# FloScan

## Pre-Installation
## Technical Information

Diesel Systems

**7000-139-00B**

# FloScan

## Technical Information

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**INTRODUCTION**

With forethought and planning, FloScan Instruments can be installed with few problems. This booklet is designed to provide the insight needed to proceed in a logical and straightforward manner.

To successfully install FloScan's Meters and Sensors, both Mechanical and Electrical skills are required. The concepts outlined in Part 1. General Mechanical Information, and Part 2. General Electrical Information, aren't readily available. Your understanding of the data presented here will go a long way towards insuring a trouble free installation.

# GENERAL MECHANICAL INFORMATION

## Threaded Fittings

There are two basic types of threaded joints. One has tapered threads, which produce a metal to metal seal by wedging the threaded surfaces together, as the fitting is screwed in and tightened. The other has straight threads with no wedging action. It uses a static rubber o-ring for sealing. FloScan system components use tapered NPT threads.

Tapered threads have several advantages over straight or running pitch threads. If the fitting develops a leak, tightening the fitting a fraction of a turn usually stops it. Their sealing ability, however, depends on how carefully the threads are formed. In the real world threads usually have numerous imperfections and won't seal regardless of how much they're tightened, unless a thread sealant is used.

## USA Standard Pipe Thread, (NPT)

(**N**ational **P**ipe **T**hread) threads are tapered and shaped to engage the mating threads on their flanks. This leaves a spiral groove along their tips, which must be closed with thread sealer, (Dope). Modern sealers usually include thread lubricants. Thread lubricants are needed to prevent thread galling, and friction welding.

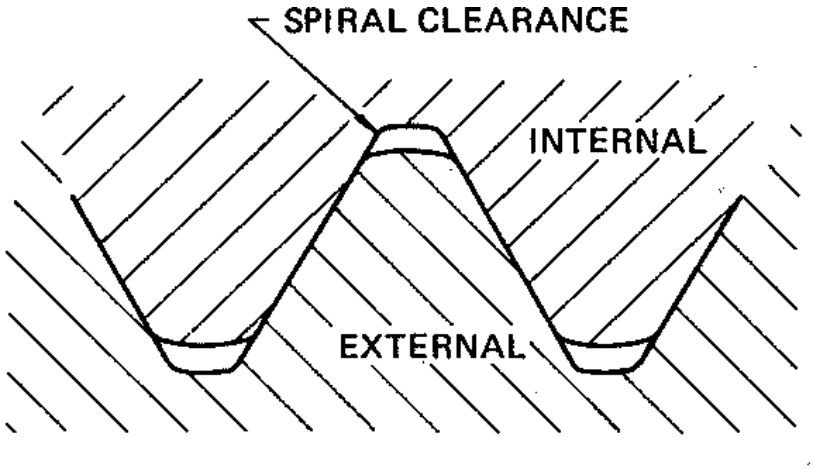


*Figure 1 WRENCH TIGHT NPT THREAD*

## USA Standard Dryseal Pipe Thread, (NPTF)

(**N**ational **P**ipe **T**hread **F**uels) are very similar to NPT pipe threads, except they are shaped to make first contact at their roots and crests. When the joint is made tight with a wrench, the thread crests are crushed until the thread flanks make full contact. They don't have the built in leakage path of NPT threads, but can still leak due to machining imperfections. When assembling NPTF fittings, a Thread Sealant-Lubricant must always be used.

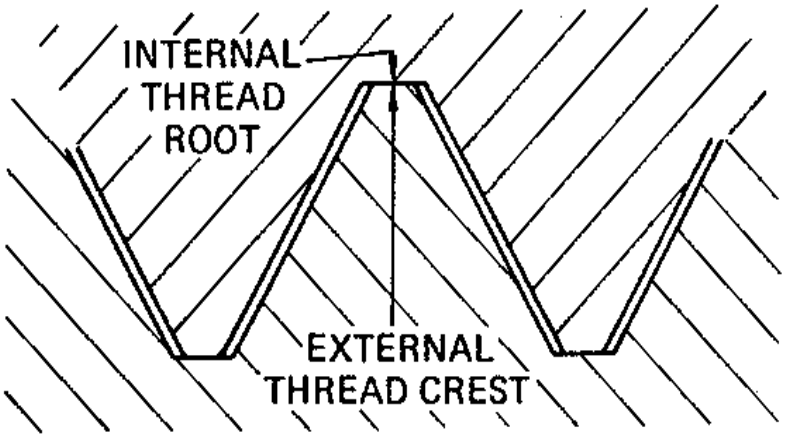


*Figure 2 HAND TIGHT DRYSEAL NPTF*

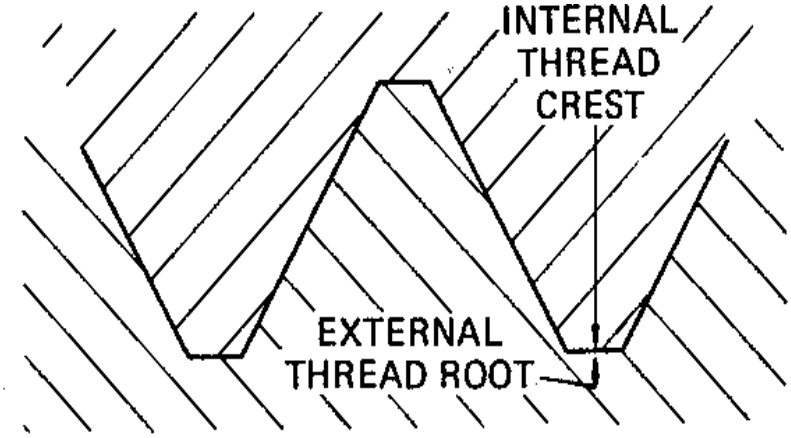


*Figure 3 WRENCH TIGHT DRYSEAL NPTF*

## Sealing Tapered Thread

Many sealants are available for sealing pipe threads. A Fuel Proof, Thread Sealant-Lubricant must be used when installing pipe thread fittings into FloScan's Zinc and die-cast Aluminum Fuel Flow Sensors, and Pulsation Dampers. Use caution when tightening pipe thread fittings as the lubricant all but eliminates, "Mechanics feel". Over tightening can crack or distort sensors and pulsation damper castings.

TFE-fluorocarbon, (Teflon) tape must never be used with FloScan system components for the following reasons:

- Teflon only lubricates. It won't seal any machining imperfections.
- Threads cut into brittle materials such as zinc and aluminum lack, "Spring-back" a property found in ductile materials like brass and low carbon steel. Spring-back increases the sealing efficiency of pipe threads. Its absence requires that an actual thread sealant be used.
- Teflon is solid and won't compress. As the fitting is turned, the Teflon shreds, and is extruded from the threads. These shreds are capable of jamming the sensor turbine and will cause it to fail.
- Solid Teflon adds to the wedge effect when tightening a fitting, making it easier to crack the sensor or damper casting.

## Flexible Fuel Hose

Vertical and horizontal fuel lines must be adequately supported, and securely clamped to those supports.

Diesel fuel system components installed after 31 July 1999 must meet the following standards:

- Flexible hose shall comply with the requirements of UL 1114, Marine (USCG Type A) Flexible Fuel-Line Hose, or SAE J1527, Marine Fuel Hoses.
- SAE J1527 does not pertain to totally metallic flexible hose.
- Hose capable of passing the 2 ½ minute fire test shall be marked, USCG Type A1 or Type A2.
- Flexible hose shall be equipped with permanently installed end fittings such as swaged sleeve or a sleeve and threaded insert, or may be secured with corrosion resistant metallic clamps.
- Clips or straps used for securing fuel lines shall be of corrosion resistant materials and of a design that eliminates the cutting or abrading action where it contacts the fuel line.

## Diesel Fuel Systems-Plumbing

Diesel engines usually have two fuel pumps. The, "Lift or Transfer" pump delivers fuel to the, "Injection" pump, and the injection pump sends it to the injectors. Fuel not used in combustion is returned to tank through the return line. There are 4 types of lift pumps in general use, (Diaphragm, gear, piston and vane). Diaphragm and gear pumps are usually bolted to the engine. Vane and piston pumps are usually incorporated in the injection pump. Lift pumps create a partial vacuum in the forward fuel line, allowing the atmosphere to push fuel through it. The theoretical maximum vacuum a pump can generate is 14.692 pounds per square inch, or 29.910 inches of mercury. By convention, vacuum is usually measured in inches of mercury, (1" Hg = 0.4912 PSI).

Vane and piston pumps, though more efficient than diaphragm pumps, are still limited in their ability to draw or lift fuel from the tank. Most engine manufacturers want fuel pump inlet vacuum kept to 10" Hg.

Every component plumbed into a fuel system contributes to that systems total pressure drop. At maximum flow, FloScan's forward sensors produce pressure drops of 1.1 to 1.63" Hg, depending on sensor and application. Other contributing factors are; fuel line length, inside diameter, numbers and types of fittings, height of the pulsation damper above fuel level, and micron rating of fuel filters.

## Forward Fuel Flow Lines

Careful planing, good plumbing practice, and a neat, orderly installation are required to successfully keep the fuel systems inlet vacuum under 10" Hg, (5 PSI). To achieve this you must:

- Size forward fuel lines and fitting I.D.'s, to keep fuel velocities between 2, and 4 feet per second.
- Make plumbing runs short and direct.
- Make radius bends in pipe or hose instead of using elbow fittings. Elbows will add the equivalent of seven + feet of fuel flow restriction to the system. They also generate turbulence.
- Use only, "Full Flow" hose fittings.
- Use hose of adequate length. Don't connect two or three shorter pieces together.
- Mount pulsation dampers no higher than necessary.
- Size Racor type fuel filters to minimize their pressure drop. It may be necessary to oversize the filter by 150%, or parallel two smaller filters.

Fixed pressure drops from the fuel tank lift pipe, suction screen, and flow sensors total approximately 5" Hg. This allows 5" Hg. for hose and pipe plumbing, Racor filter, and pulsation damper. If total inlet vacuum exceeds 10" Hg, the engine may be difficult to start and fuel starvation may occur at higher Rpm's.

Approximate Maximum Flow Rates through Schedule 40 Pipe & Fittings for Selected Line Velocity

| Pipe/Fitting Size | 2 Ft/Sec. | 4 Ft/Sec. | 10 Ft/Sec. | 15 Ft/Sec. |
|---|---|---|---|---|
| 1 / 8" .269" ID | 21.6 GPH | 43.2 GPH | 108 GPH | 162 GPH |
| 1 / 4" .364" ID | 36.0 GPH | 72.0 GPH | 180 GPH | 270 GPH |
| 3 / 8" .493" ID | 72.0 GPH | 144 GPH | 360 GPH | 540 GPH |
| 1 / 2" .622" ID | 115 GPH | 228 GPH | 570 GPH | 840 GPH |
| 3 / 4" .824" ID | 206 GPH | 396 GPH | 960 GPH | 1,500 GPH |
| 1" 1.049" ID | 330 GPH | 660 GPH | 1,620 GPH | 2,460 GPH |
| 1-1 / 4" 1.660" ID | 564 GPH | 1,140 GPH | 2,820 GPH | 4,200 GPH |

Table 1

Approximate Maximum Flow Rates through Fuel Hose for selected Line Velocity

| Fuel Hose Size | 2 Ft/Sec. | 4Ft/Sec. | 10 Ft/Sec. | 15 Ft/Sec. |
|---|---|---|---|---|
| 3 / 8 ~ .375" ID | 36.0 GPH | 72.0 GPH | 180 GPH | 270 GPH |
| 1 / 2 ~ .500" ID | 72.0 GPH | 144 GPH | 360 GPH | 540 GPH |
| 3 / 4 ~ .750" ID | 180 GPH | 360 GPH | 900 GPH | 1,500 GPH |
| 1 ~1.000" ID | 291 GPH | 582 GPH | 1,458 GPH | 2,190 GPH |

Table 2

Approximate Pressure Drop per Foot of Hose & Schd. 40 Pipe @ Selected Flow Rate and Line Velocity

| | 2 Ft/Sec. | 4 Ft/Sec. | 10 Ft/Sec. | 15 Ft/Sec. |
|---|---|---|---|---|
| Hose size | PSI GPH | PSI GPH | PSI GPH | PSI GPH |
| 3 / 8 | <.1 PSI @ 36 GPH | .1 PSI @ 72 GPH | 0.6 PSI @ 180 GPH | 1.1 PSI @ 270 GPH |
| 1 / 2 | <.1 PSI @ 72 GPH | .1 PSI @ 144 GPH | 0.5 PSI @ 360 GPH | 1.0 PSI @ 540 GPH |
| 3 / 4 | <.1 PSI @ 180 GPH | .1 PSI @ 360 GPH | .35 PSI @ 900 GPH | 1.0 PSI @ 1,500 GPH |
| 1 | <.1 PSI @ 291 GPH | .1 PSI @ 582 GPH | .23 PSI @ 1,458 GPH | 0.5 PSI @ 2,190 GPH |

Table 3

Approximate Pressure Drop for 2 Full Flow Hose Fittings @ Selected Flow Rate and Line Velocity

| | 2 Ft/Sec. | 4 Ft/Sec. | 10 Ft/Sec. | 15 Ft/Sec. |
|---|---|---|---|---|
| Fitting-" | PSI GPH | PSI GPH | PSI GPH | PSI GPH |
| 3 / 8 | <.1 PSI @ 36 GPH | .10 PSI @ 72 GPH | .55 PSI @ 180 GPH | 1.2 PSI @ 270 GPH |
| 1 / 2 | <.1 PSI @ 72 GPH | .13 PSI @ 144 GPH | 1.0 PSI @ 360 GPH | 1.5 PSI @ 540 GPH |
| 3 / 4 | <.1 PSI @ 180 GPH | .14 PSI @ 360 GPH | 1.3 PSI @ 900 GPH | 2.0 PSI @ 1,500 GPH |
| 1 | <.1 PSI @ 291 GPH | .10 PSI @ 582 GPH | .45 PSI @ 1458 GPH | 1.3 PSI @ 2,190 GPH |

Table 4

Pressure drops across standard fittings can be more than **SIXTEEN (16)** times higher than those across full-flow fittings, and higher still across medium and high-pressure fittings.

## Fuel Return Lines

Pressure drops across the fuel return line are not as critical as those on the inlet line. Using good system practice, plumb the return system so that fuel flow velocities go no higher than 10 feet per second.

## Hose Barb Fittings

Thin wall full flow hose barb fittings are designed to accommodate "FULL **PIPE-SIZE** FLOW" and provide unrestricted passage through the fitting. To achieve this and to maintain adequate wall strength, the hose barb end of the fitting is one size larger than the pipe thread end.

Reducer bushings, pipe nipples, and couplings may be required to connect the pipe thread end of the hose fitting to other system components, (Sensor, Pulsation Damper, Racor Filter, and Lift Pump). Though non-full flow standard fittings with the correct size pipe thread end are more convenient, they increase flow resistance considerably. Pressure drops exceeding 1 PSI per fitting are not uncommon. Properly sized full flow fittings have less than a 0.1 PSI pressure drop.

Barb-Tite, Push-Lok, and similar hose fittings which don't require hose clamps, have thick walls and relatively small inside diameters. They are good fittings, and can be used on the return line. If used on the forward line you may have to up size to the next larger hose and fitting to avoid excessive pressure drops.

## Swivel Fittings

There are 3 types of swivel fittings in common use.

1. 37 degree JIC, (Joint Industrial Congress) fittings.
2. 45 degree SAE, (Society of Automotive Engineers) fittings.
3. M-UFS & F-UFS, (Male or Female, Universal Female Swivel) pipe thread fittings, and pipe unions.

J.I.C, and S.A.E. swivel fittings are usually rated for medium and high-pressure applications. Their walls are considerably thicker than, "Reusable" clamp or band type, low pressure, full flow hose barb fittings. If used on the forward fuel flow line, you may have to up size to the next larger hose and fitting to avoid excessive pressure drops. UFS fittings and pipe unions should not be used on marine fuel systems.

If J.I.C. or S.A.E swivel fittings are used, their mating surfaces must be sealed with Copper Conical Sealing Washer, (Connie Seals). Connie seals may be purchased through Fittings Inc. in Seattle, WA
(206) 767-4670, 1-800-552-0632, or any hydraulic supply house.

Diesel engine fuel systems are usually protected by a "Primary" filter plumbed upstream of the engine's lift or fuel transfer pump, and a "Secondary" filter plumbed between the lift and injection pumps. Each filter type performs a different function, and both are needed for complete protection. The Primary Filter, Fuel / Water Separator (FWS) or Sedimentor is your main defense against water and heavy fuel contamination. It uses gravity and centrifugal force to remove free and emulsified water, and large contaminants. Engine manufacturers recommend that Sedimentors should also remove smaller particles in the 25-30 micron range. Many incorporate a 20 to 30-micron particle filter for additional cleaning. Using a primary filter under 20 microns results in frequent filter changes and a High Vacuum, fuel restricting pressure drop across the forward fuel line. They should be avoided.

Better quality secondary filters come with a drain port and are called Agglomarators. They also have the ability to trap suspended water droplets and remove them by coalescence. Fuel traveling at high velocity enters the filter housing where a swirling motion is created. After centrifugal force removes the larger particles, fuel passes through the secondary filter element, (Usually 7–10 microns) for its final cleaning.

## Filter Element Types – Depth & Surface

Filtration elements in use on today's Marine Diesel fuel systems fall into two categories, (Depth & Surface). In depth type filter elements, fuel is forced to travel a circuitous route through multiple layers of material. Contaminants are trapped because of the intertwining path that the fuel must take.

Surface type elements work by catching contaminants and holding them on its surface.

## Filter Element Micron Ratings – Nominal, Absolute & Beta Ratio

A nominally rated depth type filter element doesn't have one consistent hole, or pore size. Each element is assigned a, "Nominal Rating" such as 25 Micron, (1 micron = 1 millionth of a meter, or 0.000039"). A 25 micron rating means that the filter element's, "Mean flow pore size" is 25 Microns. Initially the filter will remove most contaminants 25 micron & under, but it will also allow a certain percentage of contaminants over 25 micron to pass through, (Percentages vary between manufacturers as there is no standard to follow).

Mean flow pore size is that pore size which allows half the fuel to pass through holes of equal or smaller size, while the remaining fuel passes through larger holes. In a nominally rated 25 micron filter, half the fuel flows through holes 25 microns or less, while the other half flows through holes larger than 25 microns.

An absolute filter rating gives the largest hole or pore size in the filter element. A filter with an absolute rating of 25 micron has no hole larger than 0.000975". In theory, the filter traps all particles larger than 25 microns, and most particles under 25 as well.

Beta Ratio is a method of comparing and rating filter performance. It is the ratio of particles before filtering to the remaining particles of the same size after filtering. If a filter is rated at Beta 25=75, it means that at the 25 micron particle size, the ratio of particles upstream, versus downstream of the filter is 75 to 1. At 25 microns this filter is 98.7% efficient.

## Filtration Media

Pleated paper is the most common depth type filter media used on fuel systems. They're manufactured by binding specially treated wood cellulose fibers with resin. When pleated, this process produces a structurally stiff paper with a high capacity to catch and hold dirt, a low absolute micron rating, and a greatly enhanced beta ratio performance.

Synthetic depth type elements are produced from several man made fibers including, dacron, fiberglass, and polyvinylchloride. Compared to cellulose, synthetic fibers have very smooth surfaces. A smooth surface greatly reduces fuel flow resistance, and allows for a much lower absolute micron rating.

Surface filters are manufactured by weaving steel wires or nylon monofilaments into wire screens or nylon cloth. These filters have a high or coarse micron rating and are used as fuel system pre-filters. They're sometimes used on fuel tank pick-up tubes, or up-stream of the primary filters.

# GENERAL ELECTRICIAL INFORMATION

## Wiring

Good wiring practice is vital for achieving a trouble free installation. If you do this part of the job right you will automatically eliminate many nuisance problems. The principles of good wiring are simple. Always use fuses or circuit breakers with ampere ratings of 30 to 50% greater than the maximum load they are intended to carry. Fuses should be in series with the hot-wire only, (Never fuse the grounded side). Fuses should be mounted as close to the power source and in as dry a place as possible. This will protect the greatest amount of wire from short circuits. Light grease applied to fuse clips will save them from corrosion.

Always use stranded copper wire conductors of the proper diameter, (AWG) for the installations electrical load & conductor length. Conductors should be run in sheathed pairs, (Duplex) or in sheathed multi-conductor cables. Good wiring practice and forthcoming USCG regulations dictate a minimum wire diameter on DC circuits of 16 AWG. 18 AWG may be used in sheathed pairs and in multi-conductor cables. FloScan Instruments require 18 AWG shielded conductors for wire runs up to 50 feet and 16 AWG shielded conductors for runs over 50 feet.

Conductors should be run in a wire way or along parallel boards for support. Wire runs should be made along the hull side or in the compartments overhead. It is poor practice to run conductors in the vessels' bilge. If conductors must be run in the bilge or in wet locations, all wiring and connections must be watertight. Conductors should be secured or clamped every 18 inches by one of the following methods:

1. Non-metallic clamps sized to hold the conductors firmly in place.

Non-metallic straps or clamps shouldn't be used over engines, moving shafts, and machinery, or in passageways if failure would result in a hazardous condition. The material must be resistant to oil gasoline and water and must not break or crack within a temperature range of -30 to +250 degrees.

2. Metal straps or clamps with smooth, rounded edges, sized to hold the conductors firmly in place without damage to conductor or insulation.

The section of conductor or cable directly under the strap or clamp shall be protected by means of loom, tape or other suitable wrapping to prevent injury to the conductor. In machinery spaces, metal clamps should be lined with a material resistant to the effects of oil, gasoline and water. Terminals, Studs, Lugs and Connectors.

## Terminals, Studs, Lugs and Connectors

Metals used for terminal studs, nuts, and washers shall be corrosion resistant and galvanically compatible with the conductor and terminal lug. Aluminum and unplated steel shall not be used for studs, nuts and washers. Terminal connectors shall be of the Ring or Captive Spade type. Wire connectors shall be of the Butt type. Friction type Snap, Bullet and Blade connectors may only be used if the voltage drop from terminal to terminal does not exceed 50 millivolts for a 20 amp current flow. The connection must be able to withstand a 6-pound tensile force exerted axially, for one minute.

- Twist on connectors, i.e., wire nuts must never be used.

## Soldering

Proper soldering technique is vital to good wiring. Use 63% Tin, 37% Lead, rosin core electrical solder. It has the lowest melting temperature and is the easiest to use. Don't use acid core plumbing solder or an acid based flux. Use only enough heat to make the solder flow freely into the crevices of the work. Use no more heat than this because excessive heat melts plastic insulation and will travel through the wire, causing semi-conductor damage in FloScan's Instruments and Sensors.

Many sins are committed in the areas of splicing, terminating and soldering. It's generally considered poor practice to use self insulating crimp on connectors in marine applications. Unfortunately, businesses use them almost universally because of the higher labor costs associated with soldering.

## Solder Connectors

Using only top quality, sleeveless, marine grade lugs and connectors. Strip the conductors' insulation so that the uninsulated conductor extends about 1/8th of an inch beyond the connector. With a crimping tool correctly sized for the wire gauge, crimp the connector onto the conductor. If properly crimped the connectors' mechanical connection on 18 AWG wire should be able to withstand a tensile pull of 10 pounds. 16 AWG wire should withstand a 15-pound pull. Put your clean and properly tinned soldering iron tip onto the connector. Heat the connector only enough to melt the solder. After soldering, while the connector is still hot, wrap 1½ to 2 turns of electrical tape around the connector end and wire insulation, or place and shrink a piece of Marine Grade Adhesive Heat Shrink Tubing around the connection. The tape or tubing relieves stress at the point where the connector is crimped and soldered onto the conductor. Soldering the connector and sealing it with adhesive heat shrink tubing creates an effective watertight barrier that prevents moisture and salt from wicking its way up the wire.

## Waterproof Heat Shrink Connectors

Molex-ETC manufactures a complete line of "Perma-Seal" connectors, and Anchor Marine Grade Products manufactures waterproof ring terminals and butt connectors for use on 10 to 22 AWG wire. The insulators on these connectors are adhesive lined heat shrinkable nylon tubing. When the connectors are properly crimped onto a conductor and their insulator heat shrunk, a strong watertight connection is formed. These connectors though costly, are easier to install, watertight, and meet all requirements for strength and stress relief.

## Junction Boxes

All wiring connections with the exception of connections made at the Flow Sensors, some Meter Heads, Instruments, AC Signal Generators, Alternators, Magnetic Sensors, and Engine Instrument Senders, shall be connected inside a Junction Box, using Terminal Blocks.

## Electro Magnetic Interference-Noise

Every piece of electronic equipment and every electrically operated device produce electrical vibrations or static. The list of electric noisemakers is endless, and include; relays, regulators, motors, tachometers, engine gauges, vessel rigging, drive belts, antennas, shafts turning in bearings, meshing gear teeth, fluorescent lights, depth finders, radar, radios, etc. Bottling this plethora of noise at the source isn't practical, and usually isn't done. Instead, noise sensitive equipment like FloScan Instruments must be shielded and properly grounded during installation.

Static is produced whenever electrons are boiled into the atmosphere from an offending piece of equipment. The only thing these electrons want is to get to Earth. To facilitate their journey we must create an, "Electron Superhighway" between our instruments and Mother Earth. This is accomplished through bonding, shielding, and grounding.

## Ground Plates

Ground Plates, Engine Beds and Winch Foundations serve a common purpose, they control vibrations. Beds and foundations control mechanical vibrations, ground plates control electrical vibrations. They provide an anchoring point for electrical equipment and an interface with Earth. Today's modern pleasure craft seldom have external, or even internal ground plates. There are several reasons for this, the primary consideration being economic.

Fiberglass and wood hulls lacking ground plates present definite challenges to the technician trying to eliminate electrical noise. If the vessel doesn't have a ground plate, an effective ground must be created through, "Bonding".

## Bonding

Electrically connecting the vessels' engines and metal objects with Copper strap will produce an adequate ground. It's not necessary that the ground actually be in contact with the water. We want as large a conducting mass as possible. This is achieved through extensive bonding, or connecting everything together. In twin engine vessels connect both engines. Connect them to the generator, hydraulic system, fuel tanks, reduction gear, propulsion shafting via shaft brushes, and water tanks. Anything that is metal and has some mass should be connected.

- Don't bond to any through-hull fittings. Their mass is small and connecting to them may cause Galvanic Corrosion elsewhere.

If the vessels other electronics are performing poorly, or suffering noise-related problems, a 4-inch to 6- inch wide, 26 gauge or thicker copper strip should be installed. Run the copper strip fore and aft along the inside of the hull, at or below the water line. Compared to Copper, seawater is a relatively poor conductor. This means that we need to contact the water over a large and spread-out area. A narrow strip 1inch wide by 10 feet long will work far better than a 12 inch by 12-inch sheet, even though it has less surface area. The actual area is less important than extending the strip as far forward and aft as possible. Bond the strip directly to the engines, reduction gears, propulsion shaft brushes, and everything else. The advantage of bonding to a copper strip is that it allows you to make short, direct connections, and increases the, "Ground's" efficiency.

## Skin Effect

AC noise and static are, "Broadcast" in the Radio Frequency, (RF) Spectrum. Current flowing through copper conductors at these frequencies tend to crowd towards the conductors outer surface. This is known as, "Skin Effect" and effectively increases the conductors' resistance to current flow. The actual current carrying depth of a conductor is only about .0015 inch, because of skin effect.

Use 2 to 3 inch wide copper strap when making bonding connections. Round conductors are inefficient due to their minimal surface area, and won't work nearly as well as flat strap.

## Shielding

Wiring between FloScans' Sensors, Tachometer Senders, and Instruments must be with shielded cable. Each pair of Sensors and each Tachometer Sender must have its own dedicated shielded cable. The shields, through their drain lines must be connected directly to ground in the engine room, and not through a ground buss. Make all connections short and direct.

## Ground

For our discussion the, "Electron Superhighway Interface" between vessel and Earth is, "Ground". Ground can be a:

- Ground Plate.
- Conducting Mass.
- Combination of Both.

It isn't:

- The Battery's Negative Terminal.
- The Negative Battery Buss.
- Wiring connected to the Battery's Negative Terminal or Battery Buss.

Connections to ground should be short and direct. The negative terminal and battery buss should be connected to ground, but ground connections shouldn't be made through them.