SeaSPY

Operation Manual

Revision 5.02

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SeaLINK Registration Information

A full release of SeaLINK 8.0 (1 CD) has shipped with this system. When SeaLINK is run for the first time you will need to enter registration information. You will need this information every time you install SeaLINK, so we recommend you keep this document in a safe place.

Please be sure to copy this information EXACTLY as shown here including capitalization and punctuation.

SeaLINK 8.0 is a full release, and has been well tested on a variety of computer systems, running Windows 95, 98, NT, XP, Vista, and 7. Please consult your user's manual for a description of SeaLINK's features and basic instructions for beginning operation.

Customer Feedback

The performance of our products in the field is very important to us. If you would like to submit feedback (good or bad) or suggestions for improvements to our products, please do not hesitate to contact me personally via fax, or by email at the address below.

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1 Introduction

SeaSPY is a high-sensitivity total field magnetometer packaged in a rugged marine housing that is designed to be towed behind a marine vessel. A standard SeaSPY system consists of the following components:

- A towfish unit that contains an Overhauser magnetometer sensor and driving electronics
- A high-strength marine tow cable, containing a single twisted wire pair
- A deck leader cable that is waterproof, but designed to be used out of water
- An isolation transceiver for powering and communicating with the towfish
- An RS232 interface cable that connects to a standard PC RS232 port
- A universal input (100 to 240VAC 50/60Hz) power supply that allows the system to be powered from line power anywhere in the world
- SeaLINK software for Windows 95/98/NT/2000/XP/Vista/7

Measurement of magnetic field is done completely inside the towed fish. The tow cable supplies power to the towfish, and provides a bidirectional digital communication link. All control of the fish is through RS232, using a PC or any RS232–capable computer.

The towfish requires DC power, with a range of +15 to +50VDC. For medium or long tow cables (longer than 300m), it is recommended to keep the supply voltage above +20VDC, and it is always recommended to keep the supply voltage as high as possible to reduce the voltage drop in the tow cable. In most cases, power will be supplied to the SeaSPY from the Isolation Transceiver, which produces a clean, constant +48VDC to power the towfish. The input range for the Isolation Transceiver is +9 to +28VDC.

The AC power supply (included with all complete SeaSPY tow systems) will produce a clean, constant +24VDC from a 100 to 240VAC at 50/60Hz source. The maximum power consumed by the fish is about 3W when acquiring data, and is typically around 1W when in standby. The Isolation Transceiver consumes an additional 1.5W.

1.1 Understanding the System Components

Marine Magnetics supplies a separate document called our *SeaSPY Technical Application Guide* that describes in depth how a SeaSPY magnetometer works, and how it can be used for different applications. Marine Magnetics provides this document to anyone free of charge, so please contact us if you do not already have a copy.

1.1.1 Overhauser Total Field Sensor

This is the main sensor of the system. It operates on the proton spin resonance principle, but it is drastically different from a conventional proton magnetometer sensor. The proton-rich liquid within the sensor has been specifically engineered to allow a principle known as the Overhauser effect to occur within it. This effect allows a SeaSPY magnetometer to measure with one to two orders of magnitude more sensitivity but with a tiny fraction of the power of a standard proton sensor, while keeping the excellent absolute accuracy and operational characteristics that have made conventional proton sensors so popular.

All SeaSPYs are supplied with an omnidirectional sensor that is completely isotropic with respect to magnetic field direction. The only restriction that must be observed is that **the fish must not be oriented vertically with the nose facing up**. This is a restriction with respect to the direction of gravity, not magnetic field.

The Overhauser sensor measures *magnetic flux density*, the unit for which is the Tesla (T). Magnetic flux density on the surface of the Earth typically varies between about 18μT to 70μT, depending on location. The flux density at any fixed location on the Earth's surface also varies with time due to diurnal effects, which include influence from the Sun, and movement of the Earth's molten interior.

One often speaks of a magnetometer as measuring magnetic field instead of flux density, since the two values are directly related given an environment of constant magnetic permeability (such as air or water). Some materials will distort the surrounding magnetic flux density by 'amplifying' or adding to the ambient magnetic field. Such objects are known as *paramagnetic*. Some materials (such as iron, nickel, cobalt and alloys containing these materials) exhibit this effect very strongly, and are known as *ferromagnetic*. Objects made from these materials are very easily detectable by a magnetometer. Most building materials, especially those used to build modern boats and ships, contain iron alloys and are therefore magnetic. Some stainless steels (austenitic alloys such as 316) are only weakly ferromagnetic, but will become more strongly magnetic if their microstructure is disturbed by annealing, welding, machining or severe stressing.

When an object of high magnetic permeability distorts the flux density around it, it creates a magnetic gradient that is proportional to the magnitude of its permeability. If the magnetic gradient through the volume of the magnetometer sensor is too great, the sensor will not operate correctly. For this reason, massive magnetic objects must be kept away from the sensor. **Do not expect the sensor to produce good results on the deck of a ship, or inside a building,** any more than you would expect a high-powered telescope to see distant stars in the middle of the day.

For more information on magnetic fields and how SeaSPY magnetometers work, please refer to the *SeaSPY Technical Application Guide*. This document can be obtained from Marine Magnetics.

1.1.2 Temperature Sensor

A silicon temperature sensor is located inside the towfish. Although there is a considerable delay between a temperature change outside the towfish and inside the towfish when it is traveling through water, this sensor provides a good indication of the temperature of the towfish electronics. In text mode, temperature is available in units of degrees C, with a precision of 0.1 degrees. The range of the sensor is −50°C to +150°C. Note that the temperature inside the towfish will slowly rise to about 15 to 20°C above ambient when the unit is acquiring data.

1.1.3 Leak Detector

SeaSPYs are equipped with leak sensors that sound a warning when water is present inside the towfish housing. Every reading, in text mode, displays an 'Lx' parameter, where x is a number between 0 and 9. A value of 9 indicates that water is present.

Even a small drop of water will activate the leak sensor. **If your leak warning sounds, chances are that a leak has developed in the towfish housing, and it should be retrieved immediately.** The internal structure is completely sealed, but is not pressure tolerant. If the towfish is allowed to fill with water to high pressure, damage may result to the electronics module or Overhauser sensor.

1.1.4 Pressure Sensor

The standard SeaSPY pressure sensor is a Wheatstone bridge on a silicon diaphragm. The maximum pressure that this sensor can stand before potentially suffering damage is 2500psi (1725m of water). Exceeding this depth can cause a change in the calibration tuning of the sensor, and its accuracy may suffer as a result. The pressure sensor will not suffer serious mechanical damage (i.e. will not rupture and cause a leak) until twice that pressure (about 3450m of water).

Note that the standard SeaSPY housing as a whole is rated to a depth of 1000m, which should never be exceeded or damage to the housing may result.

SeaSPYs can interface seamlessly to a variety of other pressure sensors, suited for shallow or deep water surveying. In general, a larger pressure sensor range will result in lower precision in the pressure reading. The table below lists the different pressure sensor types, their required housing ratings, and the corresponding maximum precision.

Range (psi)	Range (m)	Precision	Housing
100	69	0.1 m	1000m standard
500	345	0.1 m	1000m standard
2500	1725	0.5 m	1000m standard
5000	3450	1 m	3000m deep-tow
10000	6895	2 m	6000m deep-tow

table 1-1: Pressure sensor options

The pressure sensor is an analog device that may drift with temperature and with time. For proper operation, the pressure sensor zero-level should be reset before every survey. In moderate climates, this can be done on the deck of your ship; however, for optimal results the towfish should be submerged to allow the temperature of the pressure sensor to reach the ambient water temperature. The **p** command will zero the pressure sensor.

The **P** command will display the current pressure sensor calibration settings, and will offer the option to set the full-scale pressure calibration. The full-scale calibration is factory-set, and does not need to be altered by the operator unless below-nominal full-scale accuracy is suspected.

The pressure sensor may be calibrated by entering the factory full-scale calibration value; by entering a nominal value that is valid for a generic sensor of a given pressure range; or by submerging the towfish to a known depth and entering that depth.

1.1.5 Altimeter - Optional

A 200kHz wide-beam echo sounder may be optionally fitted to the nose of a SeaSPY towfish. This device senses the distance from the towfish to the sea bottom by emitting 10 sound pulses per second, and providing one altitude reading per second to the SeaSPY electronics. It is a self-contained digital device that does not require calibration.

The SeaSPY altimeter has a range of 2m to 100m, and a resolution of 0.1m. To see the current altitude of the towfish, use the **d** command. Altitude is displayed in meters as 'A:005.0'. In addition, an altitude value is added to every magnetic field reading. Note that the altitude data field does not appear if an altimeter is not installed in the towfish.

If the towfish altitude is out of range, or the towfish is not submerged in water, the altitude will be displayed as 'A:000.0'. This indicates that the altimeter cannot 'find' a surface underneath the towfish, but that the altimeter is working properly. If the altimeter were to stop working, the 'A:000.0' field would disappear from the data stream completely.

1.1.6 Electronics Module

The SeaSPY electronics module is the core of the SeaSPY system, located within the towfish. It controls all of the sensors in the towfish, monitors their performance, and reports their data to the host acquisition device digitally over the tow connection. Interface to the electronics module is through a single two-wire connection. DC Power and telemetry are multiplexed into the same two connections.

The electronics module requires approximately 700mW of power in standby (waiting for commands), and approximately 2.7W at full power while sampling the magnetic field.

All SeaSPY electronics modules are completely interchangeable. The only difference between them is a 16-bit serial number that is stored in non-volatile RAM within the unit. Each electronics module is a hermetically sealed, self-contained unit that is safe to handle even in dirty or wet conditions.

1.1.7 Towfish

The SeaSPY towfish is a pressurized vessel that carries all of the system sensors and the SeaSPY electronics module. It consists of a filament-wound fiberglass cylinder coated with polyurethane for abrasion and shock resistance. The nose contains a brass tow connector that is designed to bear the entire load of the tow system, in addition to providing a two-conductor electrical connection. Note that the shell of the connector bears the system common ground, and is connected electrically to the surrounding water.

A standard SeaSPY towfish is rated to a water depth of 1000m (3280ft). Depth ratings to 3000m (9842ft), and 6000m (19685ft) are available. Although the towfish housings for the different depth ratings vary in size and components, all of the housings have compatible tow connectors.

For a list of O-ring sizes in the housing seals, refer to section 10.2.

1.1.8 Isolation Transceiver

The SeaSPY Isolation Transceiver consists of power-conditioning electronics to supply clean power to the SeaSPY as well as a microprocessor to bridge the communication between the SeaSPY's FSK protocol and the PC's RS232 interface. Power and RS232 are both fully isolated from the supply ground, providing extremely high immunity to noisy power supplies at all frequencies. The wide input range of +9VDC to +28VDC allows for operation with both +12VDC and +24VDC vehicle batteries. Internal regulators produce a constant +48VDC to power the towfish. The power and communication to the towfish are multiplexed together for use with a two-conductor cable. This hardware is sealed in a rugged, blue aluminum housing that is splash proof. The transceiver also supports USB for easy use with computers that do not have a standard serial port. For more information on how to connect the transceiver, see section 3.

An Isolation Transceiver is able to communicate with a SeaSPY towfish across up to 10000m (32808ft) of the standard SeaSPY twisted-pair tow cable.

1.1.9 Gradiometer Transceiver – Optional

The Gradiometer Transceiver has all of the features of the standard Isolation Transceiver with the added capability of running two magnetometers at the same time. It uses a special binary mode of communication to be able to control two towfish over a single SeaSPY tow cable. The Gradiometer Transceiver is distinguishable by its dark cobalt blue housing.

1.1.10 Tow Cable

The standard SeaSPY tow cable (yellow in colour) is a shielded twisted pair (two conductors plus shield) with a high strength, lightweight braided Vectran strength member. The tow cable can withstand loads of up to 1000lb without any damage, and loads of up to 6000lb without breaking. It is sheathed in a tough polyurethane jacket and is fully water blocked. This means that if the jacket is cut or damaged, water migration through the tow cable will be greatly slowed, but not completely stopped depending on the external pressure. A damaged cable jacket should be repaired as soon as possible.

The two conductors in the tow cable carry the towfish DC power, and also the towfish telemetry, multiplexed with the power supply. The red conductor carries the positive voltage and telemetry, and the black conductor carries the negative voltage and common ground. The outer braid is only used to shield the inner two wires from external noise, not to carry electric current. It is connected to the cable's negative conductor at the source (topside) end of the cable only.

1.1.11 Floatation Cable – Optional

The SeaSPY floatation cable is mechanically and electrically similar to the standard SeaSPY tow cable, but has the addition of a syntactic foam layer underneath its outer polyurethane jacket. It is distinguishable by its larger thickness and orange colour. The floatation cable provides enough buoyancy to keep the magnetometer at a depth of about 2 to 3m, regardless of how much cable is deployed.

Floatation cable is very useful for shallow water environments, or when deploying with a great deal of other gear (such as seismic guns and streamers) when it is important keep the cable at a controlled depth, visible to the operators at all times.

1.1.12 Deck Cable

The deck cable is designed to connect the main tow cable spool, which is usually left on the deck of the deployment vessel near the stern, to the Isolation Transceiver, which is normally kept in a controlled interior environment. The deck cable's jacket is very tough polyurethane that is designed to withstand extreme abrasion and crushing, but is not designed to withstand towing force.

1.1.13 RS232 Cable

The RS232 cable connects the Isolation Transceiver to your PC. It is a gray cable with one female 9-pin DSUB connector that plugs into the serial port of your PC, and one female 8-pin circular connector that connects to the Isolation Transceiver.

1.1.14 USB Cable – Optional

The USB cable is an optional replacement for the RS232 cable. This cable is useful for laptops or computers that do not have a standard serial port. The USB driver supplied with SeaLINK must be installed for USB functionality.

1.1.15 AC Power Supply

The standard SeaSPY AC power supply can accept any AC power from 100 to 240VAC, at 50/60Hz, and is therefore capable of operating worldwide. It produces a constant 24VDC to power the Isolation Transceiver and SeaSPY system.

Note that the AC power supply uses a 3-prong North American style plug. **It is extremely important that the third (middle) prong from this plug is connected to a proper ground**. If not, you may experience communication problems, or even a degradation of magnetometer performance.

1.1.16 Battery Clip Cable – Optional

If AC power is unavailable, or if battery power is more convenient, the battery clip cable may be connected in place of the AC power supply. This cable has two large alligator clips for easy connection to a standard 12VDC or 24VDC vehicle battery.

Note that the voltage of a typical 12VDC lead-acid battery will vary from approximately 14VDC when fully charged to approximately 9VDC when nearly discharged. A 24VDC lead-acid battery will provide a range of 18 to 28VDC going to the SeaSPY system over the full charge cycle of the battery set.

The SeaSPY system has protection against polarity reversal. Therefore, connecting the black clip to the positive terminal, and the red clip to the negative terminal will cause no damage. However, no protection exists against over-voltage. Use caution not to connect more than 28V to the SeaSPY system.

1.1.17 SeaLINK Software

SeaLINK is a Windows application that interfaces with your magnetometer, to allow full control over the towfish, and to display and record data. For detailed information on using this program refer to the *SeaLINK Software Operation Manual*.

2 Communication

By default, all communication with the fish is via RS232 using 9600 baud, eight data bits, no parity, and one stop bit. Communication is half-duplex. Therefore, when the magnetometer transmits data, it does so in a non-interruptible string. Any commands that are sent to the towfish while it is transmitting will be ignored, but will not disrupt the transmission. The terminal must wait for the transmission segment to stop before it sends a command.

2.1 Isolation Transceiver

The Isolation Transceiver (IT) inserts an intelligent layer between you and the SeaSPY towfish. It assumes complete control over the tow cable communication link, and will drive it optimally for a wide variety of cable lengths and specifications. When you send a command to an IT, you may get a response even if there is no towfish connected. For example, you can query and set the IT's time and date with no towfish connected. As soon as you connect the towfish, the IT will recognize the towfish, and set its time as necessary.

2.1.1 Internal Clock

The IT has its own clock that keeps running when power is disconnected. The clock is powered by an internal lithium battery that automatically recharges when power is applied to the IT. The clock will keep time accurate to 0.65 seconds per day in ambient temperatures of –40 to +85°C, or accurate to 0.15 seconds per day in ambient temperatures of 0 to +40°C.

The IT clock can be set manually with the **T** command, or can be synchronized to the PC clock with a SeaLINK toolbar button. Another SeaLINK toolbar button allows you to synchronize the IT clock to an incoming NMEA GPS signal from a separate COM port on your PC.

2.1.2 Output Voltage

Standard IT units are built to output +48VDC to the SeaSPY tow cable, using input voltages of +9 to +28VDC. Power and RS232 are both fully isolated from the supply ground, providing extremely high immunity to noisy power supplies at all frequencies.

Note that all IT units use a 1.0A resettable input fuse. If your input voltage is too low, the IT will have to draw more current to supply the same power to the SeaSPY tow system.

The resettable fuse has a variable trip delay based on the amount of over-current. For example, if the IT is drawing 1200mA, you may find that the SeaSPY system will work well for a short while, and then trip the fuse for no apparent reason. If your IT seems to 'go dead,' it is possible that you have simply tripped the fuse. Just power down the system, wait a few seconds, and then turn it on again.

You can monitor the IT input and output voltages and currents at any time using the **D** command.

2.1.3 Status LEDs

The Isolation Transceiver has two status LEDs, one for power and one for communication. The *Power* LED is orange if the transceiver is powered but there is no towfish detected; green if the towfish is detected; and red if there is a fault condition. The *Comm* LED flashes blue whenever data is being transmitted between the towfish and the transceiver.

2.2 Gradiometer Transceiver

The Gradiometer Transceiver (GT) has all of the features of the standard Isolation Transceiver. In addition, a GT has the ability to control multiple SeaSPY towfish on the same tow cable using the SeaSPY binary mode polled protocol. When in this mode, the user communicates with the GT, and the GT decides when and how to communicate with the two towfish. It coordinates data from each of the two towfish in the gradiometer, and combines them as necessary to create gradient records, which are sent to the user.

2.3 Text and Binary Mode

Two modes of communication are possible with a SeaSPY magnetometer. Text mode is the simplest method of communicating with a single magnetometer on a single tow cable. In this mode, only a simple ASCII terminal is required, which can be a PC running a terminal program such as Windows HyperTerminal, or the SeaLINK software provided with your magnetometer system. In text mode, the fish responds to single byte commands sent from the terminal.

Binary mode is a less intuitive, yet more efficient mode of communicating that is intended to be used by automated data collection systems. Commands and data are sent and received in a special protocol that requires decoding software on the host (user) end. This protocol allows more than one magnetometer to be connected to the same tow cable, creating an along-the-track gradiometer configuration. A user can switch to binary mode from text mode by sending the **@** command. After this, commands must be sent according to the special binary protocol.

If SeaSPY is inadvertently placed into binary communication mode, it will not respond as expected to standard text mode commands, and may seem as if it is malfunctioning. If your fish does not seem to be responding to commands, send the **#** command at least twice to return to text mode. Turning SeaSPY off and on again will reset its communication mode to text.

3 Connecting the Equipment

The SeaSPY magnetometer system is designed for quick and easy deployment and can be setup without the use of any tools. The following diagram shows how to properly connect the system. If you are using a side scan sonar with your magnetometer then refer to section 7.6 for further instructions.

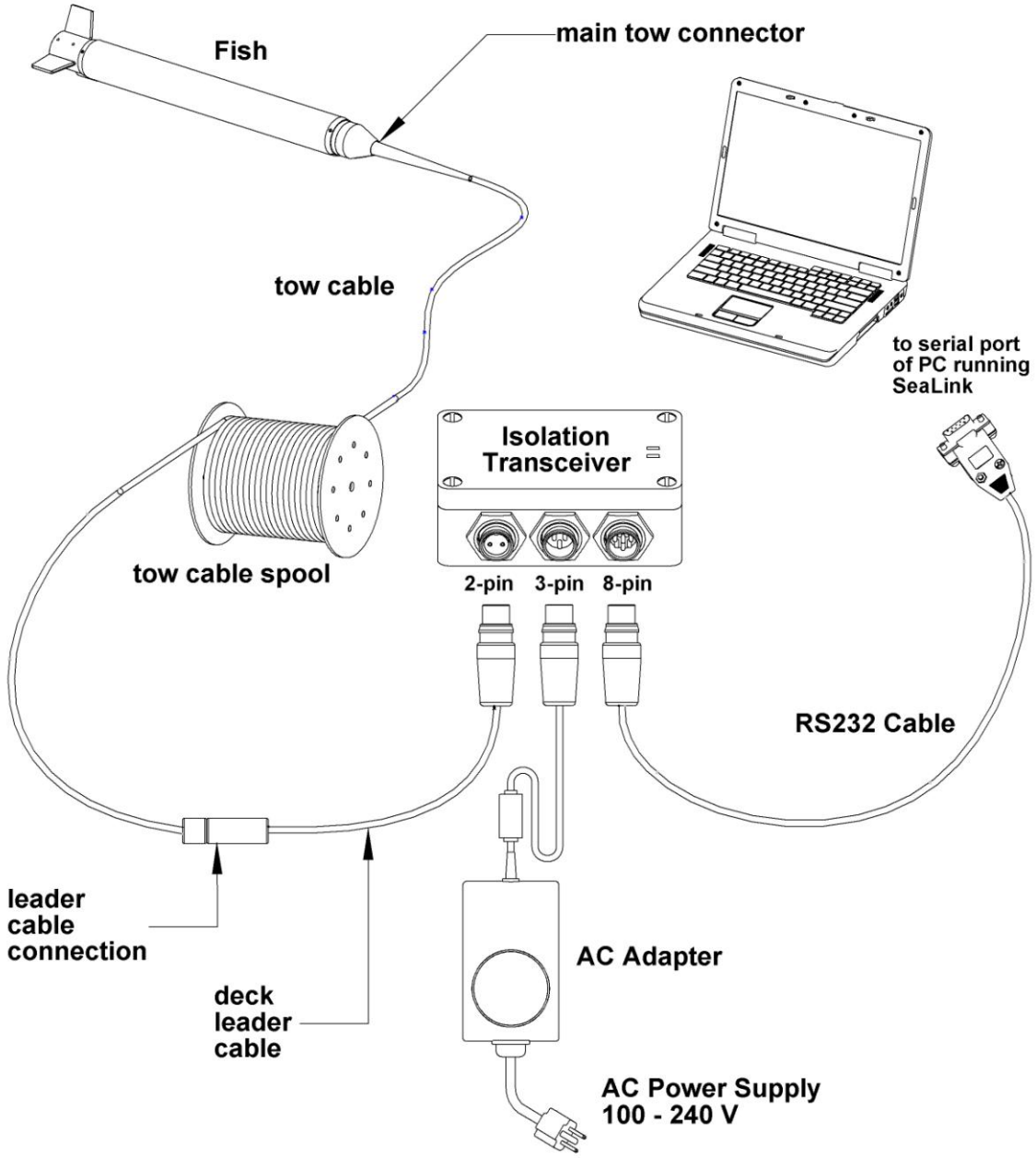


figure 3-1: SeaSPY connection diagram

3.1 Isolation Transceiver and Gradiometer Transceiver

Connect the transceiver (the small blue box) to a PC or other type of host computer using the gray RS232 cable provided with the system. Plug the circular 8-pin female connector into the transceiver and the female DB9 connector into the serial port of the PC. If your PC does not have an available serial port, you can use either a USB to Serial converter or an optional Marine Magnetics USB cable

If you are powering your unit from an AC power source, plug the circular 3-pin female connector end of the AC adapter into the transceiver and then plug the power cable into 100-240VAC, 50/60 Hz. The unit can also be powered from a DC source using the optional *Battery Clip Cable* by connecting the two large alligator clips to the battery terminals and the circular 3-pin female connector to the transceiver. The deck leader is a long black cable (typically 20 to 30m) that connects the transceiver to the main tow cable. Plug the circular 2-pin male connector end into the transceiver and then plug the coax connector on the other end into the main tow cable of the system. Note that the deck leader is not designed for underwater use, although its connectors are sealed. In addition, no towing stress should be placed on the deck leader. The tow cable must be firmly secured to the towing vessel. On larger vessels, this is sometimes done by winding the tow cable on a secured winch, and connecting the deck leader to the slip ring connection on the winch. The deck leader then provides a connection between the winch and the transceiver, which is typically in an enclosed area close to the data acquisition equipment.

3.2 Main Tow Connector

3.2.1 Standard Connector

The main tow connector (figure 3-2) provides the electrical connections to the towfish, and also bears the load of the towfish as it is towed through the water. It is a rugged, heavy-duty connector that is able to withstand a great deal of physical punishment.

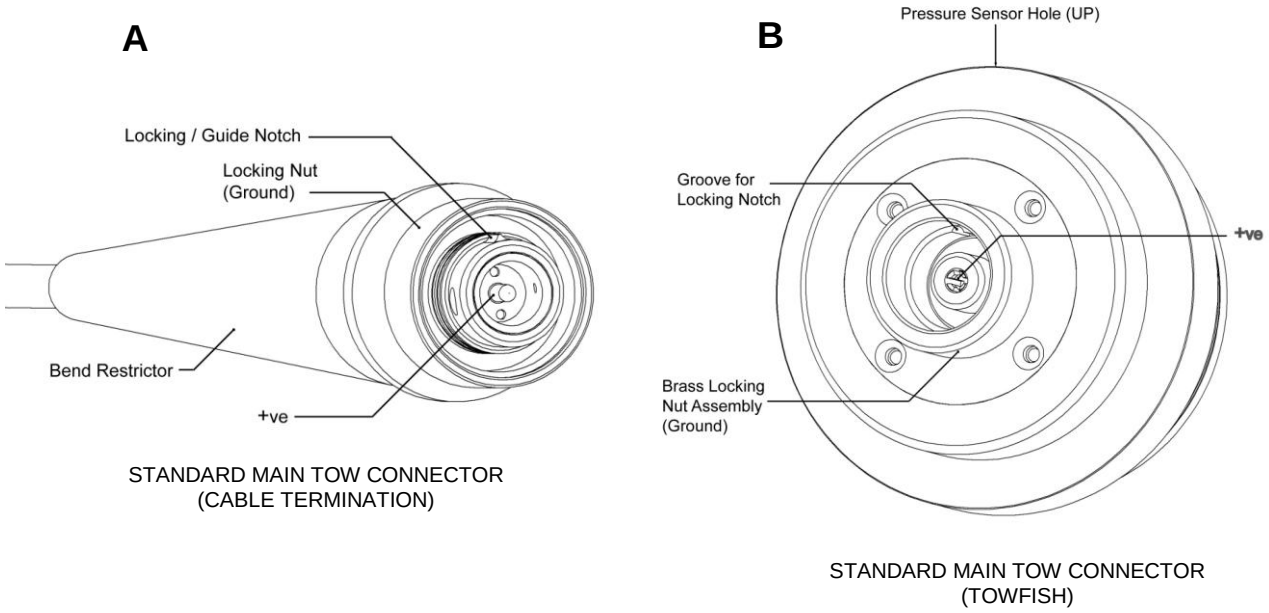


figure 3-2. SeaSPY main tow connector

The tow connector is sealed with two O-rings located on the male (tow cable) end (figure 3-2A). The O-rings seal against the inside surface of the female (towfish) connector. This seal will operate reliably indefinitely, provided that the O-rings are kept well lubricated with grease, that dust and dirt are kept away from them, and that the inside surface of the towfish connector remains free of scratches. **Always keep the black protective plastic caps installed on the male and female sides when the tow cable is disconnected from the towfish.**

The male connector has a locking notch that fits into a groove in the female side. When assembling the connector, line up the notch with the groove, and insert the male end. The male connector should slide in all the way up to the locking ridge.

You will notice that if you let go of the male connector at this point, it will begin to creep back out of the female end. This is because of air pressure inside the connector assembly. Keep the male connector firmly inserted into the female while you tighten the brass locking nut. This nut should be tightened firmly until it is felt to lock in place and cannot be tightened any more. Do not be afraid of over-tightening this nut. It is too strong to be damaged by hands alone.

When the connector is assembled, no part of the thread on the female connector should still be visible. If it is, the nut has not been tightened fully, or the slot was not inserted properly in the groove. Also, if you can still rotate the bend restrictor after the connector has been assembled, the slot was not inserted properly in the groove.

When the tow connector is fastened, screw on the nose cone over top. The nose cone protects the tow connector from side impact, and provides secondary protection against being loosened while deployed.

The most important feature of the tow connector is that all parts are fixed in place when it is fastened – no part moves against any other part. If you have used shackle connections on other marine instruments in the past, you will notice a great benefit to the ruggedness and longevity of the SeaSPY connection system. Keeping the connector in operational order requires very little effort. See section 10.1 for maintenance tips.

3.2.2 Main Tow Connector on Gradiometer Configurations

SeaSPY Gradiometer systems are shipped with a slightly different main tow connector. Instead of a single-pin configuration, the gradiometer systems are equipped with a 2-pin configuration (figure 3-3). The operation and design of this connector is similar to that of the standard main tow connector (see above). However, extra caution should be used to ensure that the two connector pins (male on cable termination, figure 3) are inserted level and aligned to the towfish female connectors. Like the standard main tow connector, the gradiometer main tow connector has a locking notch that fits into a groove on the tow fish. This ensures proper alignment of the 2-pin electrical connection.

The brass locking nut assembly (figure 3-3B) is not DC grounded but is AC grounded through a capacitor connected to the ground connector.

For longitudinal gradiometer configurations, an additional two-pin main tow connector will be present on the rear bulkhead of the front towfish.

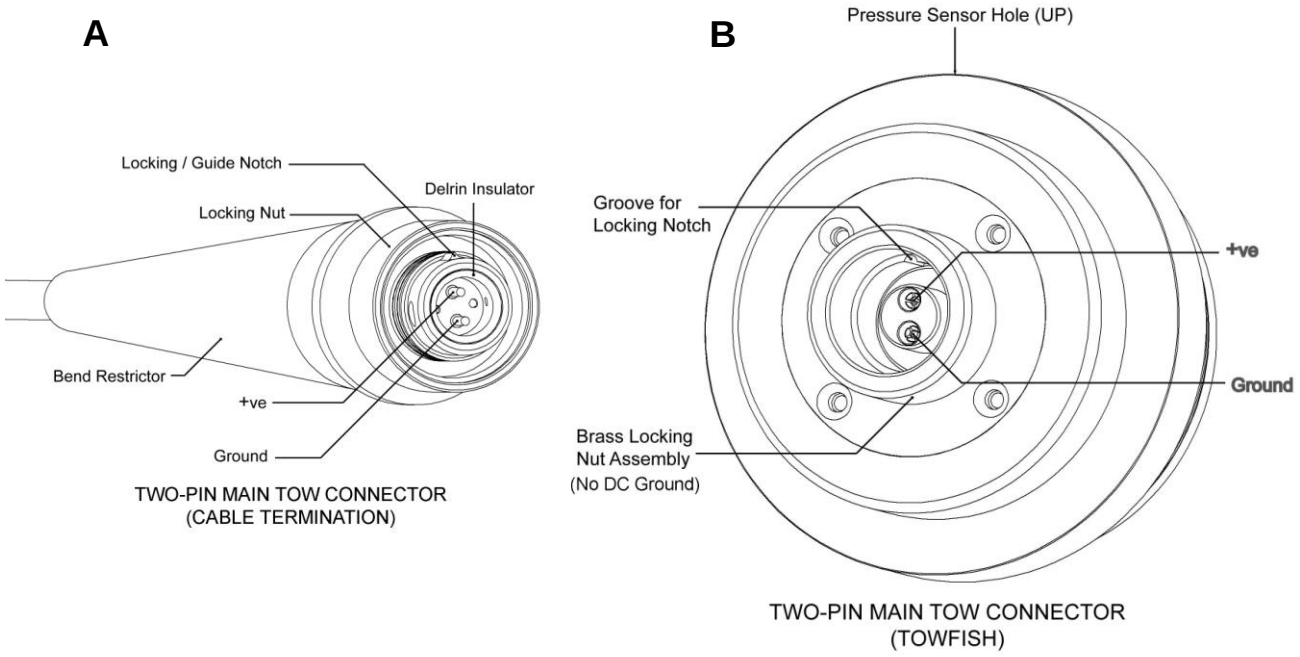


figure 3-3. Two-pin main tow connector found on SeaSPY Gradiometer systems

3.3 Longitudinal Gradiometer

A Longitudinal Gradiometer system consists of two SeaSPYs connected in line via an interfish cable. The two towfish can be towed from a standard main tow cable but require a Gradiometer Transceiver in order to communicate properly. Figure 3-4 shows how to assemble a Longitudinal Gradiometer system. The front towfish in the assembly has a tow connector on both ends. If you are using this towfish alone then make sure that the brass plug and plastic cap are in place or else the towfish can be damaged.

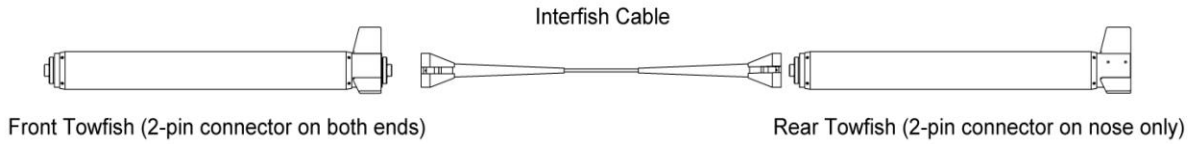


figure 3-4. Longitudinal gradiometer assembly

3.4 Horizontal Gradiometer

The SeaSPY Horizontal Gradiometer expansion kit converts two standard SeaSPY magnetometer towfish into a simultaneous horizontal gradiometer. The kit consists of a rigid frame structure, and a Y-split tow cable that carries the SeaSPY power and telemetry signals simultaneously to both towfish from a single tow cable. A Gradiometer Transceiver is required for communicating with the two towfish. The Gradiometer Transceiver software supports simultaneous communication of two SeaSPY magnetometer towfish over the same single twisted-pair tow cable.

The gradiometer frame is constructed from hard-anodized aluminum, making it relatively lightweight, yet very strong, rigid and resistant to damage from collision with obstacles while being towed. The frame's high rigidity is very important for producing precise, high-quality gradiometer data.

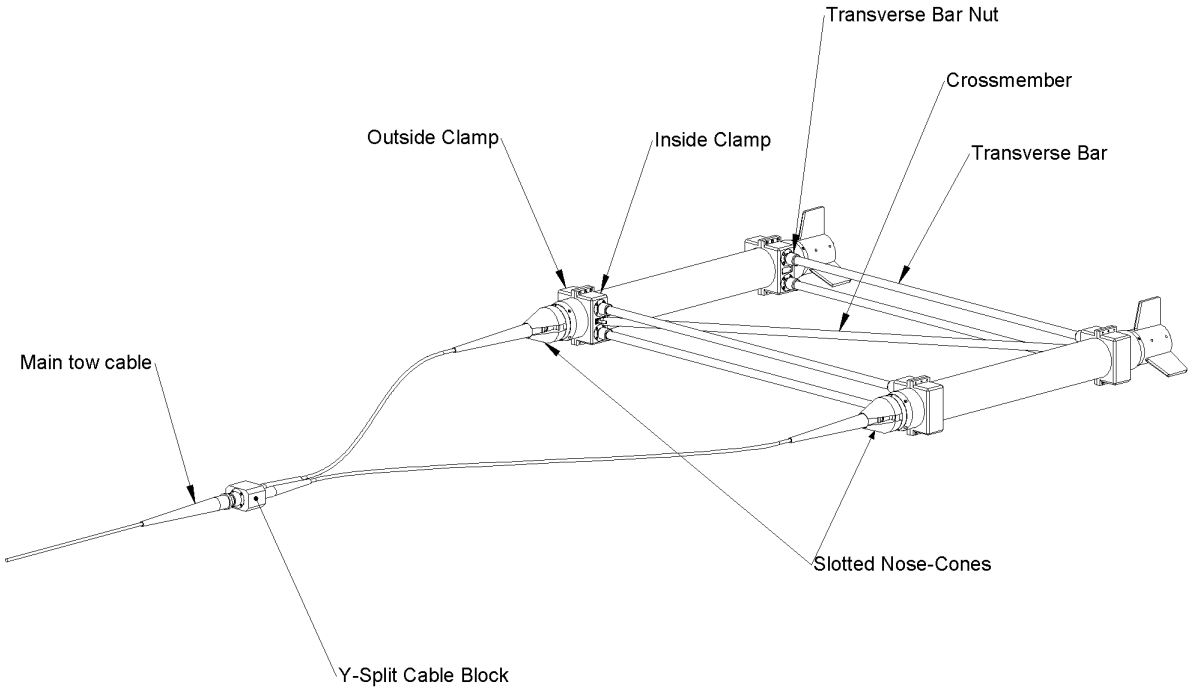


figure 3-5. The horizontal gradiometer in its final assembled state

3.4.1 SeaSPY Horizontal Gradiometer Assembly Instructions

Step 1: Unpacking the Frame

The frame is shipped fully assembled, but not attached to the SeaSPY towfish. This way, the frame can be easily collapsed to a smaller size for transport. To unpack the frame, remove all packing material and expand the frame as shown below. **Use caution not to place excessive bending stress on the hinged crossbar links when expanding the frame**. Next, remove the 24 screws as shown, and disassemble the towfish clamps, in preparation for mounting onto the two SeaSPY towfish.

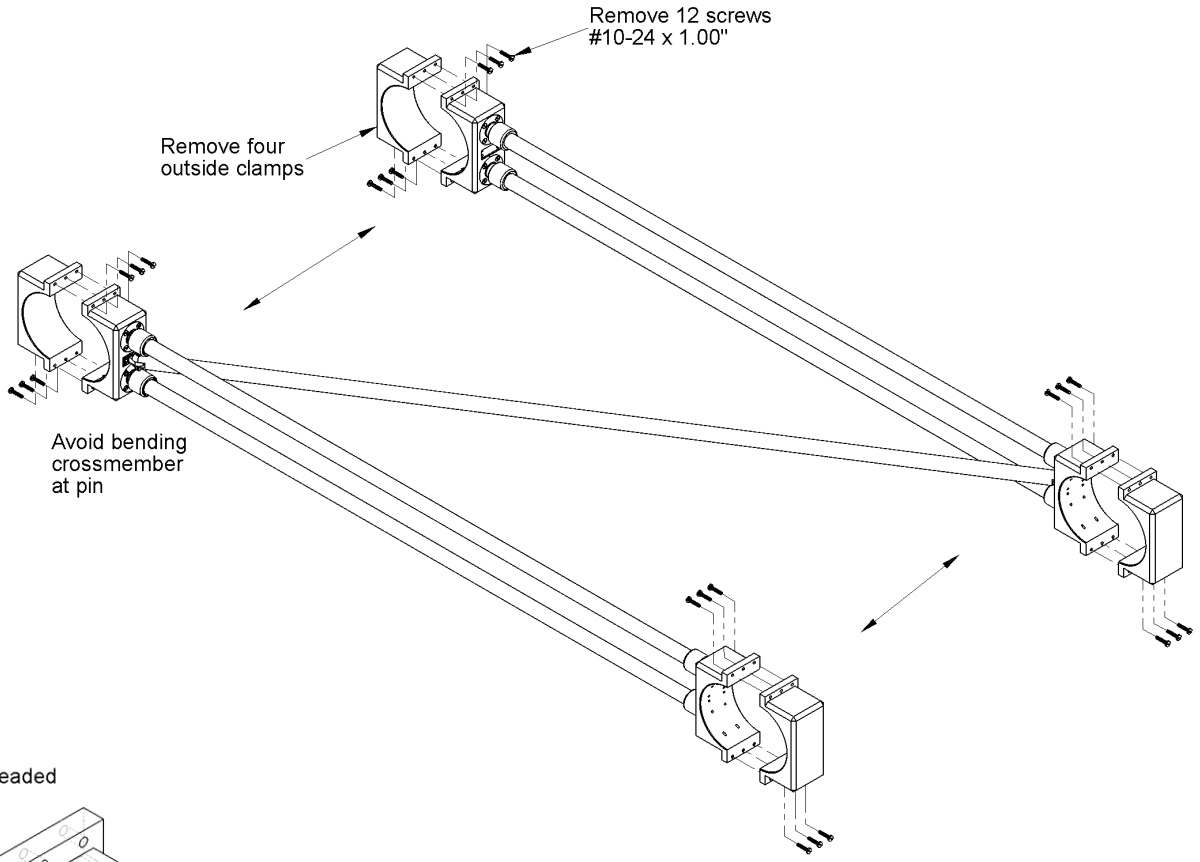
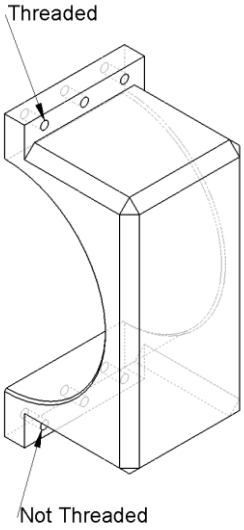


figure 3-6: Unpacking the frame assembly



A Note About the Towfish Clamps

The four sets of white clamps are machined so that one end is threaded and the other, not threaded. Therefore, the screws that bind them together when assembled must be inserted from opposite sides at opposite ends. Keep this characteristic in mind when lining up the loose clamps with the clamps attached to the frame.

figure 3-7: Towfish clamp

Step 2: Mounting the First Towfish

Stand one towfish so that it is pointing vertically as shown to the right in figure 3-8. Place two of the outside clamps, aligned as shown, onto the towfish housing. The clamps are semicircles with a slightly smaller radius than the housing tube, and will grip the housing naturally. It is very important that the clamps are spaced exactly as shown, with a 36-inch separation. Otherwise, the frame will not sit correctly when finally assembled.

Once the two clamps are on, position the towfish so that it is lying on its side, with the pressure sensor hole pointing horizontally (see figure 3-9). A table is preferable to the ground, so that the tail fin can hang over the side.

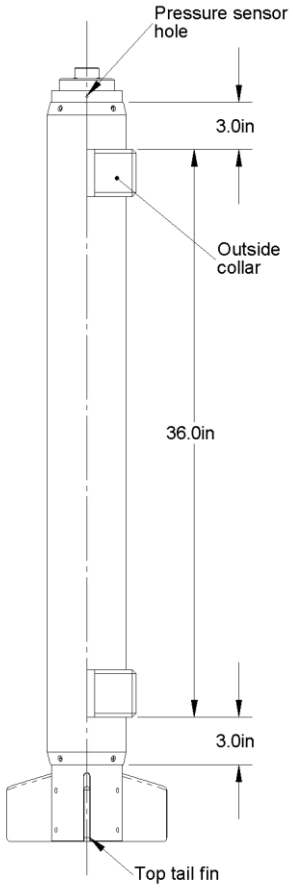


figure 3-8: Towfish clamp positioning

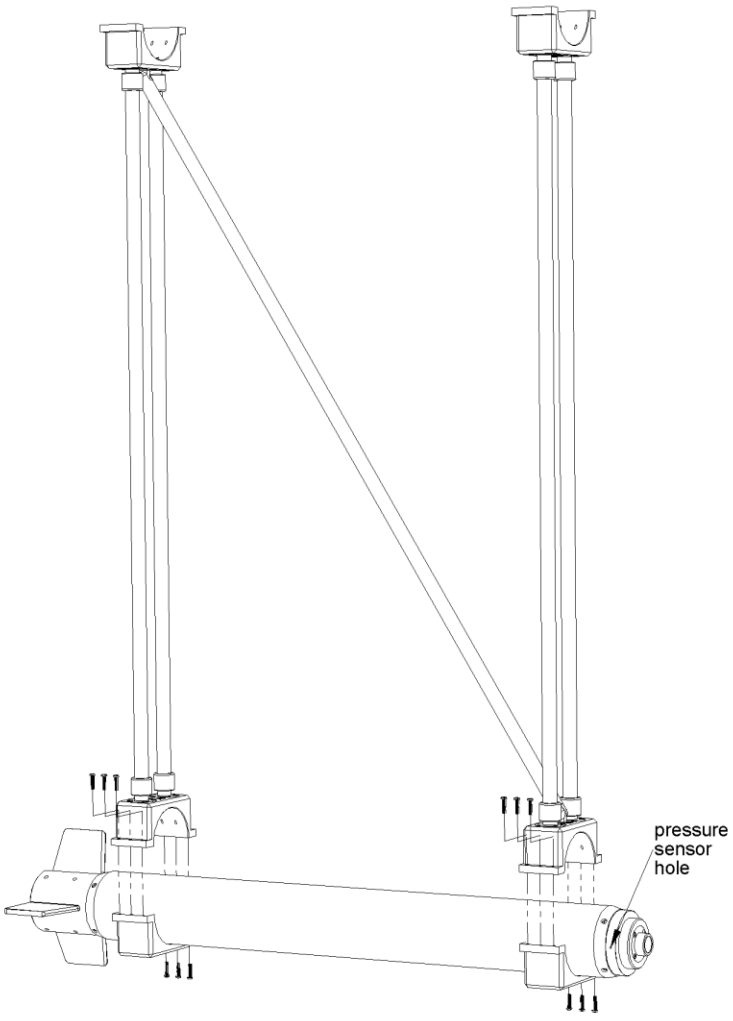


figure 3-9: Mounting the frame

Now place the frame on top of the towfish, aligning the mating clamps, and ensuring that the crossmember clevis pin heads are on the same side as the pressure sensor holes. Insert the twelve brass screws to tighten the clamps onto the towfish housing. Do not over-tighten the screws, to avoid damaging the thread in the clamp. Hand-tight is acceptable – **do not use a power drill**.

It is normal for a small gap to remain between the mating clamps when assembly is complete.

Step 3: Mounting the Second Towfish

Place the second towfish into the open clamps currently at the top of the frame, ensuring that the pressure sensor holes of both towfish are aligned. Double-check that the top clamps are positioned exactly 36 inches face-to-face as shown in figure 3-10. Now install remaining outside clamps onto the second towfish.

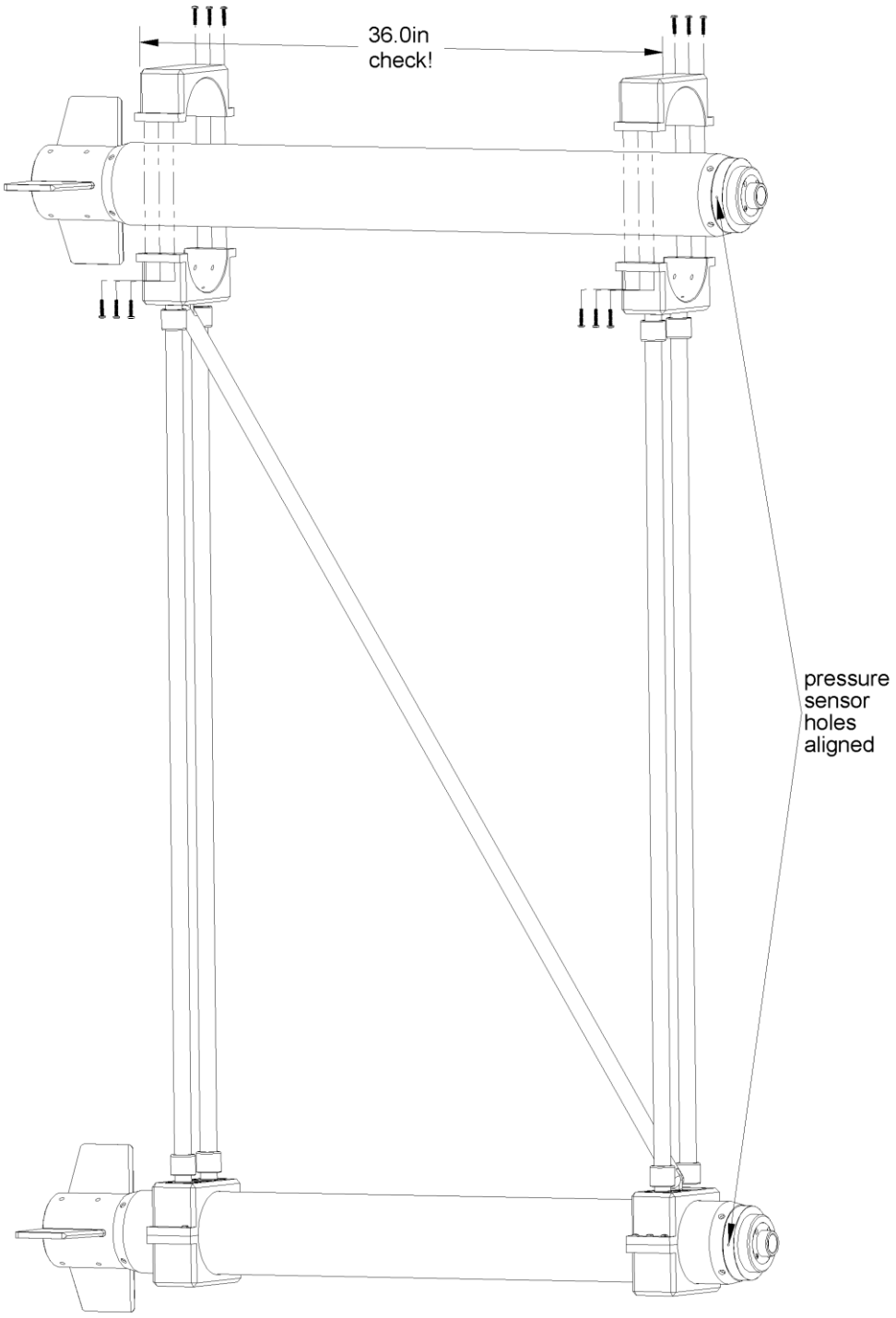


figure 3-10: Mounting the second towfish

Step 4: Checking the Frame's Integrity

The frame may now be stood up on the tails of the two towfish as shown in figure 3-11. Check each of the eight nuts at the end of the transverse bars for tightness. The nuts and mating thread are often made with very tight tolerance. You may require a belt tightener to move the nut.

Now check each of the transverse bars for rotational tightness. If any of the bars will rotate, this means that one of its nuts is loose – double-check that both nuts are tight.

The structure owes much of its torsional rigidity to the tightness of the transverse bars. If any of the bars is free to rotate, the structure will be less rigid in torsion.

Observe the structure from the side. If it appears 'warped,' slightly loosen all of the nuts on one side (near one towfish) and correct the warp. Then, retighten the nuts.

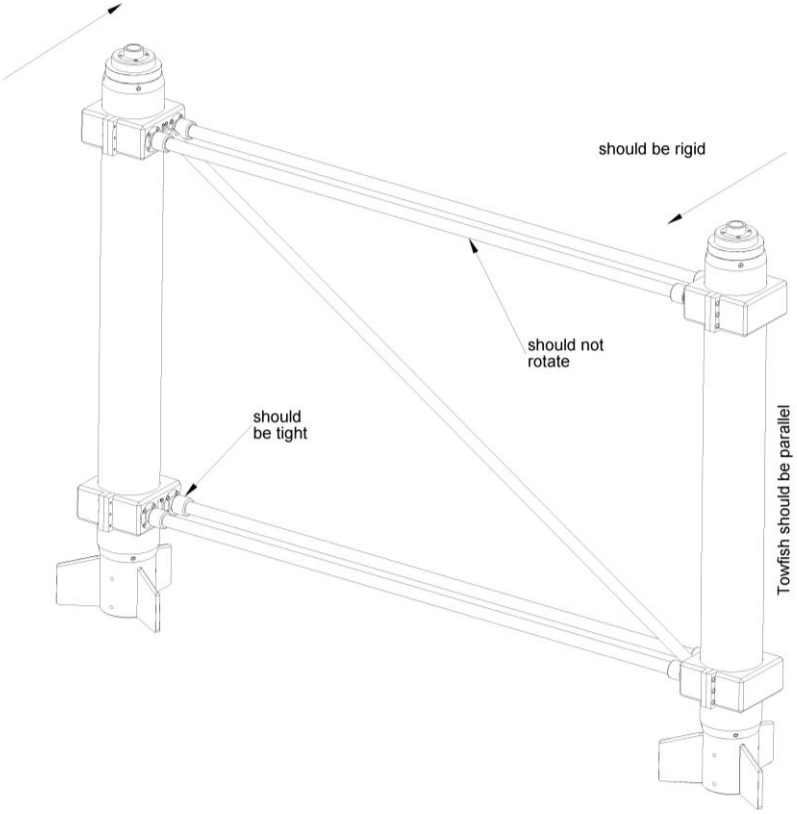


figure 3-11: Checking the frame's integrity

Step 5: Installing the Y-split Cable

The Y-split cable should be installed prior to deployment. Stretch the cable out so that there is no torsion in each of the segments. Install the male brass connector into the bulkhead connector on the SeaSPY towfish. Finally, slip the slotted nose cone over the cable, and install on the towfish over top of the brass connection.

The male connector on your SeaSPY tow cable connects to the female connector of the Y-split cable. No additional protective cone is required for this connection. Please refer to sections 4.1 and 4.2 for further information on pre-deployment preparation and normal operation of your gradiometer system.

4 Getting Started

When the transceiver is first powered up, the *Power* LED will glow orange and it will transmit a brief identification message to the PC. If a SeaSPY is detected, then the LED will turn green and the SeaSPY's own identification header will also be displayed. You will notice the *Comm* LED will flicker blue as data is transmitted between the SeaSPY and the transceiver. Upon detection of the towfish, the transceiver will automatically set the towfish time.

A good way to start is by checking battery voltage at the magnetometer with the **d** command. The **d** command provides important information about the status of both the transceiver and the towfish. The first line of data comes from the transceiver and represents the voltage, current and power being outputted to the towfish. The second line of data comes from the SeaSPY and reports the status of three important sensors as well as the voltage at the towfish end of the tow cable. The first column shows the amount of signal currently being produced by the Overhauser sensor. This is a raw number between 0 and 255, and should nominally be less than 10 when the magnetometer is idle. The second column is battery voltage. The voltage should be at least +15VDC. If it is lower, communication may be erratic, and the magnetometer may not operate properly. The voltage drop between the transceiver and the fish will depend on the length of your tow cable. The third and fourth columns display the temperature of the electronics, and the depth of the fish in meters.

Prior to each survey, it is a good idea to zero the depth sensor. In moderate climates this can be done on the deck of the vessel when the fish has already cooled or warmed to the ambient air temperature, since the output of the depth sensor will vary slightly with temperature. For optimal results, submerge the towfish to allow the temperature of the pressure sensor to reach the ambient water temperature before retrieving and zeroing it. Zero the depth sensor with the **p** command. You will be prompted for confirmation before the sensor is zeroed. The scale of the depth sensor can be set using the **P** command. You should not change this unless you suspect the accuracy of the depth measurement. For more information on the pressure sensor, see section 1.1.4.

To start collecting data, place the unit into a self-cycling mode using the **1** through **6** commands. Selecting **1** will choose the fastest cycling rate of 0.25 seconds per reading, and **6** will select the slowest of 10 seconds per reading. A rate of 1 reading per second (**3** command) is most commonly used. Note that sensitivity may drop slightly at faster sampling rates. The maximum sensitivity of 15pT RMS is retained at rates up to 1Hz. Sensitivity drops to 50pT RMS at 2Hz, and 100pT RMS at 4Hz.

If the auto-tuning feature is enabled (as is recommended), the first reading taken after power-up will initialize the instrument tuning, and will take just under three seconds. The instrument's tuning will track changes in magnetic field as time progresses. If the instrument determines later in its operation that it has become mistuned (an occurrence seen only in magnetically noisy environments), a tuning initialization procedure will commence automatically. If the auto-tuning feature is disabled, and tuning is fixed, the instrument will cycle at the programmed rate, regardless of whether it becomes mistuned or not. Keep in mind that if the unit is not properly tuned, signal quality will suffer. For this reason, it is recommended to keep auto-tuning on in normal operation.

4.1 Getting Started with a New Gradiometer System

All new gradiometer systems are configured for use in gradiometer (GRAD) mode. The above procedure is the same for these systems. All commands issued will be applied to both SeaSPYs when in GRAD mode. Note that in order to survey with a single magnetometer you must issue the **c** command and select MAG mode.

4.2 Upgrading to a Gradiometer System

If you have purchased a gradiometer expansion kit separately from your SeaSPYs then some additional configuration will be required. Follow the steps in section 11.4 for configuring and testing your gradiometer system.

5 SeaSPY Commands

Interaction with the SeaSPY system can be done with single-character commands typed in the main terminal. A complete summary of these commands is available in the following two tables. The commands are separated into normal commands, and commands that require entry into a special 'diagnostic mode'. This mode prevents accidental activation of features that may disrupt optimal performance of the system.

5.1 Normal Commands

Command	Description
SPC or t	Get Time. Requests current magnetometer time, which is displayed with a resolution of 0.1 seconds in a 20-hour cycle. Magnetometer time is used for determination of cycle timing, i.e. units with the same time value cycling at the same interval will take readings at exactly the same time, regardless of when cycling was initiated. In addition, a unit cycling at a slower interval will be synchronized with a unit cycling at a faster interval, for appropriate readings. For example, a unit cycling at 5000ms will be synchronized with a unit cycling at 1000ms every five seconds. The oscillator used to keep time on the magnetometer has a frequency stability of 1ppm over its entire temperature range, so a magnetometer may gain or lose a maximum of 86.4ms in a day in the worst possible environment.
d or D	Scan sensors. This command provides useful diagnostic information on the state of the towfish at any given time. The first value is the strength of signal currently coming from the Overhauser sensor. When the towfish is idle, this value should be around 7 to 9. The next value is battery voltage, followed by the temperature of the electronics, and then the current depth of the towfish. The last value is the leak sensor status. L0 indicates no leak, while L9 indicates a leak.
T	Input time manually. The magnetometer will respond with a prompt to enter eleven digits that represent a date and a time. There is no carriage return necessary. As soon as the eleventh digit is received, time will start from the entered value. The first three digits are Julian day, followed by two digits for year, and six digits for time in HHMMSS format. Note that this command can be executed while the magnetometer is cycling (taking readings).
f or F	Take a single reading. The magnetometer will immediately respond with an acknowledgement, and start the reading procedure, which will take 3 seconds If the tuning value is 0 when the reading is started, tuning initialization will automatically be performed. On conclusion, the magnetometer will transmit the data obtained from the reading.
6	Set 10-second cycle time. Puts the magnetometer in a mode that measures magnetic field readings at a rate of 0.1Hz. The magnetometer will continue in this mode until ordered to enter a different mode. After every reading, the magnetic field data will be transmitted automatically.
5	Set 5-second cycle time.

4	Set 3-second cycle time.
3	Set 1-second cycle time.
2	Set 500ms cycle time.
1	Set 250ms cycle time
0 (zero)	Stop cycling. This command will terminate all cycling. The magnetometer will complete a reading if one is in progress at the time of the command, and return to idle mode (awaiting further commands).
p	Set depth sensor zero pressure. Use this command prior to survey while the fish is out of the water. This will calibrate the zero level for the depth transducer. The response will report the actual zero level in mV.
P	Set depth sensor scale. This command will calibrate the slope parameter used to calculate the depth of the fish. The fish should be submerged under 1 to 9 meters of water when this command is executed. The unit will prompt for the depth of the fish, and will also allow a cancellation of the command (x) or the selection of the factory default slope. The response will report the new slope in mV/m. The factory default is 18.2mV/m.
S	Status. This will display the SeaSPY serial number, the cycling state, and the state of all relevant settings. If any setting is set to a non-default state, a warning will appear, and also the command that is required to set it back to default.
O (Oh)	Perform environment test. The unit will sweep the entire frequency band searching for noise. If the test fails, there is a source of interference present that must be eliminated for proper operation. Next, the unit will test the magnetic gradient. If this test fails, there is probably some magnetic material close to the sensor that must be removed. If all tests are passed, then the unit's environment is suitable for optimal operation.
y	Auto-tuning off. By default, an optimal tuning value is calculated at the end or every reading with 100 or more zero crossings. Fast changes in magnetic field may cause the unit to mistune. This command may be used to disable auto-tuning.
x	Auto-tuning on. Use this command to re-enable auto-tuning.
l or L	Enter tuning value manually. When this command is sent, the unit will prompt for the entry of a new two digit tuning value in µT. The magnetometer will calculate the actual tuning step number that may be incremented or decremented by the following commands.
. or >	Increment tuning. This adjusts the magnetometer tuning in the smallest possible step. The number of that step is reported as a response to the command, and also the corresponding magnetic field value in µT. If auto-tuning is not selected, the default tuning value is zero, which will cause a tuning initialization when the first reading is attempted. If auto-tuning is disabled, the default power up tuning value will be whatever the setting was when the unit was powered off.
, or <	Decrement tuning.

r or R	Toggle RF. This command may be used to turn the RF polarization circuit on or off manually. Expect the towfish current draw to rise to about 120mA if the input voltage is 48V, and if the RF is tuned properly, using the magnetometer sensor as a load.
e or E	Connect/Disconnect Overhauser sensor. When SeaSPY is in standby, the electronics are electrically isolated from the Overhauser sensor. This command manually connects the sensor to the amplifiers.
k or K	Disable/Enable/Force long deflect. Long deflect is a technique used in SeaSPY magnetometers to boost signal strength in low fields. SeaSPY will automatically switch to long deflect mode in fields below about 42μT. Although long deflect provides better signal strength, it also shortens measurement time, and it may be beneficial under certain circumstances to disable it. It is recommended to keep this function set to automatic. This command will toggle the long deflect setting between automatic, always off, and always on.
h	Increment hour. Adds one hour to the magnetometer clock.
H	Decrement hour. Subtracts one hour from the magnetometer clock
m	Increment minute. Adds one minute to the magnetometer clock.
M	Decrement minute. Subtracts one minute from the magnetometer clock.
w	Reset seconds. Sets the magnetometer seconds to 0.
W	Reset time. Sets the magnetometer time to 0:00:00.0. This is a very quick way to synchronize multiple units if the absolute time value is not important.
g or G	Retransmit last reading. The last reading that was taken will be retransmitted in the format described later in the manual. In binary mode, this command will dump all readings from the magnetometer's memory buffer, and will clear the memory buffer.
!	Get towfish serial number.
%	Get firmware checksum. The firmware checksum can be used to identify your firmware version when calling Marine Magnetics for technical support. The response will be an 8 digit hex number.
@	Switch to Binary Mode. It is not recommended to send this command manually. It is used by the automatic protocol control in the Gradiometer Transceiver. There is no acknowledgement for this command.
#	Switch to Text Mode from Binary Mode. If the fish is not responding to normal commands, it may have been switched to binary mode. Press # at least twice to switch back to text mode. The switch will be acknowledged in ASCII.
\	Enter/exit diagnostic mode. You will be prompted to confirm. SeaSPY will stay in diagnostic mode until commanded to exit, or until powered down.

table 5-1: Normal operating commands

5.2 Diagnostic Mode

The following commands are only available in diagnostic mode, which is accessed with the **** command. Since several of these commands can disrupt operation if not used properly, it is recommended to not keep the unit in diagnostic mode during normal operation. In general, diagnostic mode should not be used unless you are instructed to do so by Marine Magnetics technical support.

Command	Description
~	Test e/m telemetry transmitter. This command sends an endless 5kHz signal with 50% duty cycle from the electronics module. This feature can be used to tune the FSK receiver in the Isolation Transceiver unit in an emergency. This feature will operate for 30 seconds, after which the system will resume normal operation. During the operation of this feature, you should see a constant stream of U characters on the receiving terminal if the topside transceiver is properly tuned.
B	Change baud rate. The baud rate may be changed to 1200, 2400, 4800, 9600 (factory default) and 19200 bps. **WARNING!** This setting will be remembered even after SeaSPY is powered off. If your terminal is not set to the corresponding baud rate setting, it may appear as though the SeaSPY e/m is not functioning.
b	Change data format. See chapter 6 for more information on available data formats.
a or A	Toggle auto-deflect pulse width. Do not adjust this setting unless instructed by Marine Magnetics technical support to do so.
z or Z	Toggle auto-deflect sync. Do not adjust this setting unless instructed by Marine Magnetics technical support to do so.
j or J	Sets long deflect sample proportion. Default is 5 (50%). When long deflect mode is active, decreasing this value will increase the sample time of a measurement, but may result in weaker signal being generated by the sensor.
)	Increments deflect pulse width. This is only effective if auto-deflect-pulse-width is disabled. Do not adjust this setting unless instructed by Marine Magnetics technical support to do so.
(	Decrements deflect pulse width. This is only effective if auto-deflect-pulse-width is disabled. Do not adjust this setting unless instructed by Marine Magnetics technical support to do so.
]	Increment FSK transmitter tuning. This and the following three commands can be used to fine-tune the telemetry frequencies. **WARNING!** It is possible to mistune the telemetry frequencies, rendering your SeaSPY temporarily inoperable. Do not adjust this setting unless instructed by Marine Magnetics tech support to do so.
[	Decrement FSK transmitter tuning.
{	Increment FSK receiver tuning.
}	Decrement FSK receiver tuning.

table 5-2: Diagnostic mode commands

5.3 Isolation Transceiver Commands

The Isolation Transceiver (IT) inserts an intelligent layer between the host PC and the SeaSPY towfish, allowing it to optimize the telemetry system parameters for a wide variety of tow cable specifications and lengths.

All normal towfish commands are perfectly valid when using an IT. In addition, several commands are available to access IT functions. These commands are valid whether there is a towfish connected to the tow system or not.

When an IT is powered up, it will attempt to verify if a towfish is connected or not. This may take 3 to 4 seconds. If it detects a towfish, it will immediately set the towfish time to the IT time.

In contrast to a SeaSPY towfish, an IT will remember the time after it is powered off. A rechargeable lithium battery is used within the transceiver as the power source for the clock. The IT will keep time for approximately three months if left 'on the shelf'. If power is connected at any time, the on-board battery will automatically recharge. This battery never requires replacement under normal usage.

Command	Description
SPC or t	Get Time. Requests current transceiver time. If a towfish is connected it will also check the towfish time and synchronize it to the transceiver time if there is a discrepancy.
T	Sets IT time and date. As soon as the time is set, the IT will attempt to set the time of the towfish, provided one is connected. The IT will remember the time after it is powered off.
d or D	Scan sensors. In addition to querying the towfish, as described in table 5-1, this command also displays the current voltage being supplied by the IT, and the current and power consumption of the magnetometer.
ctrl-O	Power On/Off. Toggles power to the towfish.
ctrl-B	Change transceiver baud rate. Controls the baud rate between the towfish and the transceiver and between the PC and the transceiver.
!	Get towfish serial number.
*	Enters transceiver diagnostic mode. A security code is required.

table 5-3: Isolation Transceiver commands

5.4 Gradiometer Transceiver Commands

In addition to all of the standard IT commands, the Gradiometer Transceiver (GT) has the following functions.

Command	Description
c or C	GRAD mode. With this command you can switch between gradiometer (GRAD) mode and magnetometer (MAG) mode. This is also the command you use to set the serial numbers of the towfish in the array.
ctrl-T	Synchronizes the gradiometer towfish clocks.

table 5-4: Gradiometer Transceiver commands

6 SeaSPY Data Format

Data that is presented by the magnetometer during cycling can appear in one of three formats. An operator can choose between formats using the **b** command in diagnostic mode.

6.1 Standard Format

The Standard data format is the most commonly used, and is usually the default setting when a SeaSPY magnetometer is first shipped. The data string appears as follows:

*YY.JJJ/HH:MM:SS.S F:FFFFFF.FFF S:SSS D:+DDD.Dm A:AAA.A L:L TTTms_Q:QQ !!!! CR LF

The first character of each line is always * (ASCII code 42). This leading character is supplied for automated data collection systems that require periodic synchronization with the data stream.

Each letter shown in italics stands for a digit of a particular record in the reading.

Number	**Description**
Y	Year (time of reading).
J	Julian day (time of reading).
H	Hour (time of reading).
M	Minute (time of reading).
S	Second (time of reading).
F	Magnetic field (nT).
S	Signal strength of reading. This is a raw number generated by the magnetometer that gives (in part) a good indication of the quality of the final total field measurement. Anything over 80 is considered an acceptable signal, and anything over 130 is considered excellent.
D	Towfish Depth. The value shown is in meters. The depth sensor can be calibrated using the **P** and **p** commands.
A	Towfish Altitude. The value shown is in meters. If no altimeter is installed, this field will not be present. If an altimeter is installed, but it cannot obtain a 'lock' on the seafloor (for example if it is too far away) this value will be 000.0m.
L	Leak sensor output, 0-9. 0 indicates no leak, and 9 indicates that a leak is present.
T	Measurement time. Ideally, this should be the magnetometer's cycling time minus 35ms, with a maximum of 965ms. If you see a G message, indicating that measurement was prematurely terminated due to a high gradient condition, this value will tell you how severe the gradient is.

Q	Signal quality. This is a two-digit number between 00 to 99. The left digit is a good indication of signal strength, and the right digit indicates how much information was available for measurement.
!	Warning Messages.
CR	Carriage Return (ASCII code 13).
LF	Line Feed (ASCII code 10).

table 6-1: Standard data format description

The data string also contains various letter designators throughout the string (non-italicized letters) to help identify data types (table 6-2).

Letter	Meaning
F:	Total magnetic field reading following
S:	Signal strength following
D:	Depth reading following (+/-)
A:	Altitude reading following
L:	Leak indicator value following

table 6-2: Letter designators in the data string

6.1.1 Warning Messages

There are four different warning messages that can be displayed in the raw data log by the magnetometer. The warning messages may be summarized as follows (table 6-3). See section 6.1 for the location of warning messages in the raw data log (‘*!*’ in example string).

Letter	Meaning
W	Weak signal. This message is displayed if the signal strength for the reading is below a threshold value
G	Gradient condition. In high magnetic gradients, the signal produced by the sensor decays more quickly. This message occurs if the measurement time was prematurely terminated due to a quickly decaying signal. The strength of the gradient can be estimated by observing the measurement time. Note that sensitivity will decrease as the measurement time decreases.
P	Poor reading. This message is displayed if the signal is sampled for too short a time period, for whatever the reason. Expect this message under conditions of extremely high magnetic gradient.
M	Instrument Mistuned. The magnetometer may decide to display this message under extremely poor signal conditions, which is characteristic of poor tuning settings. When this message occurs, the instrument will attempt to retune by executing an initialize tuning procedure, if the auto-tuning feature is enabled.

table 6-3: Warning messages

6.2 Compact Format

The compact format contains most of the information of the standard format, but with no annotation. It contains 24h time information, but no date, no signal quality value, and does not support the optional altimeter. The compact data format is necessary if interfacing to an Edgetech DF-1000 digital side scan sonar.

The compact data string appears as follows:

**HH:MM:SS.S FFFFFF.FFF SSS TTTT +DDDD.Dm !!!!! CR LF*

Each letter shown in italics stands for a digit of a particular record in the reading.

Letter	Description
H	Hour (time of reading).
M	Minute (time of reading).
S	Second (time of reading).
F	Magnetic field (nT).
S	Signal strength of reading. This is a raw number generated by the magnetometer that gives (in part) a good indication of the quality of the final total field measurement. Anything over 80 is considered an acceptable signal, and anything over 130 is considered excellent.
T	Measurement time. Ideally, this should be the magnetometer's cycling time minus 35ms, with a maximum of 965ms. If you see a G message, indicating that measurement was prematurely terminated due to a high gradient condition, this value will tell you how severe the gradient is.
D	Towfish Depth. The value shown is in meters. The depth sensor can be calibrated using the **P** and **p** commands.
W	Warning messages.
CR	Carriage Return (ASCII code 13).
LF	Line Feed (ASCII code 10).

table 6-4: Compact data format description

The warning messages above are identical to those in the standard data format description, summarized in table 6-3. The one additional message is the leak message, the first of the group. If a leak is present, an 'L' message will be visible in this section.

6.3 SIS-1000 Compatible Format

The SIS-1000 compatible format contains only magnetic field, signal strength, and pressure depth. The optional altimeter is not supported in this mode. It is necessary to switch to this format when interfacing to a Benthos SIS-1000 or SIS-3000 system. Note that this mode is not required if interfacing to a Benthos SIS-1500 digital side scan sonar system.

The SIS-1000 compatible data string appears as follows:

```
$ FFFFFF.FFF SSSS DDDD CR LF
```

Note that the first character of the SIS-1000 compatible data string is a '$', not a '*' as is the case with the other two data formats.

Letter	Meaning
F	Magnetic field (nT). If the field value is less than 100,000nT (which is usually the case) there will be a space after the $ sign. If the field value is 100,000nT or greater, the space will be replaced with a '1'.
S	Signal strength of reading. This is a raw number generated by the magnetometer that gives (in part) a good indication of the quality of the final total field measurement. Anything over 800 is considered an acceptable signal, and anything over 1300 is considered excellent. It is identical to the signal strength value in the other data formats, multiplied by 10.
D	Towfish Depth. The value shown is in units of 0.1 meter. If the towfish depth exceeds 999.9m, an extra digit will be displayed. **Important**: if a leak is detected, this value will consistently read 9999.
CR	Carriage Return (ASCII code 13).
LF	Line Feed (ASCII code 10).

table 6-5: SIS1000 compatible data format description

6.4 Gradiometer Format

When conducting a gradiometer survey (see section 4.1), the following data format will be displayed in the main terminal when the magnetometers start cycling:

```
*YY.JJJ/HH:MM:SS.S F[FFFFFF.FFF SSS TTTT DDDD.D !!!] R[FFFFFF.FFF SSS TTTT DDDD.D !!!] -GRADIENT
```

Refer to table 6.1 for the meaning of the letters in italics. An example of a typical string is as follows:

```
*02.233/09:33:45.0 F[056397.170 244 0197 0316.6 ___] R[056397.224 129 0197 0316.8 ___] -000000.054
```

Note that the string has two bracketed areas, beginning with 'F' and 'R' designators. This means that the information following in the bracketed area refers to the Front and Rear towfish respectively.

The last column is the difference in the measured field value between the two towfish (F-R). To obtain the true magnetic gradient, divide the value by the distance between the two towfish.

Note that the underscores in the warning message fields for each towfish represent that no warning messages are occurring (see table 6-3 for warning messages).

7 Interfacing to a Side Scan Sonar

A SeaSPY towfish can be towed simultaneously with a multitude of different side scan sonar units. A variety of factors, including connection details, deployment method, and operating parameters will vary depending on the type of side scan you are working with. The SeaSPY must be configured differently depending on the side scan system being used. The following table shows the relevant differences between each system.

Side Scan Model	Analog/ Digital	Comm	Output Voltage	RS232 Baud Rate	Data String Format	Mechanical Interface
Benthos SIS-1000	Digital	1-way	24-30VDC	9600bps	SIS-1000	Slot
Benthos SIS-1500	Digital	1-way	60VDC	9600bps	Standard	Slot
Benthos SIS-1624	Digital	2-way	24-30VDC	9600bps	Standard	Slot
Benthos SIS-1625	Digital	2-way	24-30VDC	9600bps	Standard	Slot
Benthos C3D	Digital	2-way	24-30VDC	9600bps	Standard	Slot
C-MAX CM2*	Digital	1-way	24VDC	9600bps	Standard	Tab
Edgetech DF-1000	Digital	1-way	60VDC	1200bps	Compact	Slot
Edgetech DT-1	Digital	2-way	24VDC	9600bps	Standard	Slot
Edgetech 4200	Digital	2-way	24VDC	9600bps	Standard	Slot
Edgetech 2000-DSS	Digital	2-way	24VDC	9600bps	Standard	Slot
Edgetech 2400	Digital	2-way	24VDC	9600bps	Standard	Slot
Geoacoustics 2000	Digital	2-way	32VDC	9600bps	Standard	Slot
Klein 2000	Digital	1-way	200VDC	2400bps	-	-
Klein 3000	Digital	2-way	200VDC	9600bps	Standard	Tab
Klein 3000H	Digital	2-way	200VDC	9600bps	Standard	Tab
Klein 5000	Digital	1-way	200VDC	2400bps	-	-

*If the C-MAX CM2 is fitted with a depth sensor, this depth sensor reading will replace the SeaSPY one.

table 7-1: Side Scan parameters by model

7.1 Analog Systems

In general, interface to an analog side scan sonar system requires the use of a tow cable that is capable of carrying the sonar signal and SeaSPY telemetry on separate conductors. Electrically, this is identical to running both systems stand-alone, but packaging their tow cables under a single jacket for most of the deployment length.

Since this type of interface depends on the type of tow cable used more than the actual type of side scan unit deployed, these types of integrations will almost always be custom-made for a specific configuration or application. Operation of the SeaSPY towfish is exactly as it would be in a stand-alone configuration.

7.2 Digital Systems

Interface to a digital side scan sonar system involves sending the digital data output from the SeaSPY towfish to a data input port on the side scan unit. The side scan unit's telemetry is then used to relay the magnetometer data to the surface, where it is then decoded from the side scan data stream. Also, the SeaSPY towfish draws power directly from the side scan unit.

Interfacing a SeaSPY to a digital side scan sonar system is inherently more complex than to an analog system, but it has the benefit of not requiring extra conductors in the tow cable. Furthermore, fewer components are needed topside, since only a single telemetry decoder is required. This allows the SeaSPY to simply 'plug in' to an existing working setup.

Clearly, the two instruments work very closely together in such a configuration. Specific design features have been added to SeaSPY magnetometers, and to several side scan products to allow seamless, trouble-free operation together. Table 7-1 shows the side scan products that are currently supported by the SeaSPY design, and have been tested by Marine Magnetics. In all cases, a magnetometer interface kit is required from the side scan sonar manufacturer.

7.3 Communication

Some side scan systems provide bidirectional communication with the SeaSPY. With these systems, the SeaSPY is controlled the same as in stand-alone mode. Only the baud rate has to be programmed correctly before deployment. For side scan systems that provide only one-way communication, the SeaSPY must be fully configured before deployment since no commands can be sent down to the towfish after it is connected to the side scan unit. Data can only be transmitted up from the fish. All settings including sample rate and tuning mode must be programmed with a PC prior to deployment using the patch cable and AC power supply that are shipped with the side scan interface kit.

7.4 Baud Rate

The SeaSPY baud rate can be configured using the **B** command. Ensure that the SeaSPY baud rate matches that of the side scan unit being used. Note that if the baud rate is not set correctly prior to connecting the towfish to the side scan unit, no communication will be possible even with a bidirectional side scan system.

7.5 Power

The SeaSPY Side Scan Integration electronics will accept input voltages ranging from +24 to +225VDC and generate +20VDC to power the magnetometer. If the output current to the magnetometer exceeds 0.5A, an internal fuse will trip and stay tripped until the output load returns to a reasonable level. It will then automatically reset itself. A short in the tow cable or at the brass tow connector will not cause damage to either the interface electronics or the side scan system itself.

The SeaSPY Side Scan Integration can also be powered through the test cable provided using the standard AC Power Supply included with each SeaSPY.

ALWAYS ENSURE THAT THE SIDE SCAN UNIT IS OFF BEFORE CONNECTING OR DISCONNECTING THE INTEGRATION!!!

7.6 Mechanical Tow Point

The Side Scan Integration consists of a stainless steel interface housing that functions as a tow point, and contains power conditioning and interface electronics. The interface housing is permanently connected to a 10m tow cable that is terminated with a standard SeaSPY brass tow connector on the other end.

The interface tow point connects to an extension bar that is fastened to the side scan towfish at its center of gravity or at the rear of the platform for heavier units. The side scan tow cable connects to the top of the bar, and the SeaSPY interface clips directly to the bar with a clevis pin (provided), through a universal link that allows full rotation in two dimensions. There are two different types of universal links available (a tab or a slot), depending on which side scan system is being used.

8 Calculating Towing Depth

Controlling the depth of the SeaSPY towfish during a survey is essential to obtaining good results. The following factors will influence the depth of the towfish while towing.

1. Survey speed (slower=deeper)
2. Deployed tow cable length (longer=deeper)
3. Weight of tow cable (heavier=deeper)
4. Weight of towfish (heavier=deeper)

The above may seem obvious, but it is important to note that they are the only factors that will affect towfish depth. Manipulation of these four variables is the only way to regulate the depth of the towfish.

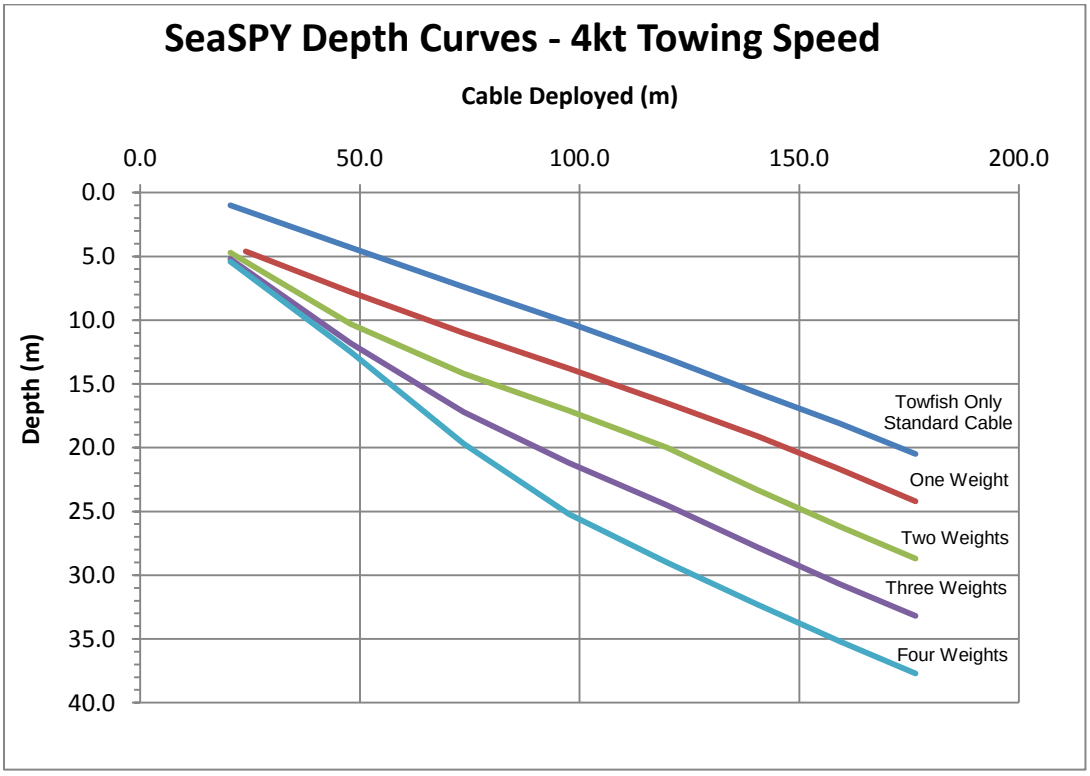


figure 8-1: Towing depth of the SeaSPY with various weight configurations at a typical towing speed of 4 knots. Each cable weight weighs 2721g

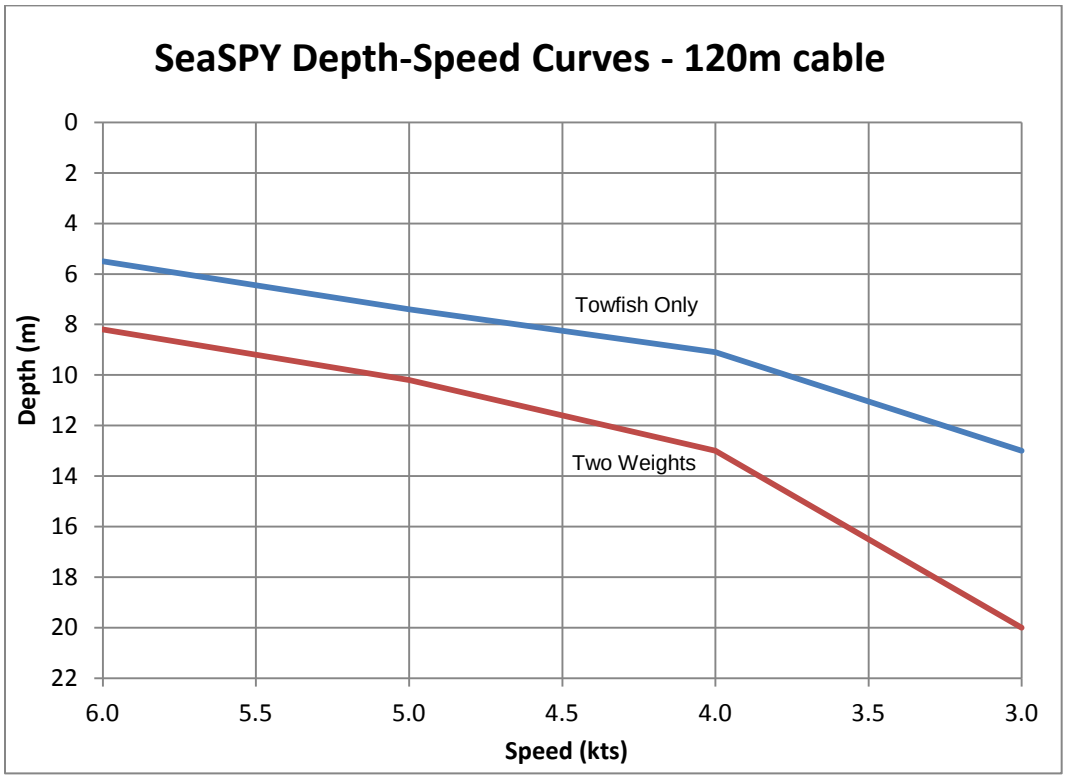


figure 8-2: Towing depth of the SeaSPY at various towing speeds between 3 and 6 knots with 120 m of cable deployed

9 Inside the Towfish

9.1 Standard Towfish

SeaSPY has a modular construction that allows for quick and easy connection and disconnection of all components and parts. For normal use, the only connection you will have to think about is the main brass tow connector. Sometimes it becomes necessary to access the internal components of the towfish - for example if you suspect something has become damaged. This section describes how to access the internal components and what these components do.

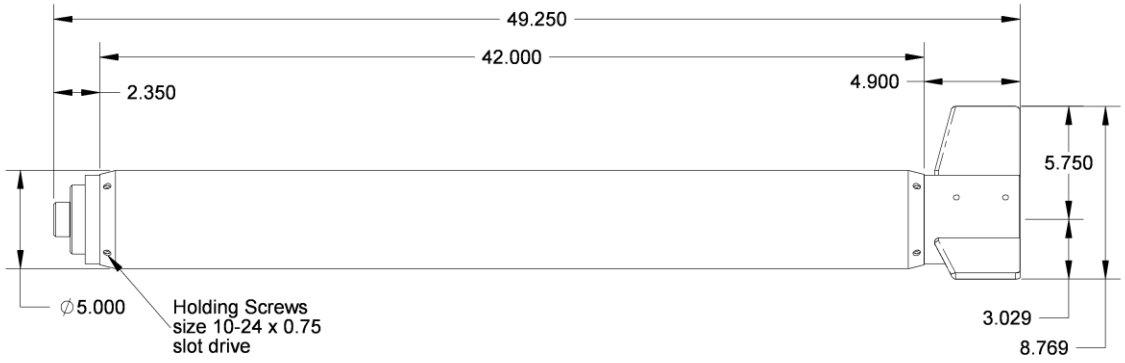


figure 9-1: Standard 1000m SeaSPY towfish dimensions

To open the towfish, remove the four brass holding screws near the nose of the towfish, as indicated in figure 9-1. All of the towfish internals are fastened to a rack that is bolted to the nose section. Once the screws have been removed, pull out the nose section to remove the internal assembly.

WARNING! When sliding out the internal assembly, be very careful not to drag the leak detector along the bottom of the inside of the housing. This can damage the smooth seal finish of the housing, and can also damage the wires leading to the leak detector.

Do not leave the towfish internals installed halfway into the housing. If you need to access the internal assembly, remove it completely from the towfish housing until you are ready to reassemble the towfish.

Figure 9-2 clearly shows all elements in the internal structure. The electronics module and Overhauser sensor are individually replaceable. Note the position of the leak sensor. If your towfish has warned of a leak, you will need to make sure that this sensor is completely dry before redeploying your towfish.

Up to four extra lead weights can be easily added to a standard towfish assembly (for a total of eight). Extra weight will increase your nominal towing depth, and will also increase rotational stability in rough seas. Contact Marine Magnetics to obtain extra weights.

The altimeter-equipped towfish is slightly different. The main difference between an altimeter-equipped towfish and a standard towfish is a larger nose that is necessary to accommodate the transducer. In addition, some extra electronics are included to supply power to the altimeter. These electronics limit the number of extra lead weights that can be added to a towfish to two (for a total of six).

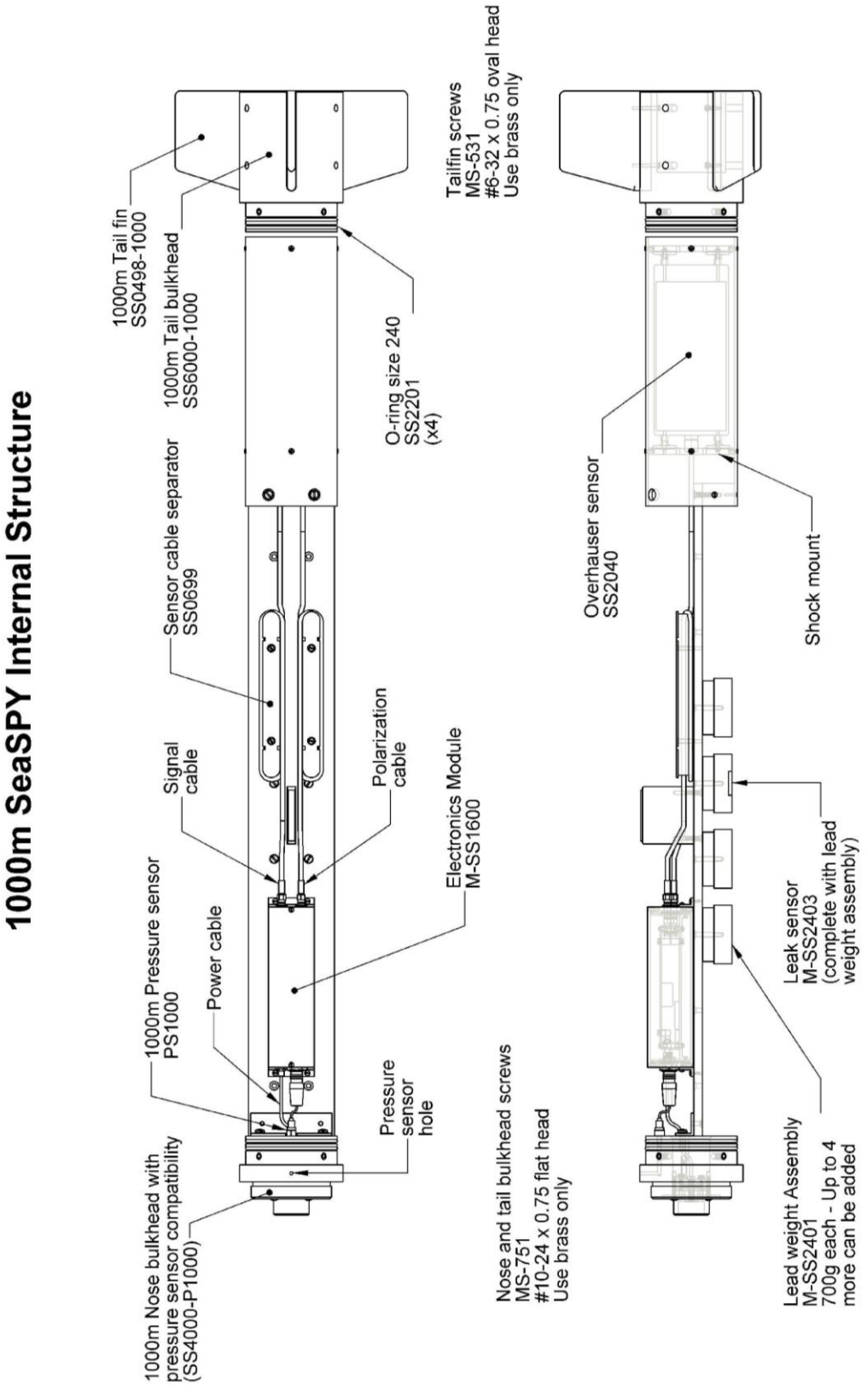


figure 9-2: SeaSPY internal structure

10 Maintenance

A SeaSPY system is designed to withstand years of use in harsh marine environmental conditions. If some simple procedures are observed when deploying and storing the instrumentation, your SeaSPY system will continue to deliver high quality performance with no need for service at the Marine Magnetics facility.

10.1 Deployment and Storage Tips

- When connecting the main tow connector, ensure that the alignment slot is properly inserted into the groove, and that the male connector is fully inserted. Tighten the holding nut firmly, making sure that any air pressure inside the connector is completely overpowered.
- Use a tow speed and cable length combination that keeps the towfish submerged at least 1m below the surface, and as far below waves and swell as possible if the water is rough. Other than this, there is no restriction on tow speed.
- Do not, under any circumstances, exceed the maximum rated operating depth of the towfish. In some cases, permanent damage may occur to certain components (such as the pressure sensor) if the towfish's rated depth is exceeded by even a small amount.
- Rinse the towfish with fresh water after removal from salt water. Surface corrosion of the brass fittings and screws will only significantly take place after exposure to atmospheric oxygen in the presence of salt water. Rinsing with fresh water will keep the brass fittings clean and shiny.
- Blow out the pressure sensor hole with compressed air after removal of the towfish from salt or fresh water. Stagnant water in the pressure sensor hole can cause pitting corrosion of the pressure sensor after long-term use.
- Do not store the towfish in direct sunlight, and keep it away from very hot environments. The operating and storage temperature range for a towfish is -40°C to +60°C, but an unsheltered towfish in a sunlit area can easily exceed +60°C. Keeping the towfish stored in moderate temperatures will prolong the lifetime of the seals and the internal electronics.

10.2 O-ring sizes

All O-rings used in the SeaSPY towfish are made from 70-durometer nitrile-rubber. All sizes are ASTM. The only 'consumable' O-rings in the towfish, i.e. the only O-rings undergoing repeated motion, are the size 022 rings used on the male tow connector. Other O-rings will not need replacement unless the towfish itself is disassembled and the O-ring receives mechanical damage.

When replacing O-rings, ensure that the new O-rings are well greased and free from dust and dirt particles. Also ensure that a coating of grease exists on the mating surface, and that it is free from scratches or gouges.

Size	Quantity	Location
020	1	Female towfish connector between brass flange and black isolator
022	2	SeaSPY male tow connector
029	1	Female towfish connector between brass flange and nose bulkhead
030	2	Electronics module housing
240	4	1000m and 3000m SeaSPY nose and tail (70D)
240	2	6000m SeaSPY nose and tail (radial-70D)
247	2	6000m SeaSPY nose and tail (facial-70D)

table 10-1: SeaSPY O-ring sizes

11 Troubleshooting

The transceiver provides detailed diagnostic information about the status of the system. It is important to ensure that the transceiver is working properly before trying to diagnose and fix other issues. **Disconnect all cables from the transceiver before proceeding.**

11.1 Transceiver Test Procedure

1) Power the transceiver

Connect the *AC Power Supply* or *Battery Clip* cable to the power source and then to the transceiver.

2) Check the status of the *Power* LED

If the ***Power* LED is orange** then the transceiver has powered up properly. Proceed to step 3.

If the ***Power* LED is off** then the transceiver is not receiving power. Verify the connection from the power supply to the transceiver and from the power supply to the AC power lines. If you are using a battery, check the battery voltage. The transceiver requires an input voltage in the range of +9 to +28VDC. Use a voltmeter to verify the voltage across pins 1 and 2 on the 3-pin connector that plugs into the transceiver.

If the ***Power* LED is red** then the transceiver is experiencing an output overload that is causing the internal poly-fuse to trip. This usually indicates a short on the output path of the transceiver. If this occurs with nothing connected to the output (2-pin connector) of the transceiver then verify that nothing is shorting the pins on the 2-pin connector, and then contact Marine Magnetics directly for assistance.

If the ***Power* LED is green** then the towfish is connected. Remove the deck leader cable from the transceiver and start the checklist again. If the deck leader cable is not connected then the transceiver is not working properly. Contact Marine Magnetics directly for assistance.

3) Check the status of the *Comm* LED

The *Comm* LED should be off if no towfish is connected. If the *Comm* LED flashes blue without a towfish connected, the transceiver may be malfunctioning. Contact Marine Magnetics directly for assistance.

4) Connect the transceiver to your PC using the RS232 or USB cable

Identify which COM port the transceiver is connected to. If you are using the USB cable then a virtual COM port will be created if SeaLink is installed. You can check the COM port using Windows Device Manager.

5) Configure SeaLink software communication settings

Open SeaLink and go to File->Preferences. Under the *Input Streams* tab, enter the COM port under the *Port 1* field and the baud rate (default=9600) under the *Baud* field. Press *OK* to apply settings and close the preference window. If the settings are correct, SeaLink will automatically recognize the transceiver and will display its serial number in the terminal window. For more information about using SeaLink refer to the SeaLink Software Operation Manual.

6) Issue the Scan Sensors command (d or D)

The response from this command should be a single line of data in the terminal window indicating the output levels from the transceiver (e.g. Output 47.4V, 001mA, 00.0W). Verify that the power consumption is zero and that the output voltage is around 48V.

7) Connect the SeaSPY to the transceiver

Ensure that the magnetometer, tow cable and deck leader are all connected when the deck leader cable is connected to the transceiver. If everything is connected properly then the *Power* LED should turn solid green and the *Comm* LED will flash blue temporarily while the SeaSPY transmits its start-up header string. If the *Power* LED turns red then there is a possible short in one of the cables, which can be caused by a damaged cable or connector. Refer to table 11-1 for troubleshooting details.

11.2 SeaSPY Test Procedure

If the SeaSPY is communicating properly, then the following procedure will verify that the magnetometer is operating correctly and is ready for a survey.

1) Check the clock

Issue the **t** or **SPC** command twice to check the clock. Verify that the time has advanced from one line to the next.

2) Scan the sensors

Issue the **d** or **D** command to check the state of the towfish. If you are using an Isolation or Gradiometer Transceiver then it will respond to the command with the first line of data before the SeaSPY responds with the second line. With a Side Scan Integration only the response from the SeaSPY (line 2) will appear. The following is a sample response to the **d** command. Note that the altitude field will only be present if the magnetometer possesses an altimeter.

Output 48.3V, 078mA, 03.8W
S:005 B:+47.7V T:+021.7C D:-000.3m A:000.00m L0

The output voltage should be close to 48V and the current will depend on the state of the system. For an altimeter-equipped magnetometer, the current draw should be around 75mA in idle and without an altimeter it should be close to 10mA.

3) Activate the RF polarization circuit

Issue the **r** command to activate the polarization circuit and then send the **d** command again. You should notice the current draw increase by about 40mA with the RF circuit activated. Deactivate the polarization circuit with the **r** command.

4) Zero the depth sensor

If the depth sensor is reading greater than +0.005m while out of the water then you should zero the pressure sensor using the **p** command.

5) Prepare for an environment test

In order to perform the environment test, the magnetometer needs to be far from any magnetic material. If you are testing on land then ensure that the

magnetometer is far from any buildings or other ferrous material. If you are on a vessel then deploy the magnetometer from the stern at a distance of at least 3 times the length of the vessel.

6) Perform an environment test

Issue the **o** (oh) command to perform an environment test. If it passes, you should see a message similar to the following.

Initiating Self-diagnostic
Amp test: 193 – Passed
Initiating Self-diagnostic
Noise Test: 000 0367 – Passed
Noise Test: 001 0351 – Passed
Noise Test: 002 0348 – Passed
Noise Test: 004 0409 – Passed
Noise Test: 008 0485 – Passed
Noise Test: 016 0460 – Passed
Noise Test: 032 0978 – Passed
Noise Test: 064 0634 – Passed
Noise Test: 128 0732 – Passed
Checking gradient – Passed

If it fails one of the noise tests, try the test again, as there may be some ambient noise interfering with the sensor. If it continuously fails the test, move the SeaSPY to a different location and try the test again, as there is too much interference in its current location.
When the SeaSPY passes an environmental test it is in a location where it should be able to take good readings of the magnetic field.

7) Start Sampling

Start cycling at 1Hz by issuing the **3** command and take 5 to 10 sample readings. Each reading should be similar to the following.

**06.327/15:16:47.0 F:055294.465 S:192 D:+000.1m L0 0965ms Q:99*

Systems equipped with an Altimeter will display a message similar to the following.

**00.001/00:00:22.0 F:055056.525 S:178 D:+010.9m A:000.00m L0 0965ms Q:99*

Notes:

- The value of the F: field may differ significantly when tested at your location.
- The value for S: should be between 130 and 200 for good quality readings.
- The value for the ms reading should be 965 when F: is greater than 42000 and it should be 465 when F: is less than 42000.
- The value of Q: should always be 99 if the SeaSPY is taking proper readings.

If the SeaSPY passes all of these tests then it is functioning properly and is ready for operation.

11.3 Side Scan Integration Test Procedure

The following procedure can be used to test a SeaSPY with a Side Scan Integration unit. Before connecting the magnetometer to the side scan unit, you can use the test cable to verify that everything is operating correctly.

1) Connect the test cable to the Side Scan Integration

Attach the 3-pin connector to the AC power adapter or battery clip cable and the female DB9 connector to the serial port on your computer. The female 8-pin Subconn connector attaches to the Side Scan Integration unit.

2) Configure SeaLink software communication settings

Identify which COM port the integration is connected to. This can be done using Windows Device Manager. Open SeaLink and go to File->Preferences. Under the *Input Streams* tab, enter the COM port under the *Port 1* field and the baud rate (default=9600) under the *Baud* field. Press *OK* to apply settings and close the preferences window. For more information about using SeaLink refer to the SeaLink Software Operation Manual.

3) Connect the Side Scan Integration to the SeaSPY

Attach the tow connector end of the Side Scan Integration cable to the magnetometer. The blue LED on the Side Scan Integration should flash momentarily as the SeaSPY sends its start-up header string to the PC. You should see this data appear in the command window of SeaLink. The LED will flash anytime data is received from the magnetometer.

4) Follow the SeaSPY test procedure outlined in section 11.2

5) Connect to the side scan unit (powered off)

ALWAYS ENSURE THAT THE SIDE SCAN UNIT IS OFF BEFORE CONNECTING THE INTEGRATION! Disconnect the Side Scan Integration test cable and connect the integration directly to the side scan unit using the 8-pin Subconn connector.

6) Follow the side scan manufacturer's instructions for operating with a magnetometer.

Table 7-1 shows the standard configuration for operation with the most common side scan units.

7) Repeat the SeaSPY test procedure outlined in Section 11.2 to ensure that the system is still working properly.

ALWAYS ENSURE THAT THE SIDE SCAN UNIT IS OFF BEFORE CONNECTING OR DISCONNECTING THE INTEGRATION!!!

11.4 Gradiometer Test Procedure

1) Follow steps 1 through 6 of the test procedure in section 11.1

2) Set the transceiver to MAG mode

Issue the **c** command to check the mode of the transceiver. If the transceiver is in GRAD mode then press **y** to switch to MAG mode and then **f** to select the front towfish. If the transceiver was already in MAG mode then press **n** to abort.

3) Connect the rear towfish

Complete step 7 of section 11.1 using the rear towfish. For a longitudinal gradiometer, the front towfish is the one with a tow connector on the front and back of the towfish whereas the rear towfish only has a tow connector on the front. For a horizontal gradiometer, the front and rear towfish can be arbitrarily selected since both towfish are identical aside from their serial numbers.

4) Check the serial number of the rear towfish

Issue the **!** command to query the serial number of the rear towfish.

5) Start SeaSPY Test Procedure

Perform steps 1 through 4 of the SeaSPY Test Procedure from section 11.2 on the rear towfish.

6) Repeat with the front towfish

Disconnect the rear towfish and connect instead the front towfish. Repeat steps 3 to 5.

7) Connect both SeaSPYs

For longitudinal gradiometers, use the Interfish Cable to connect the rear towfish to the back of the front towfish.

8) Set the transceiver to GRAD Mode

Issue the **c** command to enter into GRAD mode. The serial numbers for both towfish will displayed. Ensure that they are correct or press **y** when prompted to change the serial numbers if necessary.

9) Perform SeaSPY Test Procedure

Perform the SeaSPY Test Procedure from section 11.2 on the entire gradiometer system. You should expect the output power from the transceiver to be double what it was with a single magnetometer. Note that the environment test cannot be performed in GRAD mode.

11.5 Troubleshooting Specific Issues

The following table (table 11-1) addresses specific issues that may occur. For more details or other issues please contact Marine Magnetics directly.

Symptom	Possible causes	Solution
Transceiver *Power* LED is off	• Insufficient power is being supplied to the transceiver	• Verify the connection from the power supply to the transceiver and from the power supply to the AC power lines • Check the battery voltage • The transceiver requires an input voltage in the range of +9 to +28VDC. Use a voltmeter to verify the voltage across pins 1 and 2 on the 3-pin connector that plugs into the transceiver
Transceiver *Power* LED is red ***OR*** ***Output Overload!*** ***OR*** **Towfish is drawing more current than the maximum specification**	• There is a short in the cable or in the SeaSPY • Water is present in the circuit • Gradiometer towfish is being used alone without a plug in the rear tow connector • Slip-ring is wired incorrectly	• Starting from the towfish end of the system, remove one component or cable at a time until the LED turns orange • If the LED remains red with the deck leader disconnected from the transceiver then try cycling the power to the transceiver • If the cable is determined to be the issue, then examine it for cuts or leaks and inspect connectors for damage or shorts • If the SeaSPY is determined to be the issue, then inspect the connector. • Using an ohmmeter, verify that none of the cables or connectors are shorted
Transceiver *Power* LED is orange ***OR*** **Towfish is drawing less current than the minimum specification**	• No towfish is connected	• Connect the towfish • Make sure enough voltage is being supplied
No response from the towfish	• Error in the equipment setup	• Make sure all cables are connected and the *Power* LED on the transceiver is green • Make sure baud rate and communication protocol of the terminal software are set correctly

Communication issues	• Insufficient voltage • Damaged cable • Poor wiring or grounding through slip-ring • Gradiometer incorrectly configured	• Check the voltage going to the towfish • Inspect all cables for damage • Inspect the slip-ring connections • For gradiometers, make sure that the towfish serial numbers are correct and that the transceiver is set to GRAD mode
Poor magnetic field readings	• External noise on the sensor • Power supply amplifiers are adding noise to the system	• Move the towfish to a different location and run the environment test again • Avoid interferences such as radio waves, train tracks, on-board generator • Use batteries instead of AC power
Towfish leak	• SeaSPY housing damaged from impact • SeaSPY sensor bottle damaged from impact • Damaged O-ring • Maximum depth rating exceeded for SeaSPY • Gradiometer towfish used alone without a plug in the rear tow connector	• Shutdown towfish • Retrieve towfish immediately • Unscrew nose bulkhead • Check for water or sensor chemical • If water is present then examine housing and O-rings for damage • Check plug for gradiometer towfish

table 11-1: Troubleshooting specific issues

11.6 Electrical Specifications

The following table shows the expected measurements under working conditions. If you are experiencing abnormal results then consult table 11-1 for troubleshooting tips.

Location	Parameter	Min	Typ.	Max	Units
Transceiver	Input Voltage	9	24	28	V
@ 24V	Input Current (no towfish)	60	66	184	mA
	Output Voltage	47.5	48	48.5	V
	Output Current	-	-	500	mA
Side Scan Integration	Input Voltage	24	-	225	V
	Output Voltage	19	20	21	V
	Output Current	-	-	500	mA
SeaSPY	Input Voltage[1]	15	48	50	V
Cycling	Input Power	-	3.6	7.2	W
Standby @ 48V	Input Current[2] (no altimeter)	10	15	20	mA
Standby @ 48V	Input Current[2] (with altimeter)	75	80	85	mA
Cycling @ 48V	Input Current[2] (no altimeter)	65	75	85	mA
Cycling @ 48V	Input Current[2] (with altimeter)	120	135	150	mA
Tow cable	Resistance (along conductors)	-	15	-	mΩ/m
	Resistance (between conductors)	10	∞	-	MΩ

Notes:

1) The voltage will drop over extremely long cables and may cause the current consumption values to increase. This is normal. For optimum results, we suggest performing these tests over as short a cable as possible.

2) When the system is in standby, the current consumption will be quite constant. When a command is sent to the towfish, a short jump in the current consumption can be observed, which is due to the towfish communication circuitry powering up momentarily.

table 11-2: Electrical specifications

12 How to Reach Us

If you encounter a problem using your SeaSPY system, you should contact the distributor that you received the product from. You can also contact Marine Magnetics directly at the address mentioned below. If you have access to the Internet, our World Wide Web page offers support in the form of documents and file utilities, as well as information on product updates.

Marine Magnetics

135 SPY Court
Markham, ON L3R 5H6
Tel: 1 905 479-9727 fax: 1 905 479-9484
Email: support@marinemagnetics.com
URL: www.marinemagnetics.com

13 Warranty

All of the equipment manufactured by Marine Magnetics, with the exception of consumable items, is warranted against defects in materials and workmanship for a period of twenty-four months from the date of shipment. This warranty is not transferable.

During the warranty period, if any defects become evident under normal use, the buyer must notify Marine Magnetics of the defect and describe the symptoms in writing. Within thirty days of receiving said notification, Marine Magnetics will take action to remedy the defect or problem by choosing one or more of the following courses of action:

1. Replace the defective item(s)
2. Request the buyer to return the defective item(s) to Marine Magnetics for repair.

During the warranty period, replacement or repairs to items as described in 1 and 2 will be made free of charge. However, Marine Magnetics' liability in such cases will not extend to transportation charges for any item to or from the buyer, or to any lost time or to other costs that the buyer may incur.

If the buyer requests a technician on-site to complete the repair(s), the buyer will pay for all of the lodging, food and local transportation costs while the technician is affecting the repair(s).

13.1 Indemnity

The Customer agrees to indemnify and save Marine Magnetics harmless from and against all loss, damage and expense whatsoever resulting from any personal injury or damages to property directly or indirectly caused by the Equipment or any part thereof during the term applicable to such Equipment, including the operation and handling of the Equipment.

13.2 Disclaimer

Marine Magnetics makes no representation or warranties and there are no conditions with respect to the merchantability, the suitability or durability of the Equipment or any part thereof for the purposes or uses of the Customer, unless the Customer notifies Marine Magnetics in writing of any defects in the Equipment or part thereof on delivery of such Equipment. All such Equipment or part thereof shall be deemed conclusively to have been delivered to the Customer in good and efficient working order and repair, and the Customer shall be deemed conclusively to have accepted delivery thereof on the date of delivery.