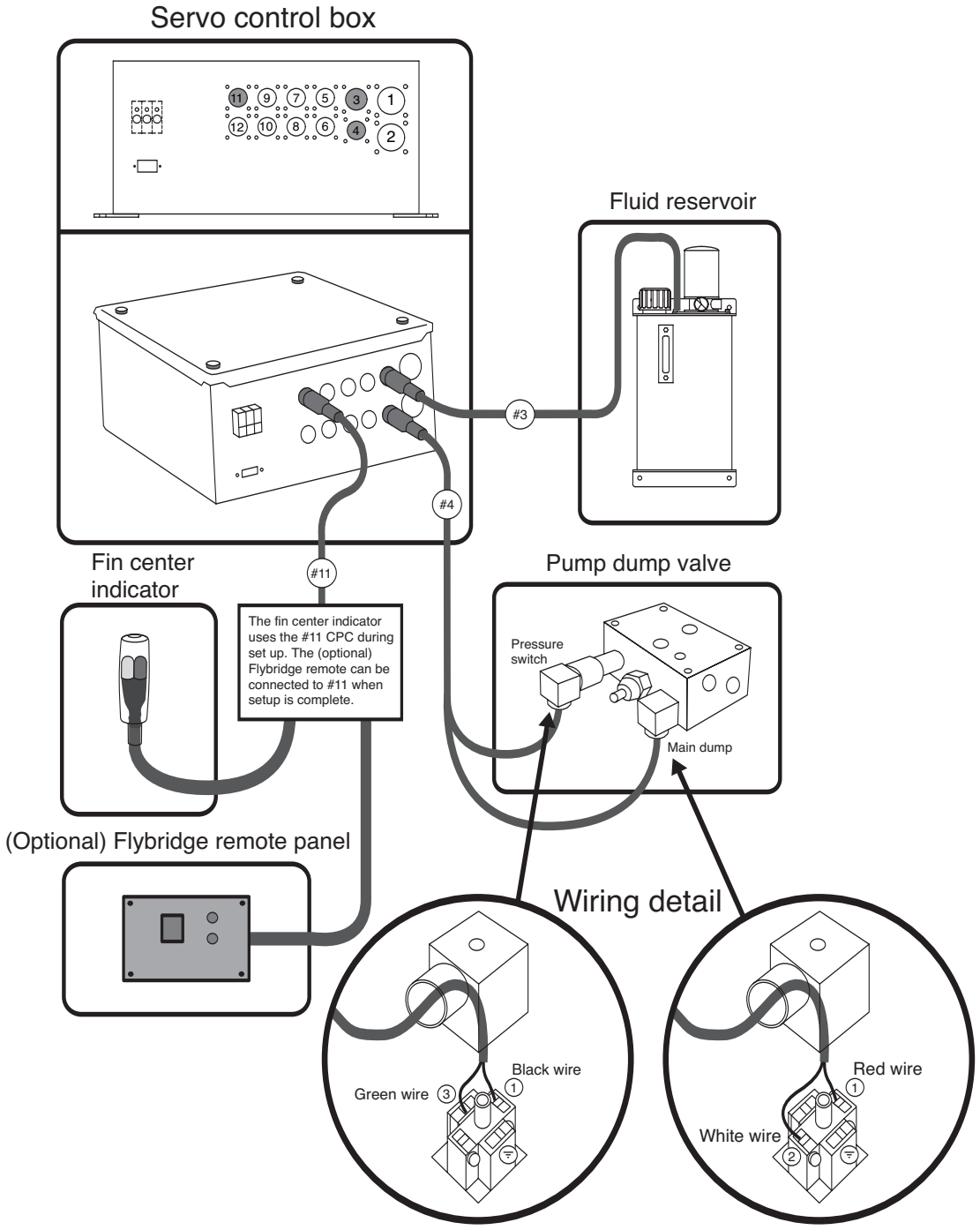


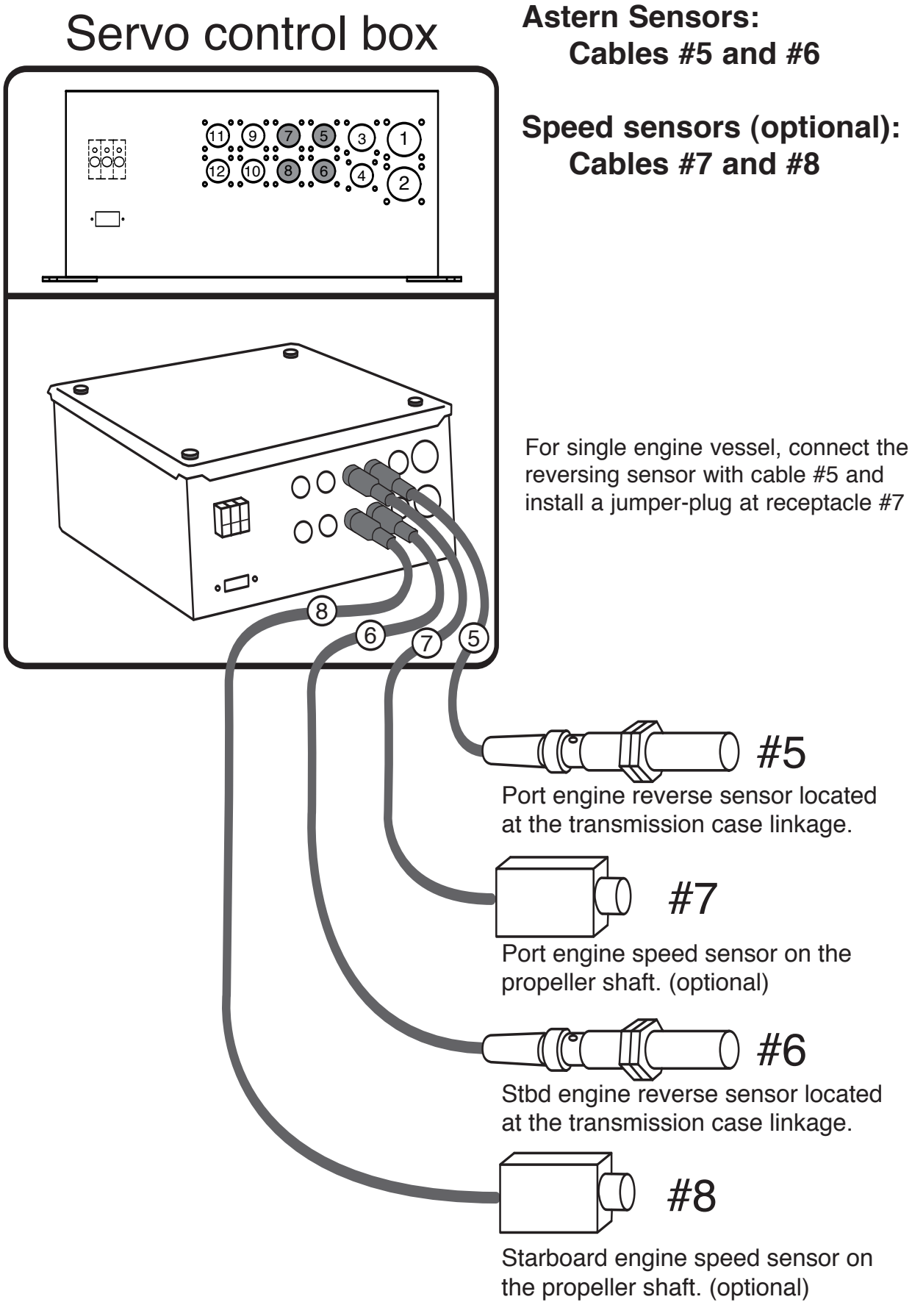
Ver.04 Pilot House Panel

Reservoir Alarm Switch Cable #3

Pressure Control Manifold Cable #4

Remote Pilothouse Cable #11 (A temporary set-up cable uses receptacle #11 at the Servobox only during initial adjustment of the system)





Astern Sensors:
Cables #5 and #6

Speed sensors (optional):
Cables #7 and #8

For single engine vessel, connect the reversing sensor with cable #5 and install a jumper-plug at receptacle #7

#5

Port engine reverse sensor located at the transmission case linkage.

#7

Port engine speed sensor on the propeller shaft. (optional)

#6

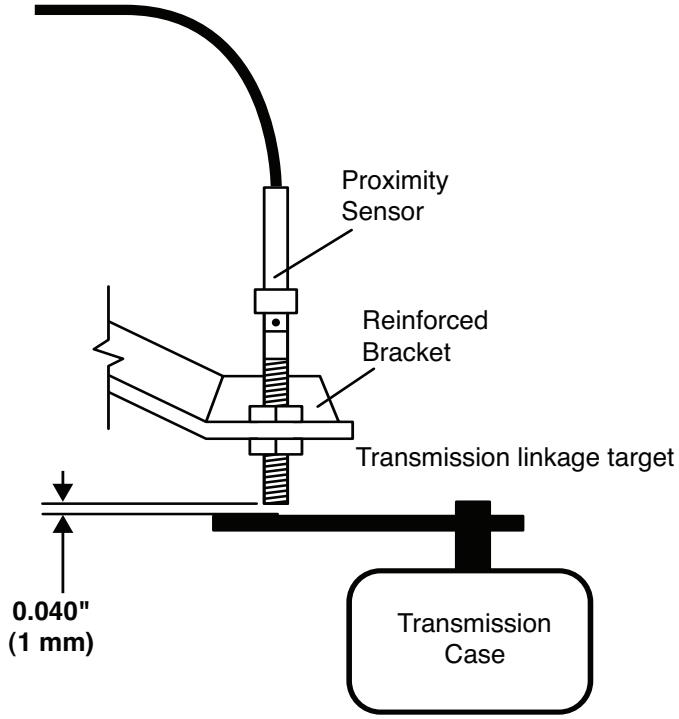
Stbd engine reverse sensor located at the transmission case linkage.

#8

Starboard engine speed sensor on the propeller shaft. (optional)

Reversing-sensor installation is illustrated here: (speed-sensor installation is shown in Section 7)

Each transmission must have a reversing sensor. For single engine vessels use only one reversing sensor connected with cable #5, and also install a jumper plug at Servobox receptacle #7.



Mount reversing sensor securely. The face of the sensor must be within 1 mm of a ferrous metal target when the transmission is shifted into reverse.

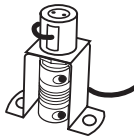
For vessels fitted with transmission equipment which does not permit alignment of proximity sensors to mechanical linkage, consult with American Bow Thruster.

Section 10

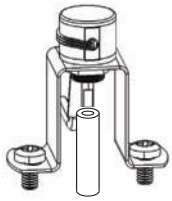
Position Sensor Installation

All fin position sensors are factory assembled to a sensor mounting bracket.

Because there are two different methods of coupling the Sensor Shaft to the Actuator Shaft Extension, it will be necessary to identify your systems hardware according to illustrations shown here and then follow the installation procedures that match your coupler design.



Shaft-Position Sensor Assembly.
Helical Coupler Style



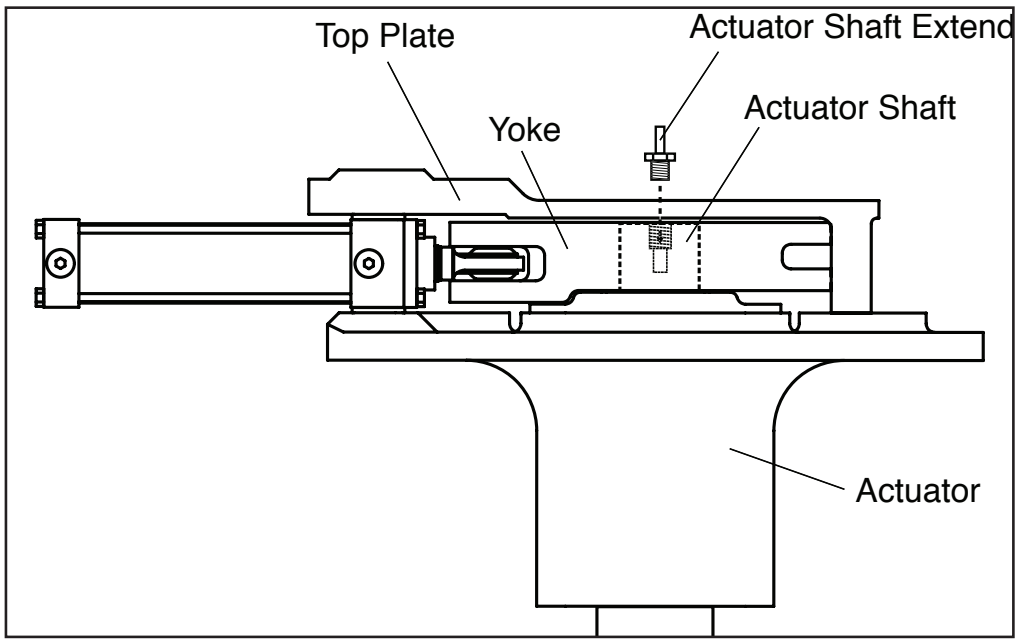
Shaft-Position Sensor Assembly
Silicone Tube Style

For either type of coupler, the sensor assemblies should not be installed until all other stabilizer electrical components are installed and ready to be electrically powered.

Then, for either type of coupler:
(1) first install the actuator shaft extender
(2) also connect and route the temporary set-up cable #11 from the Servo Control Box to the location of the actuators.

Installing the Actuator Shaft Extender

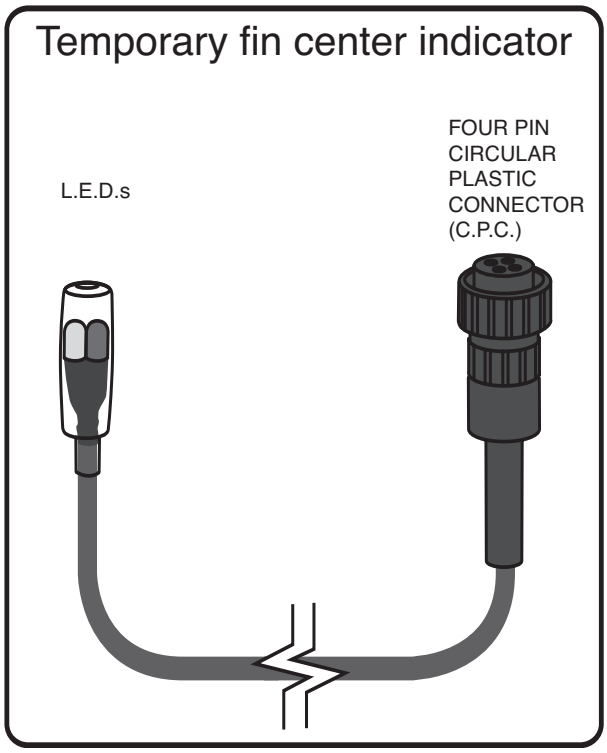
Install the actuator shaft extender by coating its threads with high strength locking compound and screwing it into place at the top center of the actuator shaft. The bottom of the extender hex flat must be tight against the top of the actuator shaft. Do not proceed if there is a gap between the bottom hex flat and the top of the actuator shaft.



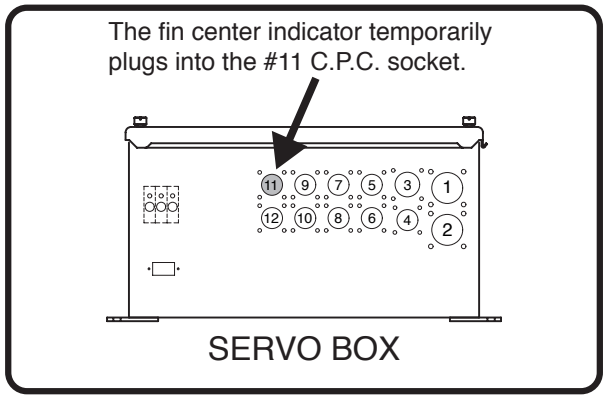
Connect Temporary Cable #11

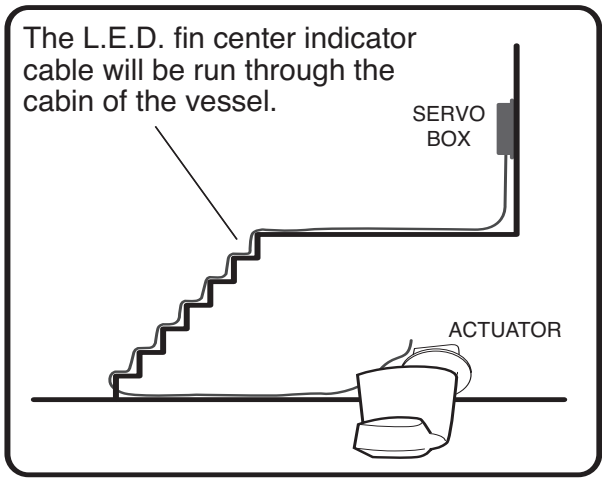
Temporary Cable #11 with its indicator lamps will be used to complete the installation of shaft position sensors.

This set-up cable is included with the system cable set and can be identified by the presence of two LED lamps at one end, and circular connector at the other end.



Connect the set-up cable to Servobox Connector #11 and route the cable through the vessel along any convenient path to bring the indicator end to the vicinity of the actuators.

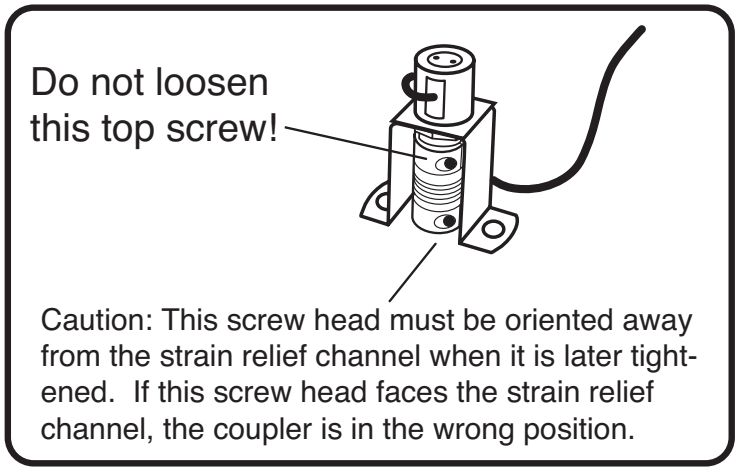




Installing Sensors with Helical Couplers

1) Slide the sensor coupler over the actuator shaft extension. The coupler is pre-installed on the sensor shaft (top screw) and should not be loosened from the sensor shaft. the lower coupler screw will clamp the coupler onto the extension shaft, but this lower screw should not be tightened yet.

The coupler should rotate freely on the extension shaft.



Caution: This screw head must be oriented away from the strain relief channel when it is later tightened. If this screw head faces the strain relief channel, the coupler is in the wrong position.

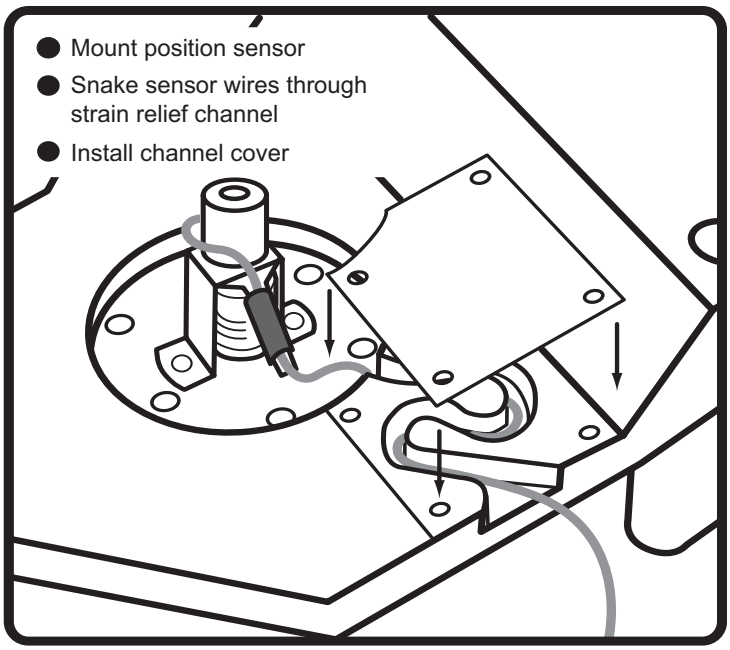
2) Install the mounting bracket screws using medium strength thread locker. The cable tongue on the sensor assembly must be pointing toward the top plate strain relief channel.

When the mounting bracket screws are fully tightened, check that the coupler will rotate freely on the shaft extender. If it does not, then there is an alignment problem that must be resolved.

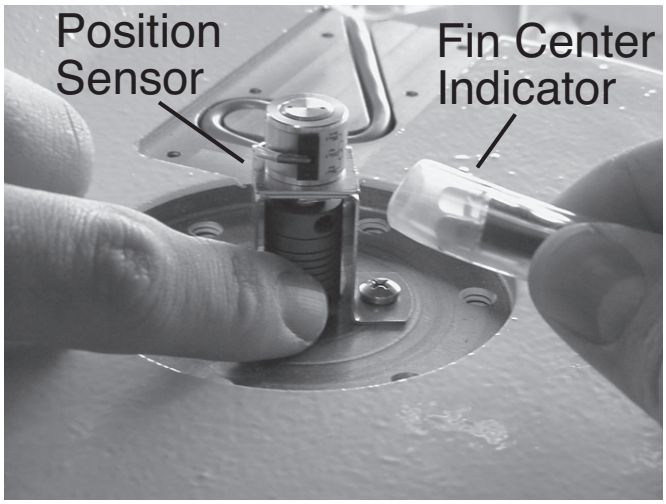
3) Route the sensor cable through the strain relief channel and install the channel cover.

4) Apply DC power to the Stabilizer Servobox.

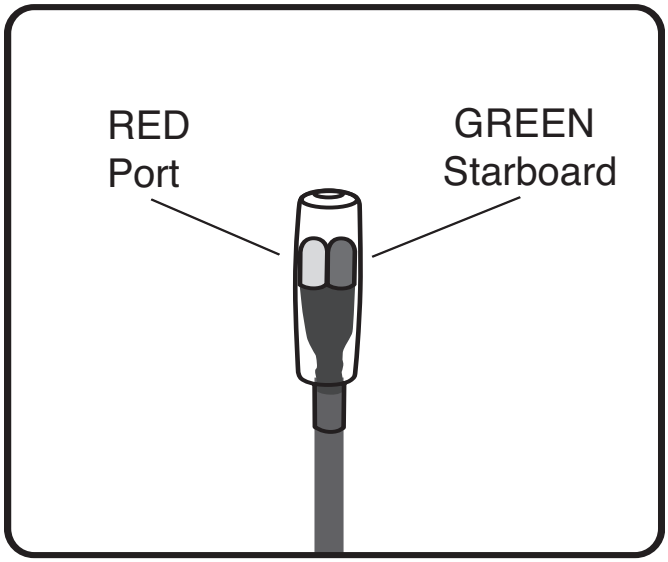
5) Confirm that the fins are wedged on the neutral line, parallel to the keel. With Notch-Lock Yokes, wedges may be removed but yokes must be engaged and pinned by locking cylinder rods and fins must be approximately parallel to the keel.



6) Bring the indicator end or the set-up cable to the location of the sensor that is being calibrated.



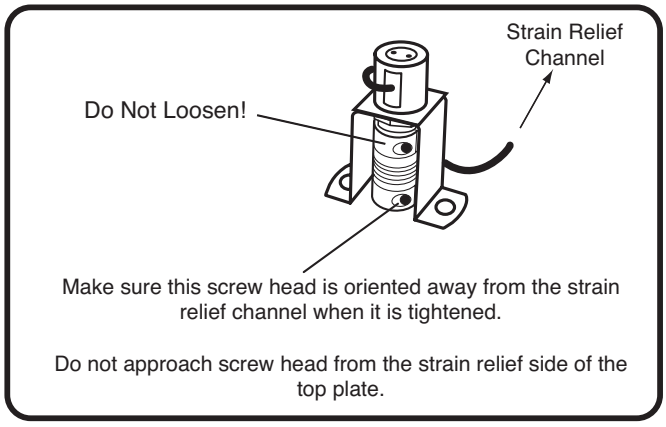
7) Rotate the coupler on the extender shaft until a lamp illuminates steadily; red for port side, green for stbd.



In 360º rotation of the coupler, the lamp will light at two points, 180º apart.

If the fixing screw hex head is pointing toward the strain relief channel. This is the wrong coupler orientation.

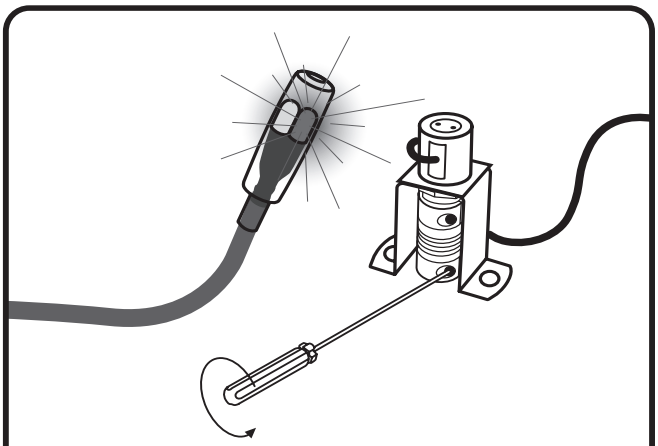
At the correct point, the fixing hex head screw is pointing away from the strain relief channel.



8) With the hex head of the fixing screw in the correct direction, find the exact point at which the LED indicator in turned on. Tighten the fixing screw to lock the coupler in this position on the extender shaft.

When the coupler is tight, the indicator lamp should be turned on.

9) Repeat this procedure for the other actuator.



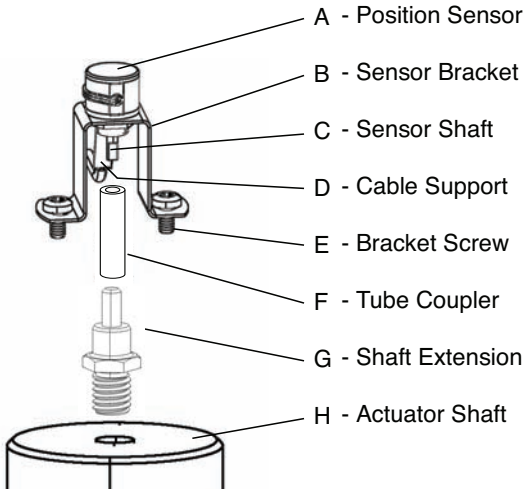
When the L.E.D. lights up, tighten the socket head cap screw on the coupler.

Installing Sensors with Silicone Tube Couplers

1) Confirm that the Actuator Top Plate and Top Plate Screws have been fully installed (but first read step 2 below)

2) Install the Shaft Extension Fitting [G] onto the Actuator Shaft [H] after the Extension has been pre-fitted with a length of Silicon Tubing Coupler [F]. Use high strength thread locker on the fitting threads.

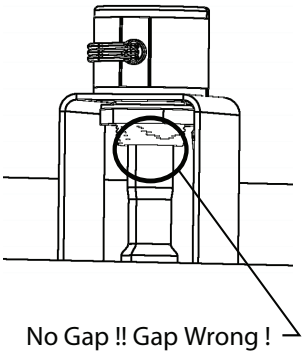
Factory fitted lengths of Silicone Tubing measure:
0.98" for 220, 250 & 640 Actuators.
1.08" for 300, 370, & 440 Actuators.



With the Top Plate installed, this fitting can be tightened using a 0.5" (13mm), thin wall, deep hex socket. If this hex socket is not available, then Top Plate removal will be required for installation of the Extension Fitting.

3) Confirm that the installed Tubing Coupler [F] has a length which will engage 0.375" of the Shaft Extension Fitting [G] and 0.25", not more, of the Position Sensor Shaft [C].

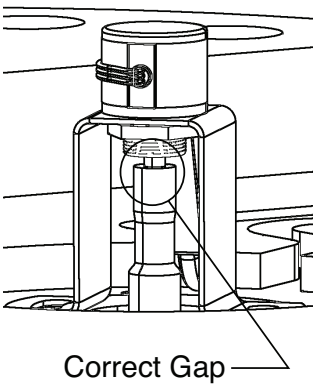
The Coupler Tube must not contact the face of the Position Sensor (there should be 0.06" gap between the end of the Coupler Tube and the face of the Position Sensor).



Evaluate this gap by placing the Sensor Bracket [B] on top of the Top Plate with the sensor shaft immediately adjacent to the Coupler Tube.

4) If necessary, prepare and install a revised length of Coupler Tube (from material supplied with the parts kit) until the fit and clearance criteria of step 3 are achieved.

5) Confirm that the fins are wedged on the neutral line, parallel to the keel. With Notch-Lock Yokes, wedges may be removed but yokes must be engaged and pinned by locking cylinder rods, and fins must be approximately parallel to the keel.



6) Connect and route the temporary set-up cable #11 to the location of the sensor that is being calibrated, then apply DC power to the Stabilizer Servobox.

7) Rotate the sensor shaft until the shaft flat (usually marked with

yellow paint) faces away from the cable support [D] side of the bracket, and until the appropriate Cable #11 indicator lamp is steadily illuminated.

8) With the flange feet of the Sensor Bracket centered above the bracket mounting holes in the Top Plate, push the Sensor Shaft into the Coupler Tube and press downward until the Bracket Feet contact the top plate.

9) Install the Bracket Screws [E] with medium strength thread locker, keeping the screws slightly loose to permit rotation (+/– 12°) of the Sensor/Bracket Assembly.

10) Rotate the Sensor/Bracket Assembly as needed (if bracket is not slotted for rotation, see note below) until the appropriate set-up lamp illuminates steadily (red for port side, green for stbd) then final tighten the bracket screws while maintaining illumination of the lamp. Repeat this procedure for the other side.

Note:

When a Silicone Tubing Coupler must be installed to a Position Sensor which is mounted to a Sensor Bracket that does not have slotted mounting holes the final adjustment at Step 10 can be made by slightly turning the exposed Sensor Shaft with a fine needle nose plier. First fully tighten the Bracket Screws, then turn the sensor shaft in slight increments until the set-up lamp illuminates steadily for the side under adjustment.

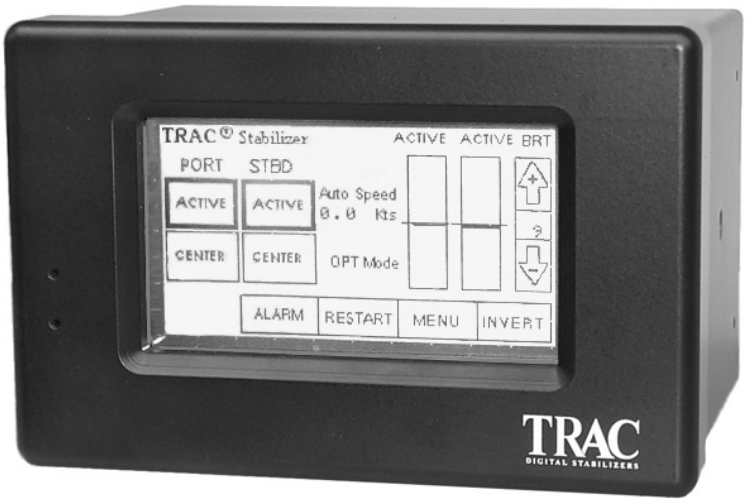
TRAC

DIGITAL STABILIZERS

by American Bow Thruster

BASIC SYSTEM OPERATION

VER 3.4



TRAC DIGITAL STABILIZER - SYSTEM OPERATION

CONTENTS

SECTION 1 - INTRODUCTION

Preparations for System Use

Before using TRAC Stabilizer equipment, the vessel operator should become familiar with basic system features by reading this short document, especially Sections 1, 2, 3, and 6. Beyond this, a basic understanding of the systems plumbing and electrical details should be attained. Consult the system wiring and plumbing diagrams and discuss these with American Bow Thruster as needed.

Basic Operating Requirements

Except for circumstances described in the immediately following paragraph, the TRAC stabilizer system must be operating whenever the vessel is underway or maneuvering. It is important for the stabilizer fins to be under system control whenever water may be forced over them, regardless of whether water flow is from forward or reverse motion of the vessel, or from prop wash during reversing maneuvers.

In some exceptional circumstances, where a fin cannot be placed under normal system control during vessel operation, then the disabled fin must be manually locked at its actuator. Exceptional circumstances would result from system hydraulic, electrical or mechanical problems. Failure to lock an uncontrolled fin may lead to actuator equipment damage from high energy mechanical stresses. For this reason, the procedure for locking fins will be discussed immediately below, before proceeding with other system operation details.

Procedure to lock a non-operating fin

The procedure by which a non-operating fin would be manually locked would vary with the style of yoke which connects the actuator shaft to the actuator cylinder. Two different yoke styles, standard and Notch-Lock, are illustrated in section 6 of the TRAC Stabilizer Installation Manual. You should determine which yoke style is installed on your vessel.

Standard Yokes

For actuators with Standard Yokes, either fin can be mechanically locked by manually adjusting the Yoke Jacking Bolts to rotate the yoke to a near-center position. When the yoke has been rotated to this position, the locking guide pin (no pin for 440 systems) can be inserted through the yoke-end and into the locking swing arm (original actuator designs) or into the locking plate (illustrated on pg 6 –2 of the installation manual).

Use extreme caution when inspecting or working near the actuator mechanism.

DANGER !!! USE EXTREME CAUTION !!!
Unexpected and sudden yoke movement may occur.
Hazardous Pinch Points exist at the actuator assembly !!!

Do Not place hands or fingers under or around the edges of the actuator top plate.
Do Not place hands or fingers between the actuator cylinder and the actuator top plate.
Do Not rest hands or fingers on the locking plate.

1) Use the jacking bolts to rotate the yoke until the pin hole in the yoke's free end is aligned with the hole in the swing arm or the locking plate. For 440 systems, rotate until the yoke is symmetrically positioned with respect to cylinder trunion sockets.

2) Insert the locking pin through the yoke end and swing arm or locking plate.

3) Snug both Jacking Bolts against the yoke, and tighten the bolt jam nuts against the Jacking Bolt Blocks.

Notch-Lock Yokes

For actuators with Notch-lock Yokes, a fin will be mechanically locked when the locking cylinder's pin, which is spring loaded for extension, is pushed into the yoke's locking notch. Under most circumstances, the yoke will lock automatically whenever system hydraulic power is shut down in a normal sequence. Thereafter, the yoke will remain locked in a near-center position, even in the absence of system hydraulic power. Locked yokes are mechanically held at near-center position until the fin is "Enabled" (at the Pilothouse Panel touchscreen) and the locking pin is hydraulically retracted under normal system control.

If any circumstance should cause a fin to become disabled when the fin's yoke is not locked, then one of two procedures should be followed depending on prevailing conditions.

a) If the fin becomes disabled while the boat is underway forward, then speed should be reduced and "S" turns should be repeated until the disabled fin's yoke passes through the center position to engage the spring loaded locking pin.

Extension engagement of the yoke locking pin can be confirmed by visual inspection at the actuator.

Use extreme caution when inspecting or working near the actuator mechanism.

DANGER !!! USE EXTREME CAUTION !!!
Unexpected and sudden yoke movement may occur.
Hazardous Pinch Points exist at the actuator assembly !!!

Do Not place hands or fingers under or around the edges of the actuator top plate.
Do Not place hands or fingers between the actuator cylinder and the actuator top plate.
Do Not place hands or fingers between the yoke and a retracted locking pin.

b) If the fin becomes disabled when the boat is not underway, and when, by co-incidence, the yoke is not in a locked state, then the yoke should be manually rotated until the yoke notch engages with the spring loaded locking pin.

1. Release stabilizer system pressure by pressing “RESTART” at the TRAC Pilothouse Panel’s HOME page. This will de-energize the servovalve assembly’s A/B dump valve(s) to permit unrestricted actuator cylinder movement.

2. Observing the **Cautions** stated immediately above, inspect the disabled actuator to visualize the bolted clamping split in the actuator’s yoke.

3. Insert the flat blade of a stout 12” screwdriver into the yoke’s split (use other pry points if the split is not accessible) and apply steady pressure to rotate the yoke until the locking pin engages the yoke slot.

Operating the vessel with a mechanically locked fin

Mechanically locked fins will be secured against all normally encountered forces, and the vessel can be operated in any normal manner without concern for damage to the locked fins or actuator mechanisms. A disadvantage of mechanically locked yokes is that they will not yield to excessive rotation forces that could occur with abnormal or extreme conditions.

In some cases, the vessel may be operated with one fin locked and other fin(s) operating normally. All normal operating procedures will apply to any enabled fin.

In other cases, the vessel may be operated with all fins mechanically locked. Regardless, the TRAC Stabilizer control system should be turned on whenever possible to permit monitoring the system hydraulic oil temperature and level.

Whenever system hydraulic pumps are turning, temperature status of the system’s hydraulic reservoir should be monitored. For some installations, system control power may be required for normal operation of system hydraulic cooling. Whenever there are questions about these details, consult American Bow Thruster.

Normal TRAC Stabilizer operation

Normal operation will be described in Section 2 (following) after some general observations are made here.

As soon as the vessel’s engines have been started (and system hydraulic pressure becomes available) the TRAC Stabilizer system should be made live by turning on DC power, and both fins should be “Enabled” at the Pilothouse Panel touchscreen. Fins should be “Centered” until the vessel is underway forward, after which time they may be made “Active”.

Transmission linkage sensors are fitted on all systems to detect reversing on any propulsion engine. The control will automatically bring fins to center position when reversing is detected, and the Pilothouse Panel will display “Backing”.

In systems with standard yokes, fins are hydraulically held at center position during backing maneuvers.

In systems with Notch-Lock yokes, fins are mechanically held at center position during backing maneuvers.

In either type of system, the display shows “BACKING” when sensors detect transmission reverse.

When the vessel goes to neutral or to forward after backing maneuvers are completed, the display will show “CENTER” for fin position (Notch-Lock yokes will unlock but remain at center position). It will be necessary to manually depress “Active” at the touchscreen panel once the vessel is underway (unless the “auto-active” feature is enabled in system parameters). The border of the “ACTIVE” key will flash if the key is pressed while inside the preset “backing-coasting” time interval. If the latter occurs, ACTIVE status will begin automatically at the end of coasting delay time.

When the vessel is underway, fins should be “ACTIVE” or at “CENTER”. Fins should not be mechanically locked when cruising except to address exceptional circumstances involving malfunction in the stabilizer system. Mechanically locked fins will not yield to excessive rotational forces that would normally be limited by relief valve action. Protective relief valves are defeated when yokes are mechanically locked.

Hydraulic functions in TRAC Integrated Systems

Where vessels are fitted with TRAC Hydraulic Thrusters as well as TRAC Stabilizers, there are variable requirements and capabilities for making appropriate hydraulic power available to all hydraulic functions.

Any limitation on simultaneous use of thrusters and other hydraulic functions, including the stabilizers, should be understood through consultation with American Bow Thruster.

All integrated (thruster/stabilizer) systems will have two separate control logic units. One of these, the Servo Control Box, serves only the stabilizer system. The other, the Central Control Box, serves the thruster(s) and additional hydraulic functions when the latter are included in the system. In integrated systems, the Central Control Box may affect hydraulic pump functions that are required for the stabilizer system and may require dc circuit power at all times.

SECTION 2 - NORMAL SYSTEM OPERATION

Start-up and Run Procedures

1. Start engine(s) to drive the stabilizer hydraulic pump(s).

2. Turn on the TRAC Stabilizer DC circuit breaker.

3. Select or enable hydraulic pumps (if not done automatically).

4. Enable both fins at the TRAC Pilothouse Panel touchscreen and observe that both fins are “CENTERED”.

5. Check for normal water flow from the stabilizer cooling pump’s discharge through-hull (when so equipped).

6. During maneuvering, both fins should remain at “CENTER”. Notch-lock yokes will be locked while backing, but the display will show “BACKING”.

7. If standard yoke fins are driven off center during backing, stop backing and wait for the fins to center themselves; then resume maneuvering more gently.

If the vessel is maneuvered or reversed when fins are not powered to the center position (Standard Yokes) or locked (Notch-Lock Yokes), there can be abnormal high force contact between actuator assembly parts. Shaft, yoke, or cylinder damage can occur.

8. When backing is completed, and transmission reversing is no longer detected, the control will unlock Notch-Lock yokes. For both yoke types, the Pilothouse Panel will indicate fins at “CENTER.

9. When forward speed reaches 4 to 5 knots then, at your discretion, make both fins “ACTIVE”.

10. In normal operation, fins should be “ACTIVE” or at “CENTER” whenever the vessel is under way. Any fin which, because of system malfunction, cannot be brought to either of these states, should be manually centered and locked at the earliest convenience.

11. At the HEEL page, select “ZH”, “OPT”, or “MAX” mode according to your preference. See Section 6 for details about the Pilothouse Panel’s HEEL page and a description of Heel Modes.

12. Insure that proper vessel speed information is displayed at the HOME page speed indicator. See Section 6 for details about the Pilothouse Panel’s SPEED page and a description of proper speed settings.

13. Procedures to be followed after docking or mooring depend on type of actuator yoke.

For systems with standard yokes, if possible, keep the TRAC Stabilizer DC circuit breaker turned on after engine shutdown. When DC circuit power is maintained, the hydraulic system will create high resistance to fin movement even when the hydraulic pump is stopped.

By contrast, if the TRAC System DC circuit breaker is turned off, standard-yoke fins will be free to move as the boat rolls at anchor, When a fin is free at anchor, the actuator yoke may strike against mechanical end stops whenever roll motion is sufficiently large.

When the boat is docked or anchored for extended intervals of non-cruising, yoke pins should be inserted to secure fins in near-center position. Pinning is most easily accomplished by "Centering" fins under hydraulic power, and then manually turning jacking bolts to bear against the yoke. Use Extreme Caution when inspecting or working around the actuator equipment.

DANGER !!! USE EXTREME CAUTION !!!
Unexpected and sudden yoke movement may occur.
Hazardous Pinch Points exist at the actuator assembly !!!

Do Not place hands or fingers under or around the edges of the actuator top plate.
Do Not place hands or fingers between the actuator cylinder and the actuator top plate.
Do Not rest hands or fingers on the locking plate.

For systems with Notch-Lock yokes, the yokes will normally become automatically pinned during the sequence of docking maneuvers that precedes engine shutdown. When pins are automatically set, no special steps should be required to subsequently lock fins for short or long periods of non-use. However, when prolonged non-use is expected, it is recommended that yoke-pin status be visually confirmed by inspection of the actuators prior to leaving the vessel.

STAR Operation:

Vessels equipped for STAR™ (Stabilization At Rest) operation will have the option of activating fins for reduction of roll motion when the vessel is not under way. STAR™ configurations typically include:
1) generator driven hydraulic pumps for system power when propulsion engines are off,
2) extended chord fins for enhanced lift-stroke capacity, and
3) actuator size upgrade.

STAR™ is enabled via parameter settings at the time of system commissioning. This mode of operation can then be from the Pilothouse Panel's HOME page whenever the vessel is at zero speed (providing hydraulic power is available).

STAR™ operation poses extreme danger to any swimmer or personal watercraft near the sweep area of any fin. Fin motion may occur suddenly, with high force and with extreme speed. Swimmers and watercraft must be kept away from fins when the system is operating in STAR™ mode.

DANGER! EXTREME PERSONNEL HAZARD!
RISK OF SERIOUS INJURY OR DEATH !

1) Take all necessary steps to keep any person away from the fins. Unexpected fin motion may occur at any time. Keep persons clear of fins whenever STAR™ is enabled.

2) Make sure that a generator driven pump is operating to support STAR™operation. This pump is typically selected at a system Pump Select Panel.

3) When the vessel speed is at "Zero" speed, as indicated at the HOME page display, and when transmission reversing is not detected, and when all enabled fins are "ACTIVE", the system is ready for STAR™ operation. When these conditions have been met, the border of the "AT SEA" key (lower left corner of Pilothouse Panel) will become highlighted to signify button enabled.

4) Touching the enabled "AT SEA" key will cause the key to display "ANCHOR" and will cause STAR™ operation to begin.

5) STAR™ operation will begin with an initialize routine** (see below) which automatically transitions to stabilization at rest.

STAR™ stabilization will continue until manually suspended at the Pilothouse Panel, or until automatically terminated by transmission reversing sensors or shaft speed sensors.

6) Manually suspend STAR™ operation at any time by depressing “CENTER” at the Pilothouse Panel. Fins will become motionless at center position, without setting of the yoke locking pins. The lower left key will continue to display “ANCHOR”.

From this state, STAR™ operation may be resumed, by depressing “ACTIVE”. When STAR™ is resumed, initialization motions (described below) will not be repeated.

7) Automatic termination of STAR™operation occurs if transmission reversing is detected or if non-zero shaft speed is detected. The lower left key will display “AT SEA”. After termination, STAR™ operation can be resumed according to steps 2 and 3 above.

With automatic termination of STAR™, the TRAC control transitions to an appropriate state determined by the cause of termination. When reversing is detected, fins will automatically center and lock via setting of yoke locking pins. When maneuvering is completed and the boat is underway forward, then fins should be made “ACTIVE” in the normal sequence of operation. If STAR™ has been active and the boat gets underway without backing then the fin command state will automatically change to AT SEA and the fins will remain ACTIVE.

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** STAR™ Initialization consists of several initial slow sweeping motions of the fins which explore the limits of fin movement. These “initialization” movements automatically transition to normal STAR™ operation which then continues until cancelled by one of the actions in steps 4 or 5 above.

SECTION 3 - ABNORMAL CONDITIONS

Emergency abnormal conditions may involve different parts of the stabilizer system including the mechanical actuators, the fins, the electrical control circuits, or the hydraulic power circuits. Each of these categories is addressed below.

Where mechanical impact to a fin or shaft has occurred or is suspected:—

1. At the touchscreen, press “RESTART” to set the fins free.

2. Immediately make visual checks in the area of the actuator mountings. Look for any sign of damage to the actuator assembly or to the surrounding hull.

DANGER !!! USE EXTREME CAUTION !!!
Unexpected and sudden yoke movement may occur.
Hazardous Pinch Points exist at the actuator assembly !!!

Avoid pinch points for equipment parts that may move. **Do Not** place fingers below the actuator top plate.

3. Check for normal appearance of the connection between the actuator cylinder rod end and the yoke.

4. If no damage is evident, then enable one or both fins and make visual checks for normal actuator movement once under way.

5. If mechanical damage has occurred to an actuator cylinder, or if it is intended, for any reason, to deactivate the actuator on a given side, then mechanically lock the fin on the disabled side as described previously on pages 3 to 5 of this operations manual.

6. When systems have live pumps, hydraulic cooling is always necessary. Therefore the following conditions must be set to allow cruising with both fins free:

a. Maintain power to the Stabilizer Servo Box.

b. When systems have a Central Control Box, maintain power to this unit.

c. When integrated systems have a Stabilizer select switch at a Pump Select Panel, maintain “Stabilizer” state.

Where electrical control malfunctions are indicated by Pilothouse Panel alarms including "communication errors", "low voltage error", "servo error", "fin position error". (See sections 4 and 6 of this manual for additional details on alarms)

1. In most instances of control system malfunction, the fins can be set "FREE" and the boat can continue with forward motion, at reduced speed, without adverse consequence. The fins will approximately self-trail (or automatically lock near center in systems with Notch-Lock Yokes) and should not influence maneuverability when underway forward. The stabilizer system circuit breaker should remain on to provide reservoir temperature alarms (unless the pump is decoupled from the engine).

2. It is always recommended to mechanically lock disabled fins as soon as possible. See procedures on preceding pages 3 to 5 of this operations manual.

3. In some instances, transient conditions may cause control errors. If a Pilothouse Panel alarm occurs, it is important to write down the exact nature of the alarm(s) and also to note any remarkable vessel operating conditions that preceded or coincided with the alarm(s).

4. If a transient condition has caused an alarm, then it may be possible to restore normal function by cycling the dc circuit breaker power to the stabilizer system.

5. If possible, consult with factory for trouble shooting guidance.

6. If normal operation is intermittent, and if symptoms do not produce uncomfortable motions of the boat, then continue with one or both stabilizers active.

7. If normal operation is intermittent, and if symptoms are localized to one side, then deactivate the troubled side and proceed with one side operational.

8. For any side that is de-activated (i.e. not enabled at the Pilothouse Panel) the yoke jacking bolts should be run in to secure the yoke at a position that aligns the fin approximately parallel to the keel. This position is indicated by the swing arm gage (when fitted), or alternately by the pointer gage on the top plate.

9. When systems have live pumps, hydraulic cooling is always necessary. Therefore the following conditions must be set to allow cruising with both fins free:

a. When systems have a Central Control Box, maintain power to this unit.

b. When systems have a Stabilizer select switch at a Pump Select Panel, maintain "Stabilizer" state.

<u>Where Pilothouse Panel alarms indicate oil temperature, oil level, or oil pressure</u> problems. (See sections 4 and 6 of this manual for additional details on alarms)

1. Reduce speed or turn off the engine that drives the stabilizer hydraulic pump, then immediately inspect the stabilizer system hydraulic oil reservoir to confirm oil level and temperature with the sight glass thermometer assembly on the front of the reservoir.

2. For confirmed temperature problems, inspect and restore cooling pump water flow to all system the heat exchanger(s).

- Temperature warning occurs at approximately 160 deg F.
- Temperature shutdown (Manifold de-energized) occurs at approximately 180 deg F.
- System temperature should not be allowed to exceed 220 deg F.
- Oil temperature cannot be rapidly reduced unless both oil and cooling water flow is established thorough their respective sections of the system heat exchanger(s).

3. When the normal cooling pump water flow cannot be restored then consider temporary connection of either a raw water or fresh water source (7 to 9 gpm) to the heat exchanger water inlet.

4. For the pressure alarm, especially when correlated with a low oil alarm, check for loose and leaking hydraulic fittings, leaking actuator cylinders, or ruptured hydraulic hoses. Find and fix the source of leakage.

5. When temperature or level problems cannot be resolved, then the hydraulic pump(s) coupling to the engine should be removed. Live pumps should be disconnected from pto pads and pto cover plates should be securely installed.

6. Unpowered fins should be mechanically locked by using the procedures described on pages 3 to 5 of this operations manual.

SECTION 4 - SYSTEM ALARMS

(See sections 6 of this manual for additional details on alarms)

Two Types of Alarms

1) ACUTE ALARMS will produce insistent alert sound from the Pilothouse Panel. These alarms can be muted at the touchscreen, but will not clear themselves even if the cause is transient. The alarm will stay in place until the system is “Re-Started” at the Pilot House Panel.

Any alarm relating to reservoir temperature or oil level should be immediately investigated.

Acute alarms, except for individual fin error alarms, shut off flow of oil to the stabilizer servo valves. This may minimize, but not necessarily prevent further loss of oil, or further oil temperature rise.

2) WARNING ALARMS will produce less urgent alert sounds from the Pilothouse Panel. These alarms may also be “MUTED” and will clear themselves when the cause of the alarm goes away. These alarms should be logged and investigated as soon as possible, particularly if the warnings are for oil temperature or oil level.

Selected Alarms and Suggested Responses

Alarm 1: **"High oil temp / Warning only / Check cooling system"**

Suggested response: Mute alarm at Pilothouse Panel, then reduce or stop engine speed to minimize hydraulic pump flow.

Immediately inspect the stabilizer system hydraulic reservoir to confirm the alarm. The temperature warning will occur at probe 160º F. The reservoir would be very hot to the touch and the sight gage temperature indicator should confirm this high level.

Inspect for cooling pump water flow from the discharge through-hull. If water flow is impaired, the lack of cooling flow will need to be immediately repaired.

When the cause of the temperature rise cannot be remedied, minimize heat gain in the hydraulic system by following steps detailed Section 3, Reacting to Abnormal Conditions.

The cause of temperature warnings must be resolved in order to prevent risk of injury to personnel and damage to equipment.

Alarm 2: **"Extreme high oil temp / System disabled / Check cooling system Danger! Install locking pins first"**

Suggested response: Mute alarm at Pilothouse panel, then if possible stop the engine(s)coupled to the stabilizer hydraulic pump until a temporary alternate source of heat exchanger cooling water is in place.

Cool the system down by connecting a temporary alternate source of cooling water flow to the heat exchanger water inlet. With alternate cooling water flow in place, circulate hydraulic oil through the system by running the engine connected to the stabilizer hydraulic pump.

If an alternate cooling source is not available, then decouple the system hydraulic pump from the engine to prevent hydraulic flow and additional heat gain.

When the system temperature has fallen below 120 degrees, determine whether a repairable stoppage of cooling water flow was responsible for the heat gain condition. Do this by restoring normal cooling water connections and checking for through-hull discharge when the stabilizer system is enabled.

When the cause of the temperature rise cannot be remedied, minimize heat gain in the hydraulic system by following steps detailed Section 3, Reacting to Abnormal Conditions..

Alarm 3: **"Low oil level / Warning only / Check system"**

Suggested response: Press "RESTART" at Pilothouse Panel in order to set fins "FREE". This action will reduce oil flow to the servo valves.

Start in the engine room and first confirm the validity of the alarm at the reservoir sight gage. If oil level is low in the sight gage then look for signs of leakage around all hoses and fittings in the engine room. We are looking for several gallons of oil in the bilge.

If leakage is not found in the engine room, then proceed to the actuators and inspect hoses and fittings at port and stbd actuator cylinders & Servo Valves.

Loose fittings, failed hose crimps, ruptured hoses, or leaking cylinders must be fixed prior to re-use of stabilizers.

Consult the system Plumbing Diagram to guide your search for leakage.

When an immediate remedy is not possible, then center the fins and run-in the yoke jacking bolts to secure the fin position approximately parallel to the keel.

When immediate remedy is not possible, remove the pump(s) from the pto and install the pto cover plate.

Pumps must not be run without oil. Pumps run dry or without cooling may be destroyed.

Alarm 4: **"Extreme low oil level / System disabled / Check system / Danger! Install locking pins first"**

Suggested response: Press "RESTART" at Pilothouse Panel in order to set fins "FREE". This action will reduce oil flow to the servo valves. If possible, temporarily stop the engine that drives the stabilizer hydraulic pump.

Start in the engine room and first confirm the validity of the alarm at the reservoir sight gage. If oil level is not visible in the site gage then look for signs of leakage around all hoses and fittings in the engine room.

If leakage is not found in the engine room, then proceed to the actuators and inspect hoses and fittings at port and stbd actuator cylinders & servo valves.

Loose fittings, failed hose crimps, ruptured hoses, or leaking cylinders must be fixed prior to re-use of stabilizers.

The leakage source must be found and a determination made of as to whether reservoir oil level can be restored and maintained.

The option of restoring stabilizer function will depend on whether the leak source can be

repaired or isolated, and whether the reservoir can be refilled without introducing contamination.

When an immediate remedy is not possible, then center the fins and run-in the yoke jacking bolts to secure the fin position approximately parallel to the keel.

When immediate remedy is not possible, remove the pump(s) from the pto and install the pto cover plate.

Pumps must not be run without oil. Pumps run dry or without cooling may be destroyed.

Alarm 5: **"Lost communication"**
"Danger! Servo failure / Install locking pins / Open circuit breaker / Call factory"

Suggested response: Turn TRAC Stabilizer 24VDC Ckt breaker to "OFF". Proceed to inspect the Power Cable (Cable #12) and the Serial Cable connections at the back of the Pilot House Panel and also at the Servo Control Box. Check twist lock connectors for tightness of mating connection.

If loose connections are found then remedy and restart immediately.

If no loose connections are found, then wait through 1 to 2 minutes of power-down and then try to restart the system.

If the system restarts then immediately measure DC supply voltage at the power terminals of the Servo Control Box. Also check these supply terminals for tight connection.

If the system cannot be restarted then keep the circuit breaker off and run-in the yoke jacking bolts to secure the fin position approximately parallel to the keel.

When the boat must be run with the stabilizer fins not enabled, then follow steps detailed in Section 3 "Reacting to Abnormal Conditions" : Electrical Control Malfunction.

Call factory to discuss problem.

Alarm 6: **"Low Voltage on Servo"**
"Danger! Servo failure / Install locking pins / Open circuit breaker / Call factory"

Suggested response: Turn TRAC Stabilizer 24VDC Ckt breaker to "OFF". Proceed to measure DC supply voltage at terminals of Servo Control Box. Also check these supply terminals for tight connection.

If low voltage condition (less than 23VDC) is found at Servo Control Box supply terminals, then trace the problem to the source and remedy the cause of low voltage. Then restart the system.

If the voltage problem cannot be remedied then keep the circuit breaker off and run-in the yoke jacking bolts to secure the fin position approximately parallel to the keel.

When the boat must be run with the stabilizer fins not enabled, then follow steps detailed in Section 3 "Reacting to Abnormal Conditions" : Electrical Control Malfunction.

Call factory to discuss the problem.

Alarm 7: **"Servo Watchdog"**
"Danger! Servo failure / Install locking pins / Open circuit breaker / Call factory"

Suggested response: Turn TRAC Stabilizer 24VDC Ckt breaker to "OFF".

Run-in the yoke jacking bolts to secure the fin position approximately parallel to the keel.

When the boat must be run with the stabilizer fins not enabled, then follow steps detailed in Section 3 "Reacting to Abnormal Conditions" : Electrical Control Malfunction.

Call factory to discuss problem.

SECTION 5 - SERVICE ITEMS

Required Hydraulic Oil for Trac Stabilizer Systems

ISO 46 for warm climates with seawater above 70º F (21º C)
ISO 32 for mild to cold climates with seawater below 70º F (21º C)

Recommended Inspection and Service Intervals

**	** Indicates Maximum Interval. Recommend more frequent inspection.
Each Engine RM Check	Inspect Hydraulic Reservoir oil fill level and temperature at sight gauge. Oil level at black full line with cold reservoir. Operating temperature range 90ºF to 140ºF.
DAILY (After System Start-Up)	Check Cooling Pump operation & water discharge overboard. For systems with 11 or 20 gal reservoirs, check cooling water flow indicator at heat exchanger.
DAILY While Underwa "ACTIVE"	Check System Pressure at Stabilizer Manifold gauge for normal operating pressure.
DAILY While Underwa "ACTIVE"	Listen for normal Stabilizer Actuator sounds.
MONTHLY WEEKLY When Cruisin	Inspect Stabilizer Actuator Mounting Area for water-tight integrity.
MONTHLY WEEKLY When Cruisin	Inspect Stabilizer Actuators and Cylinders for oil leaks. Inspect Cylinder Hoses for chafing.
MONTHLY	Check Return Filter Pressure Gauge at Hydraulic Reservoir during Fin motion. Change filter if needle at red zone or at 20 psi (4.7 gal res) or at 45 psi (11 gal & 20 gal res).
3 MONTHS	Check Pencil Zincs at Reservoir Heat Exchanger(s) (when equipment is fitted with zincs).
6 MONTH	For Hydraulic Pump Drivelines with rubber element(s) inspect rubber for visual signs of crazing or wear.
6-12 MO	For Hydraulic Pump Drivelines with U-Joint components, pump grease slowly into lube fittings just until grease appears at cap seals.
YEARLY	Examine all Field Electrical Connections. Clean and tighten connections as necessary.
YEARLY	Check Stabilizer Actuator Bonding Strap. Clean and tighten as necessary.
YEARLY	Replace Reservoir Return Filter Element.
YEARLY	Replace Cooling Pump Impeller when fitted to rubber impeller pump.
YEARLY	Inspect all Hydraulic System Hoses for chafing or external damage; Inspect all hydraulic fittings for leakage.
1 to 2 YEARS	Inspect and Replace Stabilizer Shaft Zincs. Inspect and replace more frequently as indicated by condition of zinc.
2 YEARS OR LESS	Inspect Cooling Pump Impeller when system has centrifugal pump.
800 HR	Replace Cooling Pump (if fitted with DC Motor driven Rubber Impeller type).
1000 HRS	Inspect Cylinder fit to Trunion Bushings. Cylinders should move axially in bushings without radial slop. Original trunion pin dia. clearance is 0.006 inch.
6 YEARS	Replace Stabilizer Actuator Shaft Seals.
6 YEARS OR 2000 HRS	Replace Stabilizer Actuator Cylinder(s).

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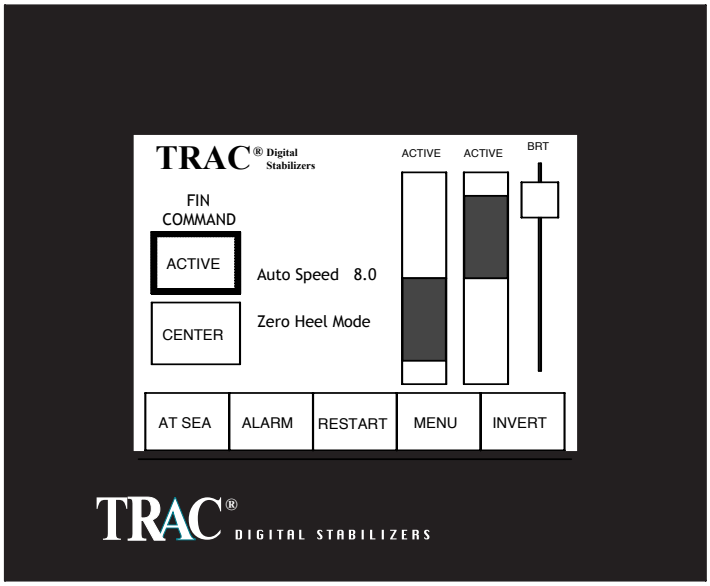
SECTION 6 - PILOTHOUSE PANEL TOUCHSCREEN

The main operator interface for the TRAC Stabilizer system is the touchscreen Pilothouse Panel. The current version of this panel is designated PP v.04. The current version software for this panel will be designated 4.022 or higher (the installed software version displays on the MENU page).

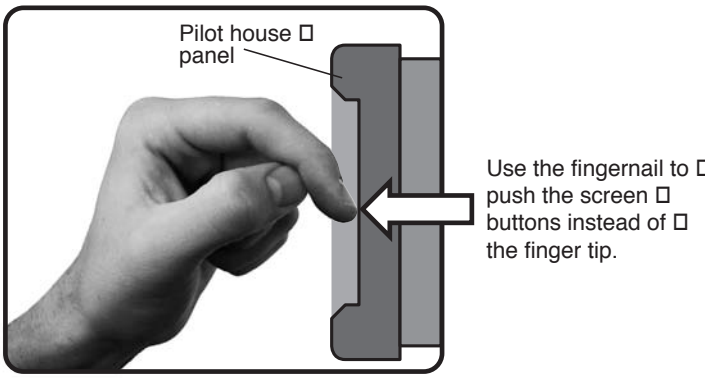
The appearance of the HOME page of the v.04 panel, with version 4.022 software installed and and with fins enabled and active, is illustrated here.



Once the stabilizer system has been made ready for action (by making hydraulic pressure available and by making all necessary electrical circuits live) operator control of the system is asserted at appropriate pages of the Pilothouse Panel. These pages with their different control functions are described below in the order in which pages would likely be accessed during normal operation.

System control parameters are set into non-volatile system memory at a series of Parameter pages at the time of system commissioning. Thereafter,system operation will normally proceed without requiring change of parameter values. Unless through consultation with authorized technical personnel, parameter settings should not be changed.

Hint:
Contact with the touchscreen for adjustments or selections may be more effective when contact is with the fingernail instead of the fingertip. Alternately use the plastic end of a pen. Never press with metal objects.



System Control: Stabilizer Initialization

The ENABLE page

The Pilothouse Panel's ENABLE page will appear whenever the stabilizer system dc circuit breaker is first turned on.

The ENABLE page will also appear if dc power is cycled off-to-on, or whenever a "RESTART" function key is available and depressed on another page.

Selections made at this page will determine which fins will be enabled for hydraulic control, and which fins will be kept "FREE" (not hydraulically powered).

Normally press the "ALL" key to enable all fins.

Any fin that is not enabled must be manually locked at the actuator before turning propellers (see Sections 1 & 2 of this Operations Manual).

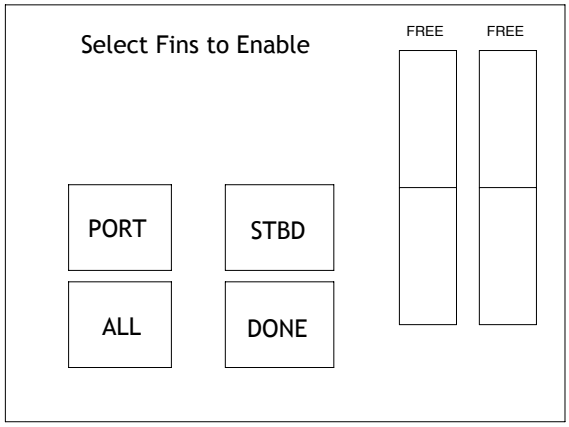
Alternatively, depress "PORT" and/or "STBD" followed by "DONE".

Either of these keypress sequences will cause automatic advance to the HOME page.

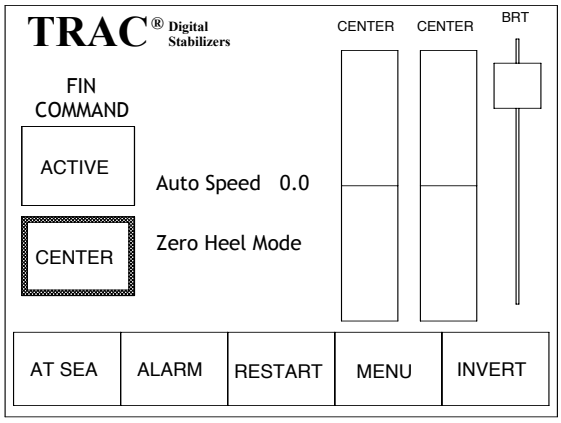
Any enabled fin will be at "CENTER"; that is, the enabled fin(s) will be hydraulically held at center position.

Any non-enabled fin will be indicated (above the fin position bars) to be "FREE", and should be manually locked before turning any propeller.

For many vessels, the ENABLE and HOME pages will be the only pages routinely used for normal operation.



Automatic transition



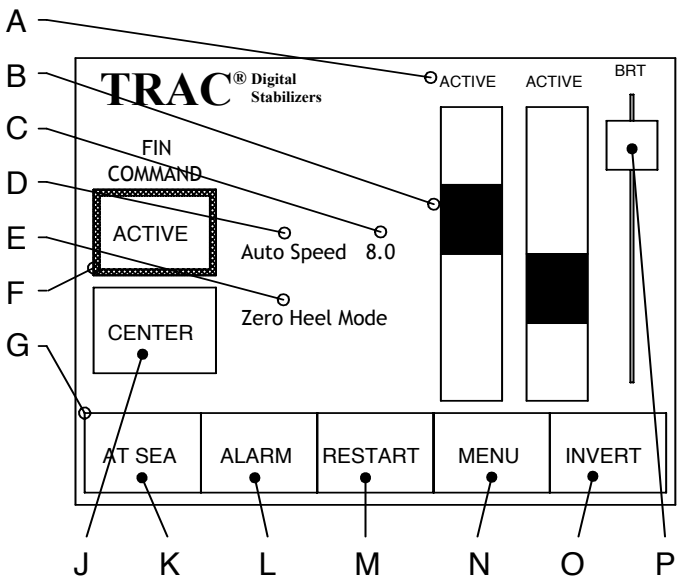
Home Page Overview

The HOME page will be displayed most frequently during normal stabilizer operation. This page has two purposes:

1) it provides indicators for basic information about system settings and performance.

2) it provides function keys for commanding basic system operations, for adjusting the panel appearance and for navigating to other panel pages.

<u>INDICATORS:</u>



A. Status of individual fin; “ACTIVE”, “CENTERED”, “LOCKED” or “FREE”.

B. Fin position indicator. Position of fin’s trailing edge in relation to fin centered.

C. Vessel speed sensed by shaft sensor(s) (Auto Speed Mode) or set at SPEED page (Manual Speed Mode).

D. Current Speed Mode as set at SPEED page.

E. Current Heel Mode as set at HEEL page.

F. Highlighted function key border indicates status of function.

G. “At Sea” function key is visible only when the STAR™ Stabilization at Rest feature is available on the vessel. Special equipment is required for this function.

<u>FUNCTION KEYS:</u>

J. Press “CENTER” to command fins to center position (parallel to the keel). Key border is highlighted when fins are hydraulically held at center position.

K. The STAR™ function is available when the border of “AT SEA” is highlighted. At that time, pressing this key will toggle the key display to “ANCHOR” and STAR™ operation will begin.

L. Depress the “ALARM” key to navigate to the ALARM page.

M. Depress the “RESTART” key to set all fins “FREE” and return to the ENABLE page.

N. Depress the “MENU” key to navigate to the MENU page.

O. Depress the “INVERT” key to toggle the Pilothouse Panel display between normal and reversed backlighting.

P. Touch and slide the brightness button to adjust intensity of display screen backlighting.

System Control: HOME page - Fins Centered

The HOME page is automatically opened after selections are completed at the ENABLE page.

This page displays all indicators and keys needed for most normal stabilizer control functions.

Normally at the time fins are enabled, hydraulic power will be available and transmission levers will be in neutral position.

Therefore, when the HOME page appears, the TRAC control will be commanding fins to center position. This will be indicated by highlight border around the “CENTER” key, and by center status and center position at the fin position indicators.

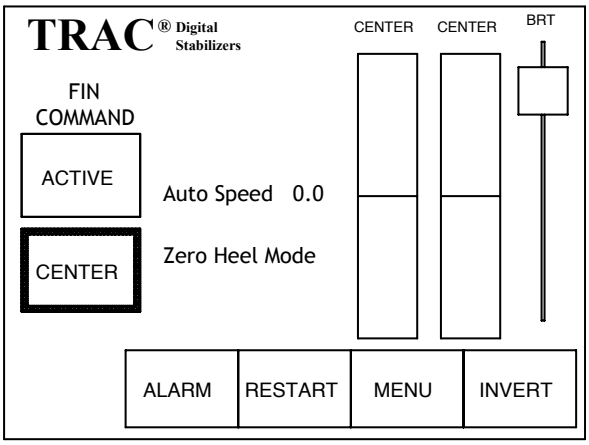
In systems without STAR™ accessories, the HOME page appears as illustrated in A (top right). In systems equipped for STAR™ operation, the HOME page appears as illustrated in B (middle right). The only difference is presence of the AT SEA function key.

• If the “ACTIVE” key is pressed, fin action could commence to counteract roll motion and heel angle. This should not be done until the vessel is underway. At dockside fins should be kept centered. STAR™ functions are discussed later.

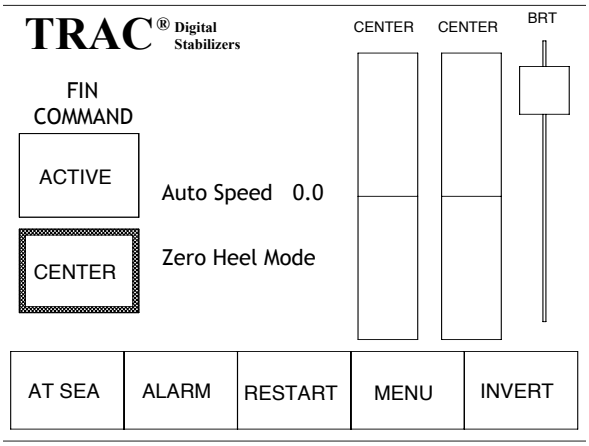
• If the highlighted “CENTER” key is pressed, the fin yokes would lock. The display would flip to the ALARM page and a silent message would advise against manual locking the yokes. Pressing “HOME” would return to the HOME page where “LOCKED” would be reported for fin command and fin status.

• If transmission reversing is detected while maneuvering, yokes will automatically lock to hold fins mechanically at center position. The command will show BACKING (illustration C at lower right) until transmission(s) are out of reverse. Thereafter the command will show CENTER until expiration of backing-coasting delay time (parameter variable).

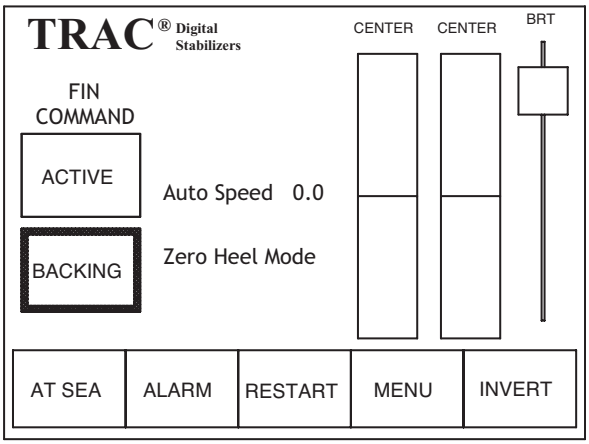
A



B

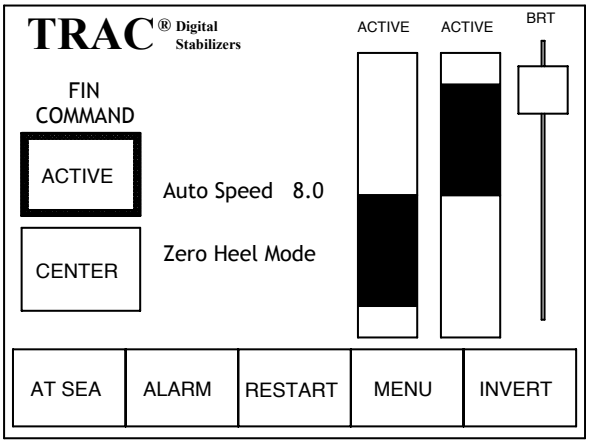


C



System Control: HOME page - Fins Active

When the vessel is underway, the “ACTIVE” key can be pressed to commence stabilization.



The display backlight intensity control slider is always available for reducing illumination during night operation. The INVERT key may be used at any time to also affect display brightness levels.

The fin position indicators provide nearly linear representation of each fin’s deviation from center position (center is approximately parallel to the keel). Fin angles will be roughly symmetric, but since each fin is controlled by an independent loop, slight asymmetries may occasionally appear and are normal.

Normal Operation

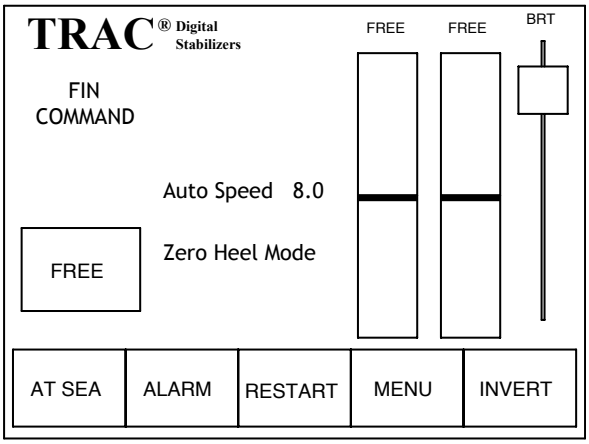
In normal operation (no stabilizer equipment problems) all fins should be ACTIVE or hydraulically at CENTER whenever the vessel is underway.

Speed displayed at the speed display should equal or should be greater than the water speed of the vessel. The latter is possible only when manual control of speed setting is asserted at the SPEED page (described later).

The current Heel Mode can be set at the HEEL page. Differences between Heel modes are described in Section 2 of this operations manual and also later in this section.

Abnormal Operation

In the event that system malfunctions prevent all fins from being enabled, any or all fins may be FREE. With all fins FREE, the HOME page appears as illustrated here (lower right).



Any fin that is FREE should me manually locked at the actuator at the earliest possible time (see Section 1 of this operations manual). The vessel should not be backed down, nor should any propeller be reversed with any fin free. Damage to actuators may occur.

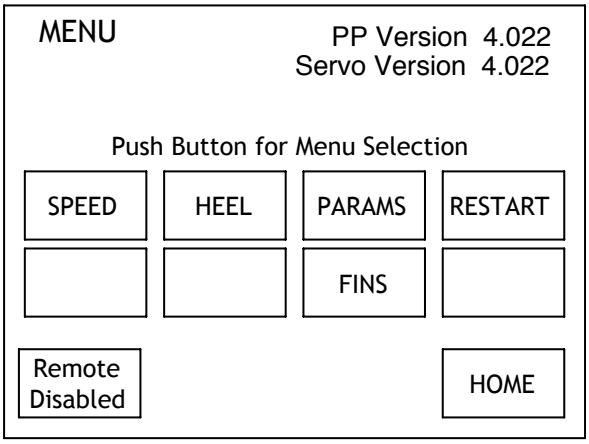
Independent control over the status of any fin can be asserted at the FINS page.

System Control: MENU page

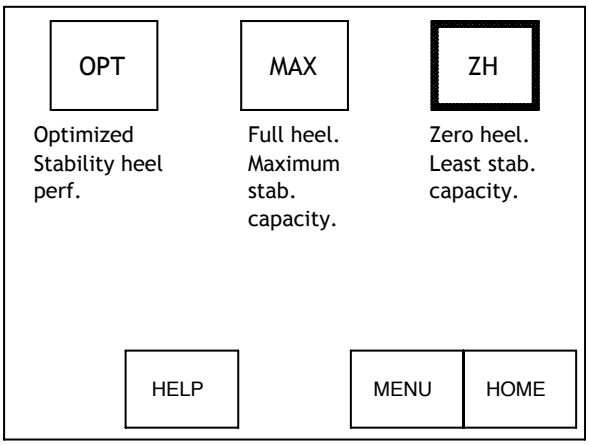
The MENU page, accessible with keypress from the HOME, SPEED, and HEEL pages, is the portal to all main function control pages.

The MENU page lists the current installed versions of software for the Pilothouse panel and for the Servocontrol,

The REMOTE DISABLE / ENABLE key appears on this page only when a system parameter has been set to indicate the presence of a flybridge remote control. The function of this key is to activate or deactivate the remote flybridge control.



System Control: HEEL page



At the HEEL page, one of three different system operating modes can be selected.

ZH mode: The control works within the lift capacity of the fins to keep the vessel flat to the horizon. The horizon is set by parameter entry during system commissioning. When properly set the horizon parameter should not require further adjustment.

In ZH mode, the fins will resist heel from any source including wind and vessel trim imbalance. Fin strokes will oscillate through a line that can become far from the normal centerline. As a result, while holding the vessel flat to the horizon, fins may lose movement range needed to respond to roll impulses from the sea. Also, drag from the fins will be increased as the point of fin oscillation moves further from the normal centerline.

ZH mode is best for light sea conditions; preferably when the vessel is trimmed prior to making fins active; or when holding a flat horizon has priority over potential drag.

MAX mode: In MAX mode, the control will allow an amount of steady heel (set by parameter value: normally to 10 degrees). Fin motion will not be used to correct for heel that is within this allowed range. Therefore fin strokes will oscillate through a line that is closer to normal centerline. On average, greater movement range will be available for countering roll impulses, and fin induced drag will be minimized.

MAX mode is preferred for heavy beam seas, or for minimizing drag, or for maintaining feel for the trim state of the vessel.

OPT mode: In OPT mode the control performs like ZH except that it automatically and incrementally compromises toward MAX performance when the vessel experiences increasing steady trim imbalance. When the control detects continuing excessive restriction of available symmetric range for fin movement it allows increasing steady heel within the allowable range set by parameter value.

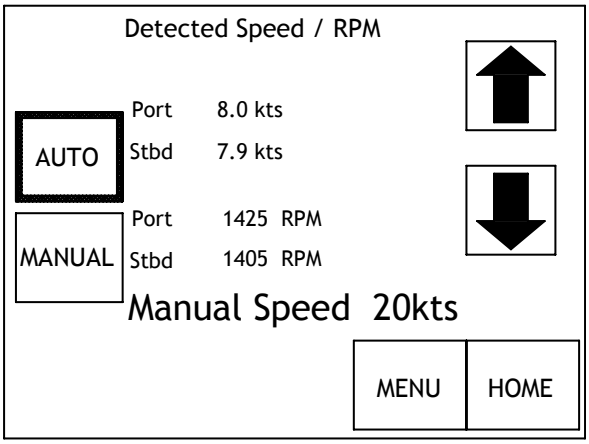
After HEEL mode selection has been made , press the HOME button to save the selection and return to the HOME page. The HELP button takes the user to a description of each mode. From the HELP page, push RETURN to reach the HEEL page.

System Control: SPEED page

Depending on stabilizer system equipment, vessel speed will be set automatically (by shaft rpm sensors) or manually (by keypad entry at the SPEED page).

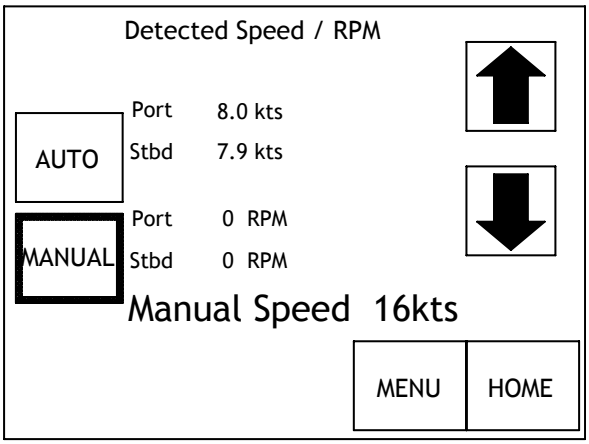
Manual speed entry is possible on any vessel, even those fitted with shaft speed sensors.

It is essential that the TRAC servo control be informed of vessel speed. Reported speed, whether automatic or manual, must equal or exceed the actual through water speed of the vessel. These reported speeds are used by the control for setting system gains and for restricting maximum fin angles.



<u>When the vessel is equipped with speed sensors</u>, select “AUTO”. Then ignore the Manual Speed message which is irrelevant and always defaults to a value determined by parameter setting.

Speed sensors directly report propeller rpm which is displayed on the SPEED page. Speed values are derived from these rpm values through curve points entered as parameter values. When two sensors exist, the higher of the two reported values is used by the control.



<u>When the vessel is not equipped with speed sensors</u>, select “MANUAL”, then use the arrow keys to adjust Manual Speed to equal or exceed the current water speed of the vessel.

Whenever dc power in applied to the TRAC servo control, the current setting of MANUAL speed defaults to a value set in system parameters. This insures safe operation of the stabilizer but may not optimize performance.

When MANUAL setting has been selected, the SPEED page should be revisited as needed to insure that manual speed is set to a value equal to or just exceeding the vessel speed.

Manually set speed should not be allowed to be lower than vessel water speed.

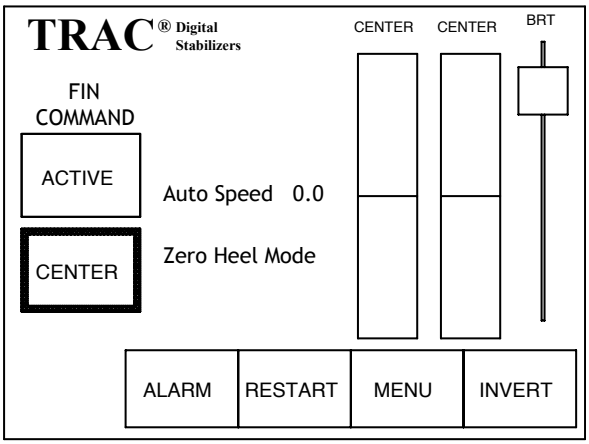
After speed selections and settings have been made, press HOME to save settings and return to the HOME page.

System Control: Fins page

The HOME page is shown here (top right) for convenient reference. The single ACTIVE and CENTER keys will command <u>all</u> enabled fins to these respective states. Also, the CENTER key, when highlighted, can be depressed to command <u>all</u> enable fins to the LOCKED state.

Individual fins are not addressable at the HOME page.

Fins not enabled at the ENABLE page are not addressable at the HOME page.

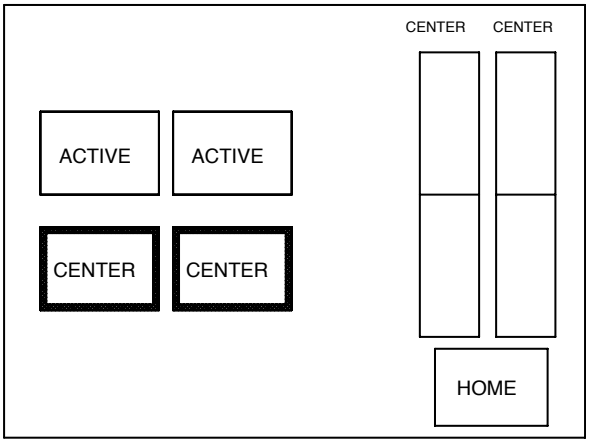


Whenever individual control over a fin is required, the FINS page allows setting any fin to any operational status.

From the MENU page, navigate to the FINS page.

Individual fins may be made ACTIVE, or brought to CENTER.

When the CENTER key border is highlighted, pressing “CENTER” will cause that fin to become mechanically LOCKED by release of the spring extended yoke locking pin.



<u>Fin Locking</u>

Under normal conditions actuator yokes will be mechanically locked only when transmission reversing sensors detect backing position. At all other times the yokes and fins will be either hydraulically CENTERED or ACTIVE. Manual locking of yokes (see Section 1 of this Operations Manual) should be done only when normal system control is not possible.

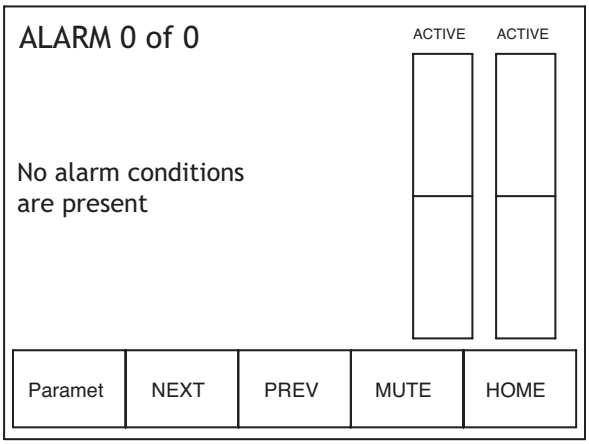
The control sequence that leads to automatic locking and unlocking is one in which the control appropriately sets or retracts the locking pin and then dithers the actuator cylinder to confirm entrapment or release of the yoke. When confirmation is not achieved, the system alarms and the unconfirmed fin is set FREE.

System Control: Alarm page

The ALARM page is reached in one of two ways.

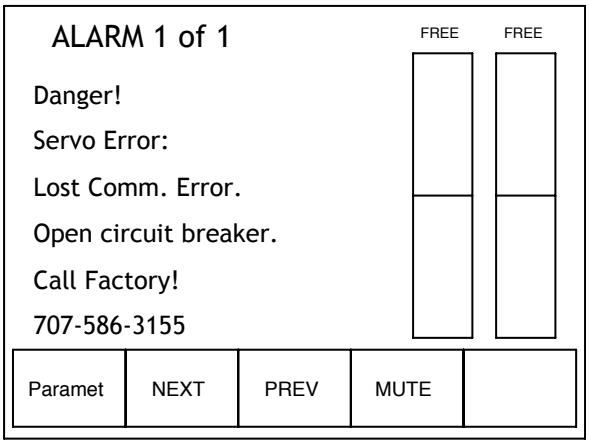
1. At the HOME page, depress the ALARM key to navigate to the ALARM page.

This can be done at any time, and when no alarm conditions exist, the ALARM page will appear as shown in the illustration at top right.



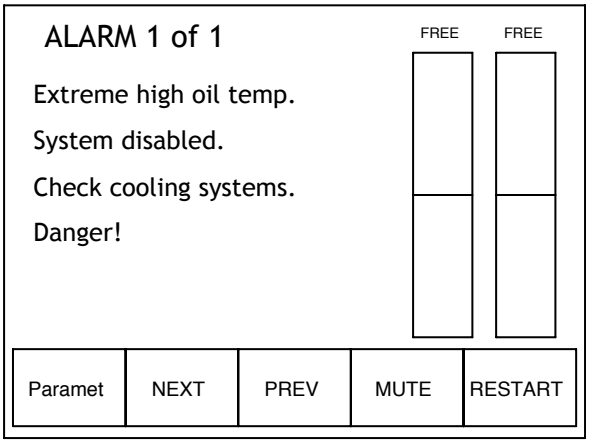
No operational status is changed when manually navigating to the ALARM page. Manual navigation to this page may be done when alarms have previously occurred and have been muted.

2. The control, upon sensing an alarm condition, will automatically flip to the ALARM page. One example is illustrated at middle right.



When any alarm occurs, the exact wording of the alarm condition should be recorded and recommended actions should be followed.

Refer to Sections 3 and 4 of this operations manual for more specific information on major alarm conditions and recommended responses. These sections should be studied in advance, if necessary in consultation with American Bow Thruster, to facilitate optimal responses in the event of system malfunction.



From the examples illustrated here, it can be seen that ALARM page options for navigation away from the page can vary depending on the type of alarm.

In most instances, response to an alarm will be to depress the MUTE key, then follow the recommended actions on the screen and as presented in Sections 3 and 4.

Check for multiple alarms. The occurrence of simultaneous multiple alarms will be indicated at the top left of the ALARM page. Individual alarm conditions can be examined by using the NEXT and PREV keys.

System Control: Alarm Types

There are two alarm types; Acute alarms and Warning alarms.

1. **Acute alarms** will change the operational status of the system. They will always require RESTART to return the system to active status, and they may require cycling of dc power to the control.

The cause of acute alarms, especially those involving reservoir temperature or level, should be immediately investigated.

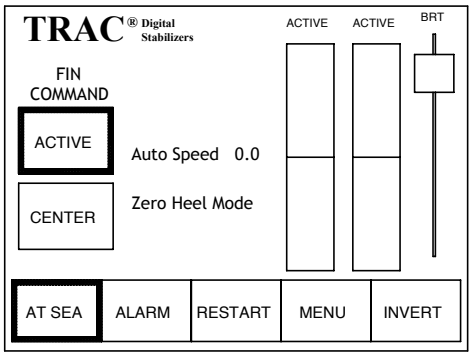
The stabilizer system cannot be made active until acute alarms are resolved.

2. **Warning alarms** will not change the operational status of the system. These alarms may be muted at the ALARM page. The alarm is considered “acknowledged” by the vessel operator when the HOME key is pressed to return to the HOME page.

At the HOME page the presence of any acknowledged alarm, which has not been resolved, will be indicated by continued flashing of the ALARM key border.

It is highly recommended, that Sections 3 and 4 of this Operations Manual be studied, preferably in association with the system plumbing and electrical diagrams to gain familiarity with the components and component locations for the stabilizer system. This knowledge will greatly enhance ability to investigate and resolve possible system malfunctions.

System Control: STAR™ OPERATION



On vessels fitted for STAR™ (Stabilization at Rest), this function is initiated at the Pilothouse Panel HOME page.

Necessary conditions to begin STAR operation are:

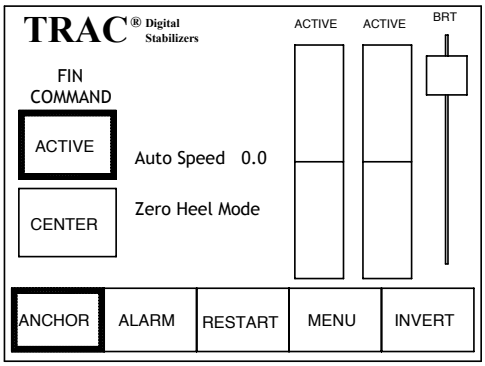
1) **DANGER! EXTREME PERSONNEL HAZARD!** Take all necessary steps to keep any person away from the fins. Unexpected fin motion may occur at any time. Keep persons clear of fins whenever STAR™ is enabled.

2) Reduce vessel speed to zero kts (confirmed at the speed indicator display).

3) Make sure that all enabled fins are “ACTIVE”.

4) Make sure that no reversing sensor is detecting transmission reversed.

5) When these conditions have been satisfied, the borders of the ACTIVE and AT SEA keys will be highlighted. Pressing the “AT SEA” key will then commence STAR™ operation.



The lower left key will change to display “ANCHOR”; this being the current status of active stabilization.

STAR™ operation begins with an initialization routine where fins sweep together, up and down at approximately the same rate (expect some rate difference between fins), until limits of travel have been established. These initial sweeps transition automatically to normal STAR™ operation.

STAR™ operation will continue without interruption until one of the following occurs:

1. The “ANCHOR” key is pressed. This action changes fin command status to “AT SEA” and “ACTIVE”.
2. The “CENTER” key is pressed to bring fins hydraulically to center position.
3. Transmission sensors detect reversing (fins center and lock).
4. Speed sensors detect non-zero speed, with reversing not detected (fins transition automatically to ACTIVE and AT SEA.

With interruptions 1 or 2 (above), STAR™ operation is suspended and may me resumed by key presses to highlight the “ACTIVE” key and the “ANCHOR” key. With interruptions 3 & 4, STAR™ operation is terminated and can be resumed only by setting up the necessary conditions described at the top of this page.

Refer to Section 2 - Normal Operation for additional description of STAR™ operation.

System Control: PARAMETER page

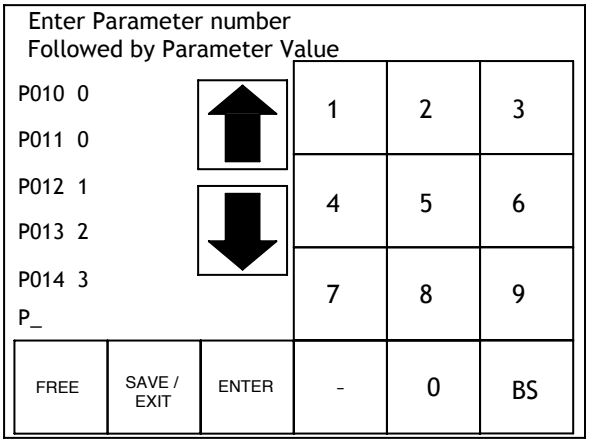
More than one hundred system parameters are set at the time of system commissioning to insure optimum system performance. These values are confirmed and adjusted by qualified technical personnel and should not be adjusted unless through consultation with American Bow Thruster.

You may navigate to the PARAMETER page to review parameter values by ascending through the list with the down arrow key.

To go directly to a parameter, enter the parameter number (enter a leading zero to address two digit parameters) then press “ENTER”.

The values set for parameters cannot be changed unless a password is first entered at P010.

To exit the PARAMETER page and return to the HOME page, press the SAVE/EXIT key.



Display Control: CONTRAST ADJUSTMENT

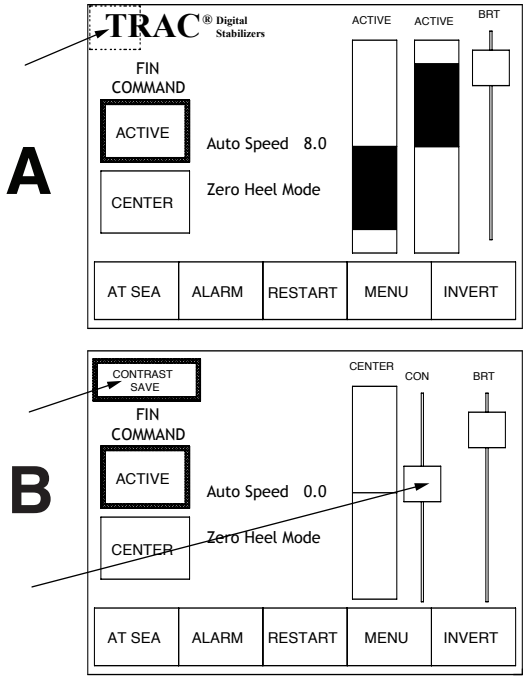
As shown earlier (HOME Page Overview) the display backlight Brightness Slider is always available.

Another display screen control which can affect screen legibility and which may need adjustment at some time is Screen Contrast.

The screen Contrast Slider is normally hidden but can me made visible at any time by touching a hidden button at the upper left corner of the touchscreen (illustrated in panel A).

After touching this hidden button, the Contrast Slider appears as illustrated in panel B. If no contact with the slider occurs, the screen will revert to normal status in 5 seconds.

If contrast adjustment is made by moving the Contrast Slider, the new setting must be saved by pressing the CONTRAST SAVE key.



IMPORTANT. If the screen vanishes during extreme limits of contrast adjustment, simply do nothing further. The display will revert to its previously stored contrast setting after 5 seconds of inactivity. Contrast adjustment can then be repeated and the desired contrast can be saved by pressing CONTRAST SAVE.

In the event that extreme contrast settings are inadvertently saved and the screen becomes invisible, a screen recovery procedure is described below.

Display Control: CONTRAST RECOVERY

In the event that display Screen Contrast is inadvertently adjusted and saved when set to a level that renders the display screen invisible, the following simple procedure can be used to restore a visible screen.

1. RESTART the stabilizer system by cycling dc circuit power to the TRAC stabilizer servocontrol box.

2. Wait 15 seconds to insure automatic arrival at the ENABLE page (now invisible).

3. Touch the display screen as shown in A, first in the upper right corner (1) and then immediately in the upper left corner (2).

4. Wait until the control begins to cycle contrast to make the backlight and contrast sliders visible (as in B).

5. When the sliders are visible, touch the contrast slider button as shown in C (1). This will make a CONTRAST SAVE key appear (2). Continue by adjusting the contrast slider to achieve desired setting, then press CONTRAST SAVE.

If an acceptable level can't be found, don't press CONTRAST SAVE. The control will continue to automatically cycle the contrast setting and step 5 can be repeated.