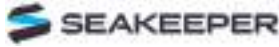




SEAKEEPER

INSTALLATION MANUAL



 SEAKEEPER	INSTALLATION MANUAL	Product:	Document #:	Rev:
		SEAKEEPER 1	90519	1

SEAKEEPER 1

INSTALLATION MANUAL

MAY 2020

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Section 1: MECHANICAL INSTALLATION

1.0 INTRODUCTION

This document is intended to give details and guidance for a boat builder or equipment installer to properly install the Seakeeper 1. The Seakeeper 1 can produce forces of up to 1,515 lbs. (6.74 KN) in the vertical direction, 2,248 lbs. (10.0 KN) in the longitudinal direction, and 1,697 lbs. (7.55 KN) in the lateral direction at each of the four mounts. Careful consideration should be given to foundation design to ensure it is capable of safely transferring these loads into the hull. These loads represent a worst-case operating condition that includes a 6G acceleration evaluated in each direction independently. The responsible party for designing the supporting structure (boat builder, installer, or hired sub-contractor) must accommodate the above forces plus a reasonable factor of safety. **Seakeeper recommends a minimum safety factor of 2.0** (yielding a safety margin of 2.0).

It is assumed that the installer is familiar with mounting using mechanical fasteners to marine structures and has performed structural analysis to ensure the structure to which the Seakeeper mounts can properly transfer the loads the Seakeeper exerts into the hull structure. If the installer has any doubt about the ability of the structure to transfer the loads to the hull, then the installer should contact a licensed naval architect or engineer to perform a structural analysis.

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

Reference Documents & Drawings:

- *90510 – Seakeeper 1 Hardware Scope of Supply*
- *90515 – Seakeeper 1 Crate Unpacking Instructions*
- *90516 – Seakeeper 1 Bolt-in Installation Details*
- *90514 – Seakeeper 1 Bolt-in Clearances*
- *90559 – Seakeeper 1 Generic Installation Guide*
- *90517 – Seakeeper 1 Installation Fixture Kit*

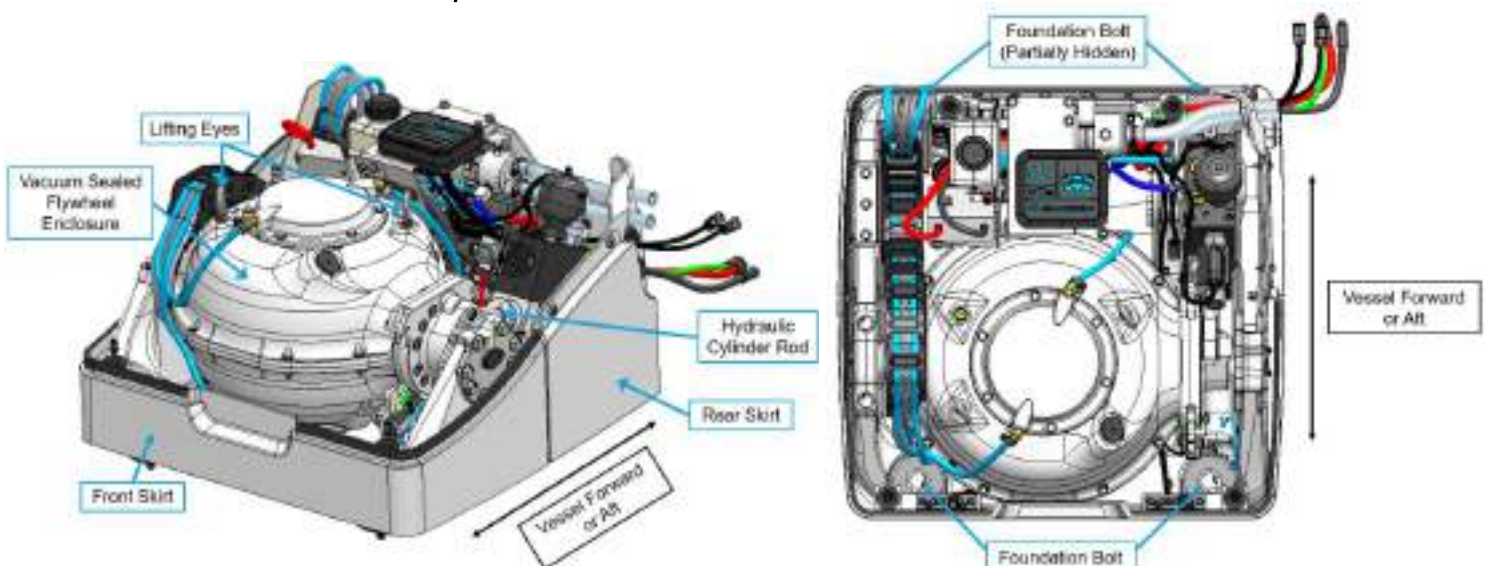


Figure 1: Seakeeper 1 Components – Isometric (left) / Top-Down (right)

Section 1: MECHANICAL INSTALLATION

1.1 PRECAUTIONS

1. The Seakeeper must only be lifted from the supplied lifting eyes (see Section 1.3).
2. The Seakeeper flywheel is supported by precision bearings. While unpacking and lifting the Seakeeper assembly, DO NOT drop or impart mechanical shock as damage to bearings could result.
3. While handling / installing the Seakeeper assembly, protect exposed hydraulic brake cylinder rods (see Figure 1) from scratches or damage as this could lead to premature seal failure and oil leaks.
4. Exercise care to protect any exposed surfaces as damage to finish could lead to early appearance degradation of the Seakeeper.

1.2 SELECTION OF SEAKEEPER INSTALLATION LOCATION

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

1. **The Seakeeper should be installed aft of amidships to minimize high acceleration loadings due to hull/wave impacts during operation at high speed or in large waves.** If the only possible Seakeeper location is forward of amidships, then the installer should have Seakeeper review the installation location prior to finalizing the design.
2. **Top-down access or sufficient clearance for access and removal of the Seakeeper 1 cover is required.** See drawings 90516 – Seakeeper 1 Bolt-In Installation Details and 90514 – Seakeeper 1 Bolt-in Clearances for reference.
3. Provide adequate clearance for all recommended scheduled maintenance and any repairs that may be necessary, as shown in Figure 3 and Drawing No. 90516.
4. Access for the removal and re-installation of the Seakeeper 1 should be considered.
5. The Seakeeper should be installed in a dry space to minimize effects of corrosion.

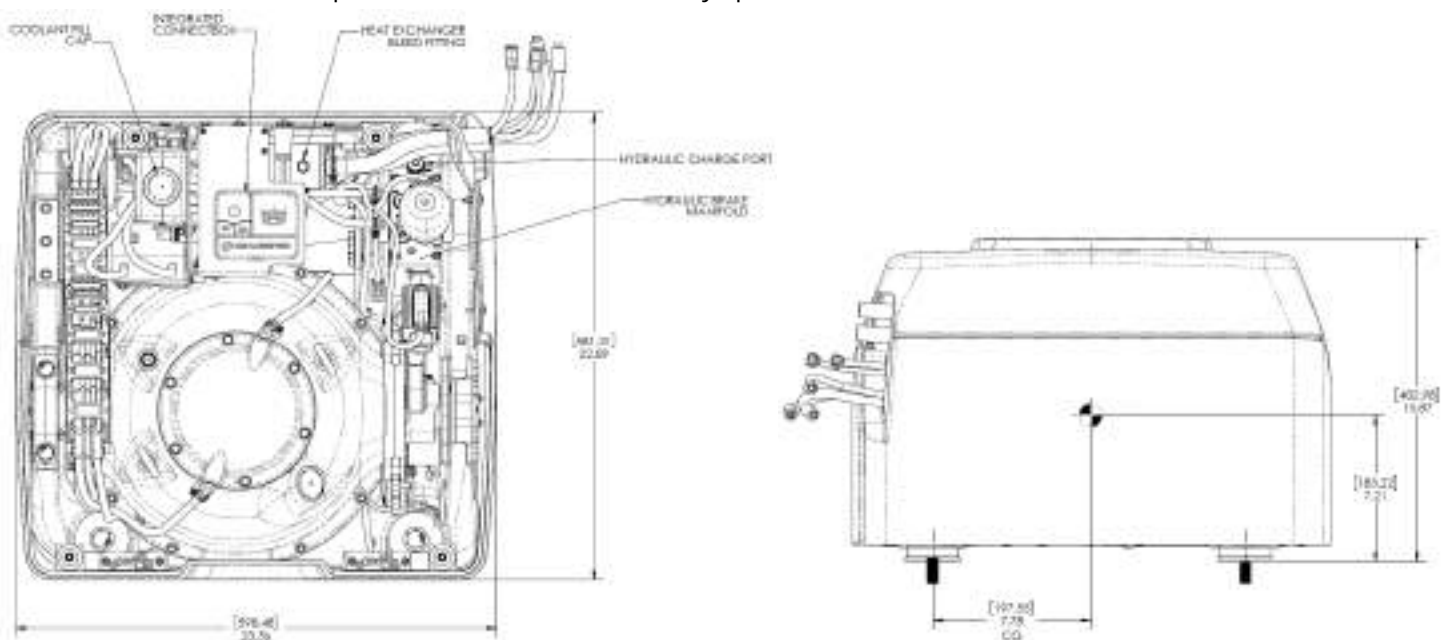


Figure 2: Seakeeper 1 Overall Dimensions (Drawing No. 90516)

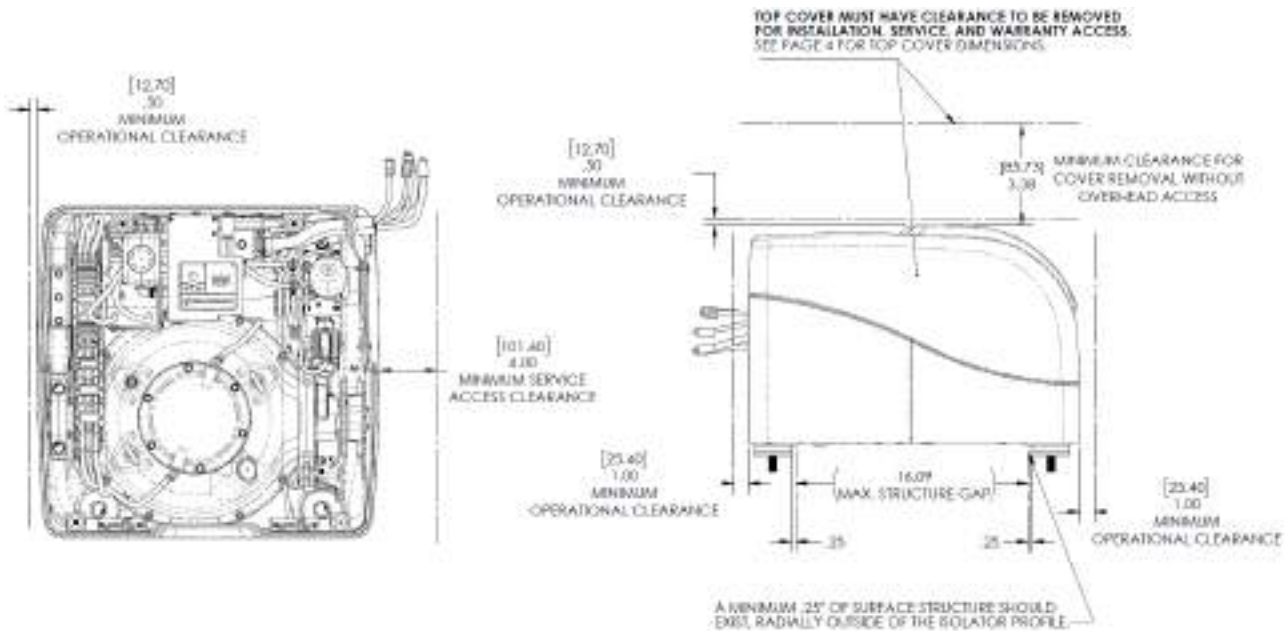
Section 1: MECHANICAL INSTALLATION


Figure 3: Seakeeper 1 Service and Operating Clearances (Drawing No. 90516)

Note: Adequate access to remove the Seakeeper 1 cover must be incorporated into the installation design to allow for regular maintenance, service, and repair of components.

1.2.1 SAFETY


There is a large torque about the gimbal axis when the Seakeeper is precessing. The Seakeeper 1 enclosure is provided to prevent personnel or equipment from contacting the Seakeeper 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. If it is ever necessary to access the Seakeeper while the flywheel is spinning, the Seakeeper must be locked at the display to stop the Seakeeper from precessing. Seakeeper regular scheduled maintenance should only be performed by authorized personnel when the Seakeeper is locked and the flywheel has stopped spinning.

1.2.2 NOISE / SOUNDPROOFING

Seakeeper noise has been measured under steady state conditions (no wave load) in Seakeeper's Engineering Lab and in our Factory Demo Boat. The steady state noise at 1 meter is typically in the range of 62-64 dBC un-weighted. As the frequencies emitting the highest sound pressures are low (like other marine machinery), it is recommended that the Seakeeper be installed in an enclosed space such as a leaning post / seat, bilge, center console, or machinery space.

Section 1: MECHANICAL INSTALLATION

1.3 TRANSPORT AND UNPACKING

Reference Drawings:

- 90510 – Seakeeper 1 Hardware Scope of Supply
- 90515 – Seakeeper 1 Crate Unpacking Instructions
- 90516 – Seakeeper 1 Bolt-In Installation Details

1.3.1 TRANSPORT

1. Use a Seakeeper-provided shipping crate for transport, part number 12098. The overall dimensions of a fully-packed Seakeeper 1 crate are 27.5" L x 27.5" W x 23.25" H (0.70 L x 0.70 W x 0.60 H m) with a weight of 430 lbs (195 kg), including accessories.
2. Do not stack Seakeeper shipping crates.
3. Both air and ground transport are acceptable and available through Seakeeper.
4. Seakeeper shipping crates must be transported in environmental conditions between -20°C and 60°C.

1.3.2 UNPACKING CRATE

Reference Seakeeper 1 Crate Unpacking Instructions (90515) for detailed unpacking instructions. Once the Seakeeper 1 crate has been unpacked, follow these instructions when lifting the unit:

1. Remove and set aside cover, electrical components, cables, and misc. items.
2. Attach Small Gyro Lifting Bar Kit (Seakeeper P/N 11766) to the two lifting eyes located on the top of the Seakeeper enclosure.
 - a. Stay clear of the Seakeeper 1 when the unit being lifted and use safe practices for working under a suspended load. The Seakeeper 1 weighs 365 lb. (165 kg).
3. See Figure 4 for proper lifting arrangement. Additional details can be found in the Seakeeper 1 Bolt-In Installation Details (90516).
4. Remove lifting eyes once unit is installed. **Lifting eyes must be removed prior to operation.**

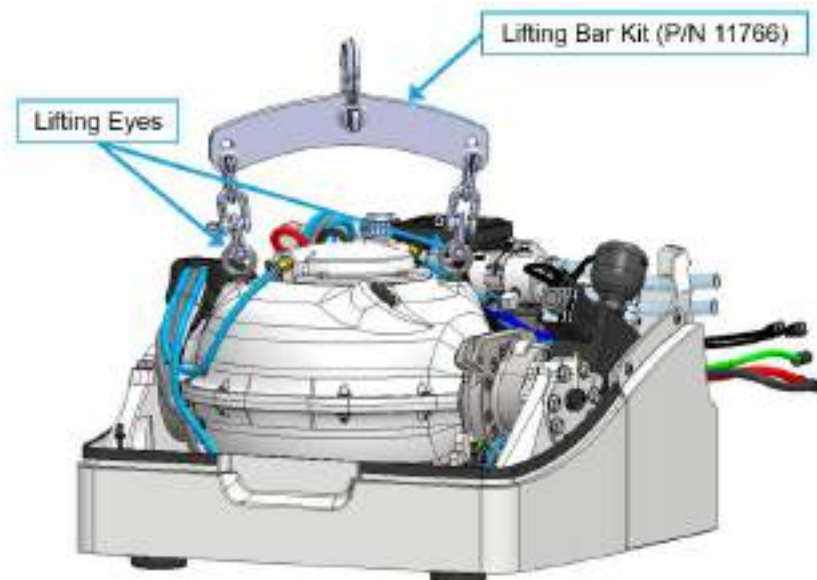


Figure 4: Seakeeper 1 Lifting Arrangement

Section 1: MECHANICAL INSTALLATION

1.4 MECHANICAL INSTALLATION

Reference Drawings:

- 90559 – Seakeeper 1 Generic Installation Guide
- 90516 – Seakeeper 1 Bolt-In Installation Details
- 90517 – Seakeeper 1 Installation Fixture Kit
- 90599 – Seakeeper 1 Bolt-In Kit

1.4.1 PREPARATION OF VESSEL STRUCTURE

The Seakeeper 1 Generic Installation Guide (90559) shows various structural arrangements to support the integration of the Seakeeper 1. The Generic Installation Guide offers above and below deck installation arrangements with fiber-reinforced plastic (FRP) and aluminum structures, which should provide solutions for most vessels. Depending on the structure to which the Seakeeper is fastened, blind threaded holes or through-bolting can be utilized. The Seakeeper 1 is affixed to the hull via four bolts in the Seakeeper 1 frame. Each Seakeeper 1 foundation bolt has a vibration isolation assembly to minimize the transmission of vibrations to the hull structure.

Refer to Seakeeper Drawing No. 90516 – Seakeeper 1 Bolt-In Installation Details. This drawing contains critical design dimensions and loads that must be considered in the design of the boat's structure that will receive the Seakeeper 1. It is assumed that a proper structural analysis has been performed for the vessel structure to which the Seakeeper will be fastened to ensure proper strength margins for the loads the Seakeeper will create during operation.

The vessel structure supporting the Seakeeper should be installed so the Seakeeper is parallel to the waterline in the transverse direction and within 2 degrees longitudinally. **In addition, the four areas on top of the structure on which the Seakeeper 1 will rest need to be co-planar within .06" (1.5 mm) to minimize potential distortion of Seakeeper isolation mounts when installed.**

Seakeeper offers an installation fixture kit, P/N 90517. The fixture has 4 holes located at the same centers as the mounting holes on the Seakeeper 1. The fixture locates the hole patterns at the proper spacing both in the fore-aft direction and the port-starboard direction. See Figure 5 for more details regarding the Seakeeper 1 template.

Note: Do NOT use the installation fixture to establish the Seakeeper envelope dimensions or clearances. Refer to Drawing No. 90516 – Seakeeper 1 Bolt-In Installation Guide – for envelope dimensions. A 3-D model of the Seakeeper 1 is available on the Seakeeper website (<https://www.seakeeper.com/technical-library/>) to aid in designing the Seakeeper foundation and the space around the Seakeeper.

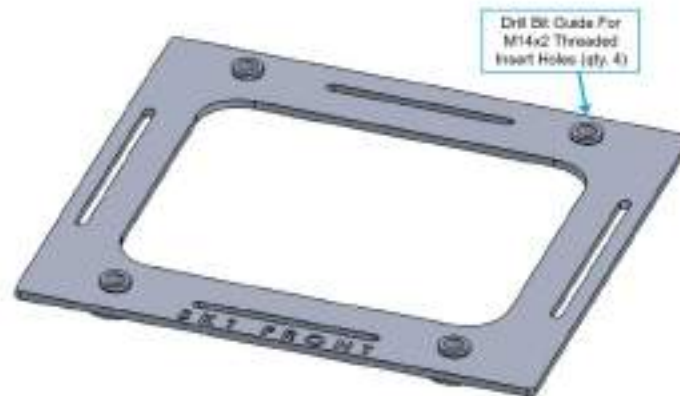
Section 1: MECHANICAL INSTALLATION


Figure 5: Seakeeper 1 Fixture Kit (P/N 90517)

1.4.2 TRANSFER OF HOLES TO BOAT STRUCTURE

The following instructions should be used to establish the Seakeeper 1 bolt pattern on the hull structure that has been designed to accept the Seakeeper 1, based on the information provided in Drawing Nos. 90599 and 90516.

1. Lower installation fixture onto vessel structure.
2. The four Isolation Mounts, where the Seakeeper 1 contacts the hull structure, must be coplanar to within 0.06 in (1.5 mm).
3. Align fixture in desired location and transfer holes from fixture plate to the vessel structure by transfer punch. Note that holes in fixture plate are $\varnothing 9/16"$ (14.287mm).
4. Using the bushings in the fixture holes as a guide to stay perpendicular with the vessel structure, drill 4 X $9/16"$ diameter holes for M14 x 2.0 1.5xDIA (21mm length minimum) threaded inserts in vessel structure at marked locations to mate with holes in the Seakeeper foundation.
5. Tap threads in holes for M14 x 2.0 1.5xDIA threaded inserts.

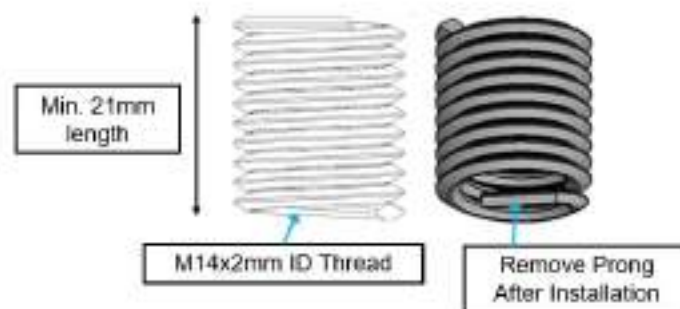


Figure 6: Stainless Steel Threaded Insert Details

6. Install threaded inserts into holes using Helicoil installation tool.
7. Remove threaded insert prongs after threaded inserts are installed.

Section 1: MECHANICAL INSTALLATION
1.4.3 INSTALLATION OF SEAKEEPER

1. Locate and position the lower snubbing washers onto vessel foundation structure at each of the 4 hole locations.
 - a. NOTE: Sealant or caulk is recommended to be applied around the outside edge of the lower face of each lower snubbing washer, where it contacts the vessel structure. This will maintain the position of the snubbing washer and prevent water from wicking between the parts and setting up corrosion.
 - b. Sealant is not required between the snubbing washer faces and isolator bushings.
2. Lower the Seakeeper 1 onto the lower snubbing washer on the vessel structure and align over drilled holes.

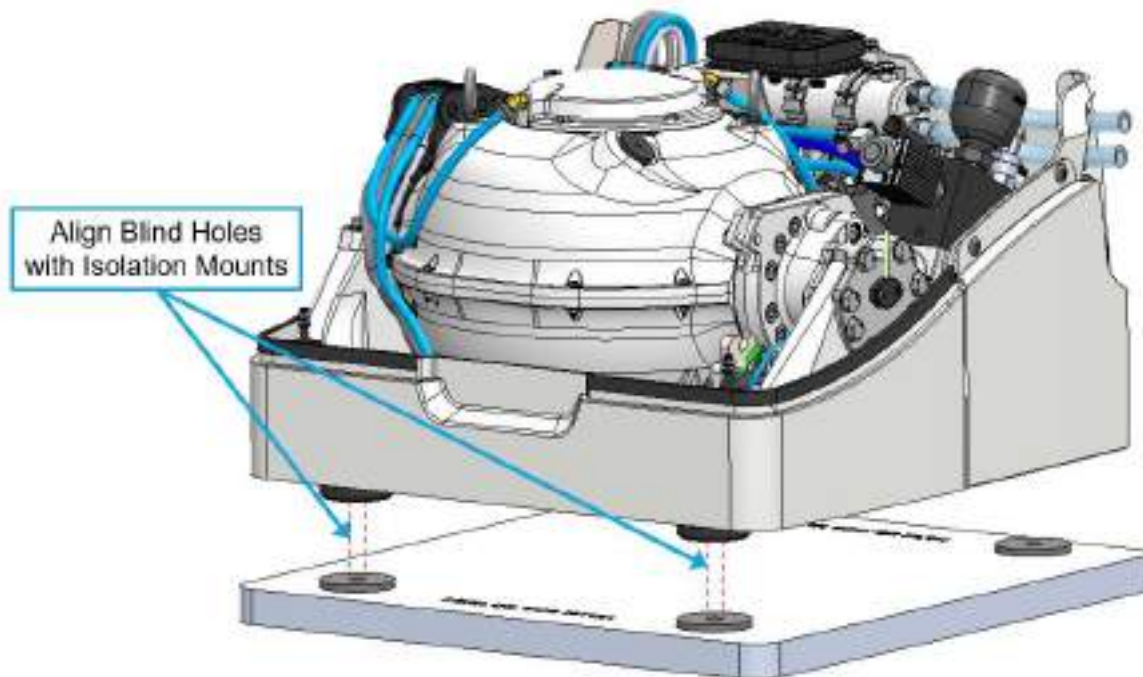


Figure 7: Seakeeper 1 Installation

3. Using a flexible extendable magnet (McMaster P/N: 3838A42 or similar), install the Seakeeper 1 Bolt-In Kit – P/N 90599: isolator mount sleeve tube, upper snubbing washer, wedge-lock washer, and bolt at each isolation mount.
 - a. Figure 8 shows an exploded view of the Bolt-In Kit.
 - b. Before installation, apply a moderate coat of anti-seize to the threads of each bolt.
 - c. The upper snubbing washer, wedge-lock washer, and M14 Bolt can be stacked as one assembly by attaching the magnet to the snubbing washer.
4. **Torque all fasteners to 115 ft-lbs. (156 N-m).** New bolts must be used for each installation and reinstallation.
 - a. Threaded inserts can be reused if they are found to be intact and without damage.

Section 1: MECHANICAL INSTALLATION

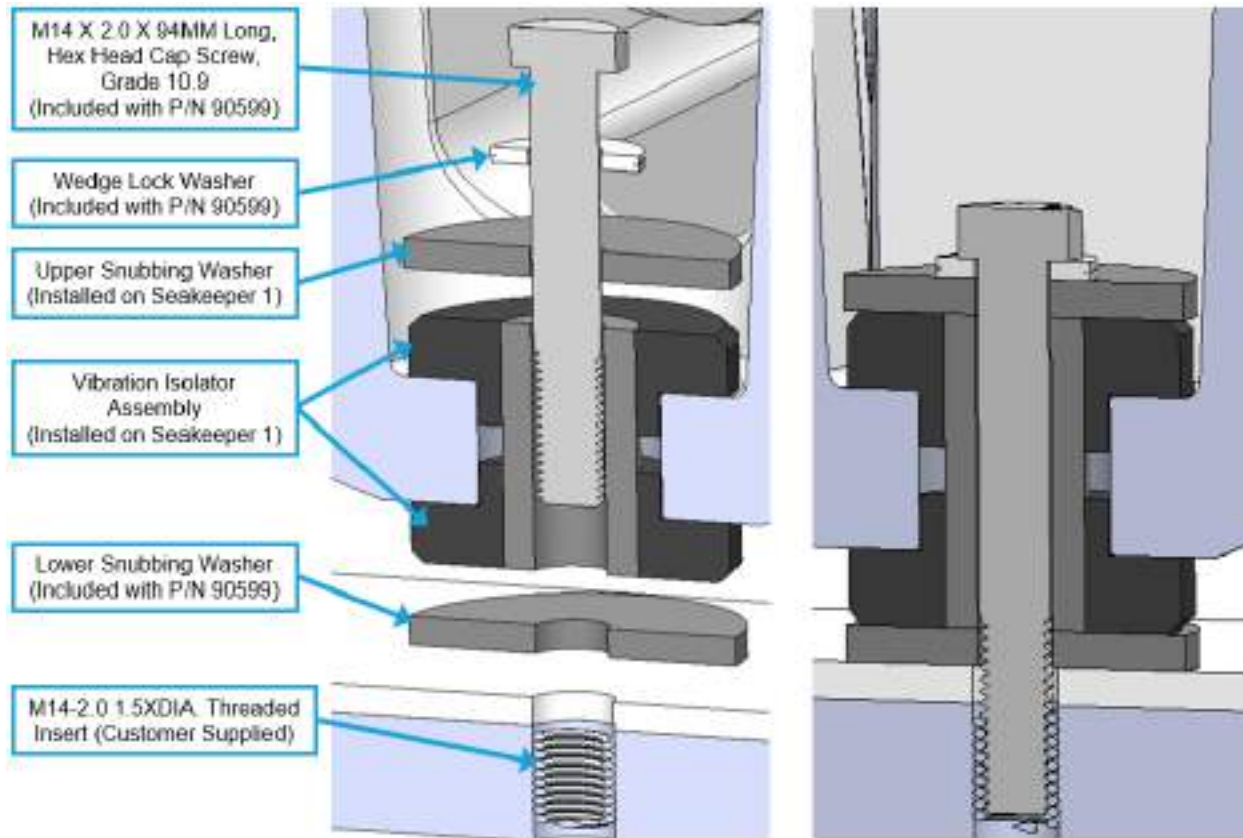


Figure 8: Seakeeper 1 Bolt Stack Arrangement Exploded (left) / Installed (right) (P/N 90599)

Section 2: ELECTRICAL INSTALLATION

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:

- *90510 – Seakeeper 1 Hardware Scope of Supply*
- *90511 – Seakeeper 1 Cable Block Diagram*
- *90512 – Seakeeper 1 Cooling Water Schematic*
- *TB 90191 – Seawater Cooling Pump Recommendations*
- *TB 90573 – Seakeeper 1 Display Options*
 - *TB 90478 – Garmin and Seakeeper Compatibility*
 - *TB 90479 – Raymarine and Seakeeper Compatibility*
 - *TB 90480 – Simrad and Seakeeper Compatibility*
 - *90600 – Seakeeper 1, 5" Touch Display*

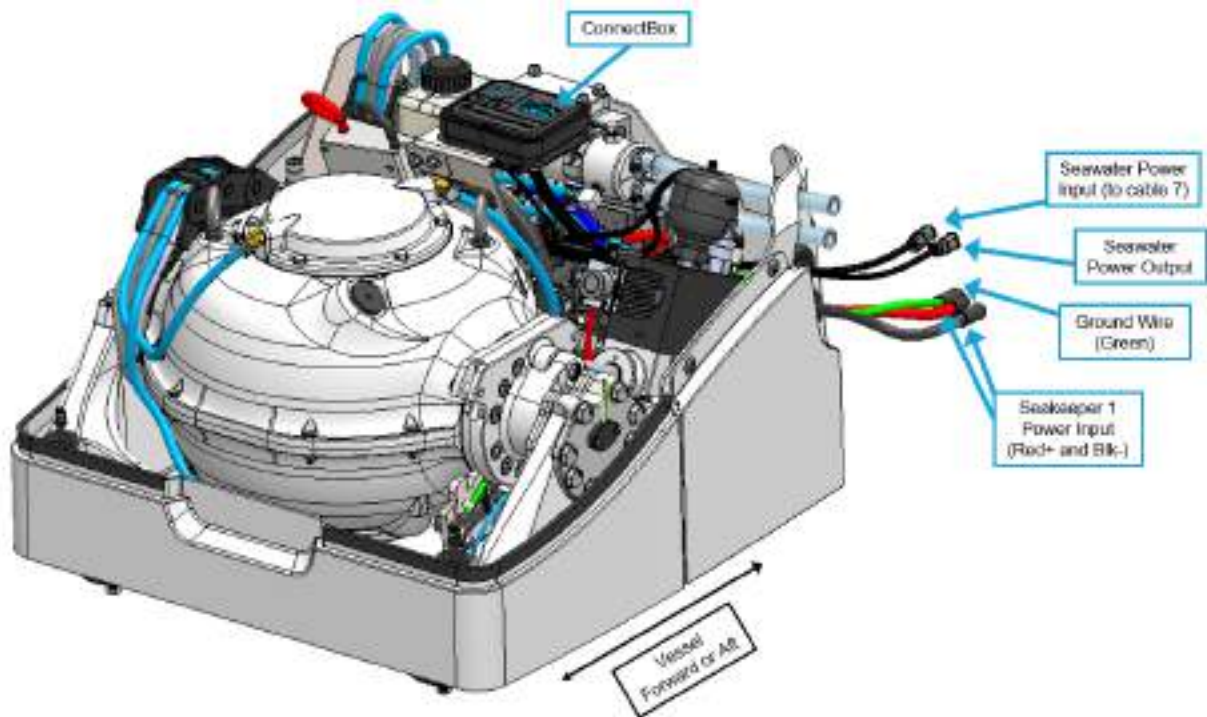


Figure 1: Seakeeper 1 Isometric View with Electrical Connections

Section 2: ELECTRICAL INSTALLATION

2.1 ELECTRICAL EQUIPMENT CONNECTIONS

Reference Documents & Drawings:

- 90510 – Seakeeper 1 Hardware Scope of Supply
- 90511 – Seakeeper 1 Cable Block Diagram

The following figures show the electrical equipment included with the Seakeeper 1 Hardware Scope of Supply (Dwg No. 90510):



Figure 2: ConnectBox



Figure 3: Cable 1 & 2, 2AWG, 12VDC Input / Cable 6, 4AWG Ground



Figure 4: Cable 7, 2x16AWG, Pump Pwr Input

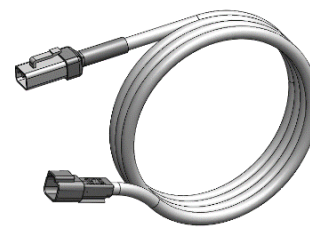


Figure 5: Cable 5, 2x16AWG, Pump Pwr Output



Figure 6: Cable 4, CAN, 0.6 m



Figure 7: Tee Adapter



Figure 8: Terminator



Figure 9: Cable 11, NMEA, 6 m



Figure 10: Cable 10, D-Code, 10 m

Section 2: ELECTRICAL INSTALLATION

2.2 HIGH CURRENT 12 VDC CONNECTION

Reference Documents & Drawings:

- 90511 – Seakeeper 1 Cable Block Diagram

2.2.1 HIGH CURRENT 12 VDC POWER SOURCE REQUIREMENTS:

1. Source: Battery Bank, 12 VDC, Marine, Deep Cycle
2. Voltage Range: 11.3 – 16 VDC
3. Continuous Current: 55 A
4. Overcurrent Protection: 80 A (Customer-Supplied)

2.2.2 HIGH CURRENT 12 VDC POWER CONNECTION INSTRUCTIONS

1. CABLE 1 and CABLE 2, 2AWG conductors, connect to the high current DC input power are supplied as length 0.35m. Approximately 0.1m is routed within the gyro frame.
2. Customer-supplied 2AWG cables must be spliced in series in accordance with the Crimping Instructions in Drawing No. 90511, using Seakeeper-supplied butt connectors, to increase to desired length. The maximum cable length is 9.0 m each.
 - a. The Crimping Instructions per Drawing No. 90511 are shown in the following figure.
3. Crimp CABLE 1 to B+ Conductor (red). Conductor should be continuous throughout entire length; do not coil. The most direct route to the 12VDC Power source should be used.
 - a. Repeat Step 3 for CABLE 2 to B- Conductor (black).
 - b. Install approximately 2" (51 mm) of double wall (adhesive lined) heat shrink tubing over entire butt connector and onto both sides of conductor insulation.
4. Connect plus conductor (B+, Red) through dedicated 80A overcurrent protection device (customer-supplied) and a dedicated isolation switch (customer-supplied), then directly to battery plus terminal or bus bar.
5. Connect minus conductor (B-, Black) directly to battery minus terminal or DC negative bus.

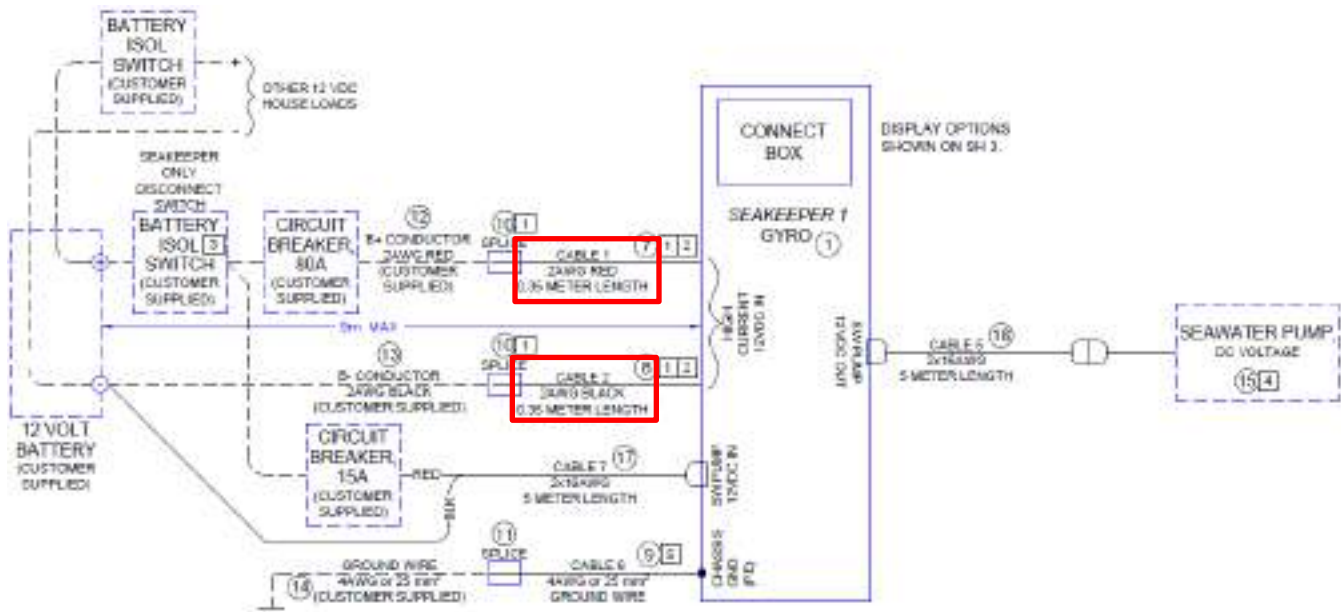


Figure 11: Seakeeper 1 Cable Block Diagram (Dwg No. 90511) – High Current Connection

Section 2: ELECTRICAL INSTALLATION


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

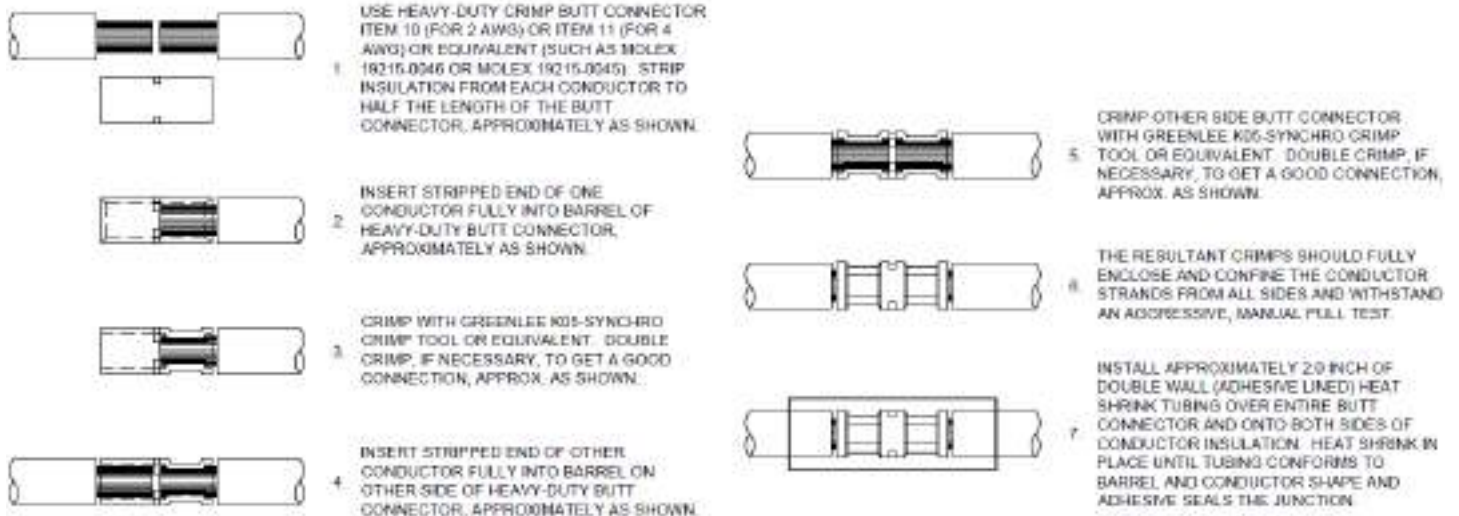
CRIMPING INSTRUCTIONS


Figure 12: High Current DC Input Crimping Instructions (Dwg no. 90511)

2.3 SEAWATER PUMP CONNECTION INSTRUCTIONS

Reference Documents & Drawings:

- 90511 – Seakeeper 1 Cable Block Diagram
- 90512 – Seakeeper 1 Cooling Water Schematic

2.3.1 SEAWATER PUMP 12 VDC POWER SOURCE REQUIREMENTS

1. Power Source: Battery Bank, 12 VDC, Marine, Deep Cycle
2. Voltage Range: 10 – 16 VDC
3. Current Rating: Max 15A rating
4. Overcurrent Protection: Per pump specification, max 15A

2.3.2 SEAWATER PUMP 12 VDC POWER INPUT CONNECTION INSTRUCTIONS

1. Connect CABLE 7 (P/N: 30327) to Seakeeper 1 “SW Pump DC In” as shown in Drawing No. 90511 with overcurrent protection corresponding to seawater pump selected.
2. Connect the 14AWG plus conductor (red) through dedicated overcurrent protection device (customer-supplied), maximum of 15A, to dedicated battery isolation switch.
 - a. The CABLE 1, 2AWG B+ conductor (red), is capable of carrying the current for both the High Current and Seawater Pump from the 12VDC power supply to the battery isolation switch.
3. Connect the 14 AWG minus conductor (black) directly to battery minus terminal or DC main negative bus.

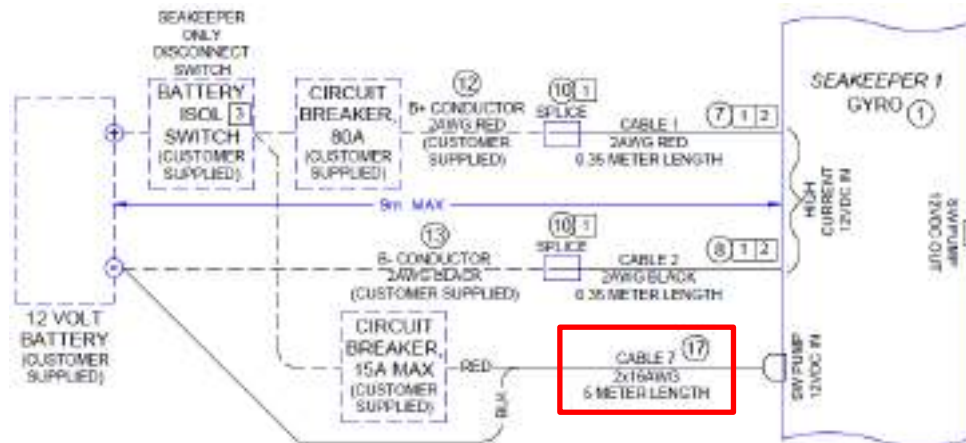
Section 2: ELECTRICAL INSTALLATION


Figure 13: Seakeeper 1 Cable Block Diagram (Dwg No. 90511) – Seawater Input

2.3.3 SEAWATER PUMP 12 VDC POWER OUTPUT CONNECTION INSTRUCTIONS

1. Connect CABLE 5 to the Seakeeper 1 “SW Pump 12VDC Out” for DC power output to the seawater pump. CABLE 5 is a 2 x 16AWG cable, 16 ft (5m) length, with a size 16 female Deutsch plug.
2. Pumps rated at 12 VDC, 15 amps maximum, customer-supplied, must be configured with a Deutsch DT series, 2-pin receptacle to mate with the connector shown in the following Figure.

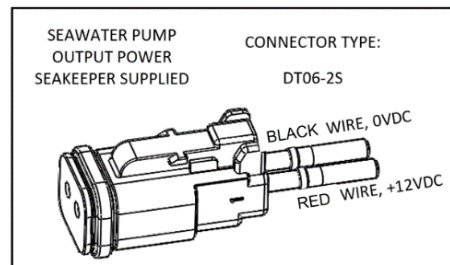


Figure 14: CABLE 5 - Seawater Pump Deutsch Connector

3. CABLE 5 must be routed and installed in the vessel from the Seakeeper 1 “SW Pump 12VDC Out” Deutsch connector (pins end) to the DC seawater pump cable Deutsch connector (socket end).
 - a. Connect CABLE 5 plug end (socket end) to the customer-supplied receptacle end (pins end). The recommended wiring is shown in the following Figure.
4. Seakeeper DC Seawater Pump Assembly (P/N 30331), which is prewired for Cable 5, is available as an option with the Seakeeper 1.

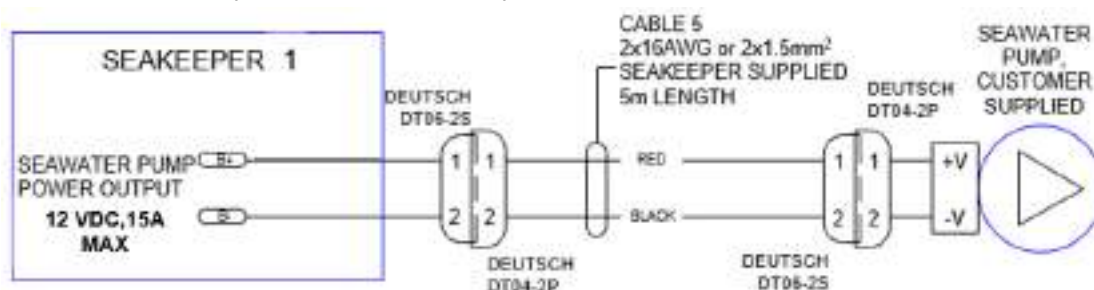


Figure 15: CABLE 5 - Seawater Pump

Section 2: ELECTRICAL INSTALLATION

2.4 ELECTRICAL EQUIPMENT GROUND CONNECTIONS

Reference Drawings:

- 90511 - Seakeeper 1 Cable Block Diagram

2.4.1 SEAKEEPER 1 TO VESSEL GROUND CONNECTION INSTRUCTIONS

1. Connect CABLE 6, 4AWG, PE cable to vessel grounding bus to comply with:
 - a. EM/IEC 60204-1 Clauses 6.3.3 and 8.2.3.
 - b. ABYC E-11 July 2018 Clauses 11.5.2 and 11.16.1.
2. Butt splice CABLE 6, 4AWG (green) to a 4 AWG ground wire (customer-supplied) suitable in length for the specific installation, as shown in the following Figure.
 - a. **Note: CABLE 6 (GREEN) SHOULD ONLY BE USED FOR GROUNDING THE SEAKEEPER TO THE VESSEL GROUND.**

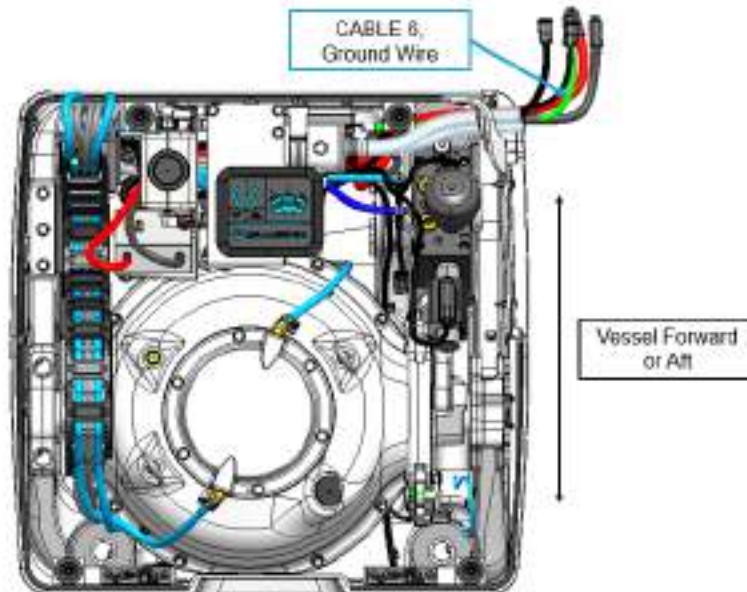


Figure 16: CABLE 6, Ground Wire

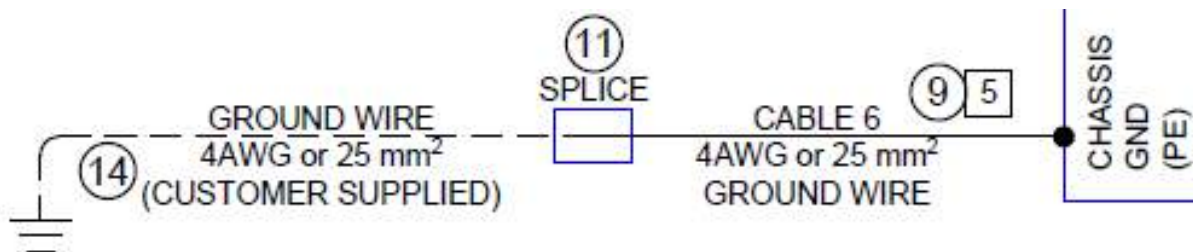


Figure 17: CABLE 6, Ground Wire Connection (Drawing No. 90511)

Section 2: ELECTRICAL INSTALLATION

2.5 SEAKEEPER 1 DISPLAY CONNECTION

Reference Drawings:

- 90511 – Seakeeper 1 Cable Block Diagram
- TB 90573 – Seakeeper 1 Display Options
 - TB 90478 – Garmin and Seakeeper Compatibility
 - TB 90479 – Raymarine and Seakeeper Compatibility
 - TB 90480 – Simrad and Seakeeper Compatibility
 - 90600 – Seakeeper 1, 5" Touch Display

2.5.1 SEAKEEPER 1 DISPLAY OPTIONS

The Seakeeper 1 has two options for establishing a Seakeeper display interface to support the Seakeeper App, as outline in TB 90573:

1. Connect the Seakeeper 1 to a compatible Multifunction Display (MFD).
2. Install an optional Seakeeper 5" Touch Display.

A Seakeeper display is required with the installation of a Seakeeper 1 to support the full functionality of the unit through the Seakeeper App in addition to the ConnectBox. The Seakeeper App provides an interface for controlling the Seakeeper 1 or viewing the Settings, Service, Info, and Alarm pages. The Seakeeper ConnectBox can be helm-mounted to provide an additional interface for the control of the Seakeeper 1 but does not replace the need for a Seakeeper compatible display.

The following Figure provides a schematic of the two display options. The subsequent sections outline the instructions and references for connecting the Seakeeper 1 to each of these display options.

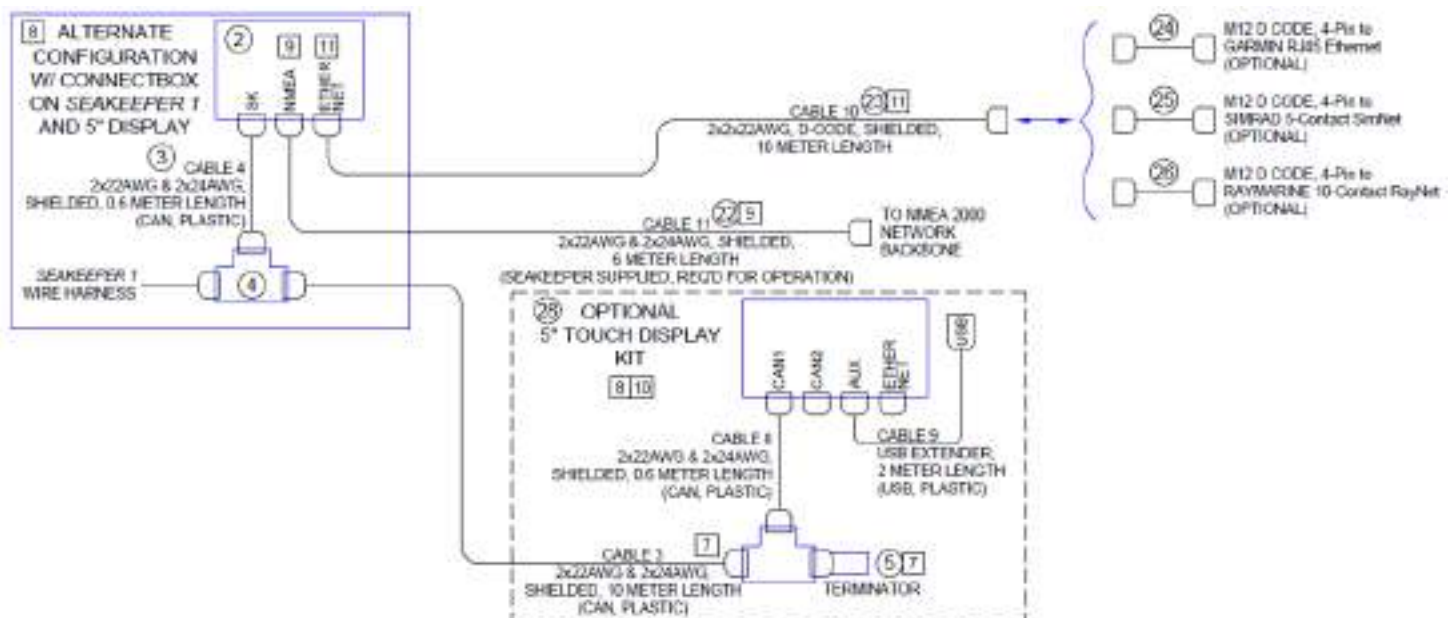


Figure 18: Seakeeper 1 Display Options (Drawing No. 90511)

Section 2: ELECTRICAL INSTALLATION
2.5.2 CONNECTING TO AN OPTIONAL COMPATIBLE MFD

1. The Seakeeper 1 can be connected to a variety of available MFD systems. Refer to the Technical Bulletins Section of the Seakeeper Technical Library for manufacturer specific MFD compatibility technical bulletins.
 - a. MFD specific Technical Bulletins will be updated regularly as new MFD systems become compatible. Currently GARMIN, RAYMARINE, and SIMRAD offer compatible MFD models.
 - b. Once a compatible MFD has been selected, refer to the appropriate manufacturer specific Technical Bulletin for integration instructions.
2. Connect Seakeeper-supplied CABLE 10, D-Code 10 m cable to MFD manufacturer-specific Ethernet adapter cable. Custom Ethernet cables for specific MFD manufacturers are available through Seakeeper and must be purchased with the Seakeeper 1 if connecting to an MFD.

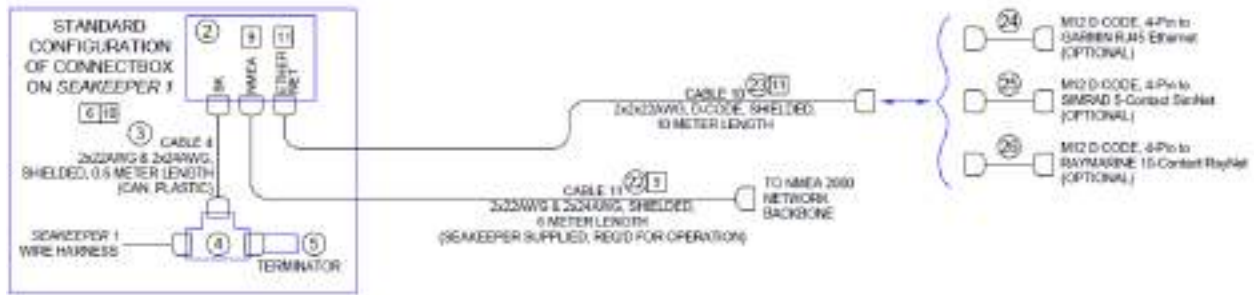


Figure 19: ConnectBox to MFD Connection

2.5.3 CONNECTING TO AN OPTIONAL SEAKEEPER 5" TOUCH DISPLAY

If not utilizing a compatible MFD display, a Seakeeper 5" Touch Display must be purchased from Seakeeper. The Seakeeper 5" Touch Display (P/N 90600) includes the components shown in the following Figure and will be integrated with the ConnectBox.

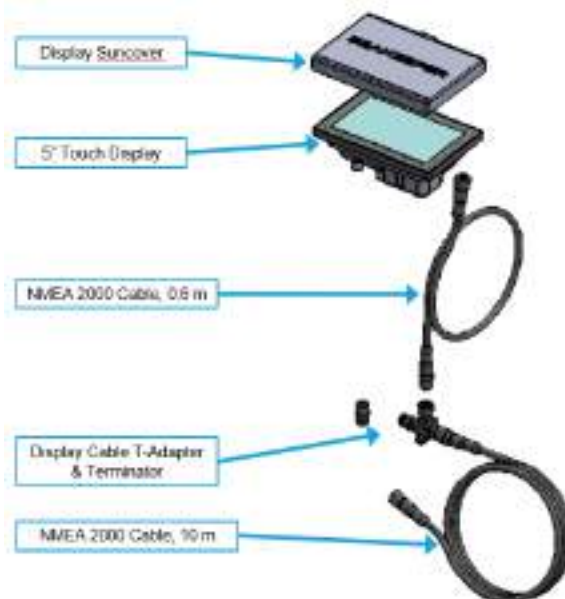


Figure 20: Seakeeper 5" Touch Display Components (P/N 90600)

Section 2: ELECTRICAL INSTALLATION

1. Determine location of Seakeeper 5" Touch Display:
 - a. The desired location of the 5" Touch Display must be determined with respect to the vessel's arrangement.
 - b. The 5" Touch Display should be located on or near the helm or another easily accessible location.
2. Route CAN communications cable:
 - a. The CAN Cable Assembly, CABLE 3, is a 10 m shielded cable that connects the ConnectBox to the 5" Touch Display.
CABLE 3 must be routed and installed in the vessel from the Seakeeper wire harness CAN Tee to the Tee Adapter at the Seakeeper 5" touch display, included with P/N 90600.
3. Install Seakeeper 5" Touch Display equipment:
 - a. Console space required: Approx. 5.24" W x 3.70 H" (133 x 94 mm)
 - b. Mounting Instructions, Surface Mount: see Envelope and Mounting Details, 5" Touch Display (90438) for details.
4. CAN 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 2 ft (0.6m) of Display.
 - c. Hardware required: One mounting screw for .197" (5 mm) diameter mounting hole on Tee Adapter.
5. Connect Seakeeper 5" Touch Display Equipment:
 - a. The Seakeeper 5" Touch Display is connected in accordance with Drawing No. 90511, as shown in the following Figure.

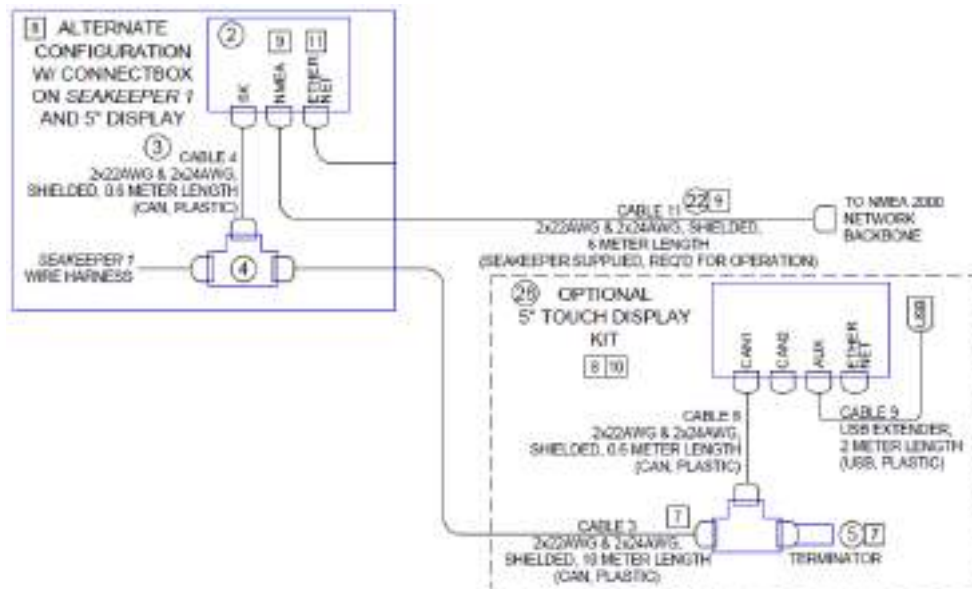


Figure 21: Seakeeper 5" Touch Display Connection (Drawing No. 90511)

Section 2: ELECTRICAL INSTALLATION

2.6 SEAKEEPER 1 NMEA 2000 NETWORK CONNECTION

The Seakeeper 1 requires a connection to the vessel's NMEA 2000 network backbone. The Seakeeper 1 will monitor information on the NMEA network to support and optimize the performance of the Seakeeper 1.

1. Connect Seakeeper-supplied CABLE 11 to the customer-supplied NMEA 2000 tee adapter on vessel's NMEA 2000 backbone.
 - a. An active NMEA 2000 compatible GPS signal is required on the vessel's NMEA 2000 backbone to operate the Seakeeper 1.
 - i. If no GPS signal is detected, a warning will be present on the Seakeeper App.

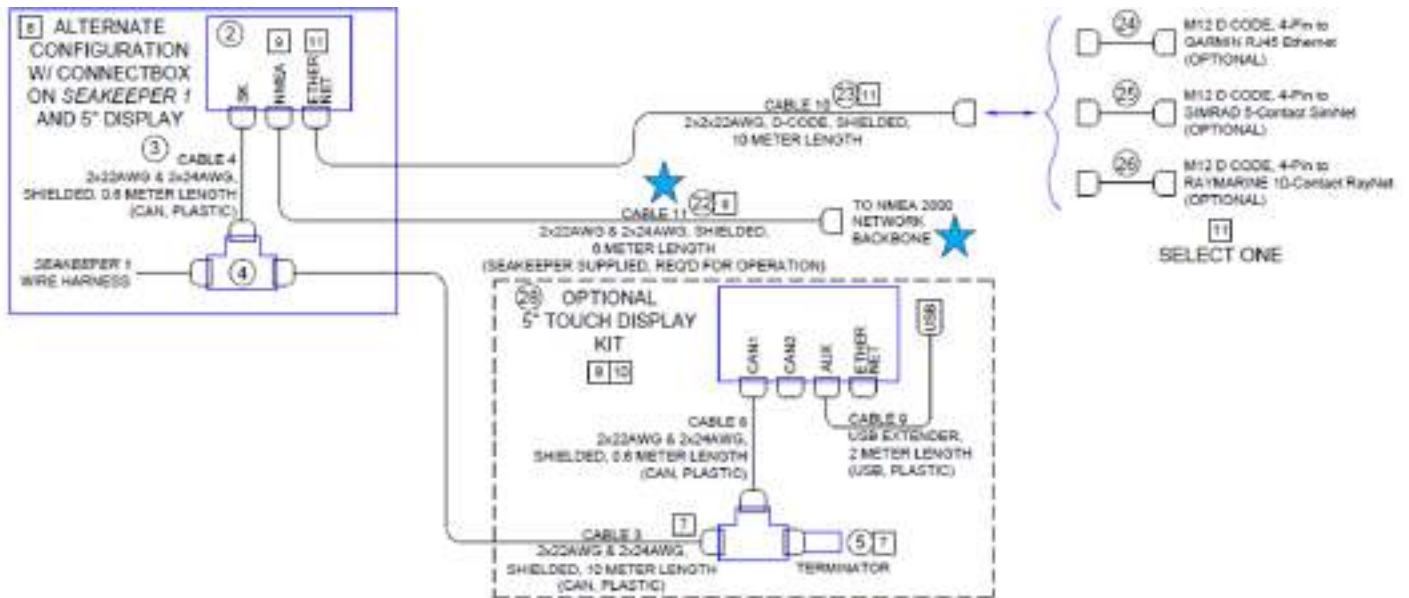


Figure 22: ConnectBox to NMEA 2000 Network Connection (Drawing No. 90511)

Section 2: ELECTRICAL INSTALLATION**2.7 ELECTRICAL EQUIPMENT MOUNTING****Precautions:**

- Each item of electrical equipment has specific mounting instructions. These instructions should be followed to ensure proper function of the Seakeeper.



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

- 1. OPTIONAL: MULTI-FUNCTION DISPLAY INTEGRATION INSTRUCTIONS**
 - a. The following Technical Bulletins outline the instructions for MFD Integration:
 - i. TB 90478 – GARMIN AND SEAKEEPER COMPATIBILITY
 - ii. TB 90479 – RAYMARINE AND SEAKEEPER COMPATIBILITY
 - iii. TB 90479 – SIMRAD AND SEAKEEPER COMPATIBILITY
 - iv. Additional MFD compatibility will be added as new integrations become available. Please contact Seakeeper for additional information.
 - b. Seakeeper MFD compatibility cable part numbers can be found in the relevant technical bulletin for the specific MFD, listed above.
- 2. OPTIONAL: CONNECTBOX HELM MOUNTING KIT**
 - a. Console space required: Approx. 3.41 L x 4.15 W inches (87 x 106 mm).
 - b. Mounting Instructions, Surface Mount: See Drawing No. 90558 for details. Seakeeper ConnectBox 3D Model available upon request.
 - c. Mount ConnectBox Replacement Blank insert into Seakeeper 1 enclosure at the original location of the ConnectBox.
- 3. OPTIONAL: 5-INCH TOUCH DISPLAY MOUNTING INSTRUCTIONS, SURFACE MOUNT:**
 - a. Console space required: Approx. 5.24 W x 3.70 H inches (133 x 94 mm).
 - b. Mounting Instructions, Surface Mount: See drawing 90438 for details. Seakeeper Touch Display 3D Model available upon request.
- 4. NMEA COMMUNICATIONS TEE ADAPTER AND TERMINATOR MOUNTING INSTRUCTIONS:**
 - a. Space required: Approx. 4 W x 3 H inches (102 x 76 mm).
 - b. Mounting Instructions: mount on vessel's existing NMEA Backbone.

Section 3: COOLING INSTALLATION

3.0 INTRODUCTION

Reference Drawings and Documents:

- *90512 – Seakeeper 1 Cooling Water Schematic*
- *90594 – Seakeeper 1 Cable Block Diagram*
- *TB_90191 – Seawater Cooling Pump Recommendations*
- *30331 – DC Seawater Pump, Seakeeper 1 Assembly*

The Seakeeper 1 is shipped with the cooling circuit filled and ready for use. The Seakeeper 1 requires connection to a raw water pump, referred to as the seawater pump, to cool the closed loop cooling circuit on the unit. The required seawater flow through the Seakeeper 1 heat exchanger is between 2 – 4 GPM (7.6 – 15.2 LPM), under all vessel operating conditions. Prior to operation, confirmation of glycol level is required.

Seakeeper offers a compatible self-priming DC Seawater Pump (P/N 30331) that is prewired for the Seakeeper 1 Installation and covered under the standard Seakeeper warranty. See Drawing No. *30331, DC Seawater Pump, Seakeeper 1 Assembly* for details and the Seakeeper Options and Accessories Price List for pricing information.

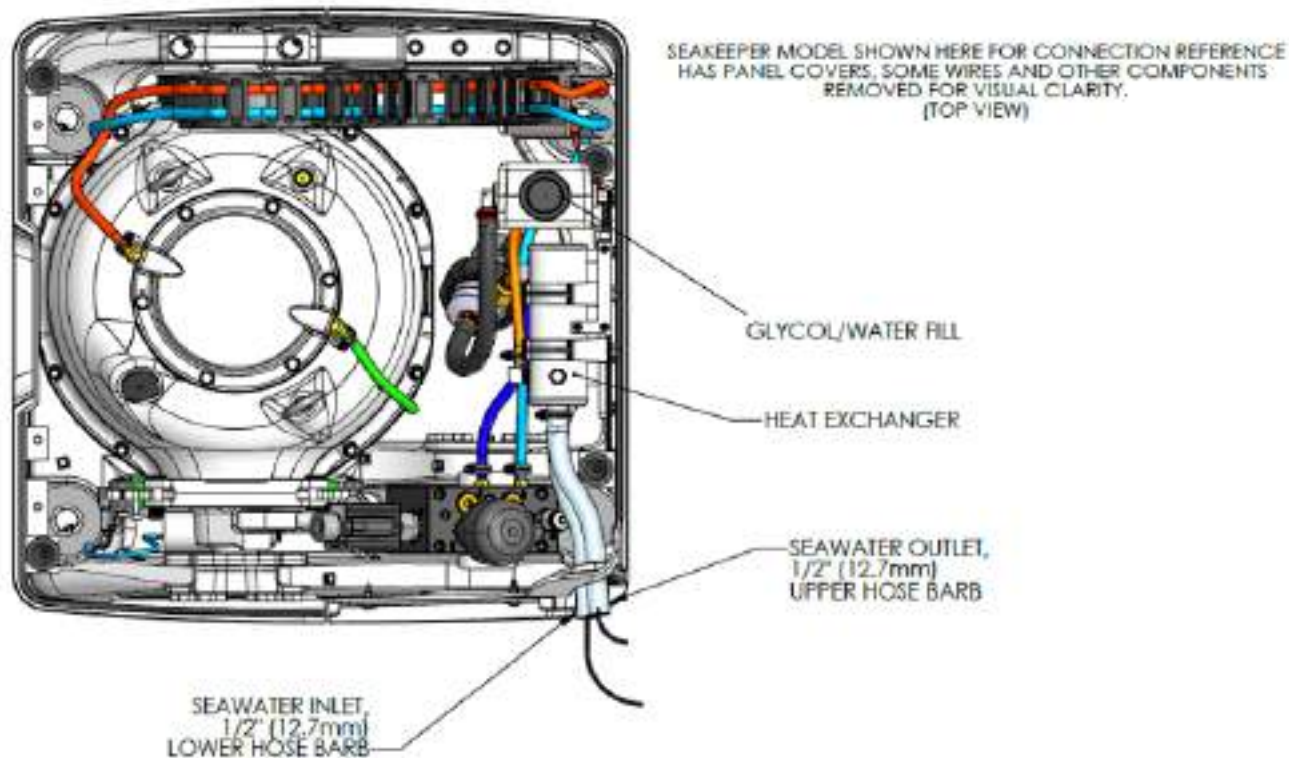


Figure 1: Seakeeper 1 Cooling Components

Section 3: COOLING INSTALLATION

3.1 INSTALLATION CONSIDERATIONS

1. The installer is responsible for supplying a dedicated seawater pump and associated plumbing. An optional seawater pump can be purchased through Seakeeper, P/N 30331.
2. Seawater connections on the Seakeeper heat exchanger mate with 1/2-inch (13 mm) hose.
3. The seawater pump is powered by CABLE 5, via “SW Pump 12 VDC Out” on the Seakeeper 1, as outlined in Section 2.
 - a. The seawater pump operates on 12 VDC with a max overcurrent protection rating of 15 A.
4. A dedicated through-hull fitting should be installed for each Seakeeper unit onboard the vessel to ensure sufficient seawater flow to each unit.
5. It is recommended that the seawater pump is located below the waterline, as close to the baseline of the vessel as practically possible, to maintain positive inlet pressure on the pump in all operating conditions.
 - a. A self-priming seawater pump may be required to maintain water flow in all underway conditions. Cavitation can occur at the seawater inlet and potentially cause an air-lock condition restricting seawater flow to the heat exchanger.
6. Maximum allowable seawater pressure in heat exchanger is 20 psi (1.4 bar)
7. The seawater flow requirement through the Seakeeper heat exchanger is 2 GPM (7.6 LPM) minimum and 4 GPM (15.2 LPM) maximum under all operating conditions.
 - a. When sizing the seawater pump, installers should consider losses for raw water plumbing.
 - b. A forward-facing scoop / highspeed seawater inlet should be installed to ensure sufficient seawater flow during underway operation.

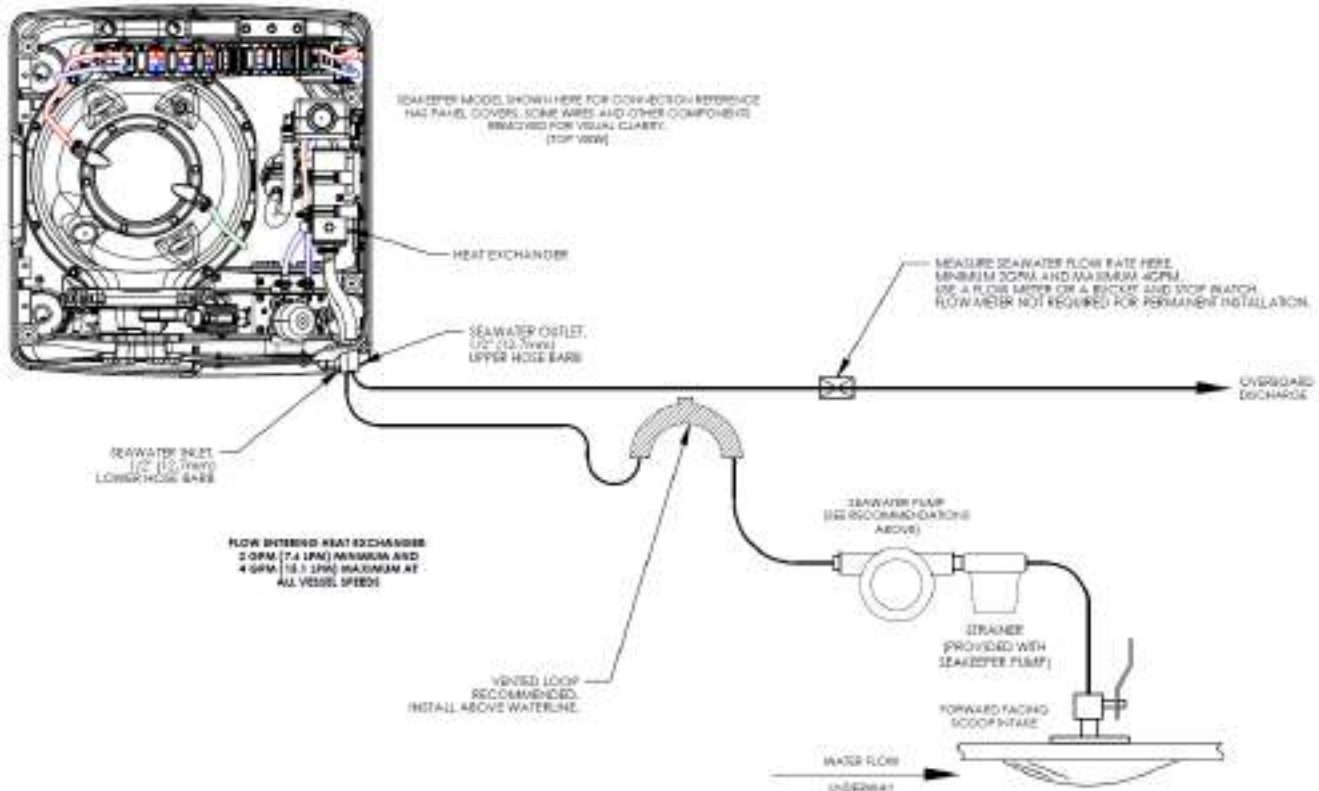


Figure 2: Typical Seakeeper Seawater Plumbing Arrangement (Drawing No. 90512)

Section 3: COOLING INSTALLATION

3.2 CONNECTING SEAWATER TO HEAT EXCHANGER

Refer to Figure 2 for typical seawater plumbing arrangement.

1. Connect seawater pump to Seakeeper dedicated through-hull fitting. A strainer and seacock valve should generally be installed between the seawater inlet and the pump.
2. Connect seawater from installer-supplied seawater pump to lower 1/2" (13 mm) hose barb on heat exchanger.
 - a. Use the same practices as other below waterline seawater plumbing.
3. Connect seawater discharge (upper hose barb) to overboard drain. Use the same practices as other below waterline seawater plumbing.
4. During commissioning, seawater flow should be checked to be within the flow requirements while the vessel is at rest, at speed, and when backing down.
 - a. If no other method of confirming flow is available, discharge line may be temporarily diverted to a bucket. Flowrate is calculated based on the time required to fill a known volume in GPM / LPM.
 - b. Flowrates in excess of 4 GPM (15.2 LPM) could affect heat exchanger life.
5. After sea trial / commissioning, inspect all raw water plumbing for any signs of leakage.

3.3 SEAKEEPER 1 DC SEAWATER PUMP P/N 30331 (OPTIONAL)

1. Seakeeper offers a self-priming DC Seawater pump as an optional addition, P/N 30331 – DC Seawater Pump, Seakeeper 1 Assembly, shown in the following Figure.
2. The Seakeeper Seawater Pump is a 24 VDC pump operated at 12 VDC for the Seakeeper 1 and maintains a seawater flow of approx. 2.5 GPM (9.5 LPM) at 12V DC.
3. The pump assembly is pre-wired for connection to Seakeeper 1 CABLE 5 and includes a seawater strainer and various fittings. The pump specifications are as follows:
 - i. Volts: 24 VDC (operate at 12v for Seakeeper 1)
 - ii. Rated Flow: 2.5 GPM (9.5 LPM), at 12 VDC
 - iii. Overcurrent Protection Rating: 15 A
 - iv. Ignition Protection: ISO 8846 or equiv.

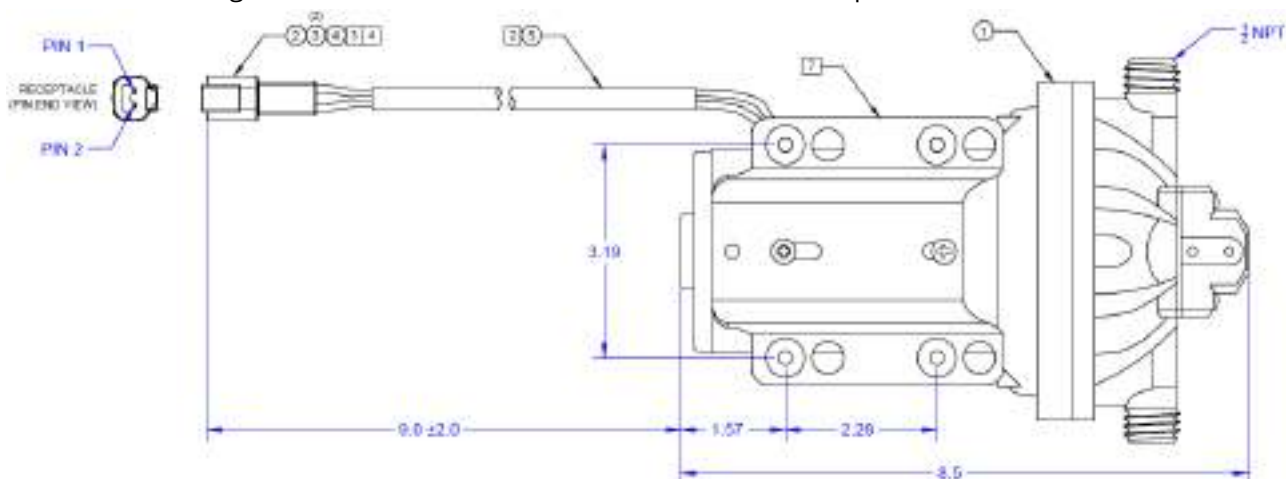


Figure 3: Seakeeper 1 DC Seawater Pump

Section 3: COOLING INSTALLATION

3.4 ADDING COOLANT

1. The Seakeeper 1 cooling system is filled to proper level when shipped, with a mixture of 50% ethylene glycol and 50% distilled water.
2. The coolant reservoir should be filled with colored coolant mixture, as shown in the following Figure. If level has dropped, check for evidence of leaks at all connections before adding fluid as described below.
3. If coolant is at the correct level, skip to Section 3.4, Connecting Seawater to Heat Exchanger.

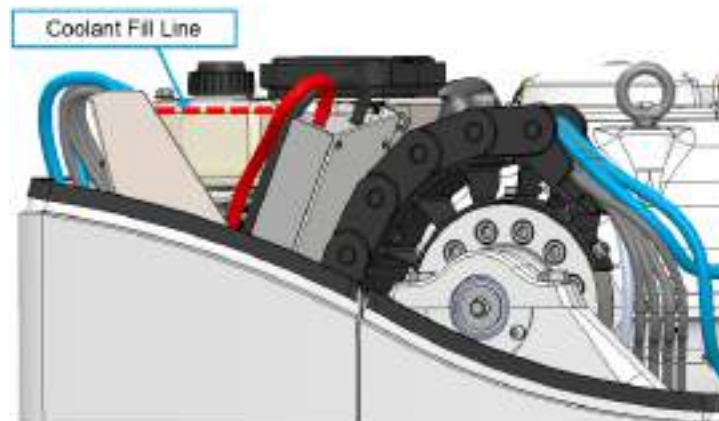




Figure 4: Seakeeper 1 Coolant Level

4. Mix 50% ethylene glycol with 50% distilled water in a clean container. Refer to glycol manufacturer's literature for freezing points.
5. Ethylene glycol with corrosion inhibitors is required. Most commercially available glycol has these additives standard.
6. Remove reservoir cap and pour mixture in until level reaches top face of the reservoir enclosure, as shown in Figure 4.
 - a. Filling reservoir above this level will not cause any damage but coolant may be expelled from the vented cap due to normal thermal expansion of coolant.
7. Once the Seakeeper 1 and DC Seawater pump are connected to 12VDC power:
 - a. Check the Seakeeper Display interface for any ALARMS.
 - b. Cycle the Seakeeper 1, press the POWER ON button: 
 - c. The flywheel will start to spin and the glycol pump will start.
 - d. Recheck glycol level with fluid circulating in coolant circuit to ensure the correct fill level is maintained.
 - e. After several minutes of running, press POWER OFF button: 
8. The cooling system is self-purging. If small amounts of air are in the system, they should be dislodged during the first sea trial. Recheck level after sea trial and add fluid if required.

Section 4: INSTALLATION REQUIREMENTS

4.0 INTRODUCTION

The Installation Requirements section outlines the components and tools needed for the Seakeeper 1 installation that are not included within the scope of supply.

4.1 REQUIRED SUPPLIES FOR SEAKEEPER INSTALLATION

Table 1 outlines the customer-supplied components required for the Seakeeper 1 installation:

Table 1: Components and Supplies Required for Seakeeper 1 Installation

Item	Description	Qty	Installation Manual Reference	Other Reference	System
1	Spreader bar for lifting the Seakeeper 1	1	1.3.2	P/N 11766	Mechanical
2	Seakeeper 1 Foundation	1	1.4	Dwg 90559	Mechanical
3	Seakeeper 1 Fixture Kit	1	1.4.1	P/N 90517	Mechanical
4	Threaded insert: M14-2 x 1.5DIA (21mm)	4	1.4.2	Dwg 90516	Mechanical
5	Seakeeper 1 Bolt-In Kit	1	1.4.3	P/N 90599	Mechanical
6	Marine Sealant	AR	1.4.3	Dwg 90516	Mechanical
7	Anti-Seize	AR	1.4.3	Dwg 90516	Mechanical
8	Conductor, Marine, 2 AWG, Red (Cable 1: B+ Positive)	AR	2.2.2	Dwg 90511	Electrical
9	Conductor, Marine, 2 AWG, Black (Cable 2: B- Negative)	AR	2.2.2	Dwg 90511	Electrical
10	Circuit Breaker, 80A (Cable 1)	1	2.2.2	Dwg 90511	Electrical
11	Battery Isolator Switch (Cable 1 / Cable 7)	1	2.2.2	Dwg 90511	Electrical
12	Seawater Pump, 12VDC, 15A max Optional: DC Seawater Pump Assembly (prewired)	1	2.3.1	Dwg 90512, P/N 30331	Electrical / Cooling
13	Circuit Breaker corresponding to pump rating (Cable 7)	1	2.3.2	Dwg 90511	Electrical
14	Deutsch DT Series 2-pin Receptacle – Female (Cable 5) *Not required with Seakeeper Seawater Pump (30331)	1	2.3.3	Dwg 90511	Electrical
15	Conductor, Marine, 4 AWG, Green (Cable 6: Ground)	AR	2.4.1	Dwg 90470	Electrical
16	Compatible MFD or Seakeeper 5" Touch Display Kit	1	2.5.1	Dwg 90511, TB 90573, P/N 90600	Electrical
17	MFD Connection Cable, M12 D Code, 4-Pin: Garmin / Raymarine / Simrad (Optional)	1	2.5.2	P/N: 20373, 20380, 20346	Electrical
18	NMEA 2000 Backbone with compatible GPS Signal	1	2.6	Dwg 90511	Electrical
19	Through-hull fittings (1 high-speed pick-up / 1 overboard discharge)	2	3.1	Dwg 90512	Cooling
20	Seawater Strainer *Included with Seakeeper Seawater Pump (30331)	1	3.2	Dwg 90512	Cooling
21	Seacock Valve	1	3.2	Dwg 90512	Cooling
22	½" ID Seawater Hose	AR	3.2	Dwg 90512	Cooling
23	Hose Clamps 1/2" (13 mm) fittings (2 per connection)	8	3.2	Dwg 90512	Cooling

- **AR = As Required**
- **Dwg = Drawing**
- **P/N = Seakeeper Part Number**

Section 4: INSTALLATION REQUIREMENTS

4.2 TOOLS REQUIRED FOR INSTALLATION

Table 2 outlines the tools and equipment required for the Seakeeper 1 installation:

Table 2: Tools and Equipment Required for Seakeeper 1 Installation

Item	Description	Use
1	Hoist, Forklift, or Crane	Unpacking and lifting Seakeeper 1 into position
2	Transfer Punch Kit	Locate foundation hole penetrations
3	Drill / Drill Press	Bolt hole penetrations
4	Threaded Insert Installation Kit	Tap and install threaded inserts (M14x2 1.5xDIA)
5	Marine Sealant	Lower snubbing washer installation
6	Flexible Extendable Magnet, McMaster P/N: 3838A42 or similar	Lowering foundation bolts into place
7	½" Drive Torque Wrench	Foundation Bolts (115 ft/lbs [15 N-m])
8	12-18" Extension, ½" Drive	Foundation Bolts
9	22mm Socket	Foundation Bolts
10	Utility knife	Scoring cable jackets
11	Wire cutter	DC Power Cables
12	Wire stripper	DC Power Cables
13	Greenlee K05-Synchro Crimp Tool or Equivalent	12VDC High Current Input Cables, 2 AWG Ground Cable, 4AWG
14	Heat gun	For conductor 1, 2, 6 heat shrink
15	Fish tape	Cable pulls
16	Hole saw	Thru-hull fittings
17	¼" (7mm) Nut Driver / Flat Head Screwdriver	Hose clamps

- **Note:** Additional tools could be required for the installation of customer-supplied components.

Section 5: INSTALLATION & START-UP CHECKLIST

5.0 INTRODUCTION

Reference Documents & Drawings:

- *90516 – Seakeeper 1 Bolt-In Installation Details*
- *90511 – Seakeeper 1 Cable Block Diagram*
- *90512 – Seakeeper 1 Cable Block Diagram*
- *90437 – Seakeeper Commissioning Form*
- *SWI-105 Commissioning Checklist*
- *90594 – Seakeeper 1 Operation Manual*
- *90569 – Seakeeper ConnectBox and Application Quick Start Guide*

The Installation and Start-Up Checklists in this section provide an overview of the primary step covered in the installation manual and should be referenced throughout the installation process. Upon completed of the Seakeeper 1 installation the installer should commission each Seakeeper unit with the Seakeeper Commissioning Form (90437). The Commissioning Checklist Work Instruction (SWI-105) provides a checklist of items to inspect and verify during the commissioning process and serves as a supplement to the Seakeeper Commissioning Form (90437).

All Seakeeper stabilizers should be commissioned to verify installation specifications and requirements have been implemented properly. The commissioning process should include completion of the Seakeeper Commissioning Form (90437), all the items in this the Installation Checklist, and verification of Seakeeper 1 operation without alarms or abnormal behavior.

5.1 INSTALLATION CHECKLIST

5.1.1 MECHANICAL CHECKLIST (SECTION 1)

- Seakeeper foundation installed per requirements of the Seakeeper 1 Bolt-In Installation Details (90516).
 - Structure designed to accommodate Seakeeper 1 forces, as defined in Drawing No. 90516 with a minimum safety factor of 2.0.
 - Foundation is co-planar within 0.06" (1.5mm).
- Clearances around Seakeeper meet service and operating specifications and no obstructions are within the Seakeeper envelope.
- Seakeeper 1 Bolt-In Kit is installed (P/N 90599), includes: M14-2 x 94mm Hex Head Bolt, M14 wedgelock washer, upper snubbing washer, isolation mount tube sleeve, and lower snubbing washer at each corner.
- Foundation bolts torqued to specification: 135 ft-lbs (156 N-m).
- Seakeeper 1 cover can be removed to access and service the unit.

Section 5: INSTALLATION & START-UP CHECKLIST**5.1.2 ELECTRICAL CHECKLIST (SECTION 2)****High Current 12VDC Power Source: CABLE 1 & 2**

- Butt splice CABLE 1 and CABLE 2 to customer supplied 2AWG B+ and B- conductors to allow for routing to 12VDC power source.
 - o Butt splice instructions can be found in the Seakeeper 1 Cable Block Diagram (90511).
- Heat Shrink
- Connect spliced CABLE 1, B+ conductor (red), through 80A circuit breaker (customer supplied) and a dedicated battery isolation switch (customer supplied), the directly to the battery plus terminal or bus bar.
- Connect spliced CABLE 2, B- conductor (black), to battery minus terminal or DC main negative bus bar.

Seawater Pump Connection: CABLE 5 & 7

- Connect CABLE 7 positive (red) directly to a customer supplied circuit breaker corresponding to the seawater pump current overprotection rating (max 15A), then to the dedicated battery isolation switch.
- Connect CABLE 7 negative (black) to the DC main negative bus bar or battery minus terminal.
- Connect CABLE 5 receptacle end (pins) to Seakeeper 1 SW Pump 12VDC Out and the plug end (sockets) to customer supplied 12 VDC seawater pump cable Deutsch connector termination.

Ground Connection: CABLE 6

- Butt splice CABLE 6 to customer supplied ground wire, 4AWG, with sufficient length to reach the vessel ground.
- Vessel grounding bus to comply with:
 - o EM/IEC 60204-1 Clauses 6.3.3 and 8.2.3.
 - o ABYC E-11 July 2018 Clauses 11.5.2 and 11.16.1.

Seakeeper Display Connection

- Ensure one of the following display options is installed, refer to TB 90573 Seakeeper 1 Display Options for a detailed description:
 - o Option 1: Compatible Multifunction Display (MFD), refer to Seakeeper MFD Compatibility Technical Bulletins.
 - o Option 2: Seakeeper 5" Touch Display, P/N 90600.
- Option1: Connect Seakeeper Compatible MFD
 - o Purchase custom Seakeeper MFD integration cable based on the compatible MFD onboard.
 - o Connect CABLE 10 to ethernet connection of Seakeeper ConnectBox.
 - o Connect 4 pin end of MFD integration cable to male end of CABLE 10 and Ethernet M12 end of MFD network port or vessel network hub.

Section 5: INSTALLATION & START-UP CHECKLIST

- Option 2: Seakeeper 5" Touch Display, P/N 90600
 - Purchase Seakeeper 5" Touch Display (P/N 90600).
 - Install Seakeeper 5" Touch Display on or near the helm station.
 - Connect CABLE 3 (included with P/N 90600) from Seakeeper 1 wire harness and route to Seakeeper 5" Touch Display.

NMEA 2000 Network Connection

- NMEA 2000 Compatible GPS signal require for installation of Seakeeper 1.
- Connect CABLE 11 to ConnectBox NMEA port.
- Route CABLE 11 to vessel NMEA backbone and connect.

5.1.3 COOLING CHECKLIST (SECTION 3)

- Purchase seawater pump for Seakeeper 1 to provide 2 – 4 GPM (7.6 – 15.2 LPM) with a max overcurrent protection rating of 15A.
 - Optional seawater pump can be purchased through Seakeeper, P/N 30331.
- Connect and route seawater inlet hoses from seacock valve to the seawater strainer, seawater pump, then Seakeeper 1 heat exchanger.
- Connect and route seawater outlet hoses from Seakeeper 1 heat exchanger to the seawater overboard.
- Test seawater pump.
 - Verify 2 GPM (7.6 LPM) minimum and 4GPM (11.4 LPM) maximum seawater flow through heat exchanger under all operating conditions of the vessel.
- Verify coolant level in heat exchanger coolant reservoir, fill if needed.

5.2 STARTUP CHECKLIST

Refer to Seakeeper 1 Operation Manual, Section 2 for detailed start-up instructions.



Prior to beginning the start-up sequence all previous Sections of the Installation Manual for Mechanical, Electrical, and Cooling installation must be complete. Before continuing, the Seakeeper 1 cover must be installed and the operating clearances must be clear of personnel and equipment

- Remove lifting bolts and install sealing bolts and washers into lifting eye holes and install cover.
- Energize battery isolation switch, high current 80A breaker, and seawater pump breaker.
- Verify Seakeeper display is active and no alarms are present.
 - If the Seakeeper 1 display does not activate, turn off both circuit breakers immediately and check all wiring connections.
- Override seawater pump "on" (at 0 RPM hold down SERVICE Button, wrench icon, for 5 seconds) and verify flow at seawater outlet.
- Press Seakeeper ON/OFF Button and follow instructions in Seakeeper 1 Operation Manual, Section 2 for complete start-up instructions.
- Verify that no ALARMS are present.
- Power Seakeeper 1 down, the Seakeeper 1 flywheel will take 2+ hours to coast down to 0 RPM.