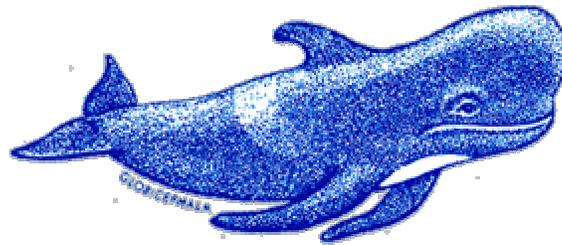


# INSTALLATION AND OPERATION MANUAL

## MODEL P-3D AUTOPILOT SYSTEM

W-H AUTOPILOTS, INC.

6 December 2016



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## WARNING

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A qualified man on watch is legally required whenever vessel is underway.

W-H autopilots are navigational aids designed, when installed in accordance with instructions furnished, to assist the man on watch to maintain the average course, which he selects.

These autopilots are **NOT** designed or approved to replace the man on watch, nor relieve him of the responsibilities required by the Rules of the Road for maintaining a good lookout or for continual safe navigation of the vessel.

Activate autopilot only in the open waters, well clear of other vessels or obstructions, and monitor heading at all times.

Be prepared to resume manual steering and inactivate autopilot immediately in the event that:

- 1) chosen heading is not maintained or abrupt heading change occurs.
- 2) an unscheduled change of heading occurs (11.11 Of Limited Warranty).
- 3) any situation arises wherein continuing set course might put vessel in jeopardy.
- 4) a radio signal interferes with the autopilot operation.
- 5) the autopilot has an electronic, electrical or hydraulic failure.

## P-3D AUTOPILOT SPECIFICATIONS

### 1. Type

Adjustable dead band, non-hunting system with variable rudder drive.

### 2. Controls on Pilot House Control (PHC)

**POWER SWITCH:** This four-position switch turns the system to Standby, Autopilot On, and Remote On or off.

In the “Standby” position:

- The “Dodge” buttons can be used for power steering in this mode (they become jog buttons).

**YAW:** This control adjusts the dead band (allowable compass deviation) from 1 to 12 degrees. It is normally kept in the fully counter-clockwise or #1 position for all but the worst seas.

**RUDDER GAIN:** This control adjusts the amount of rudder applied for a given amount of heading deviation from approximately .3 to 1.3 degrees of rudder for each degree of heading deviation. The normal setting for vessel cruising speed is in the fully counter-clockwise position at the #1 setting except when the boat is moving very slowly.

**AUTO WEATHER HELM (AWH):** A front panel switch turns the AWH off and on. It should normally be in the off position.

**DIM:** (Illumination adjustment) Press the "mode" switch down, then up for ADJ 1,2,3,&4. This will dim the pilot lights and display.

**DODGE BUTTONS:** (Port and Starboard) These buttons have green and red pilot lights which are on whenever the rudder is moving under power. A quick push will provide a permanent course change of 10 degrees. If held down the vessel keeps turning until released, at which time it will return to within 10 degrees of the original course. Quickly pushing the opposite button will return the heading to its' original course.

**TACK CONTROL:** When the Display/Tack toggle switch is held up, pressing the Port or Starboard dodge buttons will change the course by 90 degrees rather than 10 degrees. Pressing the dodge button a second time will add 10 degrees to the 90 degrees.

**GAIN BOOST:** Holding the Display/Tack toggle switch in the up position also increases the rudder gain 2 X temporarily. This is the “heavy weather” control, which brings the vessel back on course faster.

## **P-3D AUTOPILOT SPECIFICATIONS (Cont.)**

### **2. Controls on Pilot House Control (PHC) Continued**

**DISPLAY:** A four-digit LCD display has three main displays and a menu with four selectable functions. The main (and default setting) show the heading with 3 significant digits. In the standby position a small letter **c** precedes the 3 digits. This is the actual heading of the vessel. When the autopilot is activated, the small **c** (**c** stands for compass) changes to a large letter **A** (for Autopilot mode). **cXXX** indicates standby mode and boat heading. **AXXX** indicates Autopilot On and course heading. The heading shown is the frozen autopilot heading, which the unit steers to. It changes only when the 1 or 10 degree course change controls are activated.

When the display toggle switch is pressed again, the display will show the deviation to the next course. The first indication will be 5 degrees, then in 10-degree steps until 90 degrees is reached. At more than 90 degrees, the unit beeps and flashes the 90-degree reading. A **┌** symbol indicates the new course is to Port. A **└** symbol indicates a change to Starboard. This display operates only in the Autopilot On mode. If it is activated in the Standby mode, it will always read 000. (The display will also show this same reading in the Autopilot On mode when no course change has been called for. It will also show the new change in heading requested in the GPS interface mode even before this mode has been selected!)

**RED AND GREEN LIGHTS:** These lights come on whenever the hydraulic power pack is moving the rudder. They will flash on and off during normal autopilot operation as well as during power steering and dodge maneuvers.

### **3. Power Requirements**

- a. The electronic portions require about ½ amp of power at 12 vdc. The exact amount depends on the number of Rudder Angle Indicators and Remote Controllers installed and on whether the lights are dimmed or bright. Converters are available for operation with 24 or 32 vdc and 115 vac.
- b. The hydraulic power pack consumes from 3 to 22 amps (1/4 hp unit) at 12 vdc. This power consumption occurs only when the motor is running. Average power consumption can be as little as ½ to 2 amps per hour, depending on sea conditions.

## **P-3D AUTOPILOT SPECIFICATIONS (Cont.)**

### **4. Hydraulic Power Pack (HPP)**

Model HPP-1

- a. Oil Output: 0.5 to 4 cubic inches/second flow rate up to 1500-psi pressure. (Flow and maximum pressure adjustable by pulley size and electronic speed control).
- b. Ram Sizes Suitable: 6.5 to 15 cubic inches (balanced type only).
- c. Motor Rating: ¼ hp continuous duty, 144-in/oz torque at 1750 rpm. 22 amps at full load. Permanent magnetic field. A ½ hp, 24v motor is also available. Two ¼ hp 12v units are commonly used in vessels of 50 ft or more that have only 12 vdc available.

# **COMMON AUTOPILOT TERMS & DESCRIPTIONS**

## **PHC (Pilot House Control)**

The main control unit housing all controls usually mounted in the pilot house or nav station.

## **“JOG” (Power Steering)**

A method of steering using two buttons that activates the hydraulic power pack. The rudder moves as long as a button is held down or until rudder limit is reached. A rudder angle indicator is a desirable to indicate the rudder position. A model HC-2A-3 remote has rudder angle meter with lights installed.

## **PPS (Proportional Power Steering)**

A method of power steering using the hydraulic power pack, where the rudder position is proportional to the knob/lever position. The rudder goes to whatever position the knob/lever is and stays there until the control is repositioned. In general, this is a better way of steering than JOG steering, particularly for fast, quick responding boats.

## **Random On-Off Remotes**

A new technique devised by W-H to allow the autopilot to be turned on or off from any remote or from the PHC. No remote then depends upon any other station for its ability to completely function. Without this system, one always had to turn on the main PHC, then turn the PHC to remote 1 or 2, and then proceed to the remote station. Only W-H AP-4 and P-5 have this feature.

## **“Course Grabber” Feature**

Another concept devised by W-H to make autopilot operation easier. All W-H Autopilots can be turned on (no need to be on standby) and expected to immediately control the vessel on its existing course. W-H Autopilots never deviate from the existing course when turned on and operate instantaneously.

## **HPP (Hydraulic Power Pack)**

A unit normally supplied with autopilots that consists of a reversible DC motor coupled to a bi-directional hydraulic gear pump. It is connected into the main steering lines of a boat with manual hydraulic steering. It provides the power to move the rudder when the autopilot or power steering is activated.

## **COMMON AUTOPILOT TERMS & DESCRIPTIONS (Cont.)**

### **RAT (Rudder Angle Transmitter)**

This is the small waterproof unit that connects to the rudder arm. It is used to supply an electrical signal to operate the rudder angle indicators and supplies rudder angle data to the autopilot computer. It is also used when in the PPS mode.

### **RAI (Rudder angle indicator)**

An electrical meter calibrated in degrees, port or starboard that indicates to the helmsman where the rudder is.

### **Power Hydraulic Steering**

The hydraulic steering system found on many larger commercial vessels. The hydraulic pump is usually connected to the main engine. The helm units direct only the oil flow. Common trade names are Orbitrol and Sperry. To use an autopilot with such a system requires only the installation of electrically operated 4-way valves. Usually one valve is used for port-starboard and one for fast-slow speed. The valve solenoids are usually 12, 24, or 32 vdc or 115 vac. W-H builds solid-state controllers to accommodate all these voltages. No HPP is required for this system.

### **Manual Hydraulic Steering**

This is a common system for pleasure boats and commercial boats under 50 feet. This system uses energy applied to the helm unit to pump oil to the cylinder (or RAM) on the rudder arm. Commonly used systems include Hynautics, Teleflex-Capalano, and Wagner. An HPP with electric motor must be used for autopilot operation.

### **HEB (Headings Electronics Box)**

This box contains the electronics to operate the autopilot. It is used as the junction box for the system.

### **MC (Motor Controller)**

A medium-sized box supplied with all W-H autopilots that have a hydraulic power pack. It contains the solid-state circuitry to control the motor direction and speed. It is normally mounted within 3 feet of the hydraulic power pack. It needs its own separate power feed. [A #12 wire and a 30 amp breaker will do) long runs (10-40 feet) should be #10 cable.]

## COMMON AUTOPILOT TERMS & DESCRIPTIONS (Cont.)

### HC (Hand Controller)

Also known as a remote control. A small portable box that has the ability to control some autopilot functions away from the pilothouse. Some refer to these as “Dodgers”. W-H builds a variety of HC units. Most have the ability to dodge (temporary course change) and CC (permanent course change). Some turn the autopilot off and on or provide a power steering function (either PPS or JOG). Units with the latter function have built-in rudder angle indicators. Most HC units are waterproof and can be permanently mounted.

### Course Change

**A small lever switch on most W-H autopilot systems. When it is pushed to the left or right, it changes course. How far the course is changed depends upon how long the lever is held.**

### Dodge

A temporary course change. When a “dodge” button is pressed, the boat will turn and continue to circle until it is released (it will then come back to within 10 degrees of the original course). A quick push of the opposite dodge button will return the vessel to the original course.

### YAW

How far a vessel swings to port or starboard because of wave action. The YAW control on an autopilot determines how far off course the boat can go before the autopilot starts turning the rudder to bring it back. W-H autopilots are adjustable from 1 to 11 degrees.

### Rudder Gain

The number of degrees of rudder applied for the number of degrees of compass error. W-H autopilots are normally adjustable for a  $.3^\circ/1^\circ$  to  $1^\circ/1^\circ$  range. Example: When gain is set at 1 and the compass is  $1^\circ$  off course, then the pilot compensates with  $.3^\circ$  of rudder. (The number 1 position is fully CCW on the Rudder Gain knob.)

### Rudder Limit

The maximum amount the rudder will turn, regardless of how far off course the vessel is. It also limits the rudder when the dodge buttons are used. This front-panel control limits the rudder to  $\pm 8$  degrees to  $\pm 18$  degrees. Most boats need only about  $\pm 10$  degrees rudder for normal operation.

# OPERATING INSTRUCTIONS

## 1. Setting Course

- a. Set the “YAW” and the “Rudder Gain” controls fully counter-clockwise.
- b. With vessel on desired course, turn the switch on the PHC to the AP on position. Have the AWH switch in the off position.
- c. If the water is rough and the red and green lights flash on and off more than once every 3 or 4 seconds, turn the “YAW” control slightly clockwise until the time between flashes returns to 3 or 4 seconds again.
- d. If the vessel is moving very slowly and not keeping a good course, try increasing the rudder gain control clockwise. If the vessel S-curves then turn the rudder gain control clockwise until it straightens out.

## 2. Changing Course

If a small course change is needed, press the “Course Change” lever on the PHC. Press it left or right for only a **fraction of a second** for small changes and for 1 to 2 seconds for larger changes. Wait to see where the vessel ends up. If it hasn’t gone far enough, give it another quick shot. Don’t hold the “Course Change” lever down for more than 2 seconds at a time. If a larger course change is needed, use the dodge/10 degree cc buttons.

### Dodging (Temporary Course Change)

Both the PHC units and remotes have red and green “Dodge” buttons. When these buttons are pressed, the rudder goes to a predetermined position (10 degrees) and stays there until the button is released, at which time it will return to within 10 degrees of the original course. Quickly push the opposite button to return to the original course.

### Power Steering

When the power switch is in the “Standby” position, the red and green dodge buttons can be used for power jog steering. Steering in this mode is difficult unless a Rudder Angle Indicator is present. When a dodge button is pressed, the rudder will move until the button is released. The other dodge button must be used to center the rudder again. The rudder travel is limited electronically (the limits are set with the green pot, located inside the PHC). Normally these limits are set at between 30° and 40°. An easy way to make large course changes is to turn the power switch to “Standby”, press a dodge button until 10° to 15° is present, and then turn the switch to “AP On” at the exact instant when the boat is headed in the new direction.

## OPERATING INSTRUCTIONS (Cont.)

### MODE & SELECT Switch

By pushing down on the Mode/Select switch it cycles the computer menu through its five modes. Pushing up on the Mode/Select switch will select or turn on whichever mode is displayed. The mode menu can always get back to Mode 1 (AP On) while in the middle of the menu by turning the power switch to “STANDBY” and then to “AP ON”.

**MODE 1:** The display reads AXXX, where XXX is the AP course locked in from 0° to 359°. This is the default mode, which always comes up first at turn on, and where it returns when the power switch is turned from “STANDBY” to “AP ON”.

**MODE 2:** Push the mode switch down one time, the display will read “ADJ1”. When the switch is pushed up it will cycle to ADJ2, ADJ3, & ADJ4. When the proper ADJ mode has been selected, one can exit the menu by changing the power switch to “STANDBY” and then to “AP ON”, or by cycling through the entire menu with the “MODE” switch. The ADJ number selected will stay locked in until changed or if the system is turned off, it will always return to the ADJ1 position.

**MODE 3:** The display reads “┌XXX” when a nav signal is present. In this mode the nav receiver points the vessel to the waypoint only, without any cross track error corrections. A flashing “┌000” will be displayed if no nav signal is present. The nav signal must be a NMEA 0183 serial signal with either an APA or APB sentence present. This signal usually comes from a GPS receiver or electronic chart machine with GPS connected. The display will flash indicating that the autopilot has not yet gone to this heading. When the select button is pushed, the vessel will go to that heading. At this time, the “Course Change” lever switch will not function, but the dodge buttons will still operate. Switching to “STANDBY” and then to “AP ON” will put the vessel back in Mode 1 without the direction commands from the nav receiver.

**MODE 4:** The display reads “└XXX” as in Mode 3 above, except that the course is also corrected by calculating the cross track error (XTE) and applying this to the heading. This is the mode usually used for electronic navigation. The XTE Gain is adjustable with the screwdriver adjustment POT located on the HEB and is labeled XTE GAIN. Turning it counter-clockwise will provide less gain. If the vessel “S” curves around the course and makes too many corrections (due to bad GPS reception), then set this POT to less gain (CCW). If the vessel develops an XTE error of more than .1 NM, then try a higher gain setting (CW adjustment). If a route has been programmed into the nav sender, then the system will beep on arrival without any other warning. The change in heading will appear on the heading bar graph but will remain on previous course.

## OPERATING INSTRUCTIONS (Cont.)

**MODE 5:** The display will read “180°”. “This is the “U” turn mode. To turn the vessel around, press the select button and press the “Course Change” switch (for the 10° mode) and turn it to port or starboard. The vessel will make a 180° turn from the original course. The beeper will beep while in the turn. Mode 1 will be displayed when the turn is complete.

### Adjustments:

There are 4 adjustments inside the front panel of the P-3D PHC. The functions of the POTs under the front panel are listed on a label in the PHC. The POTs are screwdriver adjustable. They are coded as follows:

**Yellow = Rudder Zero:** The most critical adjustment is the yellow rudder zero POT. It must be made for every vessel and adjusted with the vessel underway. When properly adjusted, the vessel will stay on its original course when in the “AP On” position. Go between the “Standby” and “AP On” modes and adjust the yellow POT until there is no change in course between these two modes.

**Green = Rudder Limit (while in standby mode only):** The green POT sets the maximum rudder deflection in the standby or power steering mode. It is set at the factory at  $\pm 25^\circ$ , which usually is a good setting for most boats. It assumes that the rudders go from  $33^\circ$  to  $37^\circ$  before they hit their mechanical stops. If the rudder hits its stops before the electronic rudder limits stop it, then turn the green POT more CCW to limit the rudder travel.

**Red = Minimum Rudder Gain:** This adjustment should be made with the red POT sets the rudder gain with the front panel rudder gain now set at 1 (fully CCW). If the vessel has trouble steering well when going north, try setting the red POT to a more CCW (less rudder gain) position. It is set at the factory full CCW.

**White = Minimum Rudder Limit:** The white POT sets the maximum rudder angle allowed during the “AP On” mode. It also sets the maximum angle when the dodge buttons are pushed in this mode. It is set for  $13^\circ$  at the factory for sailing vessels. When the front panel rudder gain control is set to higher settings (more CW), it automatically increases the maximum rudder angle allowed. (At very slow vessel speeds, you need both more rudder gain and angle.)

# **INSTALLATION**

**NOTE: Do not use WD-40 or other similar penetrating oils on autopilot components. These can damage the units and are especially harmful to the RAT.**

## **1. PHC and RAI Installation**

The PHC is normally supplied with a stainless steel trunnion mount bracket. To mount the unit, first remove the two plastic wing screws and fasten the bracket with two #6 x 3/4" stainless sheet metal screws (supplied). Then plan where the cable will go through a 1" diameter hole. The optional RAI is mounted in a similar fashion. The PHC is completely non-magnetic and can be placed very close to the main steering compass.

## **2. Electrical Connections** (See System Wiring Diagram)

- a. The autopilot requires two power feeds from the vessel. The control circuitry needs 12 volts at up to 3 amps. This power is connected to the 5-position barrier strip, which is at the end of the six-foot long white, color-coded cable from the junction box. The wire to this barrier strip can be #20 gauge or larger. All control electronics operate with 12v, so an inverter is required on all 24v boats.
- b. The second feed goes to the motor controller (MC), which is located close to the hydraulic power pack motor. This feed can be 12 or 24 volts (depending on MC type), both at 25 amps (the motors are different for 12 and 24v) and 30 amp breakers are required at the source. This high current feed must not come from the same circuit breaker as the 3 amp control voltage

## **3. Rudder Angle Transmitter (RAT) Installation** (See Diagrams 2 & 3)

- a. The Rudder Angle Transmitter must be mounted within 16 inches from the ship's rudder arm. When the rudder arm is centered, the two indexing marks on the RAT must line up and the RAT arm should be able to travel parallel to the rudder arm.
- b. If you need to rotate the RAT arm on the shaft, loosen the cap head screw with the provided Allen wrench, hold shaft with vise grip pliers and move the arm to the proper location. Retighten the cap head screw securely, making sure the arm is resting on the top of the bushing.
- c. The RAT connecting rod has a swivel joint on each end. To mount the swivel joint on the rudder arm, locate the hole according to Diagram 3. This distance will either be 4-1/2 inches or 6-1/2 inches from the center of the rudder post (Distance D). Distance D must equal Distance C. Drill a #7 or a 13/64" hole in the rudder arm and tap with a 1/4"-20 tap. Secure screw in tapped hole. The nylon end of the swivel joint is fastened to an adjustment block to aid in location of Distance F. A hex key has been provided to tighten the adjustment block screws.

- d. The RAT unit may be mounted upside down. **The red and black wire must, however, be reversed at the barrier strip for proper operation when upside down.**

## **INSTALLATION (Cont.)**

### **4. Hydraulic Power Pack Installation (cont.)**

b. Mounting

- (1) The preferred placement for the **Hydraulic Power Pack (HPP)** is in the lazaret as close to the hydraulic cylinder as possible to minimize the hose run. The motor in this pump set has a large permanent magnet; **it must not be within 6 feet of any compass!**
- (2) The HPP can be mounted in any position. Close proximity to the main hydraulic lines is usually the first priority in choosing a location. The unit should be mounted high enough to avoid bilge water. The motor is not watertight and will be damaged if exposed to water. Remember that the pulleys and belts may have to be changed after installation. Four 3/16" or 1/4" lag screws of 1" or 1- 1/4" length are normally used to mount this unit.
- (3) The **HPP pump** is equipped with a separate lock valve that must be plumbed directly into the vessel's steering system. The outside two ports on the pump go to the main steering, while the center is plumbed to the return line of the vessel's hydraulic steering system (see Diagram 4). In the event there is no return line present, such as in the case of the vessel having a single Wagner helm, the autopilot return line must be plumbed directly into the vessel's helm return line.
- (4) The **motor controller** is usually mounted within a foot or two of the HPP, but larger distances are permissible. It is usually secured with four 1/2" #6 stainless steel sheet metal screws. It must be mounted so that the terminal strip is easily accessible.

## **Installation of the Edson Conversion Kit (OPTIONAL)**

- a. See Plumbing Diagram for correct placement of hydraulic fittings and parts. A listing of fittings supplied is also provided with this diagram. A thread sealing compound must be used on all connections to prevent leaks. **Teflon tape must not be used** as fragments of the tape can break free and contaminate the system.
- b. A W-H Model #215 hydraulic cylinder (7" stroke) is supplied as the standard with the conversion kit and the instructions to follow refer to that cylinder only. If a different cylinder is used, some differences in installation may exist. A W-H Model #222 is one of the optional cylinders. It is identical to the Model #215 except it has a 9" stroke.
- c. There are three main considerations when installing a hydraulic cylinder. #1 is the space you have available, #2 is the rudder arch or the number of degrees the ships rudder is able to turn and #3 is the geometry of the cylinder and rudder arm.
- d. It is recommended that a separate rudder arm be used to attach the hydraulic cylinder to the ships rudder. However, if the steering quadrant can be adapted to accept the cylinder without diminishing its strength, it can be used.
- e. After choosing a location for the cylinder you must determine the number of degrees throw the rudder can turn from stop to stop. Then refer to diagram #6, to determine the proper length (Radius "A"). The cylinder must be mounted in such a way that it is not used as the rudder stops. If the cylinder is completely extended or contracted before the mechanical rudder stops are in effect, serious damage to the hydraulic cylinder could result. Example: If the ships rudder turns 40 degrees each direction, a rudder arm length of slightly less than 5.45 inches should be used.
- f. Once the hole in the rudder arm has been located and drilled to 5/8" diameter, the cylinder end that moves can be bolted in place. Position the cylinder rod in it's half way position and turn the vessels rudder to it's middle position to determine the location of the fixed end of the cylinder. Radius "B" on diagram #6 should be carefully observed to insure maximum thrust from the cylinder. With all of these steps followed carefully, the cylinder will be able to move the rudder the same distance to both port and starboard.

**CAUTION: This cylinder is capable of forces of up to 1500 lbs. and the mounting brackets used must be able to accept such loads.**

- g. The center portion of the hydraulic cylinder should be positioned so that the hose fittings are on the top.
- h. Connect the clear plastic hoses to the two fittings on the cylinder (for bleeding only). They should be removed after the air bleeding process has been completed.

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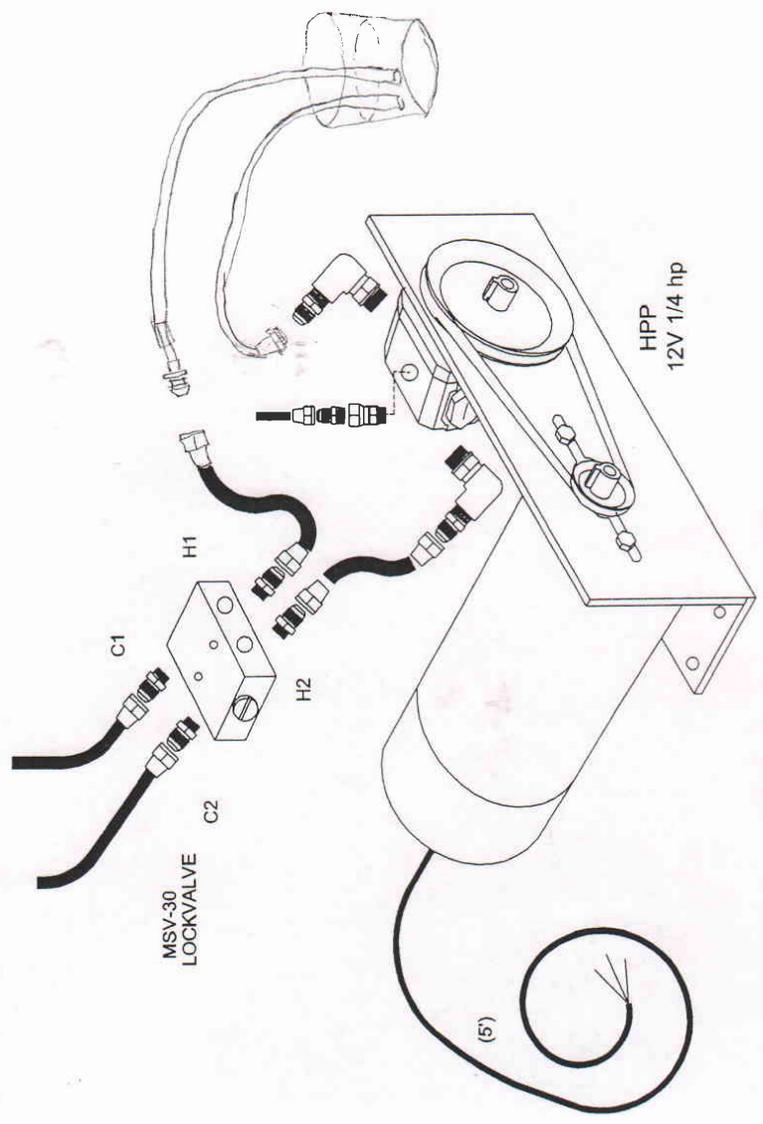
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## Bleed Kit Instructions For use with Edson Steering Kit

1. Remove one of the lines from the hydraulic pump that goes to the H1 or H2 port on the pilot operated lock valve. Drawing on page 17 shows the line removed from the pump and the two bleed hoses attached.
2. The bleed tee's on the cylinder should be closed during this procedure.
3. Place the bleed hose ends in the small plastic pail, which comes with the bleed kit.
4. Add oil to the plastic pail so that both hose ends have at least two inches of oil above them.
5. Open the bypass valve (put in the manual steering position).
6. Turn the autopilot system on in the SB mode.
7. Have someone else push the port or starboard dodge button and hold it down for a minute or so. The other person must hold the hose in the plastic pail down and stop the procedure if the oil in the plastic pail gets near the bottom. The oil level going down indicates that some air has been removed.
8. Do the same procedure in the other direction by pressing the other dodge button (you can use a remote in the SB mode if one is present).
9. While the oil is rapidly running in and out of the plastic pail one should also turn the steering wheel rapidly from full port to starboard. This should push some of the remaining air into the oil path through the pail and remove it.
10. When you think that most of the air is gone and some oil has gone in to replace it, turn the autopilot off and try to replace the pump hose without letting any air in.
11. With the autopilot turned off and the bypass valve closed (in the autopilot position) try turning the steering wheel back and forth with about 40lbs. of force. Have someone else go to the hydraulic cylinder and see if the rod moves less than 1/4". If it does, you may have to repeat the above procedure.
12. This procedure assumes that one has already run the bleed procedure with the two hoses connected to the tee valves on the cylinder.



**Hydraulic Power Pack model H.P.P., Bleeding**

SCALE	DATE	DRAWN BY	APPROVED BY	REVISED
NONE	1/25/13	M. Stockwell	WDH	
W-H Autopilots, Inc. Bainbridge Is. WA. 98110 (206) 780-2175 FAX (206) 780-2186				DRAWING NO. <b>101 806</b>

# W-H AUTOPILOT'S FLUXGATE COMPASS

## INSTALLATION PROCEDURE

### **A. HEADING SENSOR MOUNTING LOCATION:**

Each W-H Fluxgate is carefully calibrated at the factory. Care taken in determining the proper mounting position on the vessel will result in a consistently high accuracy heading reading.

In your selection of a location on the vessel for mounting the W-H Fluxgate, you must satisfy two requirements at the same time. These are:

1. The Fluxgate must be a MINIMUM of three feet (3') away from VARIABLE MAGNETIC INFLUENCES. (Please see footnote).
2. The unit should be mounted as close to the vessel's center of gravity (that is, its roll and pitch axis) as possible, while still meeting the requirements of #1.
  - a. The optimum position is at the vessel's center of gravity.
  - b. The next best positions are on the centerline of the vessel, but forward or aft of the vessel's center of gravity.
  - c. As a last resort, the position should be just forward or aft of the center of gravity, and as close to the centerline of the vessel as possible, while still meeting the requirements of #1.

### **Note About Variable Magnetic Influences**

There are some mechanical, electrical, and electronic devices which when located within three feet (3') of the Fluxgate cause variable magnetic influences due to changes in generated magnetic fields or physical position. Under these conditions, where the magnetic influence is of a variable nature, a consistent compensation adjustment is not possible. The Fluxgate must be relocated or the source of the magnetic influence eliminated. Some items that can cause variable magnetic influences are listed next.

- |   |                                      |
|---|--------------------------------------|
| 1. Loudspeakers                                   | 11. Windshield wipers                |
| 2. Horns  | 12. Electrical indicators            |
| 3. Mechanical compasses (magnets)                 | 13. Refrigerators & air conditioners |
| 4. Radio equipment                                | 14. Galley sinks                     |
| 5. Hi-Fi equipment                                | 15. Toolboxes                        |
| 6. Radar equipment                                | 16. Exhaust pipes or smoke stacks    |
| 7. The vessel's engines                           | 17. Metal doors                      |
| 8. Electrical motor & compressors                 | 18. Steering chains                  |
| 9. Voltage regulators & solenoids                 | 19. Rack and pinion steering gears   |
| 10. Generator & heavy current carrying conductors |                                      |

## **W-H AUTOPILOT'S FLUXGATE COMPASS** **INSTALLATION PROCEDURE (Cont.)**

### **B. MOUNTING THE W-H FLUXGATE COMPASS:**

After locating the sensor, follow these directions:

1. Mount the bracket with non-magnetic hardware.
2. The sensor should be mounted level so that the up arrow points vertically.
3. Align the BOW arrow forward by turning the sensor within the mounted base.
4. Tighten the thumbscrew so the sensor will not move.
5. Refer to your wiring diagram for connection of the cable (blue/yellow code) to your autopilot system.

## **W-H MODEL FG-900 FLUXGATE COMPASS** **COMPENSATION PROCEDURE** (After Installation)

The fluxgate compass is factory calibrated for normal boats, therefore there should be no need for the user to perform a calibration (i.e. Do not press the RED "start calibration" button). For extreme accuracy, however, read the calibration procedure below, and perform the calibration on a very calm day (no wind or current) and turn the vessel very slowly.

### **WHAT IS COMPENSATION?**

**COMPENSATION** is the procedure to adjust out errors in the magnetic heading readings (DEVIATIONS) that are a result of the local permanent magnetic and soft iron effects of the vessel. The W-H Fluxgate is equipped with automatic compensation software that will remove these deviations with the execution of a simple compensation procedure.

*It is best to have a professional compass adjuster compensate the W-H Fluxgate after the initial installation. The following procedure can be used if the services of a professional adjuster are not available.*

*All Fluxgates must be checked against known references or be calibrated by a professional compass adjuster before being used for navigation.*

*Auto-compensation should not be attempted unless there is evidence that the sensor has errors of more than two degrees (headings other than due North). If the North heading is off, go to step 5 first.*

To obtain the best compensation possible, the following procedure should be executed in an area of calm water, such as a cove or sheltered waterway.

1. Rotate the vessel for 2 complete turns in either direction. The rate of turn should be slow and steady at 3 ° to 6 ° per second (i.e., 1 or 2 minutes for a full 360 ° turn). In a boat with two engines, this turn can be accomplished with forward power on one engine and reverse power on the other.

**W-H MODEL FG-900 FLUXGATE COMPASS**  
**COMPENSATION PROCEDURE (After Installation) continued**

2. Turn on the autopilot and confirm that the blue indication light located inside the FG900 housing is blinking. Then, start the turn by pressing the START COMPENSATION button located on the model FG900 fluxgate until the blue light remains on when the button is released.



## FG900

3. When compensation is completed successfully the compensation light will return to blinking mode.
4. If this does not occur after 1½ or 2 turns, then turn the entire autopilot off and start this procedure again.

**5. W-H MODEL FG-900 FLUXGATE COMPASS**  
**NORTH ALIGNMENT PROCEDURE**  
**(After Compensation)**

- 1) Put the boat on a known (reference) heading of magnetic North (000 degrees) as measured by a calibrated, heading source (2<sup>nd</sup> compass, GPS, etc.).
- 2) Momentarily press the “Set heading to 0 degrees” button (about 1-3 seconds) and release the button. The FG900 heading should show 000 degrees. This procedure can be repeated as required to align the FG900 to North.

**Indicator light**

**A blue light indicates three states of the FG900**

<b>State1</b>	<b>Uncalibrated.....long flash</b>
<b>State2</b>	<b>Calibration in Progress.....continuous</b>
<b>State3</b>	<b>Calibrated.....short flash</b>

# **ADJUSTMENT AND TESTING**

## Model P-3D Autopilot Initial Turn-On Procedure

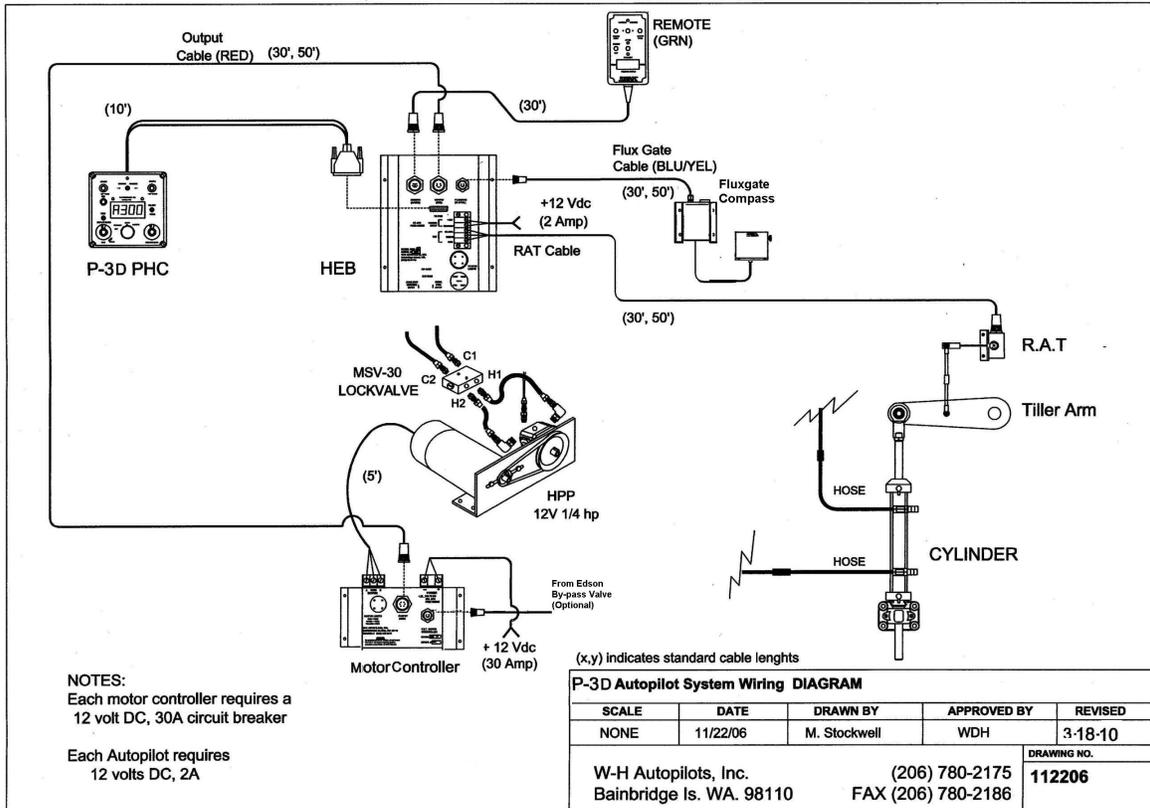
### **1. Initial Adjustments**

- a. Turn the “YAW” and “Rudder Gain” controls fully counter-clockwise.
- b. Turn “Dim” lights to “Bright” (up) position.

### **2. Yellow POT Adjustment (POT = screwdriver adjustable potentiometer)**

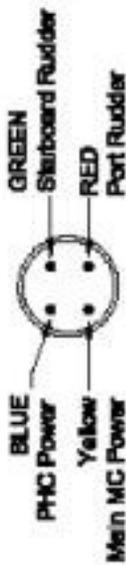
**NOTE: The adjustment of the Rudder Zero is crucial to the proper performance of your autopilot.**

- a. Move the function switch to the standby position. The display will flash “AP” for 5 seconds. Then the display should show cXXX, (XXX is the vessel heading, the small “c” stands for “Compass). When the autopilot or remote mode is engaged, the display will read AXXX. “A” stands for “autopilot on” mode. The XXX number will be frozen. See the navigational interface instructions for use of the “mode” and “select” computer menu functions.
- b. (1) Move the power switch to the “Standby” position. Press the display toggle switch to make the display read rudder angle. Press first the red and then the green “Dodge” buttons and observe that the appropriate red and green lights come on. Turn the steering wheel by hand both port and starboard to see whether the meter reads in the proper direction. If it reads backwards, it will be because the RAT is installed upside down or differently from the recommended configuration. If this is the case, reverse the red and black wires from the RAT.  
  
(2) Engage the autopilot pump by pulling the autopilot valve control up. Now press the red “Dodge” button and observe the RAI to see that the rudder is really moving to the port (left). If the rudder moves backwards, then the two wires from the electric motor on the hydraulic power pack must be reversed. Since one normally installs the hydraulic pipes arbitrarily as to port and starboard, there is always a 50% chance that the motor will be backwards. The motor leads can easily be reversed on the adjacent terminal block with a screwdriver.  
  
(3) With the autopilot turned “Off”, leave the dock and bring the vessel to normal cruising speed. Now turn the power switch to the “Standby” position and with the boat hand-steered in a very straight line, observe the position of the meter. If it is not exactly at “0” bring it to “0” by using the yellow adjustment pot in the PHC. Now turn the pilot “On” and check to see that the boat stays exactly on course. If the yellow adjustment is properly made, it should not veer more the 1 degree from its previous course as the pilot is activated.



**STATUS LIGHTS**

RED = PORT  
 GREEN = STBD  
 YELLOW = MOTOR POWER  
 BLUE = PHC POWER



When the Autopilot is ON the YELLOW and BLUE status lights will be ON.

When a DODGE button is pressed and the rudder is moving the RED or GREEN light will be ON.

If the YELLOW light is OFF

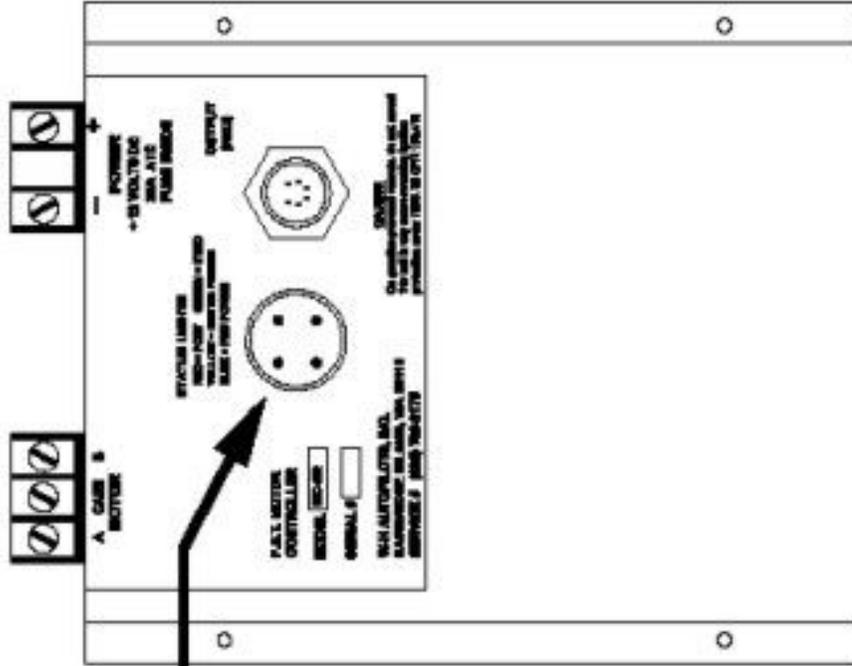
- Check the Motor Controller Power
- Check for a blown ATC 25 Amp fuse (located inside the Motor Controller)

If the BLUE light is OFF

- Check the OUTPUT cable for water damage or a broken cable
- Check the power to the Autopilot Junction box or H.E.B.

If the RED and GREEN lights come ON at the same time

- Check all of the Autopilot cables for water damage or a broken cable



**Motor Controller STATUS LIGHTS**

DATE	DESIGNED BY	APPROVED BY	REVISED
11/20/08	M. FROSTWELL	YES	
W-L-H Autopilot, Inc. Bainbridge Is. WA, 98110		(206) 760-2173 FAX (206) 760-2186	DRAWING NO. 112808

## RUDDER ANGLE TRANSMITTER

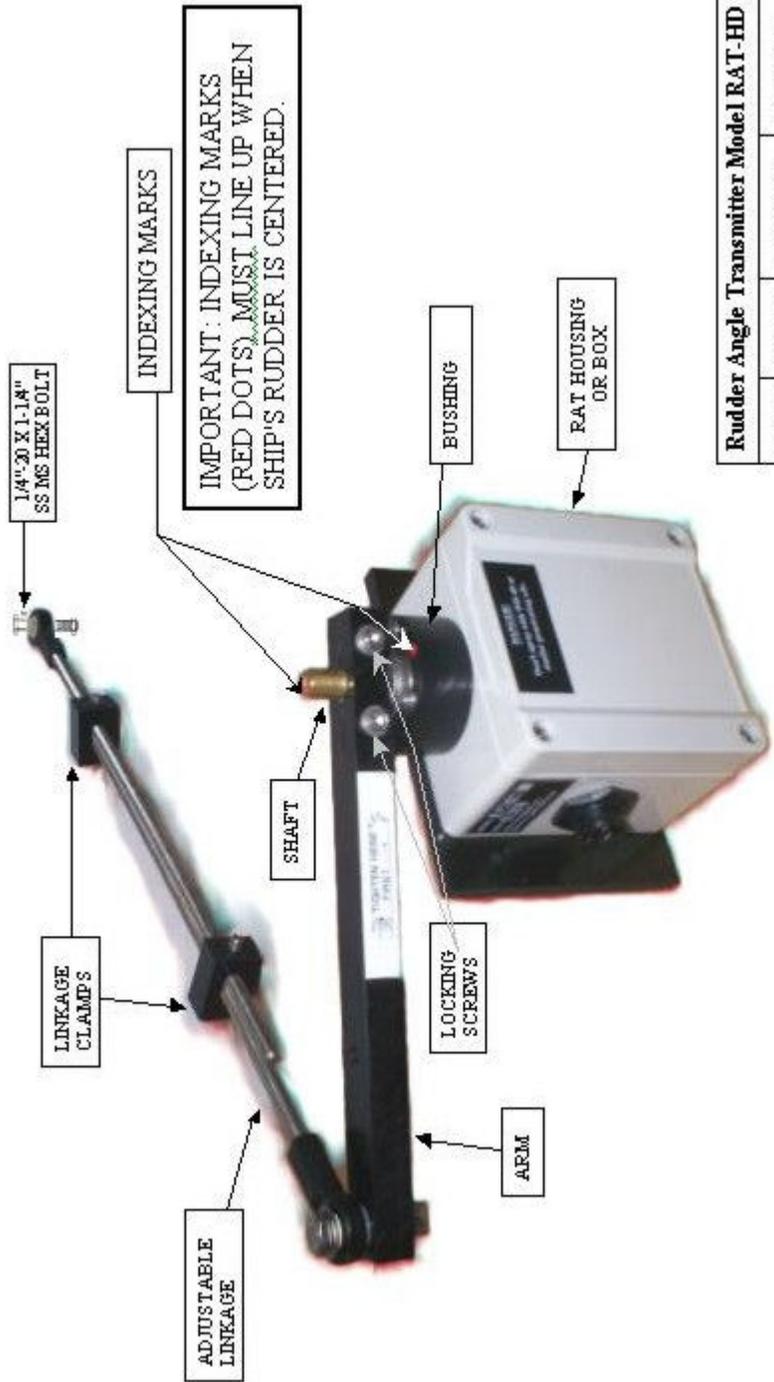


### INSTALLATION INSTRUCTIONS

1. The Rudder Angle Transmitter must be mounted within 16 inches from the ship's rudder arm. When the rudder arm is centered, **the two red indexing marks on the RAT must line up** and the RAT arm should be able to travel parallel to the rudder arm.
2. If you need to rotate the RAT arm on the shaft, loosen the cap head screw with the provided Allen wrench, hold the shaft with vise grip pliers and move the arm to the proper location. Retighten the cap head screw securely, making sure the arm is resting on the top of the bushing.
3. The RAT connecting rod has a swivel joint on each end. To mount the swivel joint on the rudder arm, locate the hole according to Diagram 3. This distance will either be 4-1/2 inches or 6-1/2 inches from the center of the rudder post (Distance D). Distance D must equal Distance C. Drill a #7 or a 13/64" hole in the rudder arm and tap with a 1/4"-20 tap. Secure screw in tapped hole. The nylon end of the swivel joint is fastened to an adjustment block to aid in location of Distance F. A hex key has been provided to tighten the adjustment block screws.
4. The RAT unit may be mounted upside down. **The red and black wire must, however, be reversed at the barrier strip for proper operation when upside down.**

Last printed 7/29/2010 10:04 AM.

# RUDDER ANGLE TRANSMITTER (RAT) INSTALLATION

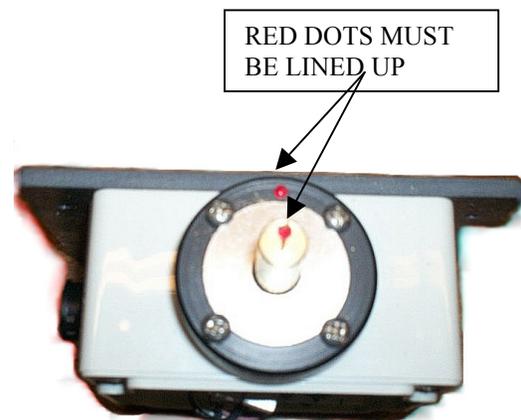
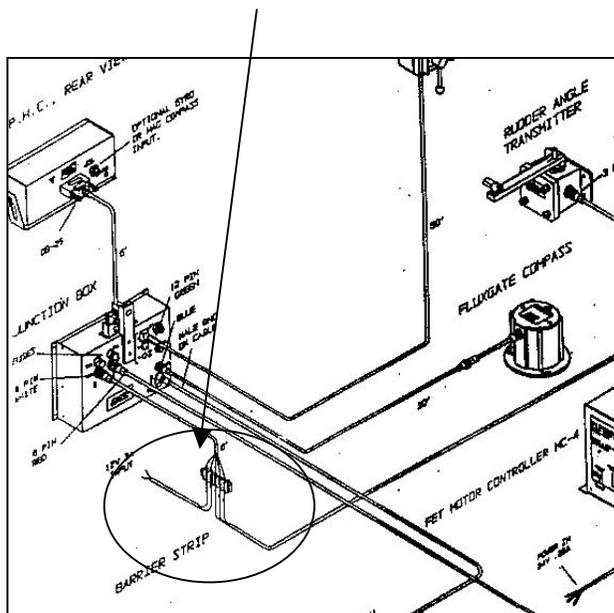


**INDEXING MARKS**  
**IMPORTANT: INDEXING MARKS (RED DOTS) MUST LINE UP WHEN SHIP'S RUDDER IS CENTERED.**

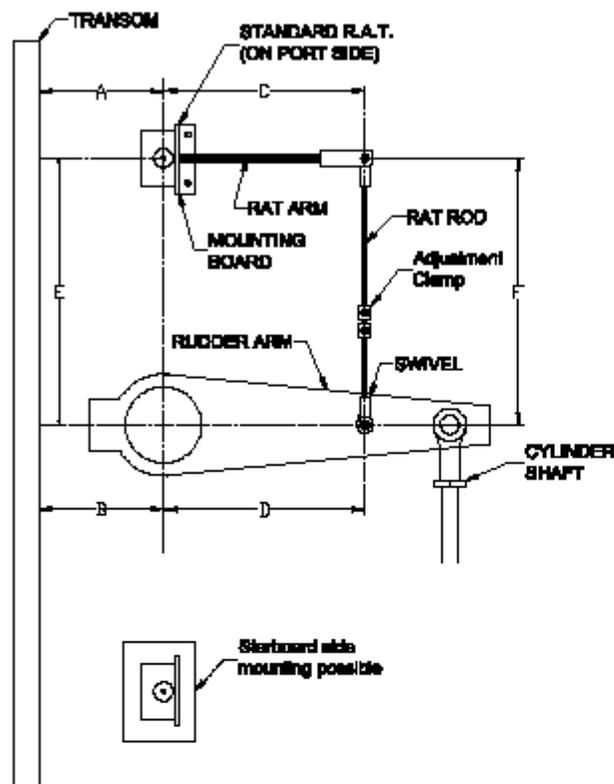
<b>Rudder Angle Transmitter Model RAT-HD</b>			
SCALE	DATE	DRAWNBY	APPROVED
	12/28/09	kg	
W-H Autopilot, Inc.		Drawing #	
207-780-2175		2009 12 28	

## Rudder Angle Transmitter (RAT) Installation

2. The Rudder Angle Transmitter must be mounted within 16 inches from the ship's rudder arm. When the rudder arm is centered, **the two red indexing marks on the RAT must line up** and the RAT arm should be able to travel parallel to the rudder arm.
3. If you need to rotate the RAT arm on the shaft, loosen the cap head screw with the provided Allen wrench, hold the shaft with vise grip pliers and move the arm to the proper location. Retighten the cap head screw securely, making sure the arm is resting on the top of the bushing.
4. The RAT connecting rod has a swivel joint on each end. To mount the swivel joint on the rudder arm, locate the hole according to Diagram 3. This distance will either be 4-½ inches or 6-½ inches from the center of the rudder-post (Distance D). Distance D must equal Distance C. Drill a #7 or a 13/64" hole in the rudder arm and tap with a ¼"-20 tap. Secure screw in tapped hole. The nylon end of the swivel joint is fastened to an adjustment block to aid in location of Distance F. A hex key has been provided to tighten the adjustment block screws.
5. The RAT unit may be mounted upside down. **The red and black wire must, however, be reversed at the barrier strip for proper operation when upside down.**



## STANDARD R.A.T. MOUNTING



DISTANCE "A" SHOULD EQUAL "B"  
DISTANCE "C" SHOULD EQUAL "D"  
DISTANCE "E" SHOULD EQUAL "F"

DISTANCE "C" IS ADJUSTABLE BY  
SHORTENING THE RAT ARM

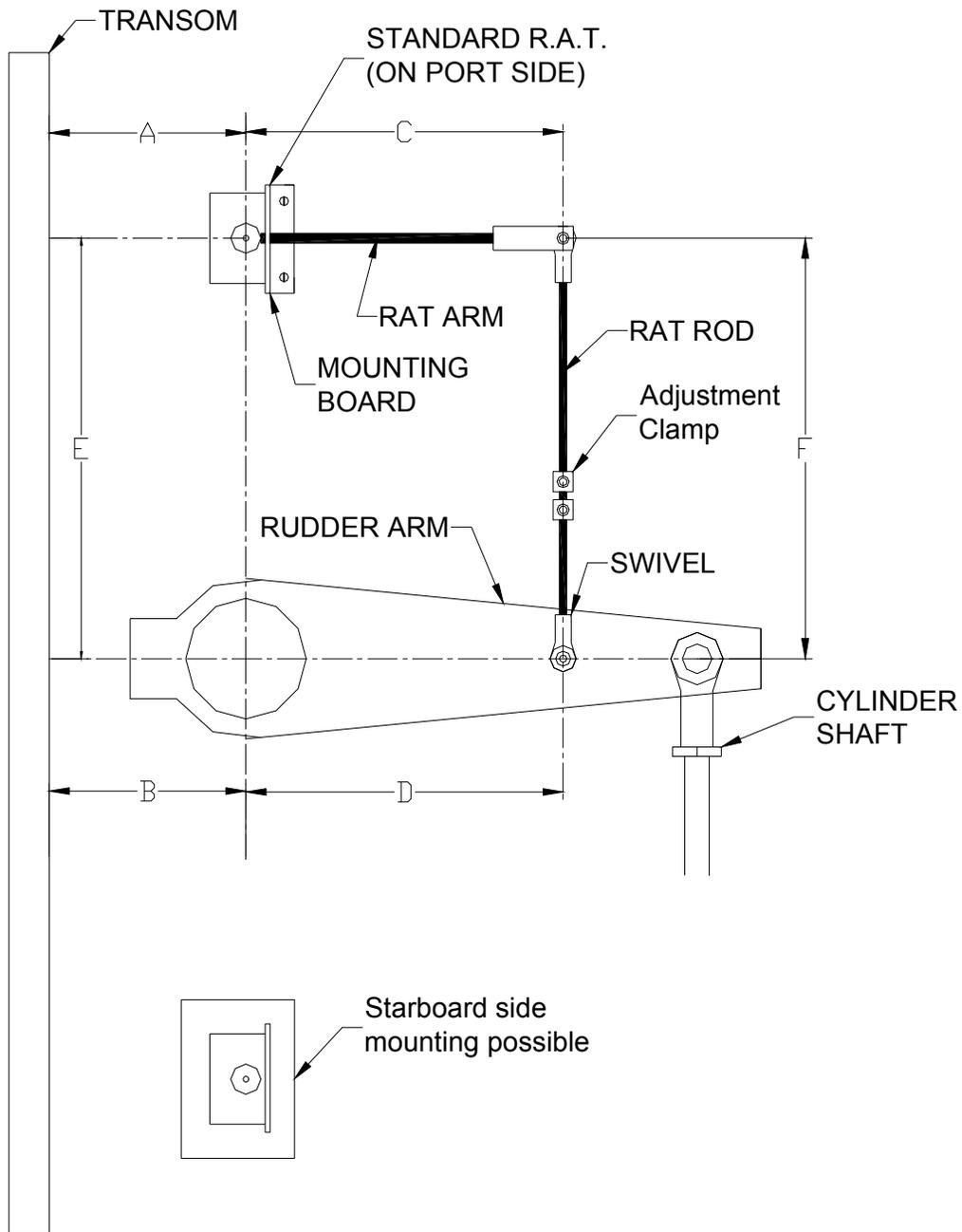
DISTANCE "F" IS ADJUSTABLE BY  
CHANGING THE RAT ROD LENGTH  
(the RAT ARM MUST be PARALLEL to the  
RUDDER ARM)

IF the RAT is mounted upside down,  
or  
IF the RAT is mounted with the RAT ARM  
pointed toward the stern:  
THEN the RED and BLACK RAT signal  
wires must be reversed at the POWER/RAT  
barrier strip.  
RED wire to BLACK terminal  
BLACK wire to RED terminal

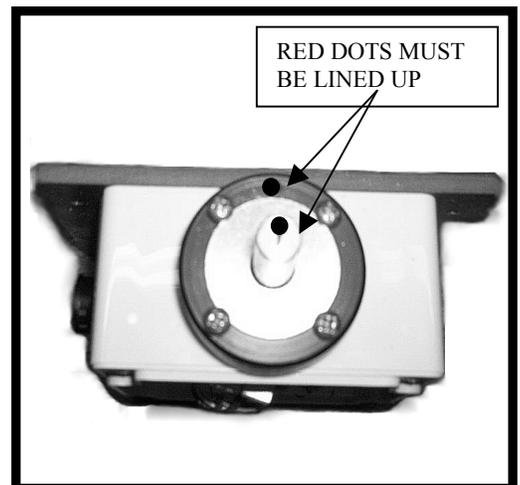
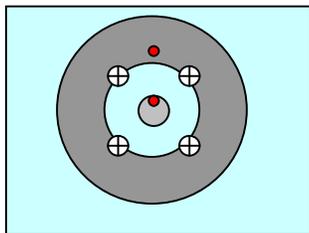
## RAT INSTALLATION

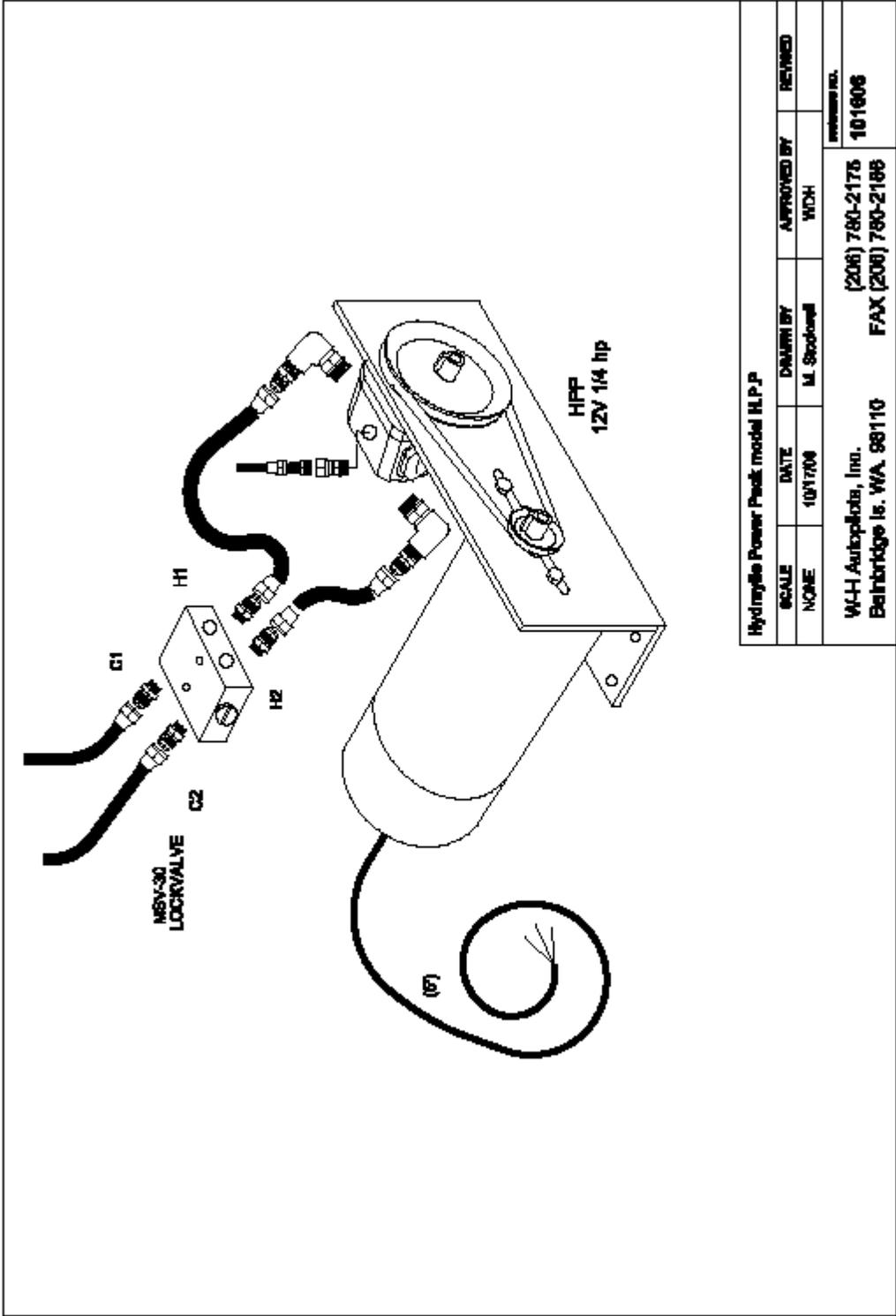
1. The Rudder Angle Transmitter (R.A.T.) should be mounted within 16" of the boat's rudder arm. When the Rudder Arm is centered, The RAT ARM should be perpendicular to the RAT mounting board and aligned with the mark on edge of the mounting board. The RAT arm should travel freely, parallel to the Rudder Arm without binding or hitting anything.
2. The RAT ROD has swivel joints on each end. It is important that the swivel not bind as the rudder moves. To mount the swivel joint on the rudder arm, locate the mounting hole according to the diagram. The distance from the center of the rudder post should be no less than 4-1/2". Drill a #21 or 5/32" hole and tap with a #10-24 tap. Secure the screw in the tapped hole. The RAT ROD length can be changed to aid in the adjustment of distance "F". A hex key is provided to tighten the adjustment clamp screws.

# HOW TO MOUNT R.A.T. DIAGRAM

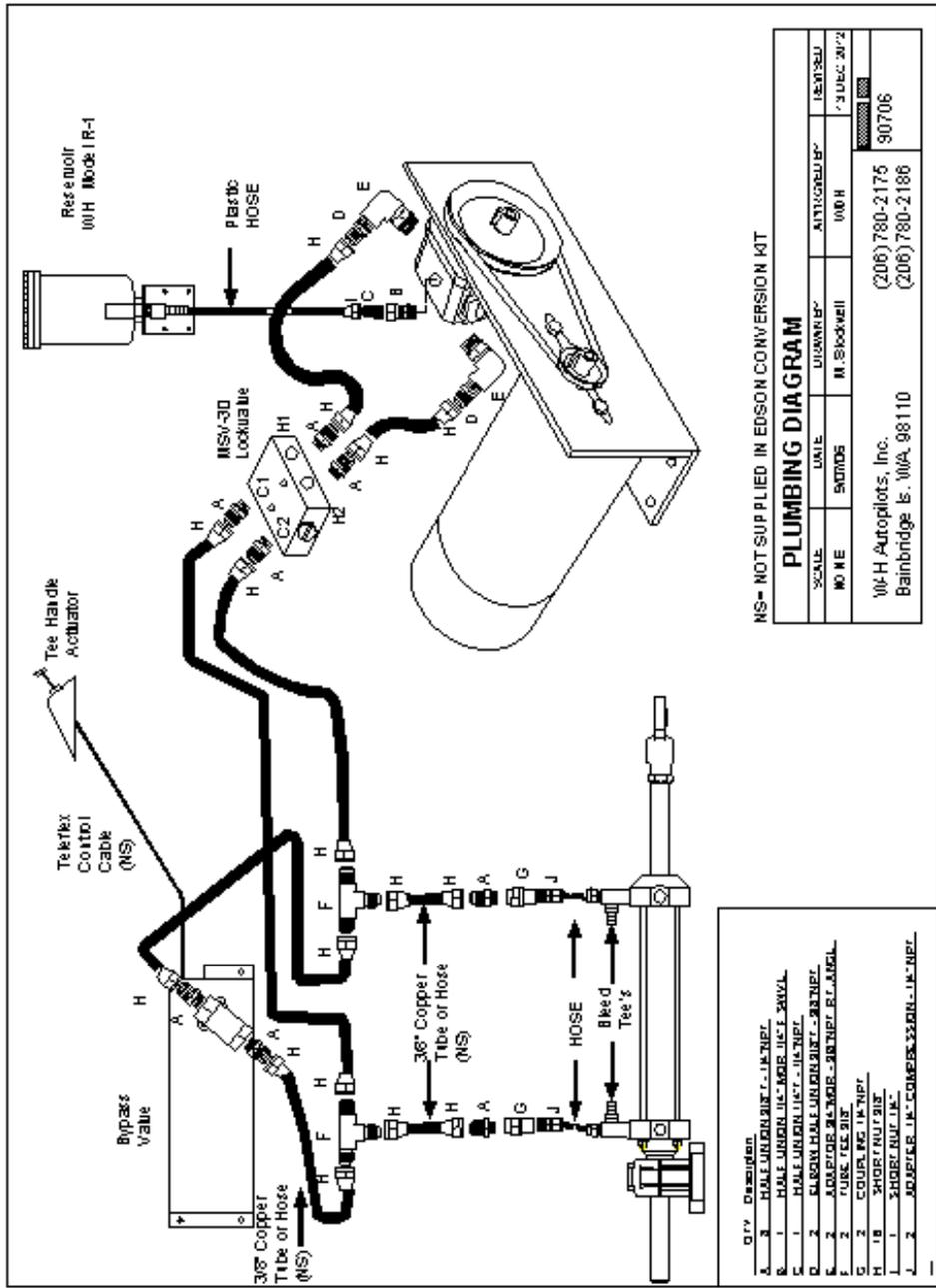


FIX!!!!!!





Hydramble Power Peak model H.P.P.			
SCALE	DATE	DRAWN BY	APPROVED BY
NONE	10/17/08	M. Spadoni	WCH
W-H Autoplata, Inc. Bellevue Is. WA 98110			REVISED
(206) 780-2176 FAX (206) 780-2186			reference no. 101606



NS - NOT SUPPLIED IN EDSON CONVERSION KIT

**PLUMBING DIAGRAM**

SCALE	DATE	DRAWN BY	APPROVED BY	REVISED
NO. 10	NOV 85	M. Stockwell	000 H	1 - JUNE 20/2
W/H Autoplots, Inc. Bainbridge St. 100A, 98110				90706
(206) 780-2175				(206) 780-2186

# W-H AUTOPILOTS, INC.

12685 Miller Rd. Ste #1400  
Bainbridge Island, WA 98110



(206) 780-2175 Fax: (206) 780-2186  
E-mail: pilotwhale@att.net

## WARRANTY REGISTRATION FORM AND CHECK LIST

**This form must be completed by the installer and returned to W-H Autopilots within 30 days of purchase or receipt of final components for installation to qualify for the 3-year warranty.**

OWNER'S NAME: \_\_\_\_\_ Boat Name: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_ Boat Type: \_\_\_\_\_  
PHONE: \_\_\_\_\_ W-H AUTOPILOT MODEL & SERIAL #: \_\_\_\_\_  
Builder: \_\_\_\_\_ Boat Length: \_\_\_\_\_ ft.  
Engines: \_\_\_\_\_

SEA TRIAL: Date: \_\_\_\_\_ Location: \_\_\_\_\_  
Person in charge of sea trial: \_\_\_\_\_ of \_\_\_\_\_  
Is the owner or skipper on board? \_\_\_\_\_ (yes/no) If yes, Name: \_\_\_\_\_

What are the sea conditions during the sea trial?: \_\_\_\_\_

What is the cruising speed of the vessel?: \_\_\_\_\_ knots/hr.

What type of drive and number of engines?: \_\_\_\_\_

What is the model and manufacturer of the steering system?: \_\_\_\_\_

- Check steering system reservoir for oil level
- Check rudder angle transmitter for proper mounting and alignment.
- Check for proper direction and speed for 30 to 30 rudder movement with the autopilot in the power steering or standby mode (yellow light on). Time for 30 degree to 30 degree rudder movement: \_\_\_\_\_ seconds.
- Adjust rudder limit - adjust POT for 3 to 4 degrees less than maximum movement (green POT labeled RL). Maximum rudder deflection in power steering mode \_\_\_\_\_ degrees port and starboard.
- Adjust rudder zero POT (yellow RZ) so vessel stays within 1 degree of original course when switched from standby to pilot modes.
- STABILITY TESTING:

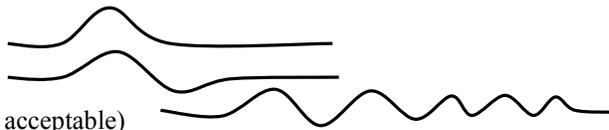
1. Have vessel going in a straight line. Press P or S dodge button until vessel is 20 degrees off course.
2. Release dodge button and watch boat return to original course. Use counter rudder to improve performance if needed.

Type of response:

1. Perfect

2. Acceptable

3. Hunting (not acceptable)



Check stability with vessel heading due North. Response # \_\_\_\_\_ 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3.

Check stability with vessel heading due East or West. Response # \_\_\_\_\_ 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3.

- Check operation of all remotes. List number and models of all remotes: \_\_\_\_\_
- List model and serial number of autopilot: \_\_\_\_\_
- What voltage W-H hydraulic power pack is installed: \_\_\_\_\_ (12,24,32). If more than one, how many? \_\_\_\_\_

If engine driven power hydraulics are aboard, describe it and who installed it:

\_\_\_\_\_

Are there one or two flow regulators aboard? \_\_\_\_\_ Is a fast/slow solenoid installed?

\_\_\_\_\_

General comments on the autopilot performance:

\_\_\_\_\_

---

Autopilot installed by: \_\_\_\_\_ Date Installed: \_\_\_\_\_

Address (location of installation): \_\_\_\_\_

Signature: \_\_\_\_\_

# W-H AUTOPILOTS, INC.

12685 Miller Rd. Ste #1400  
Bainbridge Island, WA 98110



(206) 780-2175 Fax: (206) 780-2186  
E-mail: pilotwhale@att.net

## LIMITED WARRANTY

1. This warranty shall extend only to the original purchaser of the equipment (or end user, if sold by a dealer.)
2. This warranty applies to all heavy-duty autopilots with designated 3-year warranty. The Warrantor warrants all such equipment to be free from defects in workmanship or material under normal use and service.
3. The warranty registration form must be returned to the Warrantor at the address indicated on the card before there will be any warranty coverage service for the equipment.
4. There is no warranty coverage of any kind for damage due to water immersion or salt spray, except for equipment designated as waterproof. The warranty is void if the waterproof unit has been submerged in more than 2 feet of water for more than 30 minutes.
5. Warranty work will be performed at the Warrantor's factory at the address indicated on the Warranty Registration. This warranty does not cover any labor costs outside the W-H factory.
6. This warranty is in effect for 3-years from the date of shipment from the W-H factory. If the registration forms are not completed and returned to the factory there is no warranty guarantee of any kind.
7. The purchaser shall pay the expense of transporting the defective equipment to the Warrantor's factory in advance. The Warrantor shall pay the return shipping costs (by UPS surface within the Continental USA only.) Parts found not to be defective during any part of the warranty will be returned freight collect.
8. W-H Autopilots, Inc. extends no warranty on fuses or pilot lights. All hydraulic components including pumps and cylinders will be covered for only the first 12 months of this warranty. Problems with hydraulics, such as getting the air out of the system, are not covered.
9. If the returned equipment is found by the Warrantor to be defective in workmanship or material, the equipment will be repaired or replaced at the address indicated on the Warranty Registration or at the Warrantor's place of business without charge, except for transportation charges as herein provided.
10. The purchaser's obligation in the event of a defect:

- a. Contact the Warrantor by letter or by telephone describing the problem in detail and to receive instructions as to which components to send in for repair.
- b. Deliver the defective items, freight paid, to the Warrantor factory.

## W-H AUTOPILOTS, INC.

12685 Miller Rd. Ste #1400  
Bainbridge Island, WA 98110



(206) 780-2175 Fax: (206) 780-2186  
E-mail: pilotwhale@att.net

### **LIMITED WARRANTY** **(Continued)**

11. There is no warranty, and Warrantor shall not be held liable for any damage incurred as a result of a malfunction of any part of the Warrantor's products if said damages occur during, or as a result of, the autopilot being left unattended by the operator. Warrantor will not be liable for any damages arising from collisions with other vessels or objects. The autopilot product, including parts thereof, is designed to assist the operator or the man on watch to navigate accurately by maintaining an average course selected by the man on watch. Due to the potential of a collision with an object in the vessel's path, or of an electrical, mechanical or hydraulic malfunction of the parts of the autopilot or the associated equipment of the vessel, the energized pilot should never be left unattended when the vessel is moving. Remote control units should be used only in situations where mechanical or hydraulic steering controls are near at hand or in situations where a steering failure would not cause damage before the operator could reach manual controls.
12. This warranty applies only to properly installed new equipment operated and maintained to the manufacturer's ratings and recommendations and does not cover any defect in installation. There are no warranties that extend beyond the description on the face hereof. This warranty is expressly in lieu of all other warranties, guarantees, obligations, or liabilities, expressed or implied, by the Warrantor or its representatives. All statutory or implied warranties, other than title, are hereby expressly excluded. An owner's remedy is limited exclusively to obtaining the repair and replacement of non-conforming goods or parts in accordance with this warranty. This warranty specifically excludes W-H Autopilots, Inc. and its dealers from liability for any consequential damages, including but not limited to, loss or damage to any vessel, structure, person or persons, or any delay suffered in connection with the use of the equipment. This warranty cannot be altered or modified in any way and shall be construed in accordance with the laws of the State of Washington.

Since most customer problems arise from installation errors or the autopilot not being tuned properly, W-H Autopilots, Inc. has created a checklist, which should help insure proper autopilot function and installation. The warranty is given only to the owner who returns to us a proof of purchase and copy of our installation checklist, filled out and signed by the installer, certifying all points in the checklist have been satisfactorily completed and all standards met. The Registration form must be returned to W-H Autopilots within 30 days of sale or receipt of final components to qualify for the warranty.