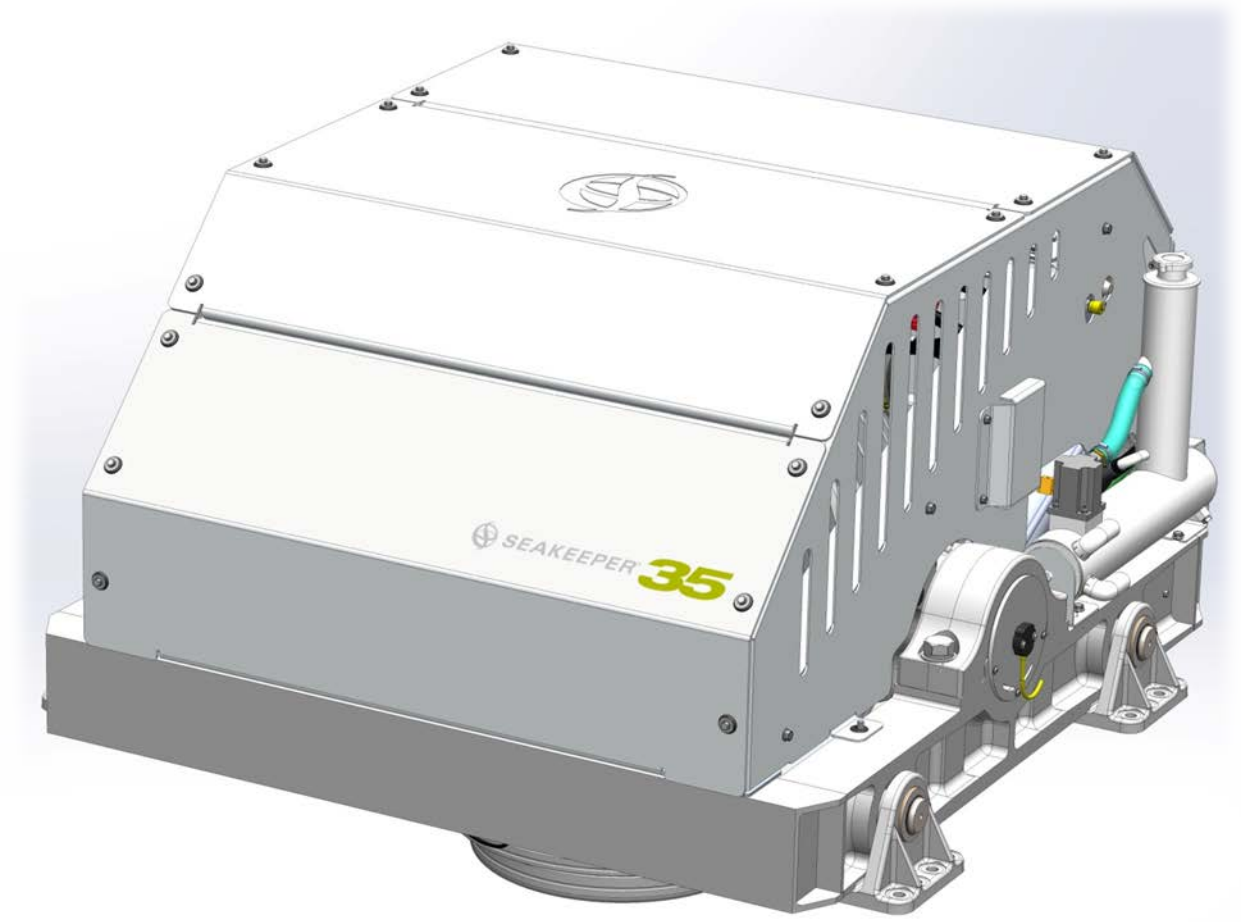
SEAKEEPER®

# *INSTALLATION MANUAL*




# *SEAKEEPER 35 GYRO*

Rev 3 FEBRUARY 2015

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**Contents:**



SEAKEEPER®


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## 1.0 Introduction

This document is intended to give details and guidance to a boat builder or equipment installer to install the Seakeeper 35 Stabilizing Gyro. The gyro is capable of producing loads up to 41.3 kN (9,270 lbs.) at each of the four mounts and careful consideration should be given to foundation design to insure it is capable of transferring these loads into the hull.

There are two methods of installing the Seakeeper 35 gyro:

1) Bolt-In Installation
2) Saddle Installation

**It is assumed that the installer is familiar with bonding using high strength adhesives or mechanical fasteners to marine structures and has performed structural analysis to assure the structure to which the gyro mounts can properly transfer the loads the gyro creates into the hull structure. If the installer has any doubt about the ability of the structure to transfer the gyro loads to the hull then he should contact a licensed naval architect or marine engineer to do a structural analysis.**

The installer should review the following list of reference drawings to ensure the installation procedure is fully understood.

### Reference Drawings

***90233 Seakeeper 35 Gyro Hardware Scope of Supply***
***90256 Seakeeper 35 Gyro Installation Details – Bolt in Method***
***90255 Seakeeper 35 Gyro Installation Details – Bond in Method***
***90290 Seakeeper 35 Gyro Cooling Water Schematic***
***90088 Gyro Saddle Installation Fixture Kit***
***90089 Gyro Bolt-In Installation Fixture Kit***
***90288 Seakeeper 35 Gyro Cable Block Diagram***

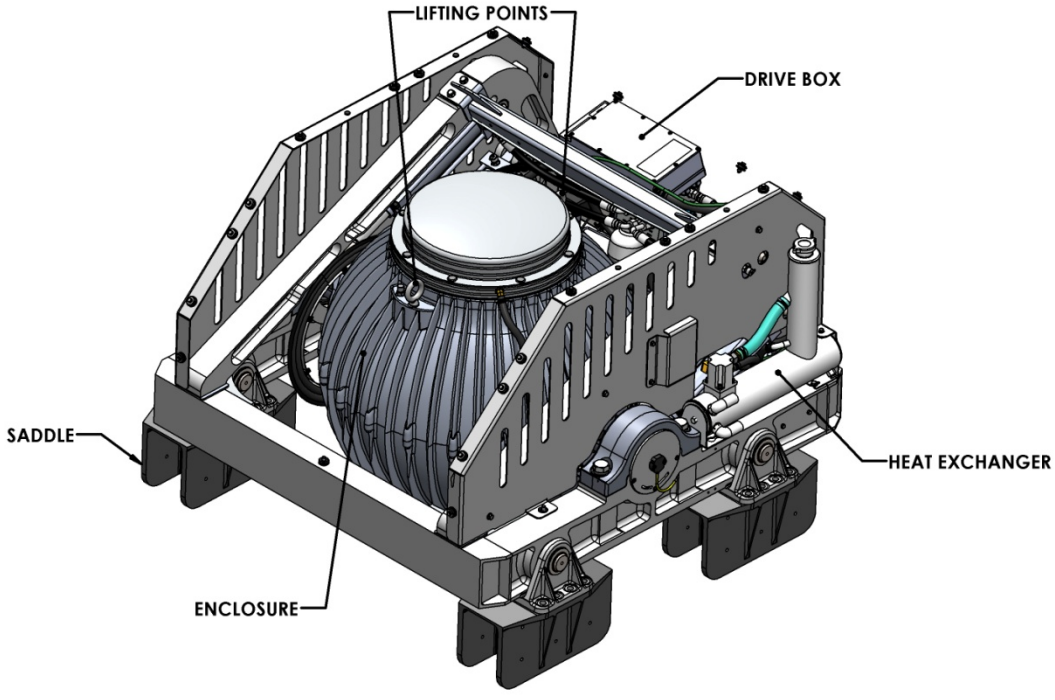



FIGURE 1 – SEAKEEPER 35 GYRO

## 1.1 Precautions

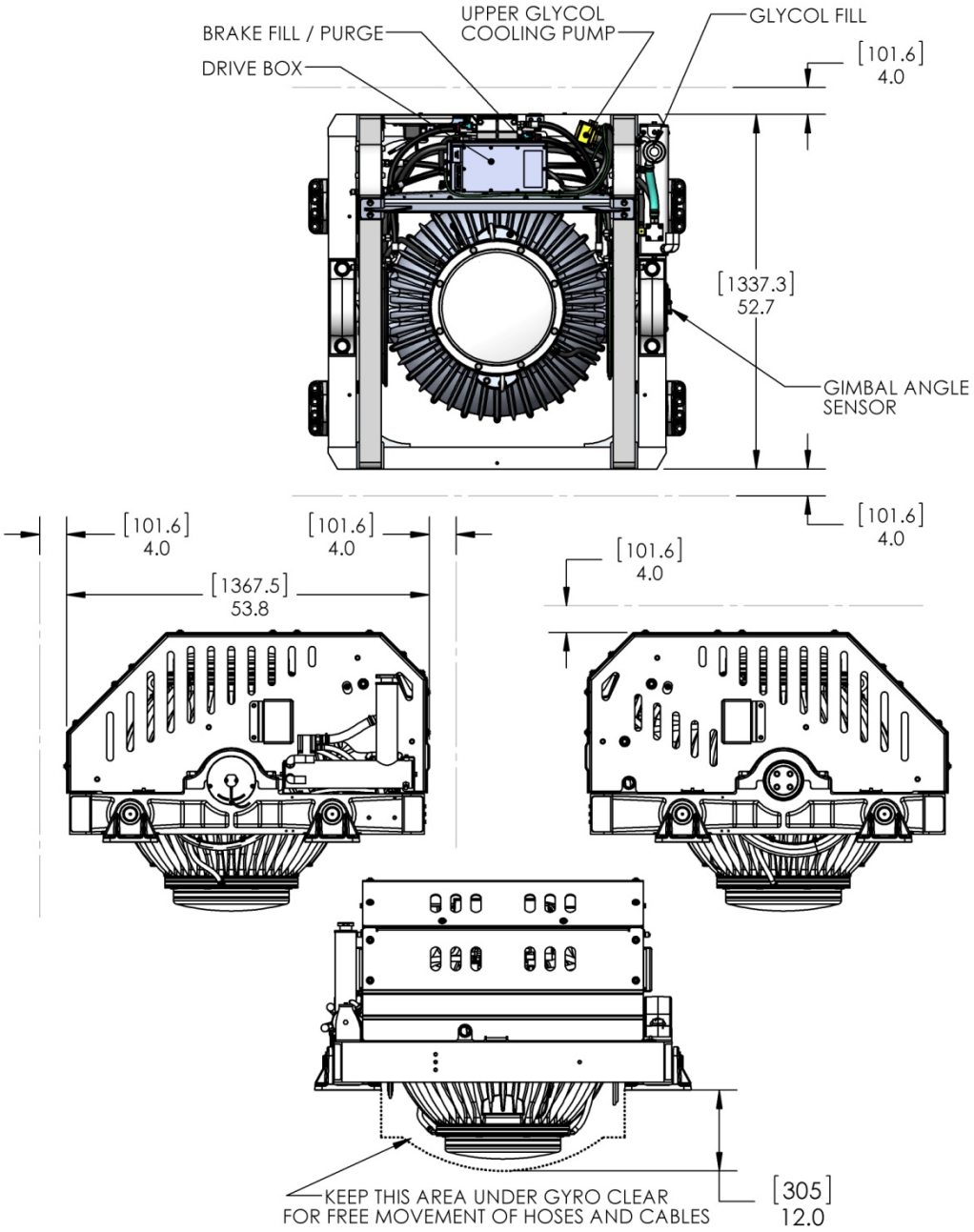
- Gyro must only be lifted from the supplied lifting eyes (See Section 1.4).
- Gyro flywheel is supported by precision bearings. Make certain while unpacking and lifting gyro assembly to **NOT** drop or impart mechanical shock as damage to bearings could result.
- While handling / installing gyro assembly, protect exposed hydraulic brake cylinder rods from scratches or damage as this could lead to premature seal failure and oil leaks.
- While handling / installing gyro assembly, do not allow electrical fittings that exit bottom of gyro enclosure to come in contact with any surface or object as this could damage the fittings and potentially affect the vacuum integrity of the enclosure.
- Exercise care to protect gyro painted finish as damage to finish could lead to early appearance degradation of installed gyro.

## 1.2 Selection of Gyro Installation Location

Selection of mounting location of gyro should consider the following desirable features:

**The gyro must be installed aft of amidships to minimize high acceleration loadings due to hull/wave impacts during operation at high speed or in large waves.**

- **Overhead access or sufficient clearance for removal / re-installation of gyro for overhaul in future years.**
- Gyro should be installed in a dry space to minimize effects of corrosion.
- Clearance for replacement of gimbal angle sensor on gyro gimbal shaft (see Figure 2).
- Clearance for filling / purging brake hydraulic oil (see Figure 2).
- Clearance for filling water/glycol cooling circuit (see Figure 2).
- Clearance for replacement of brake hydraulic cylinders (see Figure 2).

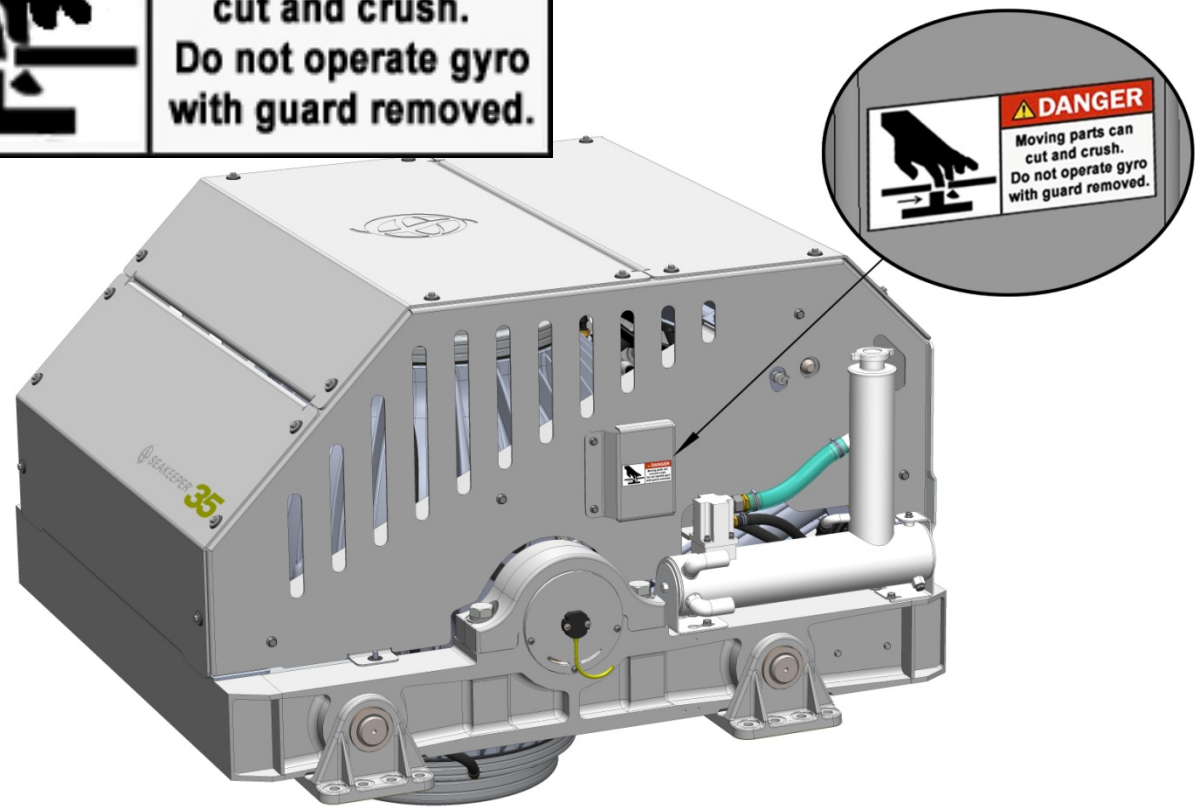



**VIEWS SHOWING RECOMMENDED CLEARANCES AROUND GYRO FOR USE OF HAND TOOLS, EASE OF MAINTENANCE, INSTALLATION AND PROPER OPERATION.**

FIGURE 2 – INSTALLED GYRO CLEARANCE CONSIDERATIONS

## Safety

**There is a large torque about the gimbal axis when the gyro is precessing. Gyro cover panels are provided to prevent personnel or equipment from contacting the gyro while it is in operation. These covers should not be stepped on, or have anything placed on top. The covers should always be in place during operation. The cover side panels contain safety shields as shown below. Do not operate the gyro without these safety shields in place.**


**If it is ever necessary to service the gyro while the flywheel is spinning, the gyro must be locked at the display to stop the gyro from precessing. Gyro maintenance should not be attempted unless the gyro is locked and the flywheel has stopped spinning. The gyro should be treated with the same respect one gives a high speed rotating propeller shaft or engine shaft.**

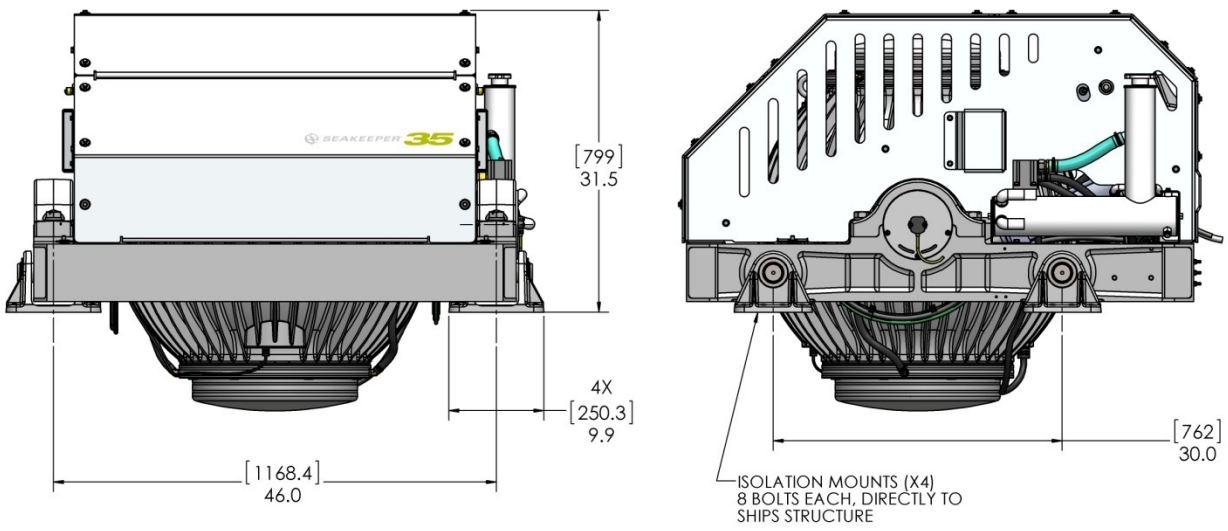
## Noise/Soundproofing

Gyro noise has been measured under steady state conditions (no wave load) in Seakeeper's lab and test boat. The steady state noise is typically in the range of 70-75 dB un-weighted. As the frequencies emitting the highest sound pressures are low (like other marine machinery), it is recommended that the gyro be installed in a machinery space that is already treated with soundproofing.

## 1.3 Selection of Installation Method

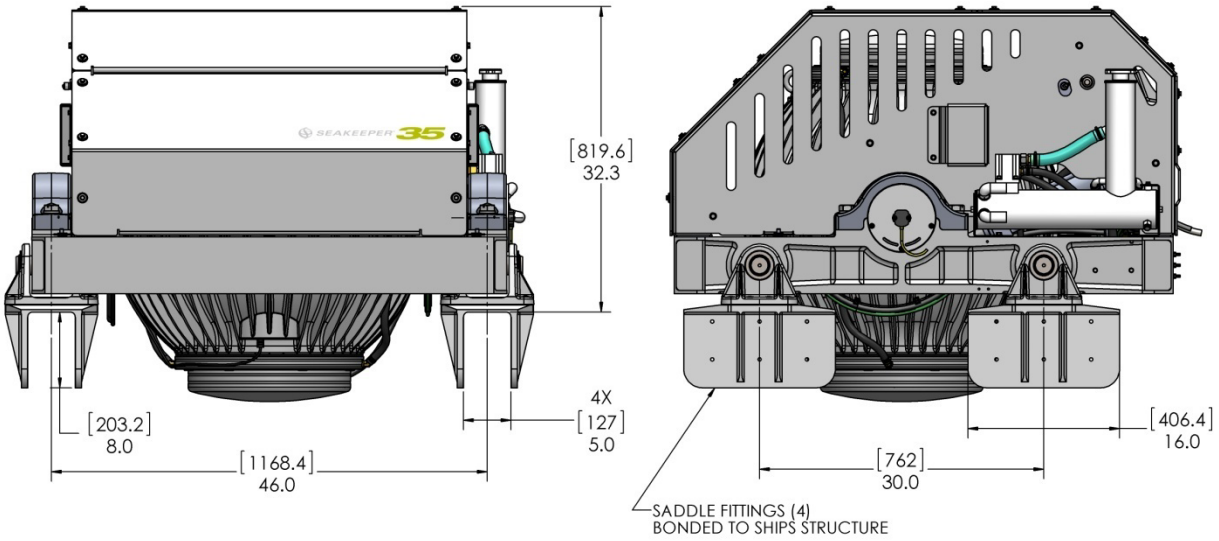
The Seakeeper 35 gyro can be affixed to the hull structure using two methods:

1) Bolt-in installation
2) Saddle installation. See figures below.




**OPTION 1 - DIRECT FASTENING OF GYRO FOUNDATION TO SHIPS STRUCTURE**

Option 1 would be applied when a metal structure is available for attachment. The foundation would fasten directly to hull structure using 32x M16-1.0 fasteners. Depending on the structure to which the gyro is fastened, blind threaded holes or thru-bolting can be utilized.




**OPTION 2 - SADDLE INSTALLATION (4 PLACES)**

Option 2 would be most commonly used on a hull constructed of glass reinforced plastic (GRP). For this option, four 16inch (407 mm) long by 8 inch( 203 mm) deep saddles are bonded to properly spaced and prepared structural members that are an integral part of the hull structure. Seakeeper recommends using a structural adhesive with a lap shear strength of 2000 psi (13.8 MPa) or greater. Careful consideration should be exercised by the installer while selecting the appropriate adhesive. Compatibility with the gyro's cast aluminum A356- T6 saddles, hull structure and pot life are three important factors to consider. Proper surface preparation in accordance with adhesive manufacturer's recommendations prior to installation is very important.

## 1.4 Unpacking Crate

1) Reference Seakeeper Drawing No. 90233, Seakeeper 35 Gyro Hardware Scope of Supply for items that ship with the gyro.
2) Remove electrical components, cables, and misc. items and set aside.
3) Remove packing materials that secure gyro assembly inside the crate.
4) Remove top and angled face cover panels to access lifting eyes.
5) Attach spreader bar to the two lifting eyes located on the top of the gyro enclosure. Note spreader bar is not supplied with gyro. Stay clear of any other parts on the gyro. Gyro weighs 1,778 kg (3920 lbs). See Figure 3 below.

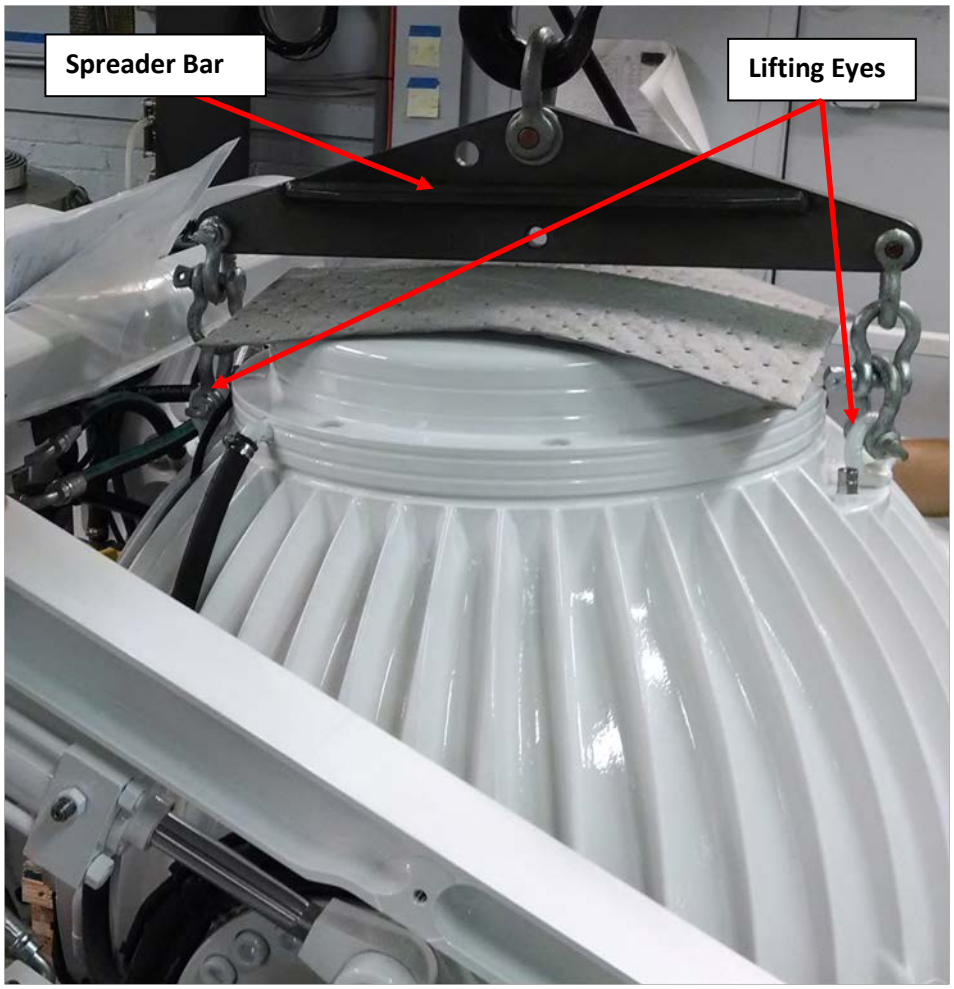



FIGURE 3 – LIFTING ARRANGEMENT

## 1.5 Bolt-In Installation

### 1.5.1 Check and Preparation of Hull Structure

Refer to Seakeeper **Drawing No. 90256, *Seakeeper 35 Gyro Bolt-In Installation Details***. Important dimensional and load information is given in this drawing that will impact the design details of the structure that will receive the gyro. It is assumed that a proper structural analysis has been performed for the hull structure to which the gyro will be fastened to insure proper strength margins for the loads the gyro will create during operation.

The hull structure supporting the gyro should be installed so the gyro is parallel to the water-plane in the port/starboard and forward/aft directions. **In addition, the four areas on top of the beams on which the isolation mounts will rest need to be co-planar within 1/8$^{th}$ inch (3 mm) to minimize potential distortion of gyro support frame when installed (Similar to Figure 12).**

Seakeeper provides an installation fixture assembly, P/N 90089 that contains four plates that mimic the mating surfaces of the four isolation mounts located on the gyro's foundation. These plates have 8 holes located at the same centers as the holes in the isolation mounts. These smaller holes can be used to locate the holes in the ship's structure through use of a transfer punch or drill. The fixture locates the hole patterns at the proper spacing both in the fore-aft direction and the port-starboard direction - see Figures 4 & 5 below. Once assembled, the fixture can be used to check clearances and alignment of the hull structure.

**Note: Do NOT use the installation fixture to establish gyro envelope dimensions. Refer to Drawing No. 90256 for envelope dimensions. A 3-D model of the gyro is available on the Seakeeper website (www.seakeeper.com) to aid in designing the gyro foundation and the space around the gyro. See Figure 6 below.**

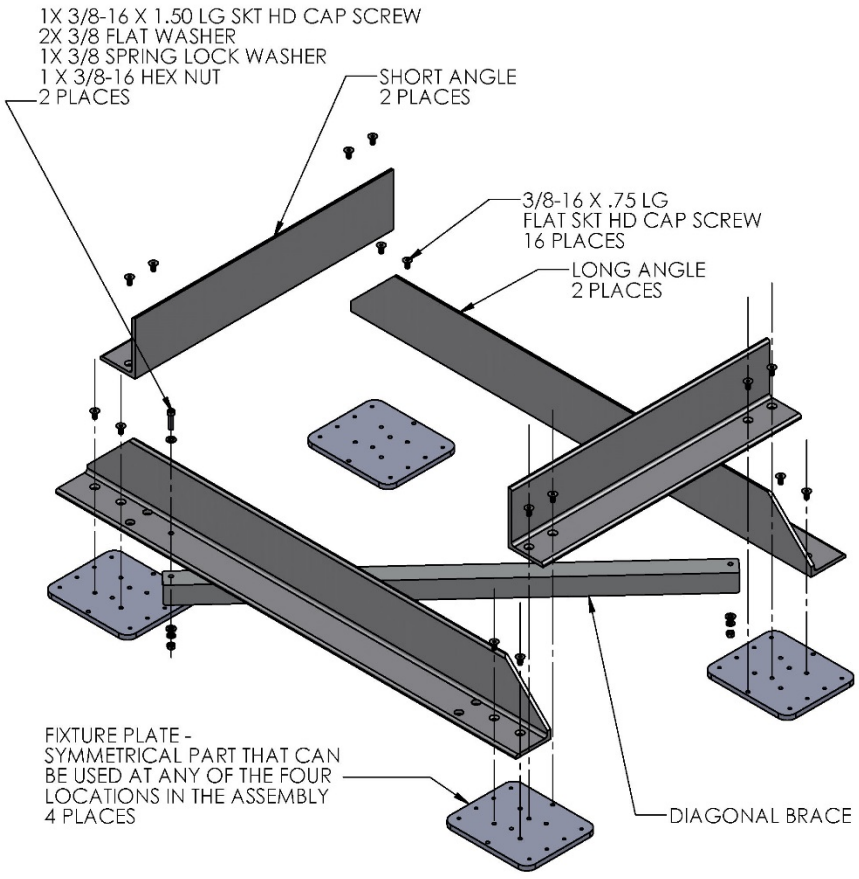
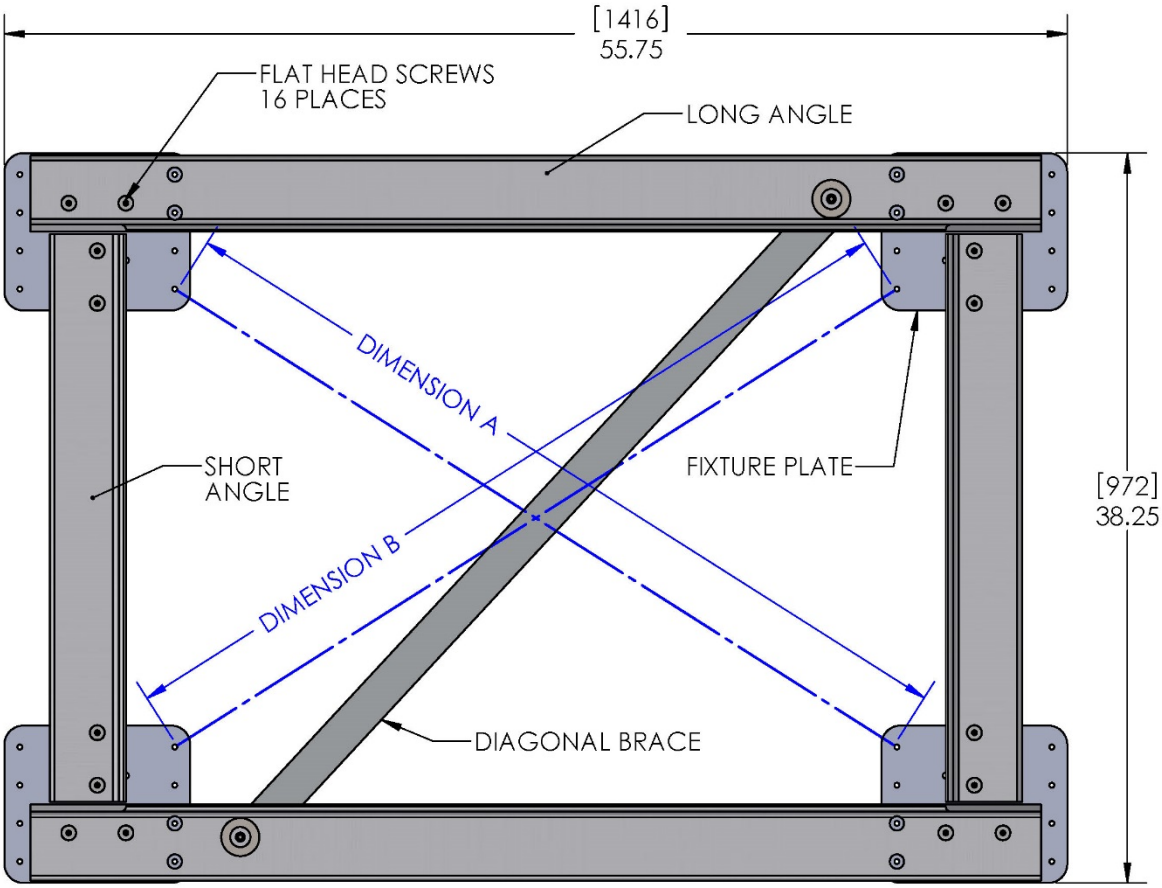



FIGURE 4 – EXPLODED VIEW OF INSTALLATION FIXTURE

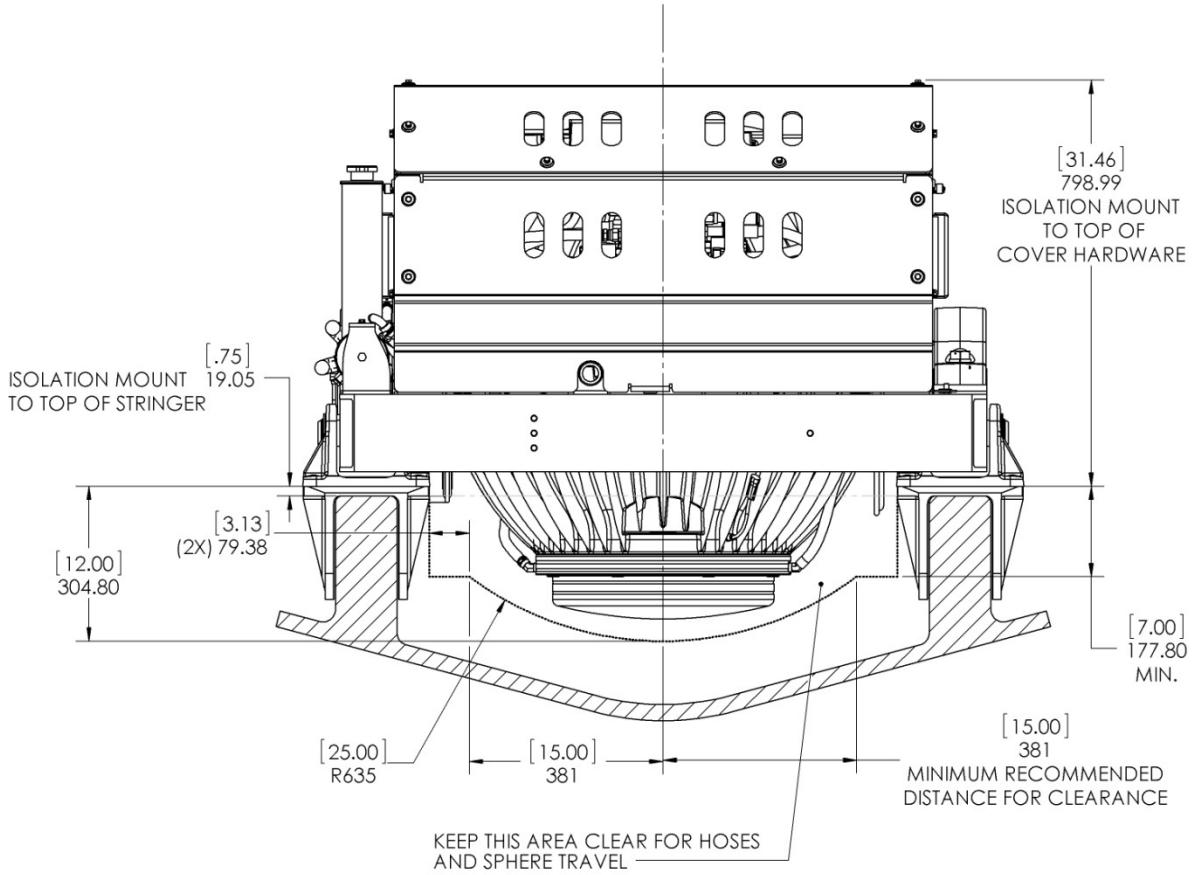
## ASSEMBLY NOTICE FOR BOLT-IN INSTALLATION FIXTURE -IMPORTANT!!

- PLACE FIXTURE PLATES ON FLAT SURFACE AND ARRANGE IN APPROXIMATE LOCATIONS
- INSTALL SHORT AND LONG ANGLES AS SHOWN BUT DO NOT TIGHTEN FLAT HEAD FASTENERS UNTIL FINAL STEP.
- INSTALL DIAGONAL BRACE USING 3/8" SKT HD CAP SCREWS, WASHERS & NUTS.
- **CONFIRM SQUARE BY MATCHING DIMENSION A & B SHOWN BELOW WITHIN 1mm.**
- FIRMLY TIGHTEN ALL FASTENERS.
- DOUBLE-CHECK SQUARE AND RE-ADJUST IF NEEDED




**VIEW FROM ABOVE FIXTURE**

FIGURE 5 – NOTICE FOR CHECKING SQUARE OF ASSEMBLY



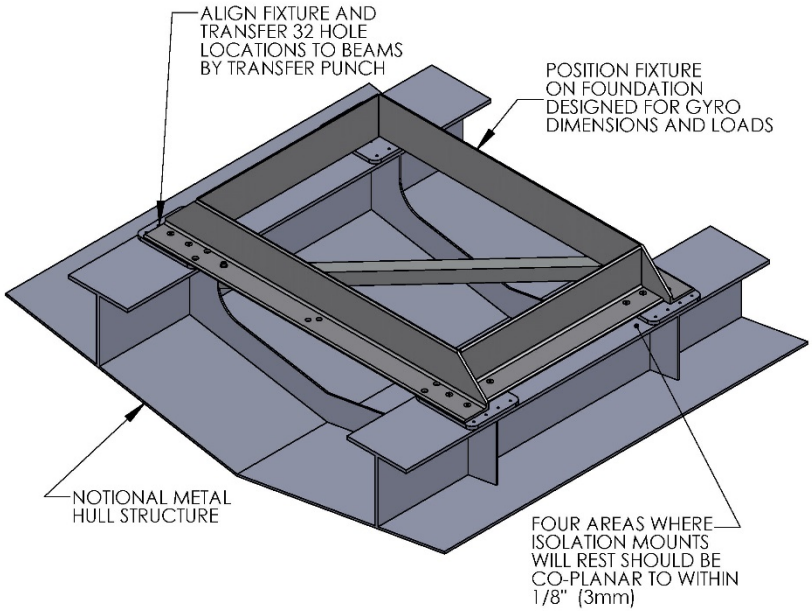

**CAUTION: Tight clearances from cable guide bands to hull structure. See above figure for dimensions and reference Seakeeper drawing NO. 90256 for complete gyro envelope.**

FIGURE 6 – CLEARANCE REMINDER

## 1.5.2 Transfer of Holes to Boat Structure

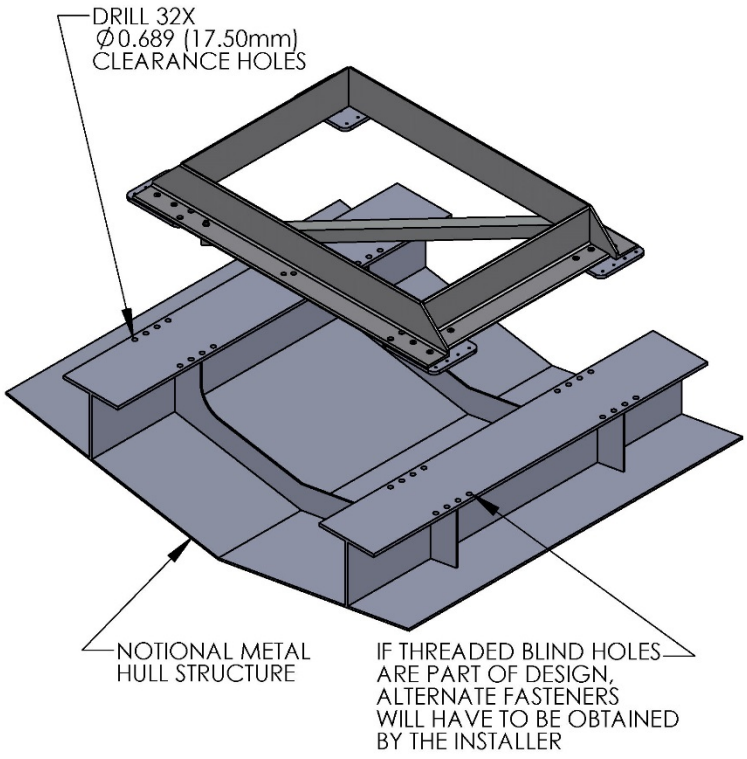
1) Lower assembled fixture onto gyro foundation.
2) **The four areas where the isolation mounts will rest should be coplanar to within 1/8" (3mm). See Figure 12.** Do not use the fixture to check co-planarity as it is not stiff enough.

3) Align fixture in desired location and transfer holes from fixture plate to the foundation structure. A transfer punch is recommended for this step. Note that holes in fixture plate are ø.257 (6.5mm).




4) Remove fixture and drill holes in foundation at marked locations to mate with holes in gyro isolation mounts. A ø.689 inch (17.5mm) hole is recommended for the provided M16 fasteners.

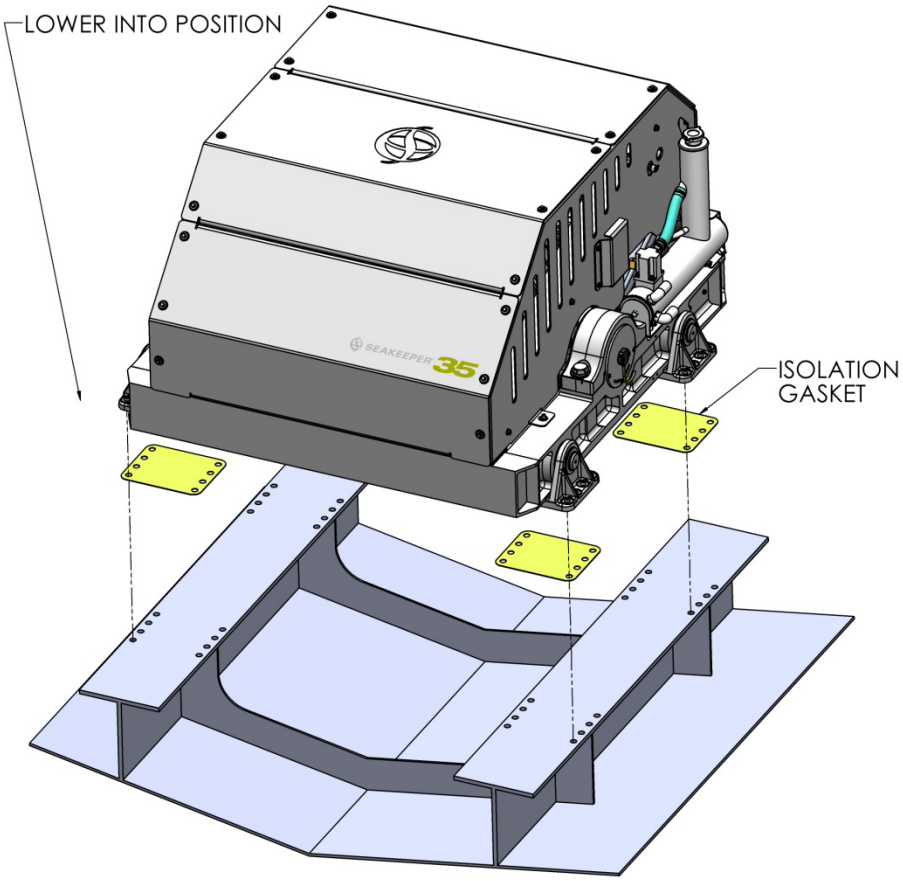
**NOTE: Certain foundation designs that employ threaded blind holes in thick plates may require the installer to obtain alternate fasteners.**



### 1.5.3 Installation of Gyro

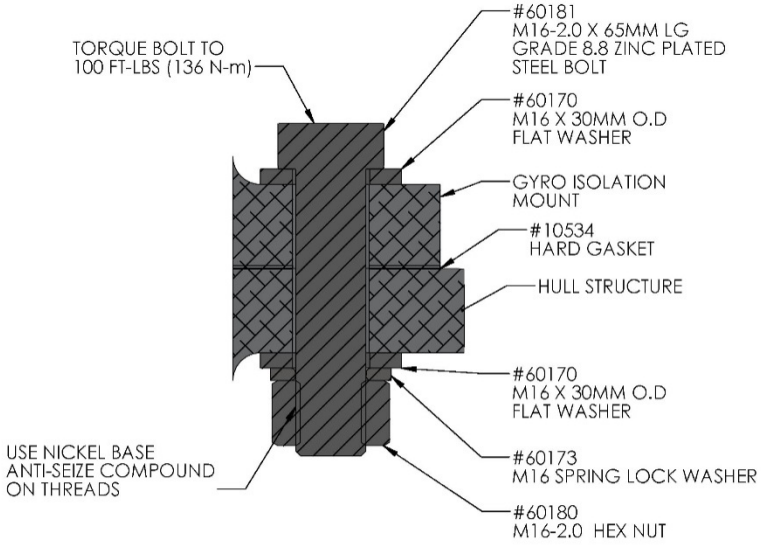
1) Locate and position 4 isolation gaskets onto foundation beams. NOTE: A **VERY SMALL** AMOUNT OF SEALANT MAY BE APPLIED TO THE GASKET TO KEEP WATER FROM WICKING INTO THE JOINT.

2) Lower gyro into position onto foundation beams and align over drilled holes.




3) Install Seakeeper supplied M16 fasteners as shown in figure to right – apply a moderate coat of nickel based anti-seize compound to the threads of each bolt prior to installation and a small amount of sealant to the washer faces.

4) Torque all fasteners to 100 ft-lbs (136 N-m).




SECTION THROUGH ISOLATION MOUNT / FOUNDATION BEAM

## 1.6 Saddle Installation

Seakeeper recommends Plexus MA590 adhesive for bonding the saddles to the GRP hull structure. Plexus MA590 is a two-part methacrylate structural adhesive that has characteristics conducive to this type of installation. Details of the bonding procedure in this manual will involve the Plexus MA590 product, but that should not exclude other suitable adhesives the installer chooses to use. **See Sheet 6 of Seakeeper drawing no. 90255 for loads information and recommended adhesive properties.**

### 1.6.1 Initial Check and Preparation of Hull Structure

Refer to Seakeeper **Drawing No. 90255, *Seakeeper 35 Gyro Installation Details – Bond In Method***. Important dimensional and load information is given in this drawing that will impact the design details of the structure that will receive the gyro as well as selection of the adhesive to bond the gyro into the hull.

The foundation "saddles" of the gyro are designed to be bonded directly to the composite hull structure of the vessel to effectively distribute gyroscopic loads. **A complete bond is required between the inside surface of the saddles and the hull structure**. Seakeeper recommends having a minimum of 18 cartridges (400 mL), 1 bottle Plexus PC-120 Primer/Conditioner, and 2 manual adhesive guns on hand for installation. Two workers should apply the adhesive at the same time to finish the installation before the adhesive starts to cure. To aid in determining the quantity of adhesive required, the interior surface area (bonding surfaces) of **each** saddle is 325in$^2$ (2,097 cm$^2$) for a total bonded surface area for all four saddles of 1,300 in$^2$ (8,387 cm$^2$).

The hull structure supporting the gyro should be installed so the gyro is parallel to the waterline. **In addition, the four areas on top of the beams that the saddles will bond to need to be co-planar within .13" inches (3 mm) to minimize potential distortion of gyro support frame when installed as shown in Figure 12.**

**Note that any paint or gel-coat present in bond area should be removed so that adhesive will bond directly to laminate fibers and resin**.

Seakeeper provides an installation fixture, P/N 90088 that locates the saddles at the proper spacing both in the fore-aft direction and the port-starboard direction. See Figures 8, 9 & 10 below. Once assembled with the provided saddle fittings, the fixture can be used to check clearances and alignment of the hull structure. The fixture will allow the builder / installer to lay-up and adjust the foundation dimensions to create a low-clearance fit between the gyro foundation saddles and the hull structure. Shear strength of the adhesive will be maximized if the cured thickness between the vessel structure and gyro saddles is at the thinner end of the adhesive manufacturer's recommended range. Therefore, the fixture should be used to confirm that the overall dimensions of the foundations are square and level and that the adhesive gap is within Seakeeper's maximum recommended thickness of .13" or 3mm.

**Note: Do NOT use the installation fixture to establish gyro envelope dimensions. Refer to Drawing No. 90255 for envelope dimensions. A 3-D model of the gyro is available on the Seakeeper website (www.seakeeper.com) to aid in designing the gyro foundation and the space around the gyro.**

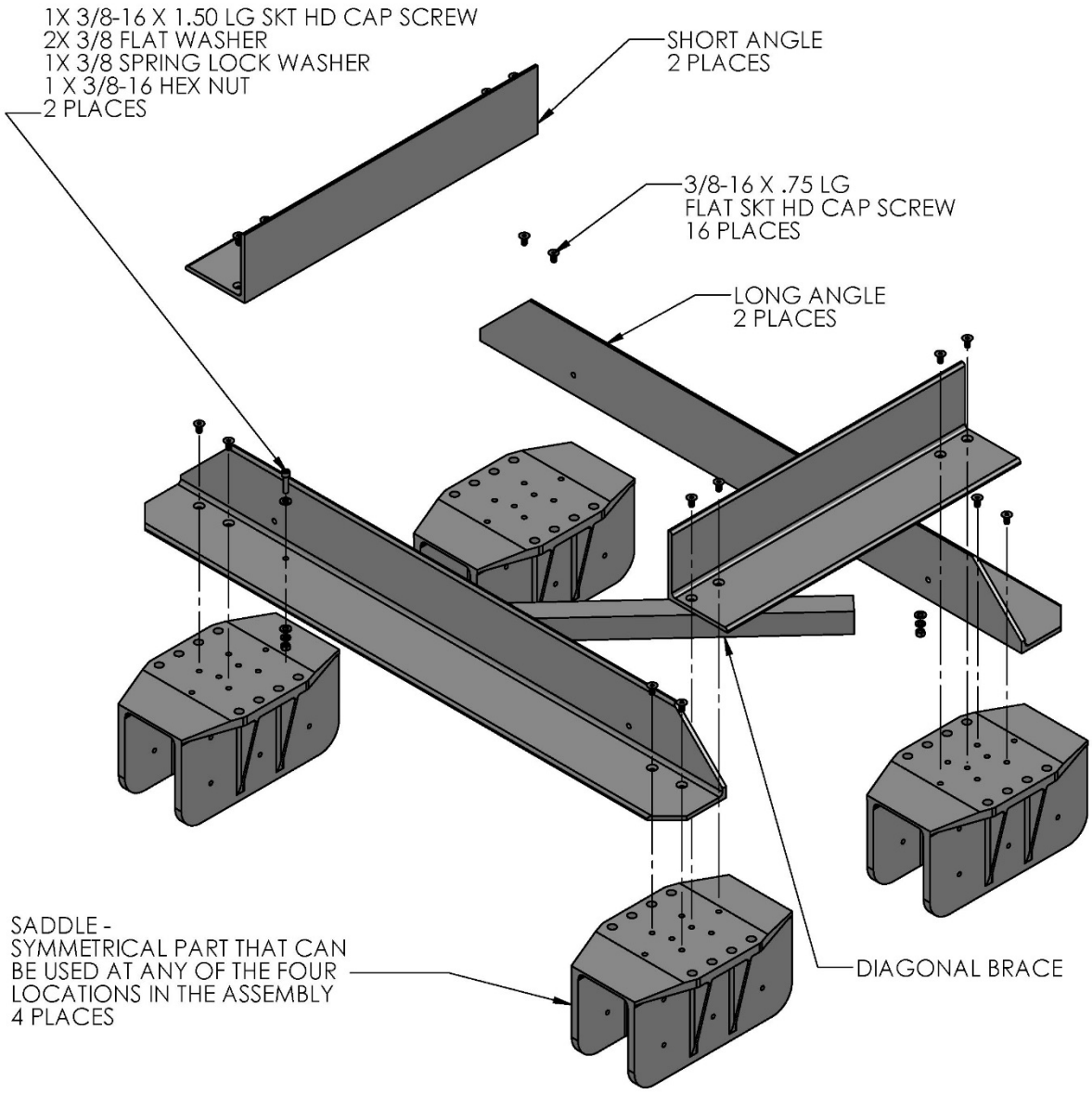
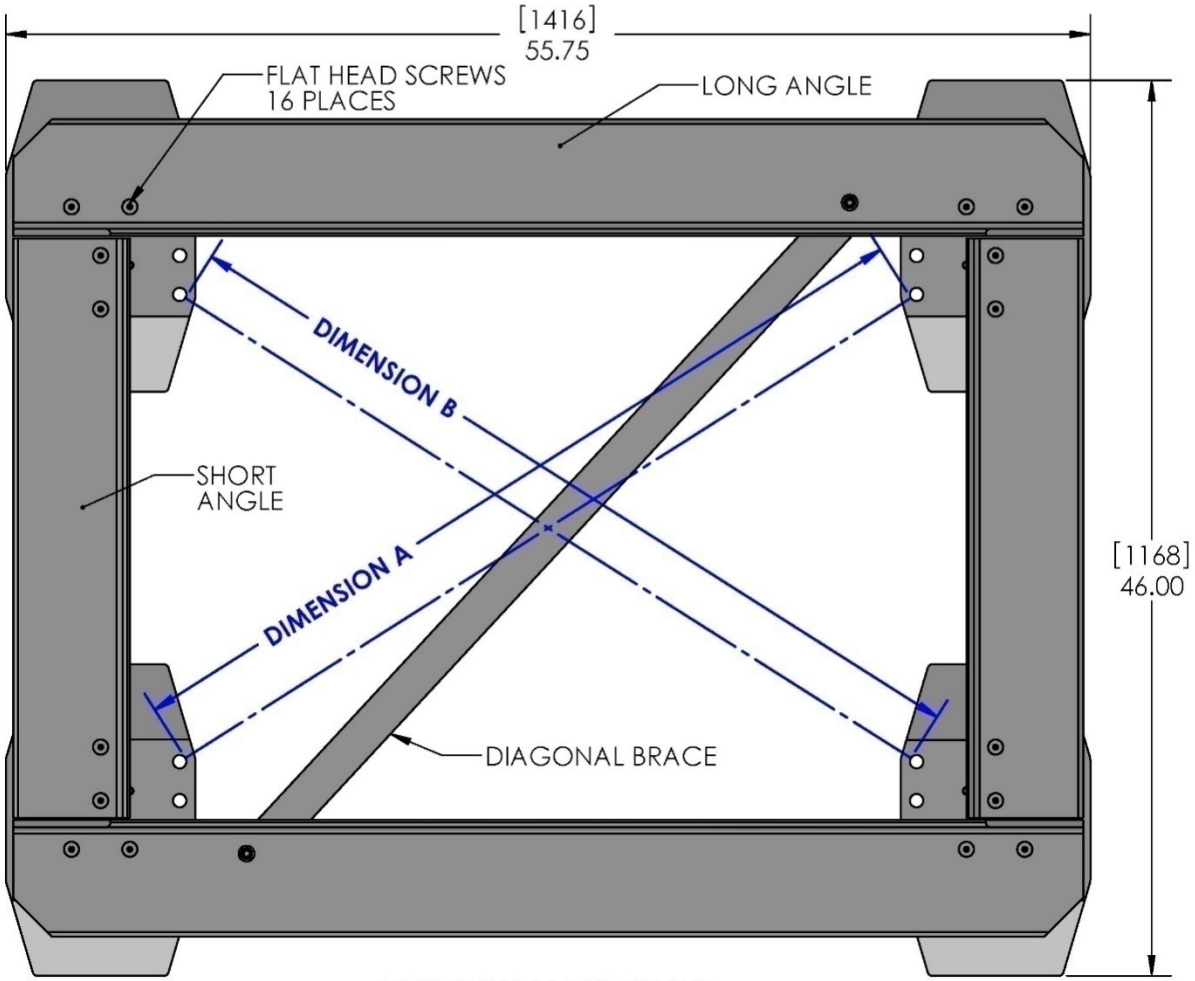



FIGURE 7 – EXPLODED VIEW OF SADDLE INSTALLATION FIXTURE

## ASSEMBLY NOTICE FOR SADDLE INSTALLATION FIXTURE -IMPORTANT!!

- PLACE SADDLES ON FLAT SURFACE AND ARRANGE IN APPROXIMATE LOCATIONS
- INSTALL SHORT AND LONG ANGLES AS SHOWN BUT DO NOT TIGHTEN FLAT HEAD FASTENERS UNTIL FINAL STEP.
- INSTALL DIAGONAL BRACE USING 3/8" SKT HD CAP SCREWS, WASHERS & NUTS.
- **CONFIRM SQUARE BY MATCHING DIMENSION A & B SHOWN BELOW WITHIN 1mm.**
- FIRMLY TIGHTEN ALL FASTENERS.
- DOUBLE-CHECK SQUARE AND RE-ADJUST IF NEEDED




**VIEW FROM ABOVE FIXTURE**

FIGURE 8 – NOTICE FOR CHECKING SQUARE OF ASSEMBLY

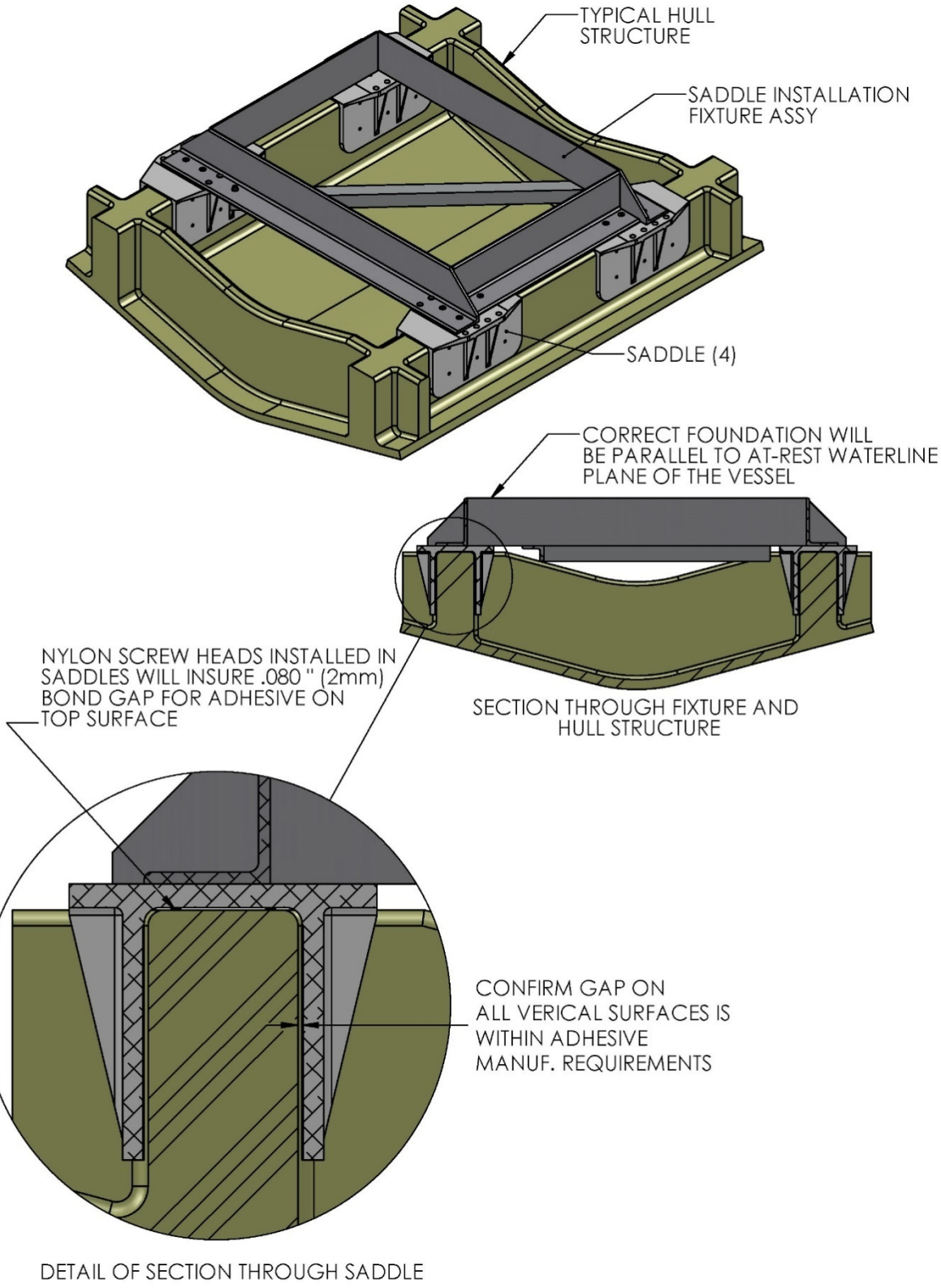



FIGURE 9 – SADDLE INSTALLATION FIXTURE ON NOTIONAL HULL STRUCTURE

## 1.6.2 Fiberglass Hull Preparation

1) Check that the screws fastening the saddles to the installation fixture are tight (Fig 8). Position installation fixture (Fig 10) on hull girders noting recommended clearances for maintenance from Figure 2.

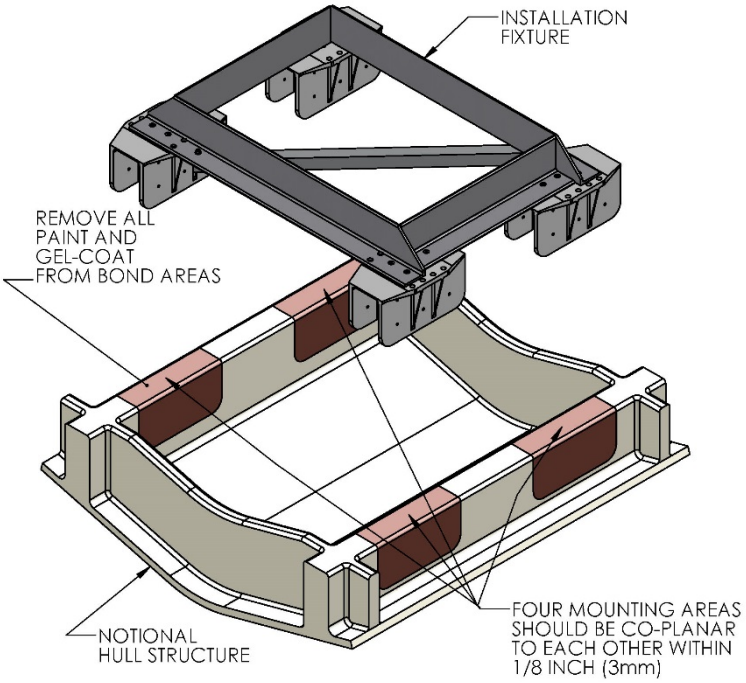



FIGURE 10 - INSTALLING FIXTURE ON HULL

2) Mask hull area (Fig 11) around foundation saddles for easy clean-up and to create outline of surface area to receive adhesive. Insure that the bond gap is within Seakeeper's recommended thickness, or 3mm if using Plexus MA590.

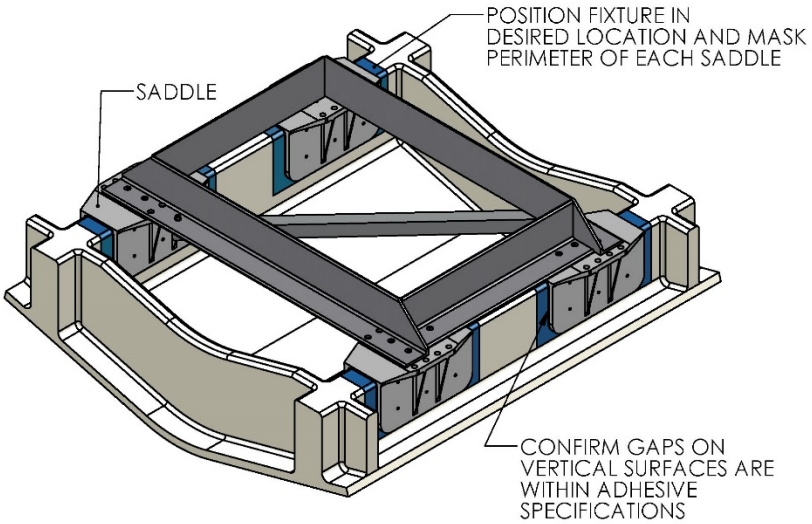



FIGURE 11 - MASKING PERIMETER OF SADDLES

3) Raise fixture clear of foundation. Check all four mounting areas are co-planar to within .13" (3 mm) to each other, as well as parallel to the water line plane, as shown in Fig 12.

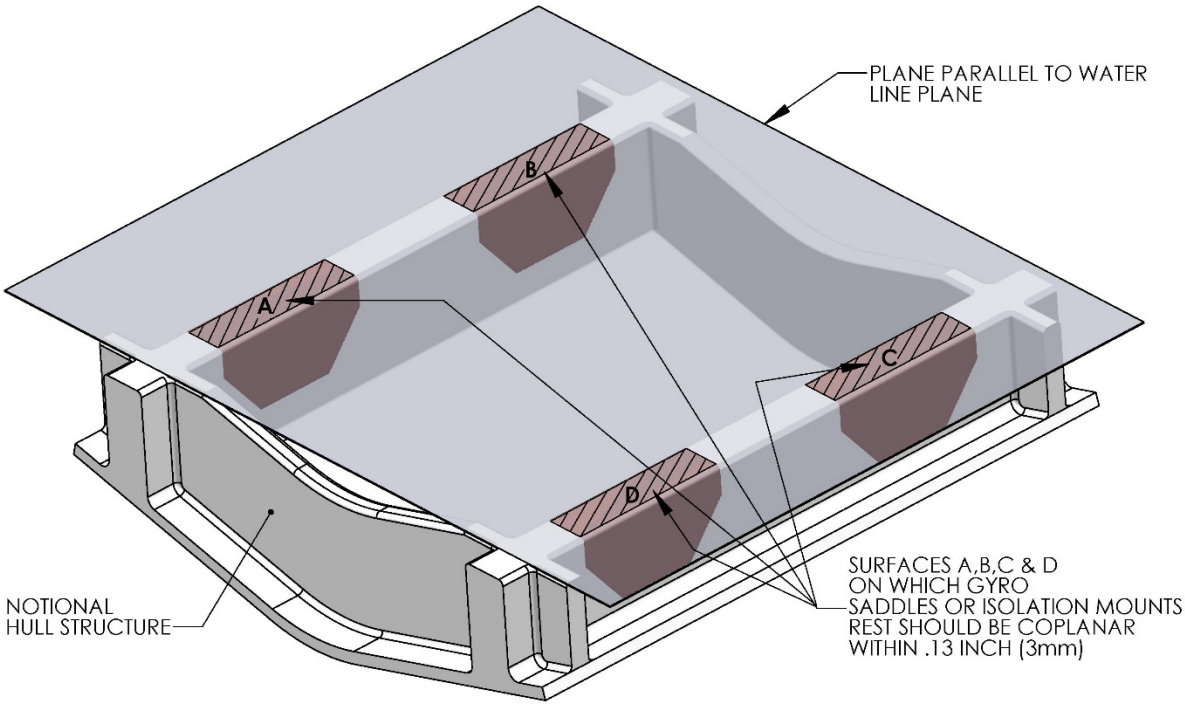



FIGURE 12 – COPLANAR PROPERTIES OF FOUNDATION

4) Thoroughly clean with alcohol or acetone all areas of girders to be bonded to remove any contaminates. Use new paper towels for cleaning, not shop rags.
5) Remove any paint or gel-coat from bond surfaces so that adhesive will bond directly to laminate fibers and resin as shown in Figure 10.
6) **Thoroughly sand girder bond surfaces with 80 grit sandpaper. (IMPORTANT – BOND STRENGTH MAY BE REDUCED IF THIS STEP IS SKIPPED.)**
7) Wipe surfaces clean from dust with alcohol or acetone using new paper towels, not shop rags.
8) Re-position installation fixture on girders and double-check that the adhesive gap is within the adhesive manufacturer's maximum recommended thickness. Seakeeper recommends a maximum gap of 3mm if using Plexus MA590.

**Note if bonding saddles to a metal structure, contact Seakeeper for hull preparation instructions.**

9) Lift installation fixture clear of foundation. Apply Seakeeper provided adhesive backed foam strips at the eight locations shown (each end of four saddles) in Figure 13 below. These strips are to serve as a dam to minimize adhesive escaping out the ends of the saddles as they are positioned over the bond area.

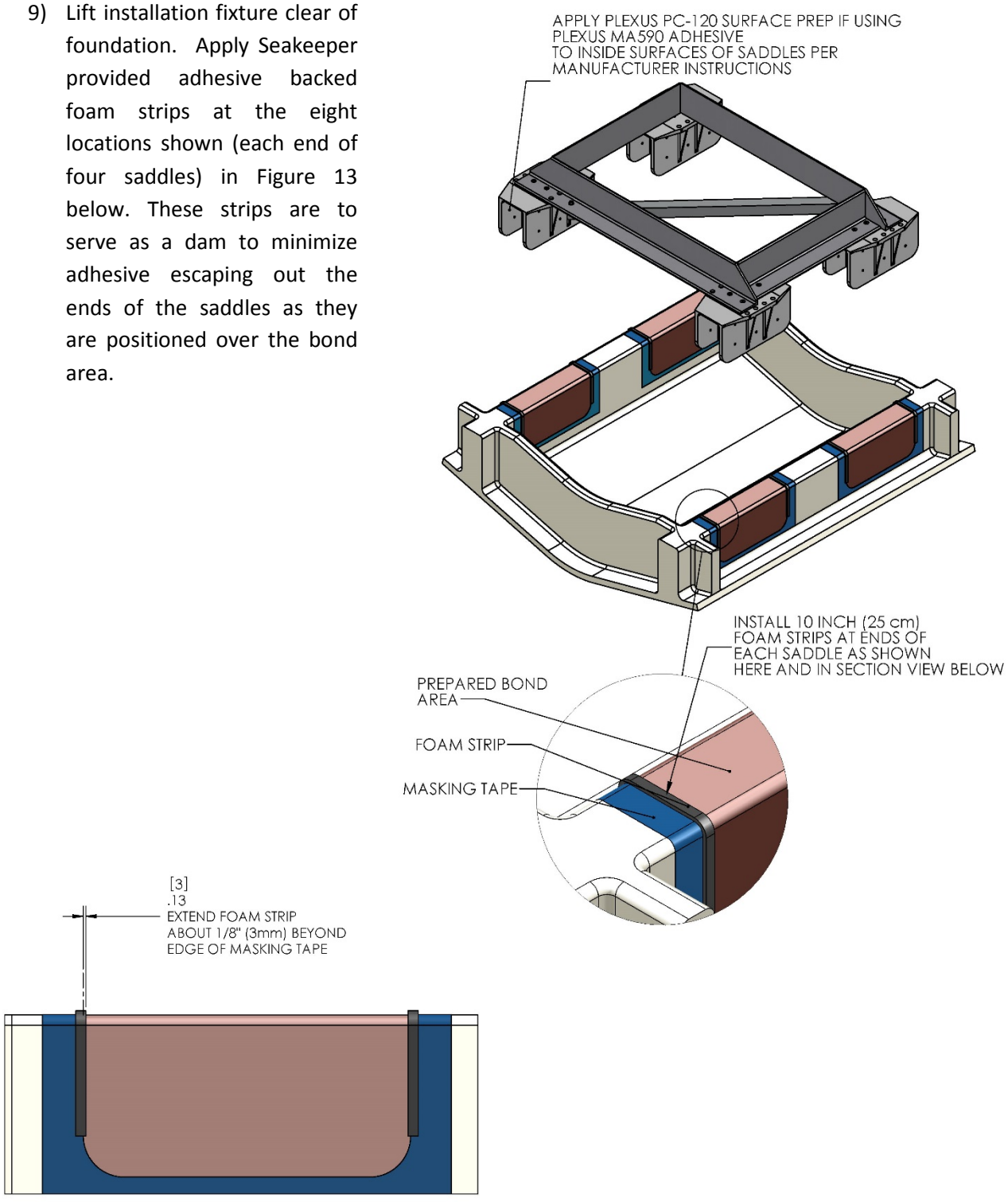



FIGURE 13 – FOAM STRIP INSTALLATION

### 1.6.3 Gyro Saddle Preparation

1) Ensure that screws fastening saddles to the installation fixture are tight.

2) Check that each saddle contains 4 plastic screws which will insure an adhesive gap of .080" (2 mm) on top surface of hull as shown in Figure 14.

3) Thoroughly clean with alcohol or acetone the inside surfaces of gyro foundation saddles to remove any contaminates as shown in Figure 14. Use new paper towels for cleaning, not shop rags.

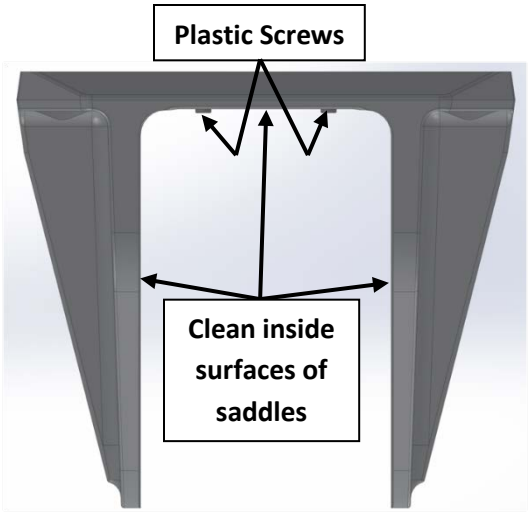



FIGURE 14 - SADDLE CLEANING

4) **Thoroughly sand all saddle inside surfaces with 80 grit sandpaper. (IMPORTANT – BOND STRENGTH MAY BE REDUCED IF THIS STEP IS SKIPPED.)**

5) Wipe surfaces clean from dust with alcohol or acetone using new paper towels, not shop rags.

6) If using Plexus MA590 adhesive, apply Plexus PC-120 surface conditioner to inside surfaces of gyro foundation saddles in accordance with manufacturer instructions. These instructions are located at the end of this section. If using an alternate adhesive, check with manufacturer if any surface conditioner/etch is required for the aluminum saddles.

## 1.6.4 Bonding Saddles to Hull

Note: If using Plexus MA590 adhesive, the gyro saddles should be installed when PC-120 is confirmed dry.

1) Assemble Plexus cartridge into either the manual or pneumatic gun as shown. Remove cap on cartridge and attach mixing tip. For pneumatic gun, start with low air pressure and increase until desired flow rate is achieved.

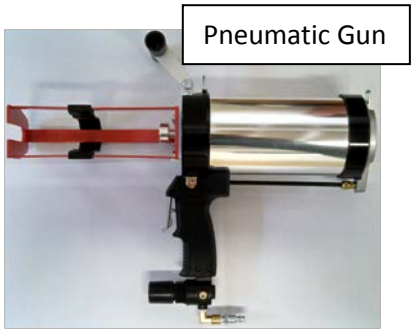
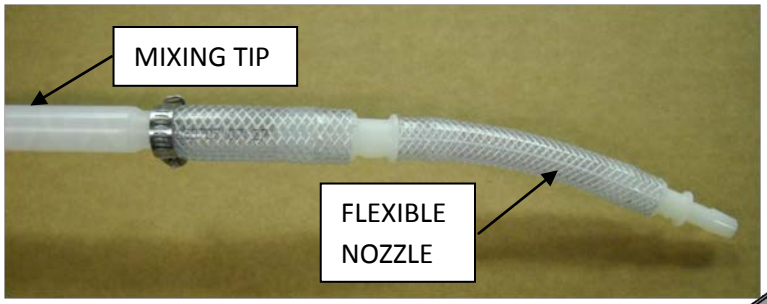



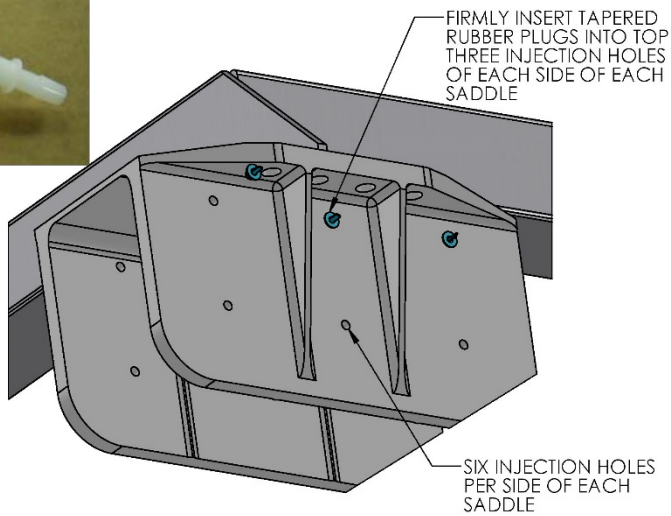

FIGURE 15 – ADHESIVE INSTALLATION SUPPLIES

2) Cut tip of mixing wand as shown in photo.

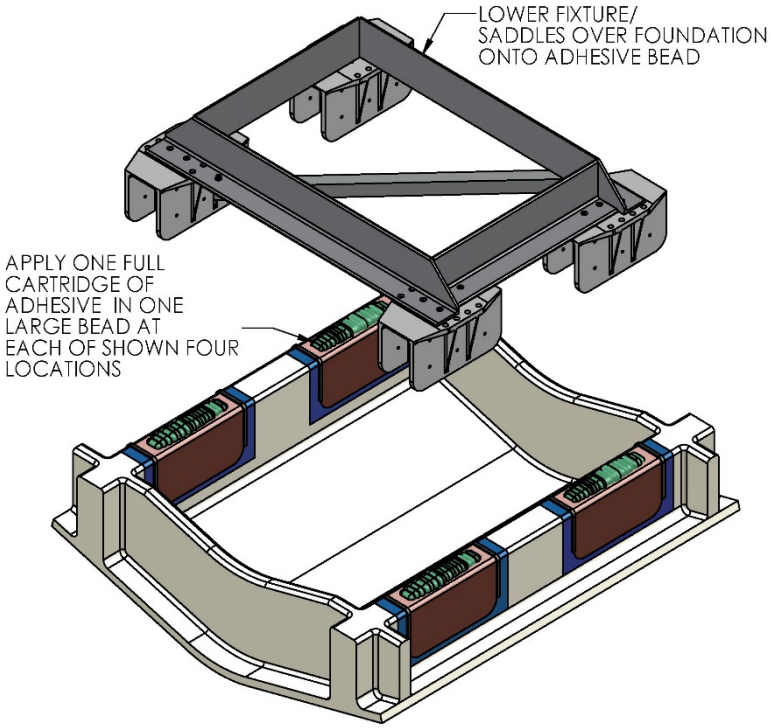
3) Prepare a second mixing wand as shown in photo below by attaching the simple flexible nozzle to the end with provided hose clamp. Set aside for now as this will be used to inject adhesive into the sides of each saddle after the fixture / saddles are in position.

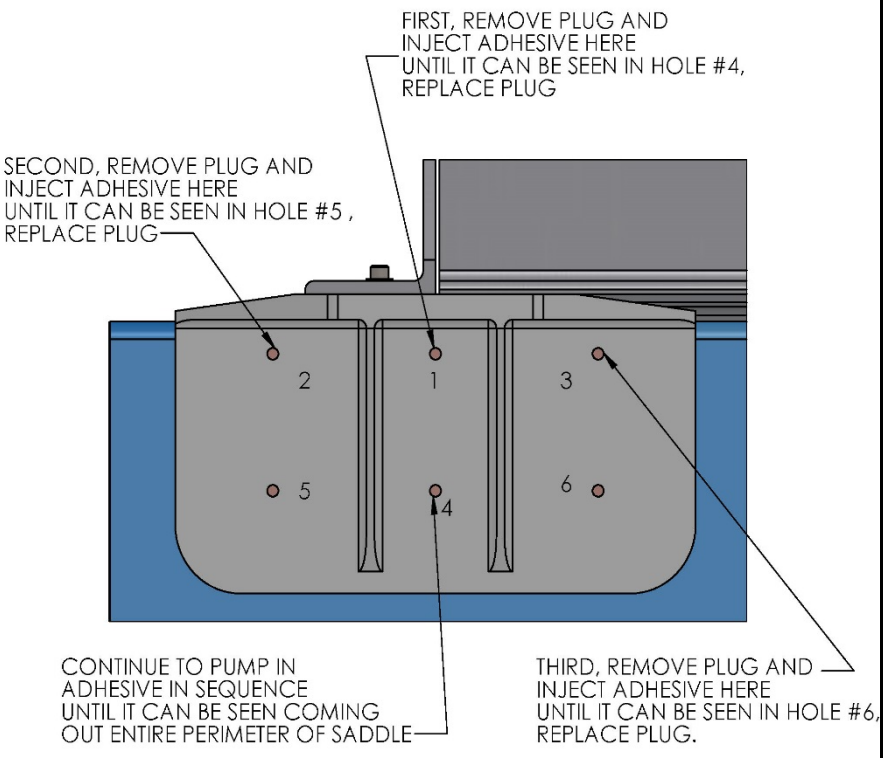



4) Install provided rubber plugs in six holes of each saddle. The plugs will limit the adhesive being forced out of the injection holes in step 6 below.



5) Apply large bead of Plexus adhesive to the hull structure as shown in the figure to the right. Apply approximately 1 ½ cartridges at each of the four locations. Work deliberate and fast as it takes some time to apply the adhesive to the structure. MA590 has a 90 minute working time at room temperature (23°C / 73°F). This working time can reduce to 40-50 minutes at elevated temperatures. Two workers should apply the adhesive at the same time to finish the installation before the adhesive starts to cure.
6) Lower fixture and saddles over the hull structure and apply light downward pressure to each of the four saddles until the four nylon screws rest on the hull structure (SEE FIG. 9). The adhesive will be forced towards the forward and aft ends of each saddle and partially down the sides of the foundation beams
7) Insert full adhesive cartridge along with mixing wand / nozzle assembled in step 3 above into gun.
8) Begin to inject adhesive into the six holes provided on each side of each of the four saddles. Follow the numbered sequence shown until the adhesive pushes out the edges of the saddle perimeter. The intent is to pump in the adhesive working from the top down and from the middle to the ends to fill the gaps and displace any air.



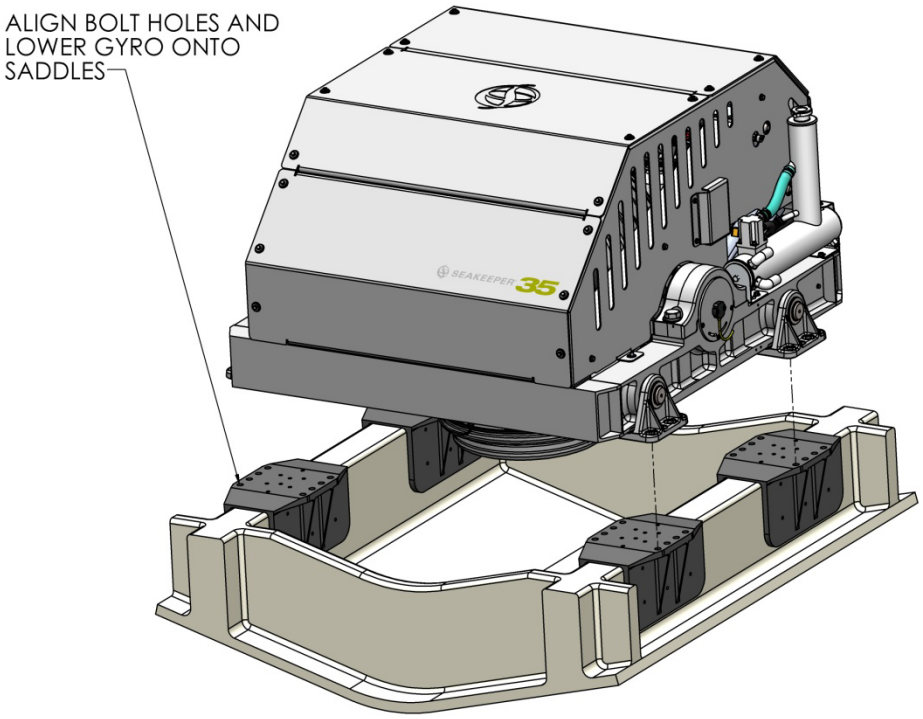




A complete bond is required – excess adhesive will be needed to make sure all bond gaps are filled.

9) Repeat above step for remaining 7 sides of the saddles.
10) When gaps have been completely filled, clean off excess adhesive, remove plugs, and remove masking tape.
11) Allow adhesive to cure per manufacturer's recommendations. Follow adhesive guidelines for curing time versus temperature prior to removing the fixture.
12) Bonding of gyro saddles onto the hull is now complete. Remove installation fixture.

## 1.6.5 Installation of Gyro

1) Rig gyro for lifting and lower gyro into position onto top surface of four saddles.

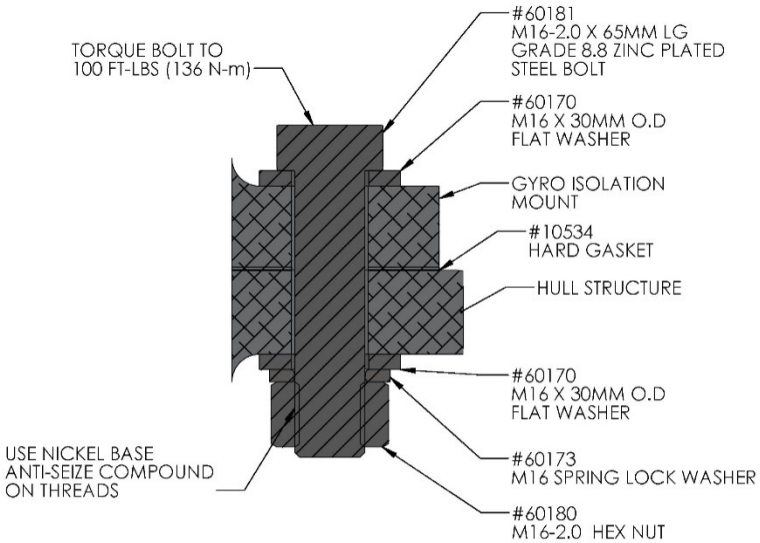



2) Apply a small bead (approximately 4mm wide) of sealant or caulk to the mating surfaces between the saddles and the gyro foundation. Adjust position of gyro until alignment is achieved for the 32 fasteners that will attach gyro foundation frame to saddles. (Note isolation gasket used for bolt-in installation is not required).

3) Install Seakeeper supplied M16 fasteners as shown in figure to right – apply a moderate coat of nickel based anti-seize compound to the threads of each bolt prior to installation and a small amount of sealant to the washer faces.

4) Torque all fasteners to 100 ft-lbs (136 N-m).

5) Proceed to electrical and cooling portion of the installation.




SECTION THROUGH ISOLATION MOUNT / FOUNDATION BEAM

## 1.7 Doc # 90213 Plexus PC-120 Application Instructions

## What is Plexus PC-120?

- Plexus PC-120 is a dual function primer/conditioner designed to clean surface contamination and leave a thin coating of primer on specific metal surfaces.
- Although designed specifically for cleaning and priming of Aluminum and Stainless Steel, PC-120 can be used to clean other surfaces in special situations. Contact Plexus Technical Service for recommendations on any surface other than Aluminum or Stainless Steel.

## Plexus PC-120 works by:

- Cleaning the surface of contamination using Isopropyl Alcohol to “lift” machine oils and other contamination.
- Depositing a thin Phosphate based coating to retard corrosion.
- Leaving a light “pink” color to assist in determining what areas have, and have not, been treated with PC-120.

## How should PC-120 be used?

- PC-120 can be brushed, wiped or sprayed onto the surface being primed.
- The PC-120 applied should then be wiped with a clean dry rag to remove any surface contamination cleaned by the PC-120 and leave only a thin, quick drying film.
- Dirty or oily rags should be replaced to avoid improper cleaning.
- Quality dye-free paper towels that don’t leave fibers behind are recommended.

## Common mistakes with PC-120

1) Using too much PC-120
2) Not removing the oils lifted off the metal surface before the PC-120 dries.
3) Not abrading corrosion that is already on the surface of the metal.
4) Using PC-120 past its shelf life.

## 1) Using too much PC-120

- Only a very thin coat should be left on the metal. You should be able to see a slight "pink" cast as illustrated below.

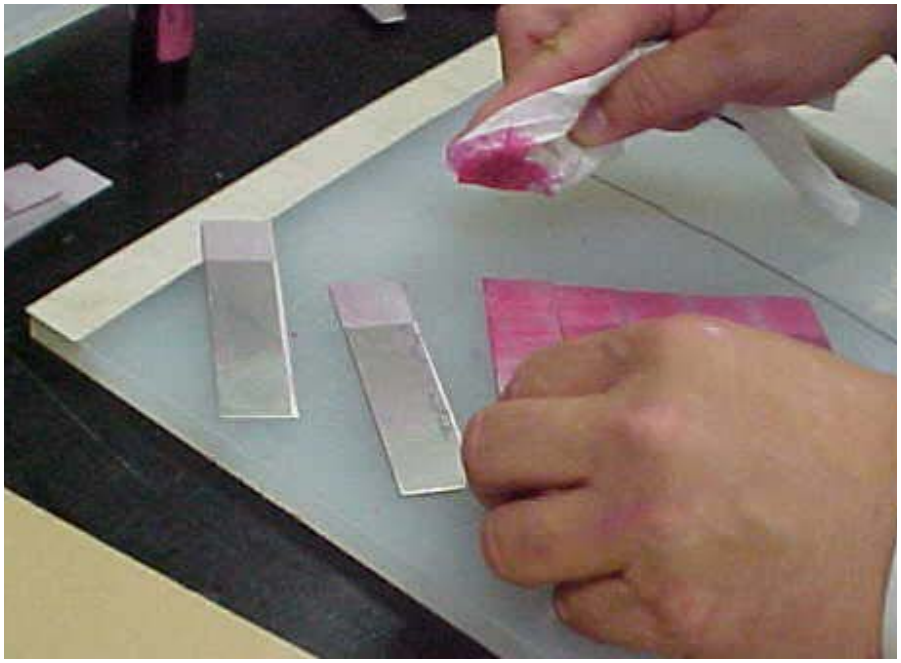
***Too Much PC-120***

***Correct Amount***

## 2) Not removing oils once primed

- The solvents in PC-120 will clean and "lift" most machining oils, but if the metal isn't wiped clean of these oils then they will be deposited right back onto the metal surface when the solvent in PC-120 evaporates!
- While still wet, wipe the PC-120 applied to the surface with a clean dry paper towel, changing the paper towel as needed.

Wipe the surface with a dry rag



Replace the rag when dirty

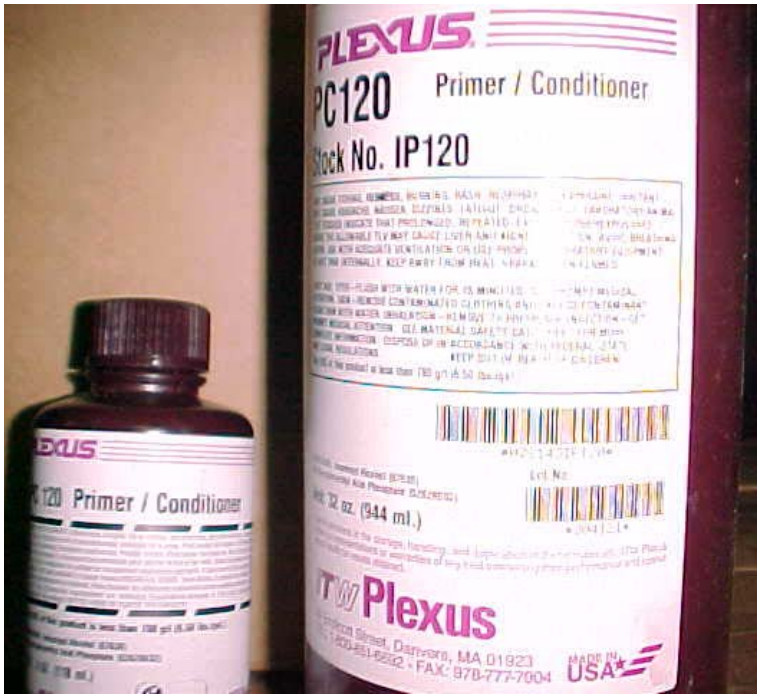
- Notice how much aluminum oxide was cleaned off "clean" looking Aluminum

## 3) Not abrading corroded surfaces

- As good as PC-120 is, it can't help bonding performance if applied to a surface that is already corroded!
- Any surface that shows signs of corrosion should be cleaned by sanding or wire brushing to remove any scale or corrosion.
- After removal of corrosion then treat the surface with PC-120 as you normally would.

## 4) Using PC-120 past it's shelf life

- When stored under normal conditions PC-120 has a shelf life of 12 months in an unopened, original container.
- PC-120 bottles are marked with a lot number that is a simple 8 digit code that gives you the date of manufacture.
    - "807241" for example is 200**8**, **07** month (July), **24**th day (the "**1**" refers to the first batch of PC-120 made that day). Use the lot number to make sure the material is still within shelf life.
- Since it contains isopropyl alcohol, PC-120 should be tightly capped when not in use to stop evaporation.



## Remember these points! To avoid problems with Plexus PC-120:

- Don't use too much PC-120. Only a thin layer is needed.
- Use a clean rag to wipe PC-120 off before it completely dries to remove surface contaminants it has cleaned. Good quality paper towels are a better choice to minimize introduction of contaminates to surface.
- Any sign of corrosion already on the surface should be removed by abrading BEFORE priming.
- Check the lot number for the date to make sure the PC-120 is less than a year old.

## Questions

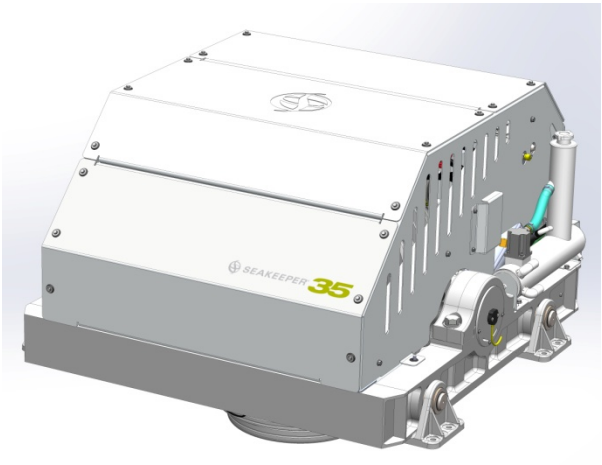
- Please contact Plexus Technical Service at 1-800-851-6692 or info@itwplexus.com

## 2.0 Introduction

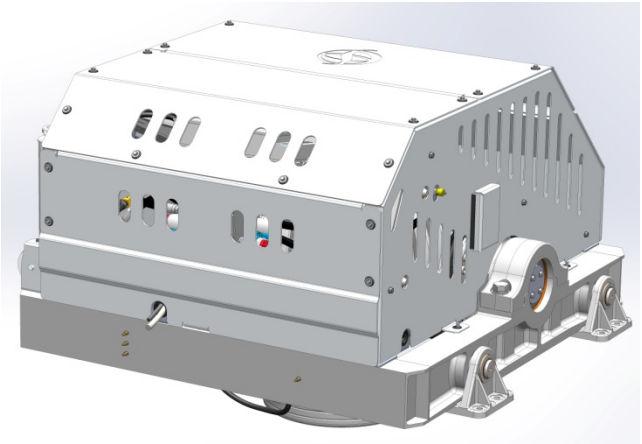
This section for electrical installation explains how to mount the electrical equipment and how to connect the electrical cables.

**Reference Documents & Drawings**

***90233 Seakeeper 35 Gyro Hardware Scope of Supply***
***90250 2nd Helm Control Station Kit***
***90269 Seakeeper 35 Gyro Operation Manual***
***90270 Seakeeper 35 Gyro Drawing Manual***
***90288 Seakeeper 35 Gyro Cable Block Diagram (includes 2nd Display Kit)***
***90337 Color Operator Display Envelope and Mounting Details***




SEAKEEPER 35 Gyro, Front Oblique View



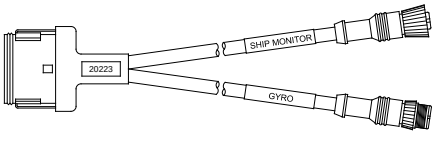
SEAKEEPER 35 Gyro, Rear Oblique View

24VDC Power Cable

Terminator, Female

Tee Adapter

Color Display




Display Interface Cable

25m Cable

FIGURE 1 – ELECTRICAL EQUIPMENT FOR SEAKEEPER 35 GYRO

## 2.1 Electrical Equipment Mounting

**Precautions**

- Each item of electrical equipment has specific mounting instructions. These instructions should be followed to insure proper function of the SEAKEEPER 35 Gyro.

**Do NOT move Gyro mounted components from their locations or incorrect Gyro operation will result.**

**1. COLOR DISPLAY MOUNTING INSTRUCTIONS, SURFACE MOUNT**

a. Console space required: Approx. 4.57 W x 4.57 H inches (116 x 116 mm)

b. Mounting Instructions, Surface Mount: See drawing 90337 for details

**2. SERIAL COMMUNICATIONS TEE ADAPTER AND TERMINATOR MOUNTING INSTRUCTIONS**

a. Console space required, Rear: Approx. 4 W x 3 H inches (102 x 76 mm), rear

b. Mounting Instructions: Rear mount on vessel console panel, within 1 ft (0.3m) of Display.

c. Hardware required: One mounting screw for .197” (5mm) diameter mounting hole on Tee Adapter.

## 2.2 Electrical Equipment Power Connections

### 1. 230 VAC POWER SOURCE REQUIREMENTS

a. 230 VAC (nominal), 1 Phase, 50/60 Hz, 30 Amps.

b. A separate circuit breaker should be used for each Drive Box.

### 2. DRIVE BOX AC POWER INPUT CONNECTION INSTRUCTIONS

a. Cable: 3 x 10AWG (3 x 6mm$^2$ CSA), 10' (3m) length, Seakeeper supplied pre-installed.

i. Locate CABLE 2 for AC power input to the Drive Box at the outward of three cable glands.

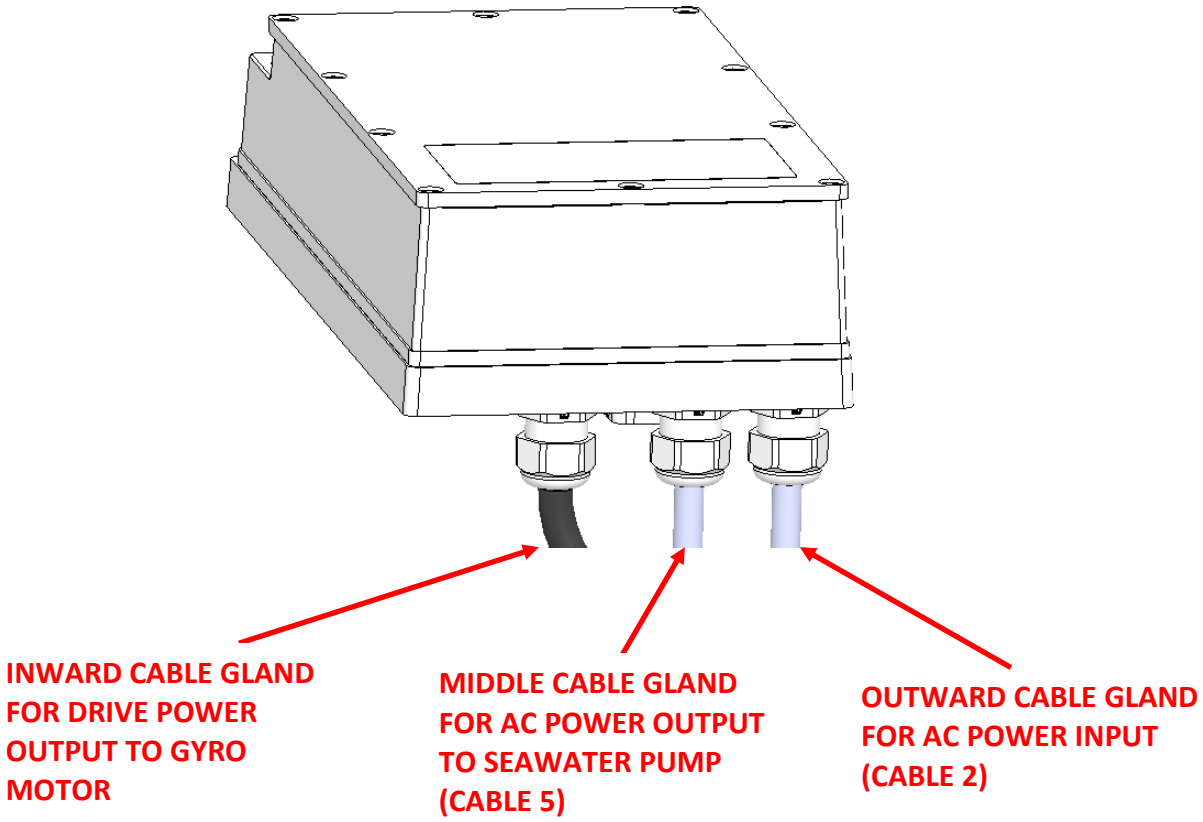



FIGURE 2 – DRIVEBOX AC POWER INPUT & OUTPUT CABLE GLANDS

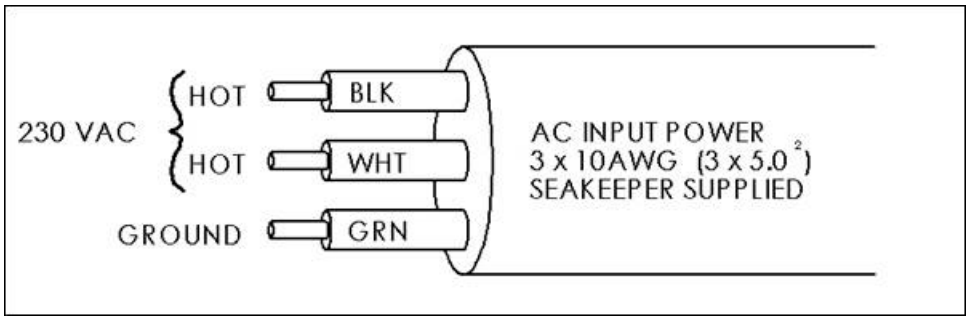



FIGURE 3 – CABLE 2 WIRE CONNECTIONS AT AC POWER DISTRIBUTION PANEL

ii. Connect 230 VAC wires in CABLE 2 to a 30 Amp, double-pole Circuit Breaker at an AC power distribution panel according to Figure 3 above.

### 3. DRIVE BOX AC POWER OUTPUT TO SEAWATER PUMP CONNECTION INSTRUCTIONS

a. Cable: 3 x 10AWG (3 x 6mm$^2$ CSA) cable, 10' (3m) length, Seakeeper supplied pre-installed.

b. Pumps rated at 230 VAC, 5 Amps max., Customer-supplied.

**Verify that AC power is OFF to the Drive Box before connecting CABLE 5 to a Seawater Pump.**

i. Locate CABLE 5 for AC power output to the Seawater Pump from the Drive Box at the middle of three cable glands. (See Figure 2.)

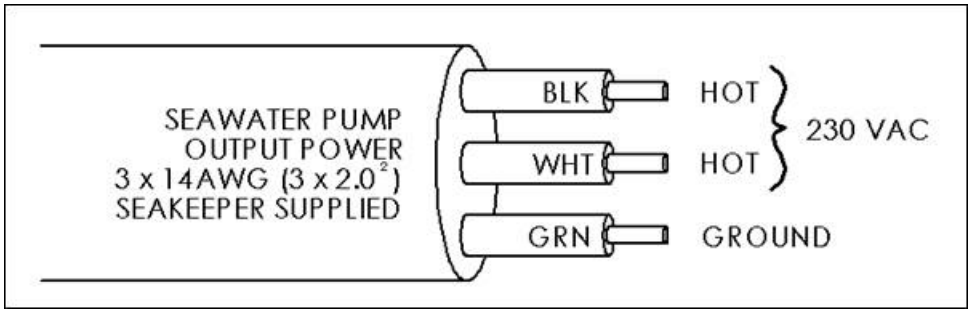



FIGURE 4 – CABLE 5, AC OUTPUT POWER CABLE

ii. Connect the 230 VAC wires in CABLE 5 to a 5 Amp maximum, Seawater Pump (approximately 1/3 horsepower or 250 W) according to Figures 4 and 5.

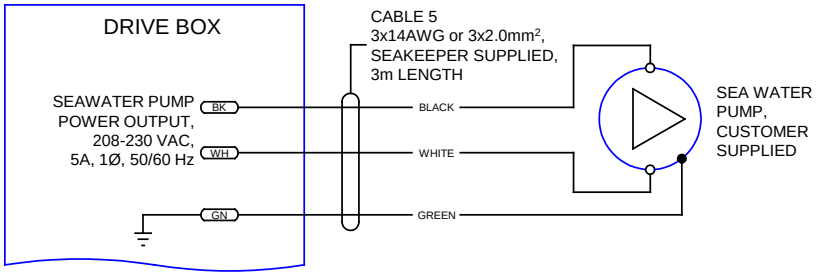



FIGURE 5– CABLE 5, WIRE CONNECTIONS TO SEAWATER PUMP

c. If the customer-supplied Seawater Pump is not rated for 230 VAC, the CABLE 5 output may be used to switch a customer-supplied relay.

   i. Locate CABLE 5 for AC power output to the Seawater Pump from the Drive Box at the middle of three cable glands as shown in Figure 2.

   ii. The recommended wiring is shown in Figure 6. Refer to Figure 4 for Cable 5 wire connections.

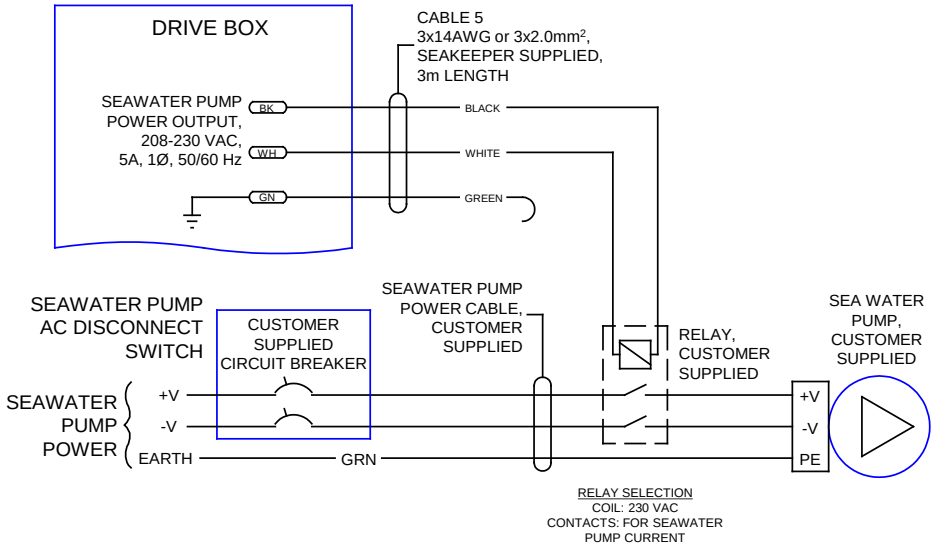



FIGURE 6 – RECOMMENDED WIRING FOR SEAWATER PUMPS NOT 230 VAC

d. If CABLE 5 is not used, bundle cable and secure to gyro frame or other area nearby which will not come in contact with moving parts during gyro operation. Do NOT cut CABLE 5 as it contains live voltage when gyro is in operation. Gyro ships with CABLE 5 permanently sealed at end of cable with protective cap in the event it is not used. Do NOT remove CABLE 5 from Drive Box as moisture will be free to enter box through open cable gland and corrode internal electronic components.

**Cable 5 contains live voltage when gyro is in operation. Do NOT cut Cable 5. Do not remove Cable 5 from Drive Box.**

### 4. 24 VDC POWER SOURCE REQUIREMENTS

a. 24 VDC, 10 Amps.

b. A separate breaker should be used for each Gyro.

### 5. GYRO DC POWER CONNECTION INSTRUCTIONS

**Reversing polarity on the DC power input to the gyro can result in damaging the electronics in the control system.**

a. 24 VDC, 10 Amps. 2 x 12AWG (3 x 4mm$^2$ CSA) Seakeeper supplied.

i. Install Seakeeper provided DC Power Input Cable, P/N: 20248 as CABLE 1.

1. Route CABLE 1 to DC Power Distribution Panel.

2. Terminate RED conductor to +24 VDC. Terminate BLACK conductor to 24V Rtn or Zero VDC.

ii. Before connecting CABLE 1 to gyro, check for proper voltage and polarity with a DC multimeter using Figure 7 below.

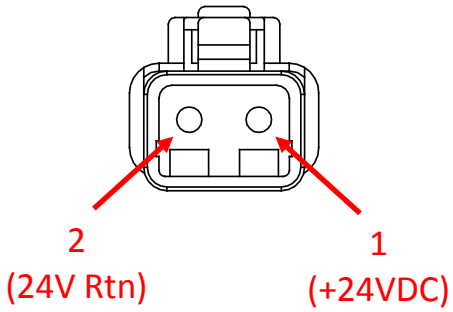



FIGURE 7 – DC POWER INPUT CONNECTOR
CONTACT ASSIGNMENTS (front)

iii. Connect CABLE 1 to 24VDC input receptacle on Gyro.

**When energizing DC power the first time, if Display does not power up immediately then disconnect and inspect connector polarity.**

## 2.3 Electrical Equipment Ground Connections

### 1. GYRO TO VESSEL GROUND CONNECTION INSTRUCTIONS

a. Connect the Gyro foundation to vessel ground.

i. Install CABLE 6 (4AWG or 22.0mm$^2$, Customer supplied) from the M6 brass ground stud on the Gyro rear foundation to a suitable vessel ground. Cable 6 should be installed on the inside rear of the foundation as shown below. **If possible, install Cable 6 prior to installing the gyro into the vessel.** If there is no access to the ground stud from below the rear of the gyro once installed, the rear cover, upper rear cover, and ECM bracket will need to be removed to access the ground stud from above the gyro.

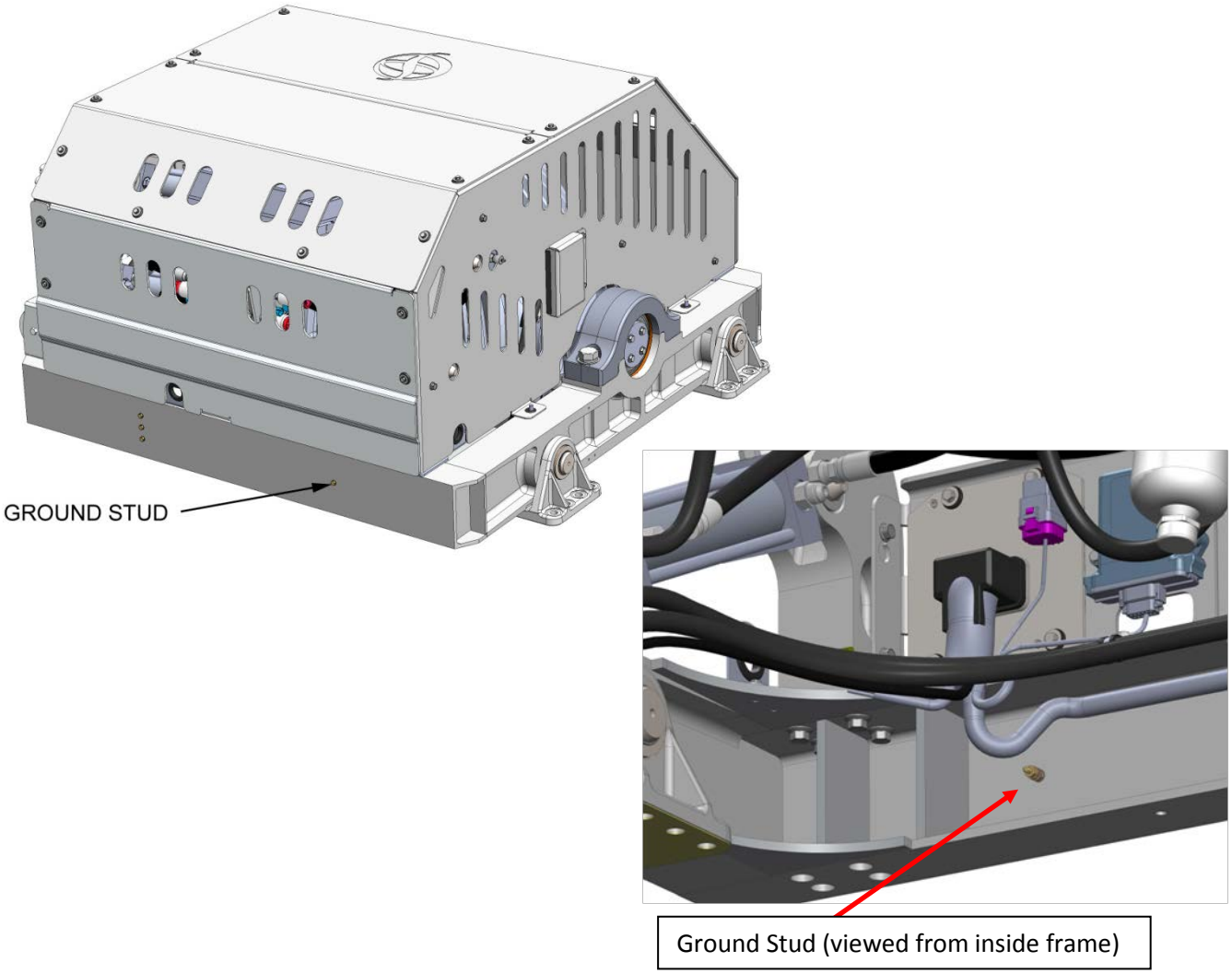



FIGURE 8 – GYRO GROUND STUD ON REAR FOUNDATION

## 2.4 Operator Station

This section explains the connection between the Operator Station equipment and the Gyro.

**Reference Drawing**

***90288 Seakeeper 35 Gyro Cable Block Diagram***

**1. DETERMINE LOCATION OF OPERATOR STATION**

a. The desired location of the Operator Station must be determined with respect to the vessel arrangement.

b. The operator display should be located on the bridge console.

c. Figure 9 below shows the CANbus communications link for the Operator Station. The Terminator goes on the far end of the Tee Adapter from the Gyro.

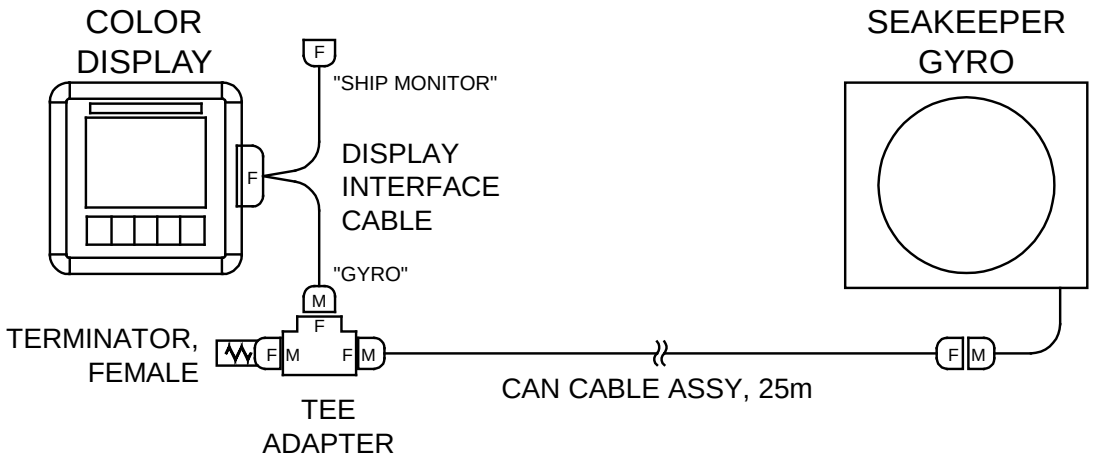



FIGURE 9 – SERIAL COMMUNICATIONS LINK FOR OPERATOR STATION

**2. ROUTE SERIAL COMMUNICATIONS CABLE**

a. The CAN Cable Assembly (30243, CABLE 5) is a 25 meter shielded cable and the largest connector is a molded plug with maximum outer diameter of .58 inch (14.8mm).

b. CABLE 5 must be routed and installed in the vessel from the Gyro (female end) to the Tee Adapter (male end) at the Operator Station.

### 3. INSTALL OPERATOR STATION EQUIPMENT

a. The Operator Station equipment is installed at the selected location using Electrical Equipment Mounting Instructions in Section 2.1.

### 4. CONNECT OPERATOR STATION EQUIPMENT

a. The Operator Station equipment is connected in accordance with the Cable Block Diagram, 90288.

## 2.5 Second Operator Station Connection

This section explains how to connect the 2nd Operator Station Kit.

**Reference Drawings**

***90250 Gyro 2nd Operator Station Kit***

***90288 Seakeeper 35 Gyro Cable Block Diagram (includes detail of 2nd Operator Station)***

### 1. DETERMINE LOCATION OF 2ND OPERATOR STATION

a. The desired location of the 2nd Operator Station must be determined with respect to the 1st Operator Station and the vessel arrangement.

b. Typical locations include:

i. Flybridge
ii. Engine room

### 2. DETERMINE CABLING ARRANGEMENT

a. Figure 10 below shows the entire serial communications link for 2 Operator Stations. The Terminator must be installed on the Tee Adapter farthest from the Gyro.

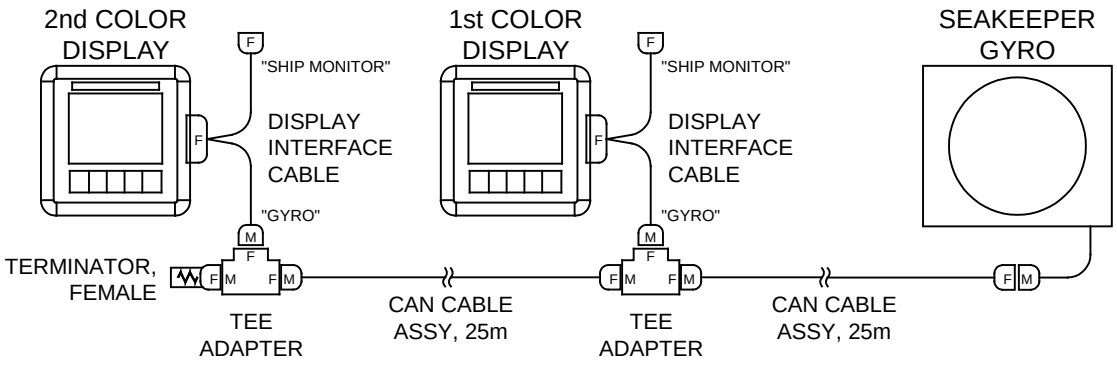



FIGURE 10 – CABLING FOR 2 OPERATOR STATIONS

b. The Operator Station nearest the Gyro should be connected to CABLE 5.

### 3. ROUTE 2ND OPERATOR STATION CABLE

a. A second CAN Cable Assembly (30243), also a 25 meter shielded cable, and the largest connector is a molded plug with maximum outer diameter of .58 inch (14.8mm)).

b. The additional CAN Cable Assembly must be routed in the vessel from the 1st Operator Station (female end) to the 2nd (male end) Operator Station.

### 4. INSTALL 2ND OPERATOR STATION EQUIPMENT

a. The 2nd Operator Station equipment is installed at the determined location using Electrical Equipment Mounting Instructions in Section 2.1.

### 5. CONNECT 2ND OPERATOR STATION EQUIPMENT

a. The 2nd Operator Station equipment is connected in accordance with the Cable Block Diagram, 90288.

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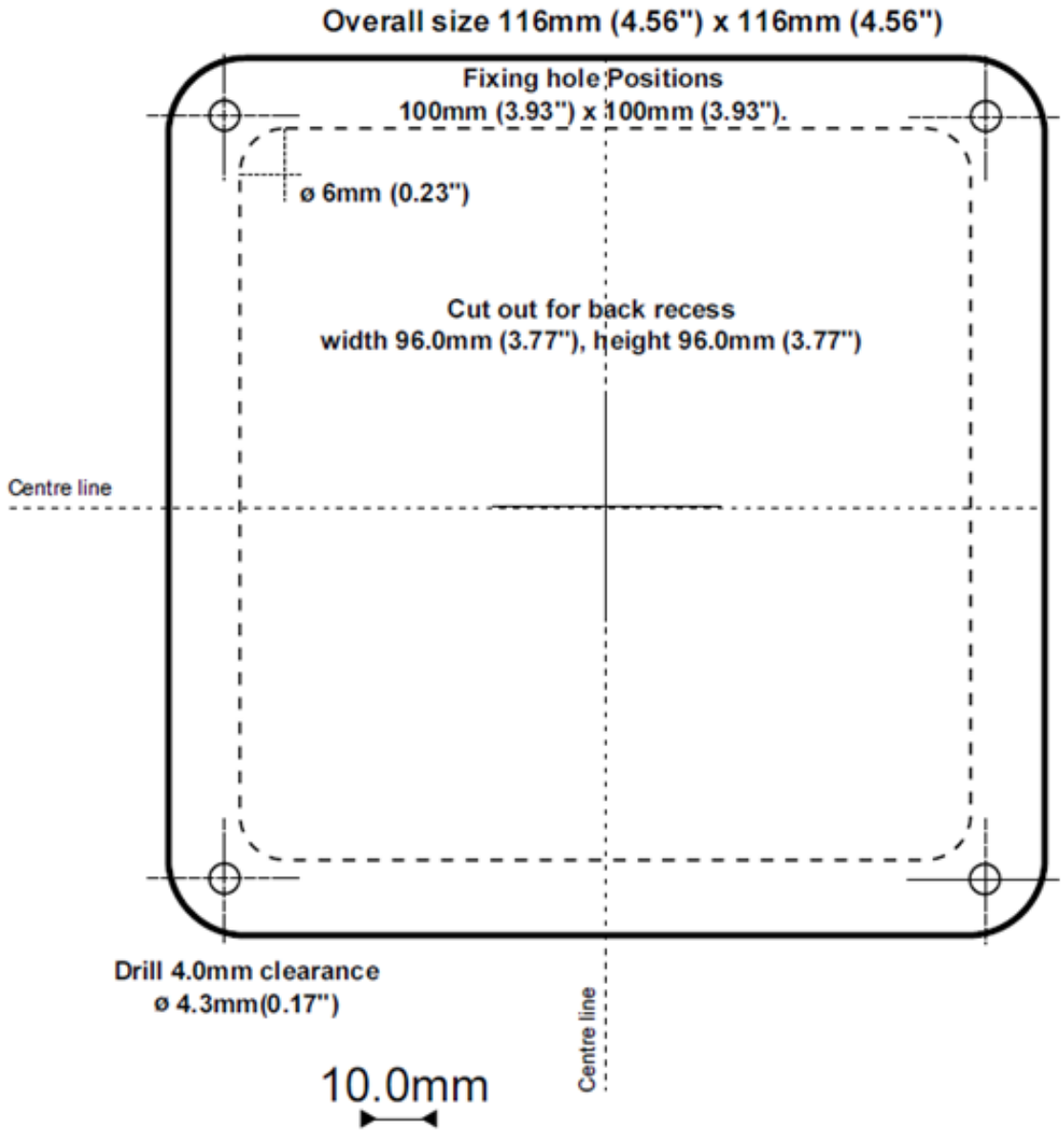
## 2.6 Display Installation Template

The following template is for mounting; before using this template, measure to ensure that the shown size is actual.




DISPLAY MOUNTING TEMPLATE

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## 3.0 Introduction

The Seakeeper 35 is shipped with the cooling circuit filled and ready for use. Only a quick confirmation of glycol level is required.

**Reference Drawings**

***90233 Seakeeper 35 Gyro Hardware Scope of Supply***

***90288 Seakeeper 35 Gyro Cable Block Diagram***

***90290 Seakeeper 35 Gyro Cooling Water Schematic***

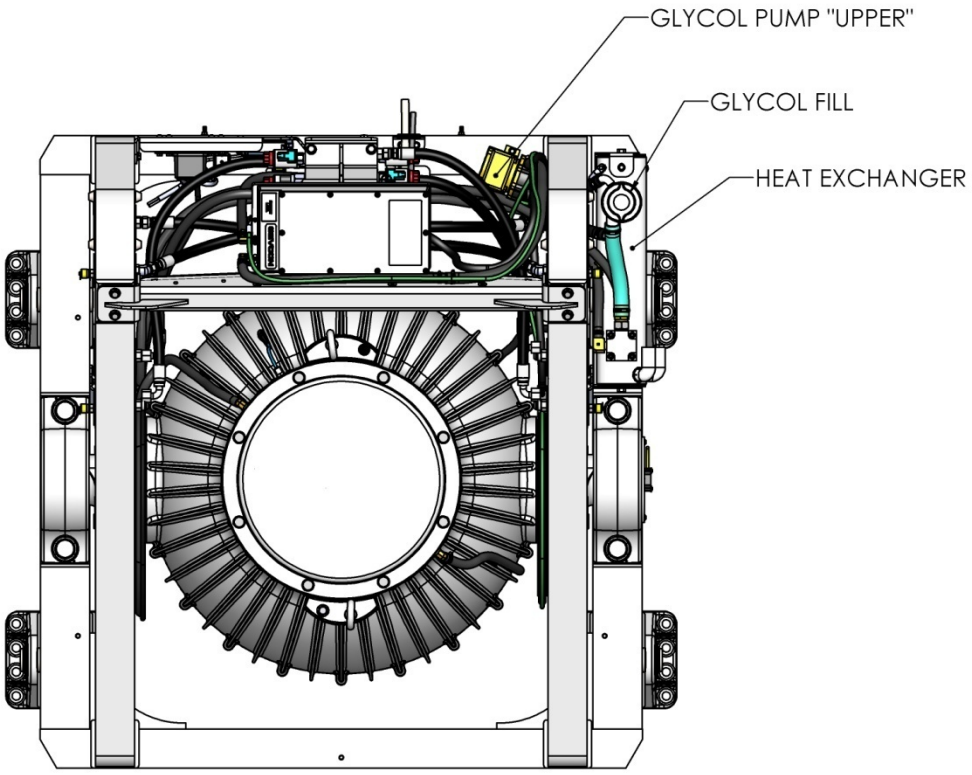


FIGURE 1 – SEAKEEPER 35 GYRO

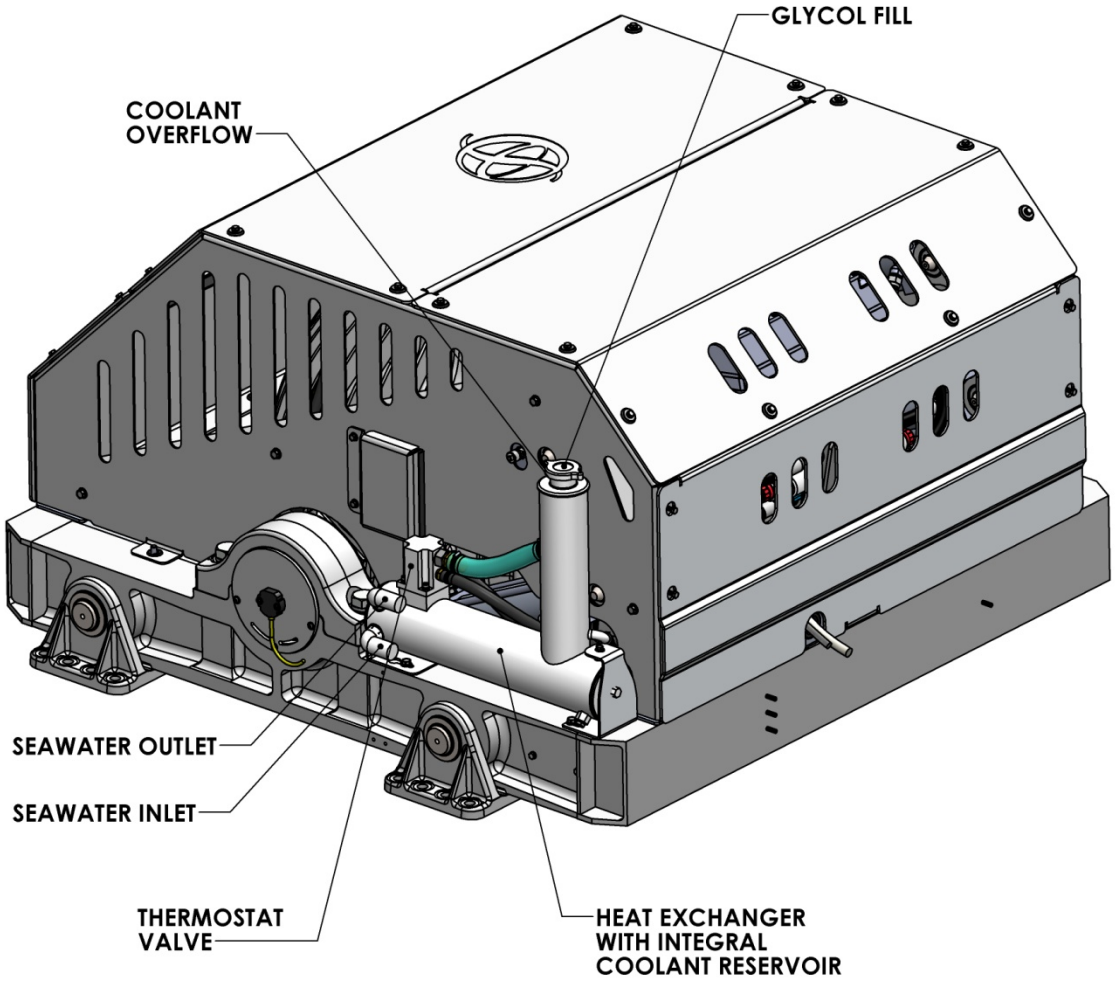


FIGURE 2 – SEAKEEPER 35 GYRO COOLING COMPONENTS

## 3.1 Precautions

- Installer is responsible for supplying a dedicated sea water pump and associated plumbing. Sea water connections on the gyro heat exchanger mate with 1 inch (25.4 mm) hose.
- There is no need to disconnect hose from glycol pump except to replace the pump. In this case, provision will need to be made to catch draining glycol as plumbing is disconnected. Use caution to avoid breaking plastic hose connections on pump casing.
- An output is available from motor drive to power and automatically control seawater pump. This pump must operate on 230 VAC single phase and consume less than 5 amps. Pumps requiring other voltages or higher current can still be controlled by using this supply from motor drive to trigger an installer-supplied contactor but a separate source of power must be provided.
- Maximum sea water pressure in heat exchanger is 20 psi (1.4 bar)
- **Seawater flow requirement through heat exchanger is 10 GPM (38 LPM) minimum and 14 GPM (53 LPM) maximum under all operating conditions of the boat.** When sizing sea water pump, installer should factor in losses for raw water plumbing. In addition to initial operation at dock, new gyro installations should be checked to be within the flow requirements while vessel is at speed. Flows higher than 14GPM (53 LPM) could affect heat exchanger life.

## 3.2 Adding Coolant

1) Cooling system is filled with a mixture of 50% ethylene glycol and 50% distilled water to proper level when shipped. Clear tube between thermostat housing and reservoir should be filled with green coolant mixture. If level has dropped, check for evidence of leaks at all connections before adding fluid as described below. If coolant is at the correct level, skip to sea water connection in section 3.3.

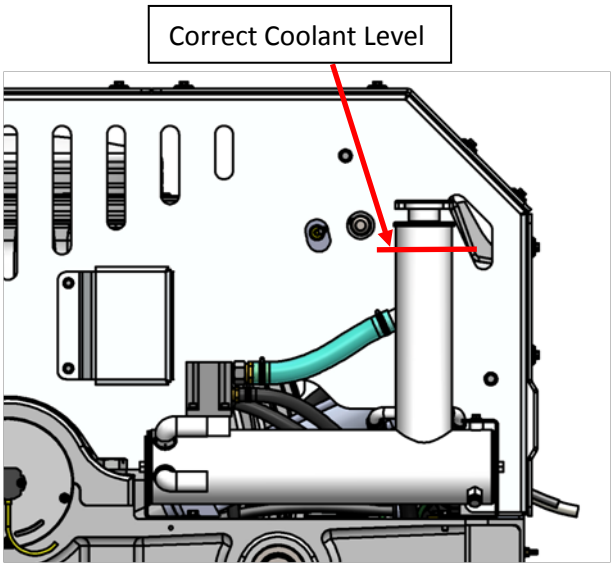


FIGURE 3 – SEAKEEPER 35 COOLANT LEVEL

2) Mix 50% ethylene glycol with 50% distilled water in a clean container. Refer to Table 1 or glycol manufacturer's literature for freezing points.

**Table 1: Freezing Point**

| Ethylene Glycol Solution (*% by volume*) | | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|
| Temperature | *($^{o}F$)* | 32 | 23 | 14 | 2 | -13 | -36 | -70 |
| | *($^{o}C$)* | 0 | -3 | -8 | -16 | -25 | -37 | -55 |

3) Remove pressure cap on top of reservoir. Pour mixture in until level is 1 – 2 inches from top of reservoir as shown in Figure 3. Filling reservoir above this level will not cause any damage but coolant may be expelled from pressure relief port below cap due to normal thermal expansion of coolant.

4) Connect 24 V to controller.

- At the Display check for any ALARMS

- Press the POWER ON/OFF button 
- The flywheel will start to spin and the glycol pump will start.
- Recheck glycol level with fluid circulating in coolant circuit. Sight down inside reservoir and check that coolant level is above upper port on reservoir as shown in Figure 3. Replace cap.
- After several minutes of running, press POWER ON/OFF button  to turn power off to the flywheel and glycol pump. The glycol pump will stop and the flywheel will coast to a stop.

5) The cooling system is self-purging. If small amounts of air are in the system, it will most likely be dislodged during the first sea trial. Recheck level after sea trial and add fluid if required.

## 3.3 Connecting Seawater to Heat Exchanger

1) Connect seawater from installer supplied pump to lower 1” (25.4 mm) diameter hose barb on heat exchanger. Use the same practices as other below waterline seawater plumbing. Required flow rate is 10 GPM (38 LPM) minimum and 14 GPM (53 LPM) maximum.
2) Connect seawater discharge (upper hose barb) to overboard drain. Use the same practices as other below waterline seawater plumbing.
3) In addition to initial operation at dock, new gyro installations should be checked for minimum 10 GPM (38 LPM) flow under all normal operating conditions. If no other method of confirming flow is available, discharge line may be temporarily diverted to a bucket. Flow is calculated from time to fill a known volume.
4) Inspect raw water plumbing after sea trial for any signs of leakage.
5) Heat exchanger contains removable end-caps to provide access for cleaning the tube bundle.

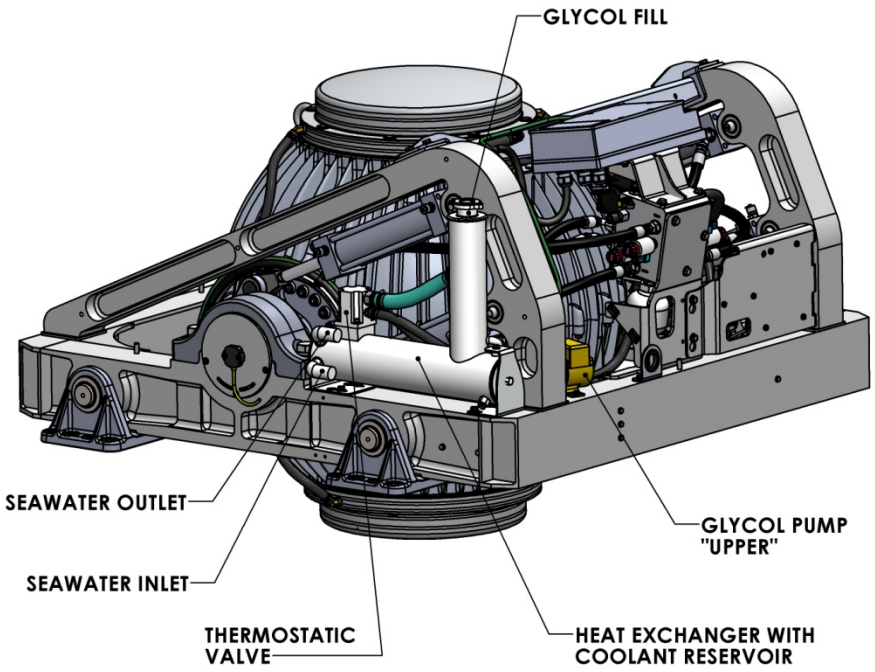


FIGURE 4 – SEAKEEPER 35 SEAWATER CONNECTIONS

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## 4.0 Introduction

This section describes the first startup of the gyro.

Also reference Seakeeper Document # 90269, Seakeeper 35 Gyro Operation Manual.

- **Previous sections for mechanical, electrical and cooling installation must be completed before this startup sequence is initiated.**
- **Before continuing, covers must be installed and the area around the gyro must be clear of personnel and equipment!**

## 4.1 Startup Instructions

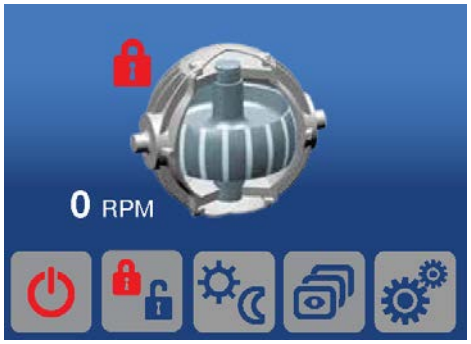
1) Energize 24 VDC supply at the customer supplied electrical disconnect.

2) Supply 220 VAC to Motor Drive Box at customer supplied electrical disconnect.

3) If sea water pump for gyro is not supplied through cable from Motor Drive Box, turn on the boat's AC or DC circuit breaker that supplies power to the sea water pump.

4) With system powered up check the display for any ALARMS. If there are any ALARMS present they must be corrected first.

5) Press the GYRO ON/OFF Button on Display.  The RED LOCK ICON and the PROGRESS BAR will appear and be RED until the GYRO is at speed, then stabilization can begin.




6) The sea water pump should have started when the ON/OFF button on the display was depressed. Confirm pump operation and flow rate, if practical. Required flow is 10 GPM (38 LPM) minimum and 14 GPM (53 LPM) maximum.

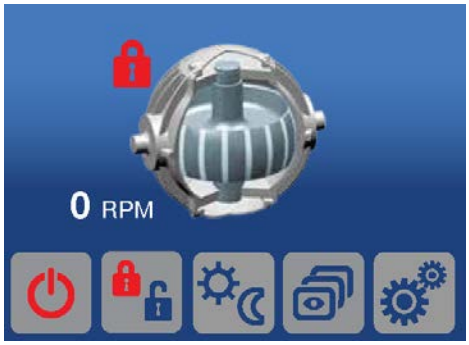
7) Verify that there are no ALARMS present. If an ALARM is present it will be displayed.

8) When the PROGRESS BAR turns GREEN from RED the GYRO can be placed in SEA mode. Depress the LOCK/UNLOCK Button  and the GYRO will be free to move and precession can occur.

9) Verify that there are no alarms. If an ALARM is present it will be displayed.

10) Press the LOCK/UNLOCK Button  to go from SEA to LOCK mode. Then press the GYRO ON/OFF Button  to power the GYRO down.

11) During normal operation, the gyro should be stopped when pulling into port and stabilization is no longer required. This maximizes long term life as it allows the gyro to start the coast down cycle before cooling is shutoff. Once the vessel is secured in the slip and the crew has shut down the generator and engines, the AC and DC breakers that control the gyro should be switched to the OFF position. The gyro will continue to spool down to zero rpm. No cooling is required during this time. Note gyro will take around 5 hours to coast down to zero rpm from full speed. When the flywheel has stopped the display will indicate 0 RPM.



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**Please Complete Checklist and E-mail to customerservice@seakeeper.com**

**or telefax to +1.410.326.1199**

## 5.0 Installation Checklist

Mechanical Checklist (reference Installation Manual Section 1)

- ❑ **Gyro Foundation Installed in Hull**
- ❑ **Foundation bolts torqued to specification**

Electrical Checklist (reference Seakeeper Drawing 90288 & Installation Manual Section 2)

**Mount Components**

- ❑ **Display (near helm)**

**Connect Customer Supplied Cables**

- ❑ **Cable 6 (customer supplied)** – **Install lugs on both ends of customer supplied 4AWG ground cable**
- ❑ – **Connect one end of Cable 6 to nearest vessel ground and other end to gyro foundation frame.**

**Connect Seakeeper Supplied Cables**

- ❑ **Cable 1 (Seakeeper supplied)** – **Connect wire leads of Cable 1 to 24 VDC power at customer supplied connection box or directly to circuit breaker**
- ❑ – **Plug connector of Cable 1 into mating connector on gyro wire harness**
- ❑ **Cable 2 (Seakeeper supplied)** – **Connect Cable 2 from Drive Box to 230 VAC single phase at customer supplied connection box or directly to circuit breaker**
- ❑ **Cable 5 (Seakeeper supplied)** – **Connect Cable 5 from Drive Box to customer supplied 230 VAC seawater pump**

- ❑ **Cable 3 (Seakeeper supplied) – Connect female end of CAN communications Cable 3 to mating connector on gyro wire harness**
- ❑ **– Route CAN communications Cable 3 from gyro to helm (male end goes to helm)**
- ❑ **– Connect male end of CAN communications Cable 3 at helm to CAN Tee Adapter**
- ❑ **– Connect Display and Seakeeper supplied Cable 4 to CAN Tee Adapter with CAN Terminator**

Cooling Checklist (reference Installation Manual Section 3)

- ❑ **Verify coolant level in heat exchanger coolant reservoir.**
- ❑ **Connect sea water hoses / open sea cocks to heat exchanger and test sea water pump.**
- ❑ **Verify 10 GPM (38 LPM) minimum and 14 GPM (53 LPM) maximum sea water flow through heat exchanger under all operating conditions of the boat.**

Startup Checklist (reference Installation Manual Section 4 and Operation Manual Section 2)

- ❑ **Remove lifting eyes, install sealing fasteners in lifting holes, and Install cover panels**
- ❑ **Turn on 24 VDC circuit breaker**
- ❑ **Turn on 230 VAC circuit breaker**
- ❑ **Verify display works and no alarms are present**
- ❑ **Follow instructions in Section 4.1 of Installation Manual to turn on the GYRO**
- ❑ **Verify sea water pump turns on when the GYRO is turned ON (if powered through gyro drive box)**
- ❑ **Verify that no ALARMS are present**
- ❑ **Follow instruction in Section 4.1 of Installation Manual to turn off the Gyro**
- ❑ **AC & DC power and sea water pump may be turned off after the GYRO is turned off by placing the GYRO in LOCK mode and Turning the GYRO off**
- ❑ **Gyro takes 5+ hours to coast down to zero rpm from full speed**

## 5.1 Required Supplies needed for Gyro Installation (not supplied with gyro)

| Item | Description | Qty | Installation Manual Reference Section | Other Reference | System |
|---|---|---|---|---|---|
| 1 | Adhesive and cleaning supplies for bonding to hull | | 1 | | Mechanical |
| 2 | Soundproofing Considerations | | 1 | | Mechanical |
| 3 | Spreader bar for lifting gyro | | 1 | | Mechanical |
| 4 | Hose clamps for seawater plumbing to 1” (25.4 mm) hose barb (2 per hose barb) | 4 | 3 | | Cooling |
| 5 | M6 terminal lug for grounding gyro at rear of foundation | 1 | 2.3.1 | | Electrical |
| 6 | Cable, 4AWG, for grounding gyro at rear brace to vessel ground (used with item 5) | AR | 2.3.1 | Dwg 90288 | Electrical |
| 7 | Sea water pump, 230V AC | 1 | 2.2.3 | | Electrical |
| 8 | Relay for sea water pump control (Not required if using 230V AC pump) | 1 | 2.2.3 | | Electrical |

AR = As Required
Dwg = Drawing

## List of common tools that may be required for installation

| Item | Description | Use |
|---|---|---|
| 1 | Wire cutter | DC Power, AC Power cables |
| 2 | Wire stripper | DC Power, AC Power cables |
| 3 | 3 mm hex key | Gimbal sensor mount plate |
| 4 | 2.5 mm hex key | Gimbal angle sensor |
| 5 | 1/4 inch nut-driver | Hose clamps |
| 6 | Terminal or quick disconnect crimper | Power cables |
| 7 | Utility knife | Scoring cable jackets |