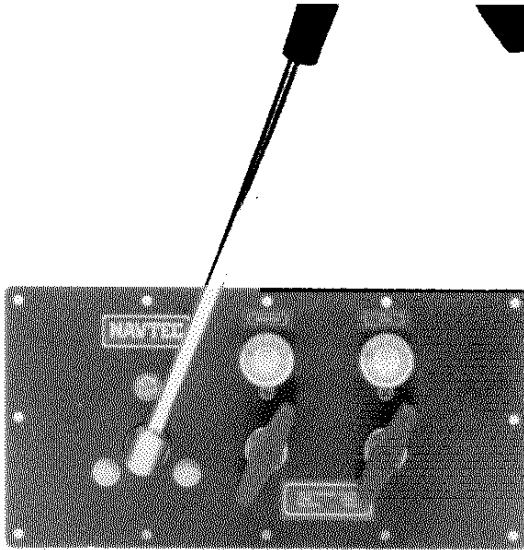
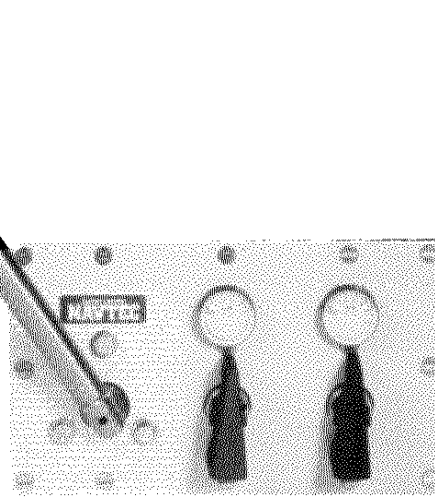


# OWNERS MANUAL

# SYSTEM VI & VII HYDRAULICS Installation and Operating Instructions



System VI Hydraulic Panel



System VII Hydraulic Panel

Thank you for purchasing the Navtec System VI or VII hydraulic panel. It is made of the highest quality materials available. Used with Navtec Backstay Cylinders, Boom Vangs, Cunningham Cylinders, etc. it will add to your sailing pleasure for years to come.

System VI and System VII panels are similar except for their valves. System VI uses standard valves which are closed clockwise to hold pressure, cracked to allow pumping, and opened several turns to release. System VII uses FAC (fast acting control) valves. These valves are lighter and higher flow than the System VI valves. Both System VI & VII use a two speed autoshift pump, a Navtec exclusive. This pump features an adjustable shift point where two of the pump's four cylinders are taken off line, thus reducing the force required on the pump handle by two thirds, as well as reducing output volume by two thirds. Pump output in high speed is .6 cubic inches per cycle (one stroke each way), and .2 cubic inches per cycle in low speed (the same output as the System V pump).

## PRINCIPLES OF OPERATION

The pressure output of the pump goes into a valve manifold which supplies any number of valves. A single valve is required for each function. The valve includes a pump/release valve, an adjustable relief valve, a flow regulator and a gauge. Each function is under constant relief valve protection and the pressure in the cylinder is indicated at all times by the gauge.

## INSTALLATION Panel and Reservoir

System VI hydraulics come in various configurations depending on the number of functions and customer specifications. They are also available as "in-deck" panels to facilitate flush deck mounting, or on other out-of-the cockpit locations.

To mount panels, locate position of the panels keeping in mind normal crew positions while pumping as well as rear access for plumbing. Cut the appropriate hole (see table I) and mount panels using 1/4" stainless steel fasteners. Using high quality marine sealant between panel and bulkhead will prevent annoying leaks. In locating the reservoir, keep in mind that the higher the reservoir is relative to the pump, the more positive the intake pressure will be. High intake pressure will make it easier to prime the pump and will insure full flow to the cylinders at all pump speeds. The reservoir should also be as close to the pump as possible, and the reservoir cap should be accessible for easy filling. Note that the reservoir must be vented. The reservoir cap supplied is vented. If replacing the cap or making your own reservoir, be sure that a vent is included. See table III for reservoir capacities and dimensions.



**TABLE I  
SYSTEM VII AND SYSTEM VII HYDRAULIC PANELS<sup>1</sup>**

Description	System VI Part Number	System VII Part Number	System VI & VII Panel Dimension <sup>7</sup>		System VI & VII Panel Depth		System VI Weight		System VII Weight	
			in	mm	in	mm	lb	kg	lb	kg
<b>SYSTEM<sup>2</sup></b>										
Single function	A330-L00-01	A360-L00-01	11.00 x 7.13	280 x 181	6.00	153	10.4	4.73	9.1	4.13
2 Function	A330-L00-02	A360-L00-02	14.25 x 7.13	362 x 181	6.00	153	13.2	6.00	11.9	5.41
3 Function	A330-L00-03	A360-L00-03	17.50 x 7.13	445 x 181	6.00	153	16.8	7.60	15.5	7.01
4 Function <sup>3</sup>	A330-L00-04	A360-L00-04	20.75 x 7.13	527 x 181	6.00	153	19.6	8.88	18.3	8.29
<b>In-deck panels</b>										
Single Function	A330-VID-01	A360-VID-01	9.88 x 7.50	251 x 191	7.00	178	12.1	5.47	10.8	4.88
2 Function	A330-VID-02	A360-VID-02	13.13 x 7.50	334 x 191	7.00	178	15.1	6.86	13.8	6.27
3 Function	A330-VID-03	A360-VID-03	16.38 x 7.50	416 x 191	7.00	178	18.8	8.54	17.5	7.95
4 Function <sup>3</sup>	A330-VID-04	A360-VID-04	19.63 x 7.50	499 x 191	7.00	178	22.0	9.96	20.7	9.37
<b>COMPONENTS<sup>5</sup></b>										
<b>Autoshift</b>										
Pump only panel	A330-PD-02	A360-PD-02	4.75 x 6.50	121 x 165	6.00	153	5.1	2.29	3.8	1.71
<b>Valve/Gauge Manifold<sup>4</sup></b>										
Single Function	A330-VGM-01	A360-VGM-01	5.75 x 7.13	146 x 181	5.50	140	4.3	1.95	3.0	1.37
2 Function	A330-VGM-02	A360-VGM-02	9.00 x 7.13	229 x 181	5.50	140	7.1	3.22	5.8	2.63
3 Function	A330-VGM-03	A360-VGM-03	12.25 x 7.13	311 x 181	5.50	140	9.9	4.49	8.6	3.90
4 Function <sup>3</sup>	A330-VGM-04	A360-VGM-04	15.50 x 7.13	394 x 181	5.50	140	12.7	5.76	11.4	5.17
<b>Fast Acting Control Valve-Retrofit<sup>6</sup></b>										
	A340-A-04	—	—	—	5.50	140	3.5	1.58	2.2	0.99

1. Panels of other configurations available
2. Includes pump, reservoir, filter and reservoir hose.
3. Additional function controls available. Call for details.
4. Does not include pump.
5. Light, Fast Acting Control Valves may be retrofit on existing System VI panels. All parts required, except the gauge, are included.
6. Does not include reservoir, filter or hose.
7. For cutout dimension, subtract 1.5 in (38.1 mm) from the panel dimension.

**PLUMBING**

The connections between pump and valve manifold have already been completed on 1,2, and 3 function systems. Omit step 1 below with these systems. On 4 function and higher systems, the pump panel and valve panel are separated to facilitate mounting the larger panels conveniently within tight cockpit spaces. With these systems, step 1 is necessary.

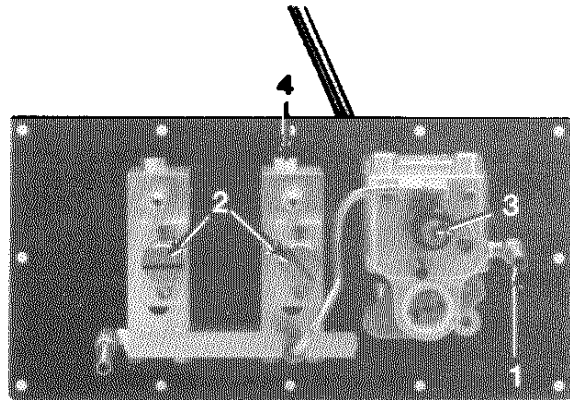
All high pressure plumbing should be 1/4"OD stainless tubing or 3/16" ID hose rated at 5000 psi working pressure or higher. If long runs or high flow rates are anticipated, 1/4"ID hose is preferable.

Low pressure hose connecting the reservoir with the pump and manifold should be 3/8"ID with 250 psi working pressure or better. Such plumbing is available from Navtec or a hydraulic plumbing distributor.

1. For separate pump/valve panels, connect pump output (labeled "out") to valve manifold input (stainless steel fitting on end of manifold) again, this connection is already completed for pump/valve panels. Valve manifold input and return connections may be made of either end of manifold block.

2. Connect either hose barb at the bottom of the reservoir with pump intake hose barb (#1) using low pressure hose supplied. Be sure there is a plastic oil filter in this line. The two hose clamps provided must be used to secure the hoses to the filter hose

barbs. Use the 3/8" low pressure hose and plastic "T" provided. Connect the two remaining hose barbs together with low pressure hose and plastic "T" supplied. Connect "T" to remaining barb in bottom of reservoir.



SYSTEM VI shown. SYSTEM VII connections are identical

## RELIEF VALVE ADJUSTMENT

The relief valve (#2) is set at the factory to approximately 4000 psi. Adjustment is provided by the 1" (25mm) round threaded cap in the aluminum valve block at the back of the panel. Maximum relief setting is 5000 psi. Turning the cap counter-clockwise will lower the setting. Clockwise will raise it. The adjustment is about 1000 psi per complete turn. To determine the setting without tensioning the rig, disconnect any cylinder from the rigging and pump that cylinder until it bottoms and the relief valve lifts which will be evident when continuous pumping fails to raise the gauge pressure. The maximum pressure observed is the relief valve setting.

## FLOW REGULATORS

The maximum rate of oil flow through the release valve is quite fast when compared to older systems. In some cases, such as the backstay, it may be desirable to prevent maximum return flow to allow the cylinder to return slowly. For this reason, flow regulators may be added in each valve block when a slower rate of release is desired. To change the rate of release, simply unscrew plug at top of block (#4). If there is no spring under plug, there is no regulator in the block. Insert regulator spring into block and replace plug (#4). Regulators are available at no charge. They come in various flow speeds with the standard being a 0.015 regulator. If higher or slower flow rates are desired, please consult your Navtec dealer

## GAUGE

The Navtec gauge has a double ended needle so that two scales can be used. The top scale, which reads in thousands of pounds per square inch, is always included and indicates the pressure within the cylinder and the connecting plumbing. A lower scale, which reads in thousands of pounds of force, can be overlaid on the gauge face if the cylinder size is known. These gauge face overlays are available from Navtec at no charge. Please specify cylinder size when ordering. The pressure within the system can be converted to actual force exerted by the cylinder using Table IV or the formula below:

$$\text{Pressure (lbs/inch}^2\text{)} \times \text{Cylinder area (inch}^2\text{)} = \text{Force (lbs)}$$

Gauges have a special backing card that is specially treated to provide night illumination. If "charge" does not provide enough light, recharge by passing flashlight beam slowly over gauge. Navtec also offers backlit gauges as a retrofit option. Contact Navtec for details.

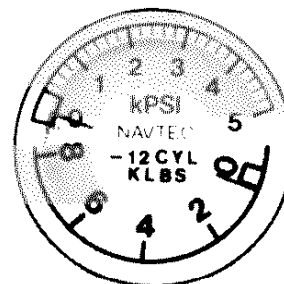


TABLE IV  
Cylinder Force vs. Pressure

CYL. or VANG SIZE	ROD DIA.		CYL. AREA		Observed Pressure (from gauge in psi)					
	(in)	(mm)	(in <sup>2</sup> )	(cm <sup>2</sup> )	1000		3000		5000	
					(lbs)	(kg)	(lbs)	(kg)	(lbs)	(kg)
-6 cyl.	0.437	11.1	0.639	4.12	640	290	1920	870	3190	1450
-6 vang	0.625	15.9	0.482	3.11	480	220	1450	656	2410	1090
-10 cyl.	0.500	12.7	1.16	7.48	1180	530	3480	1580	5800	2630
-10 vang	0.750	19.1	0.914	5.89	910	410	2740	1240	4570	2070
-12 cyl.	0.625	15.9	1.525	9.63	1525	690	4580	2080	7620	3460
-12 vang	0.875	22.2	1.28	7.93	1230	560	3690	1670	6150	2790
-17 cyl.	0.625	15.9	2.173	14.02	2170	990	6520	2960	10860	4930
-17 vang	1.000	25.4	1.695	10.93	1690	770	5080	2300	8470	3840
-22 cyl.	0.750	19.1	2.785	17.96	2780	1260	8350	2306	13920	6310
-22 vang	1.000	25.4	2.442	15.75	2440	1110	7330	3320	12210	5540
-30 cyl.	0.875	22.2	4.414	28.47	4410	2000	13240	6000	22070	10000
-30 vang	1.250	31.8	3.778	24.37	3780	1710	11330	5140	18890	8570
-40 cyl.	1.000	25.4	6.435	41.51	6430	2920	19300	8750	32170	14580
-40 vang	1.250	31.8	5.993	38.66	5990	2720	17980	8150	29960	13590
-60 cyl.	1.250	31.8	8.571	55.30	8570	3890	25710	11660	42850	19430
-60 vang.	1.500	38.1	8.031	51.81	8030	3640	24090	10930	40150	18210
-90 cyl.	1.250	31.8	11.541	74.46	11540	5230	34620	15700	57700	26170
-90 vang	1.875	47.6	10.007	64.56	10000	4540	30020	13610	50030	22690
-110 cyl.	1.375	34.9	14.646	94.49	14650	6640	43940	19930	73230	33210
-110 vang	2.125	54.0	12.585	81.19	12580	5710	37750	17120	62920	28540
-150 cyl.	1.500	38.1	18.120	116.91	18130	8220	54360	24650	90600	41090
-150 vang	2.375	60.3	15.729	99.72	15460	7010	46370	21030	77280	35050

## OPERATING INSTRUCTIONS

### Pump

Insert pump handle. To operate, pump back and forth until pumping becomes difficult. Pump will shift into low gear automatically at factory preset pressure (around 1900 PSI). The shift pressure may be increased by turning the socket head cap screw in the black cylinder on the rear of the pump (#3) clockwise, and reduced by turning it counter clockwise. A 5/16" allen wrench will be needed.

### Valves

System VII panels use the Fast Acting Control Valve (FAC Valve) which has a triangular shaped handle and is significantly wider than the System VI valve. Both are non-interconnected valves, meaning that one function can be released while a second is being pumped. FAC valves have a higher flow rate than System VI valves.

### System VI panels - Operation

To pressurize a cylinder, open the valve controlling that cylinder approximately 1/4 turn and pump. To release pressure, open the same valve approximately 1 1/2 turns to the release position. If continually operating a function (such as a mainsheet), the valve can be positioned in the pump position, close to the release position, and left there without loss of pressure. As the valve goes from pump to release position, a change in handle resistance will be felt. If the cylinder is to be left at the same pressure (as would be the case in most functions), close the valve to avoid changing pressure when pumping other cylinders.

At times, it may be desirable to release several cylinders at the same time. So as not to overload the low pressure return hose, it is best not to release more than two at a time.

### System VII panels - Operation

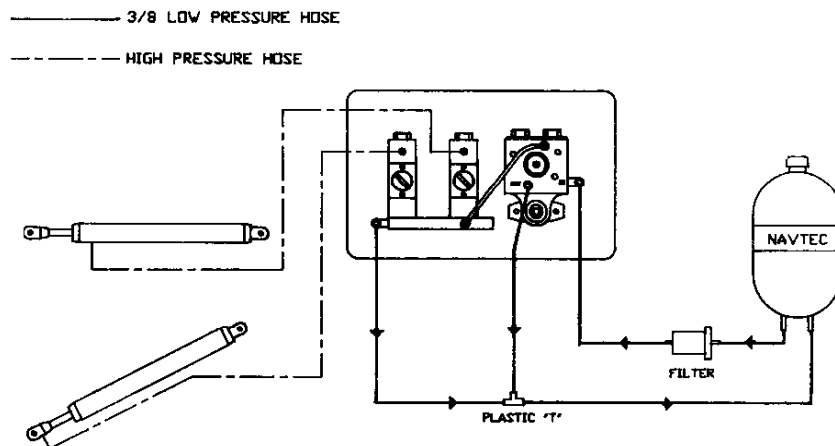
To pressurize a cylinder rotate handle one-quarter turn clockwise from vertical and pump. Pressure will be maintained when valve is in pump position. To hold pressure, set valve handle vertical. To release pressure, rotate handle one-quarter turn counter-clockwise from vertical.

### Four-way Valves

For double-acting cylinders or two cylinders pushing and pulling.

1. To maintain pressure, close both valves fully.
2. To extend or retract cylinder, open one valve fully or set to dump, and set other to pump. Pump. Close both or set to hold to maintain pressure. To move in opposite direction, reverse valve positions and pump.

It is important to recognize that there is no intermediate position as with System VI and FAC valves. 4-way valves must be fully open or fully closed for proper operation.



TYPICAL SYSTEM SCHEMATIC

## OIL AND FILTER

Use #10 hydraulic oil or #10 non-detergent motor oil. (Detergents cause foaming). Never use brake fluid as it will attack the seals. Oil should be checked periodically for cleanliness. Any particulate matter in the oil will decrease the life of the moving parts and may also cause immediate malfunctions. The oil filter should be changed if there is any indication of pump skipping due to oil starvation.

## OIL LEVEL

Your system has been supplied with a reservoir appropriate for the original installation (assuming number and size of cylinders were known at time of original order). When increasing either the number or size of cylinders installed, reservoir capacity may also increase. To determine, add the volume of each installed cylinder or vane as shown in (Table II). The proper reservoir is the next larger volume (Table III). For special stroke length cylinders calculate volume by multiplying cylinder area (Table II) by stroke length.

The reservoir should be 3/4 full when all cylinders are fully extended. If the system does not pump, check oil level in reservoir to insure adequate supply. Check to be sure cap is a special breather cap.

TABLE II

Size*	Cylinder Area and Volume		Stroke(in) (cm)		Volume (in <sup>3</sup> ) (cm <sup>3</sup> )	
	Area (in <sup>2</sup> )	(cm <sup>2</sup> )				
-6SE	0.639	4.123	9.0	22.9	5.75	94.26
-6L	0.639	4.123	13.5	34.3	8.63	141.39
-6FE	0.639	4.123	20.0	50.8	12.78	209.46
-6V	0.482	3.110	9.0	22.9	4.34	71.10
-10SE	1.160	7.484	9.0	22.0	10.44	171.11
-10LE	1.160	7.484	13.5	34.3	15.66	256.67
-10FE	1.160	7.484	20.0	50.8	23.20	380.25
-10V	0.914	5.897	9.0	22.9	8.23	134.82
-12SE	1.525	9.839	9.5	24.1	14.49	237.45
-12LE	1.525	9.839	14.2	36.1	21.66	354.93
-12FE	1.525	9.839	24.0	61.0	36.60	599.87
-12V	1.230	7.936	9.5	24.1	11.69	191.52
-17SE	2.173	14.020	9.5	24.1	20.64	338.35
-17LE	2.173	14.020	14.2	36.1	30.86	505.74
-17FE	2.173	14.020	30.0	76.2	65.19	1068.46
-17V	1.695	10.936	9.5	24.1	16.10	263.92
-22SE	2.785	17.969	10.0	25.4	27.85	456.46
-22LE	2.785	17.969	15.0	38.1	41.78	684.69
-22FE	2.785	17.969	35.0	88.9	97.48	1597.62
-22V	2.442	15.756	10.0	25.4	24.42	400.24
-30SE	4.414	28.479	11.0	27.9	48.55	795.80
-30LE	4.414	28.479	16.5	41.9	72.83	1193.70
-30FE	4.414	28.479	40.0	101.6	176.56	2893.82
-30V	3.778	24.376	11.0	27.9	41.56	681.14
-40SE	6.435	41.519	12.0	30.5	77.22	1265.64
-40LE	6.435	41.519	18.0	45.7	115.83	1898.45
-40FE	6.435	41.519	45.0	114.3	289.58	4746.13
-40V	5.993	38.667	12.0	30.5	71.92	1178.70
-60SE	8.571	55.300	14.0	35.6	119.99	1966.70
-60LE	8.571	55.300	21.0	53.3	179.99	2950.05
-60V	8.031	51.816	14.0	35.6	112.43	1842.79
-90SE	11.541	74.463	16.0	40.6	184.66	3026.51
-90LE	11.541	74.463	24.0	61.0	276.98	4539.77
-90V	10.007	64.565	16.0	40.6	160.11	2624.24
-110SE	14.646	94.496	18.0	45.7	263.63	4320.86
-110LE	14.646	94.496	27.0	68.6	395.44	6481.29
-110V	12.585	81.198	18.0	45.7	226.63	3712.83
-150SE	18.120	116.910	18.0	45.7	326.16	5345.76
-150LE	18.120	116.910	27.0	68.8	489.24	8018.64
-150V	15.457	99.729	18.0	45.7	278.23	4560.12

\*S indicates standard cylinder length, L is long cylinder length  
F is flattening reef/mainsheet cylinder, V is boomvang.

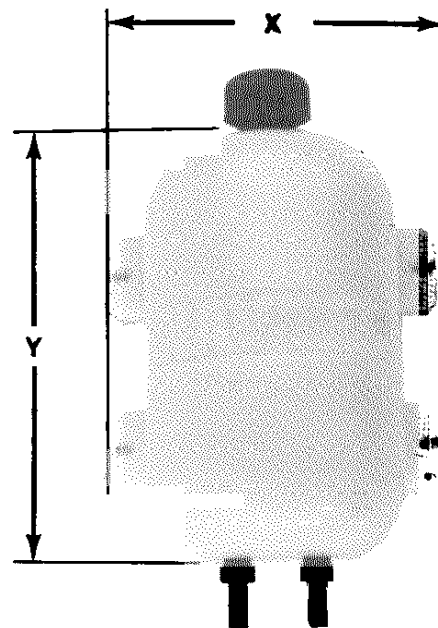
## CYLINDERS

Standard Navtec cylinders are equipped with an air-pressure return. This return is pressurized through the "tire" valve at the clevis end of the cylinder. A bicycle pump or service station air hose can be used to charge the return up to 100 psi. The air pressure should be adjusted to give the desired rate of return. **WARNING:** Once charged, do not attempt to disassemble the cylinder. This should be done only by an authorized Navtec hydraulic service center or Navtec Inc.

TABLE III

Reservoir Capacity & Dimensions

Size	Usable Vol. (in <sup>3</sup> ) (cm <sup>3</sup> )	X(in) (mm)	Y(in) (mm)	Depth (in) (mm)
1 QUART	60 983	6.88 174.8	8.00 203.2	4.88 124.0
2 QUART	120 1967	7.75 196.9	10.88 276.4	5.75 146.1



## BLEEDING THE SYSTEM

After installing the panel, cylinders and plumbing, oil should be added to the reservoir and the system bled of all air. Each cylinder and line must be bled separately.

- Step 1 - Open valve fully (SYSTEM VI) or set to dump (SYSTEM VII).
- Step 2 - With hose attached to cylinder, extend cylinder fully. If there is air pressure in lower chamber, the cylinder will extend automatically.
- Step 3 - Disconnect hose at cylinder. **Note:** always disconnect slowly to allow any remaining pressure to decrease slowly. Be prepared for possible oil drips.
- Step 4 - Set valve to pump and pump, holding the hose-end in a can to collect oil. When oil is bubble-free, reconnect hose to cylinder.
- Step 5 - Pump cylinder all the way down (with cylinder detached from rigging). Then open release valve and allow cylinder to return fully.
- Step 6 - Repeat above procedure for each cylinder and line.

## WARRANTY

1. **WARRANTY:** Navtec warrants its products, in normal usage, to be free of defects in materials and workmanship for a period of one year from date of original purchase by the user, subject to the conditions and limitations below. Any part that proves to be defective in normal usage during that one year period will be repaired or replaced by Navtec. This warranty is subject to the following conditions and limitations.

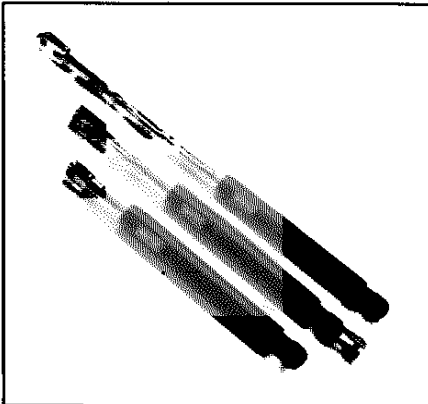
A. Navtec's liability shall be limited to repair or replacement ( choice of remedy at Navtec's option ) of goods or parts defective in materials or workmanship. This shall be the buyer's exclusive remedy in contract, tort or otherwise. B. Except as otherwise provided, quality shall be in accordance with Navtec's specifications. C. Determination of the suitability of the material for the use contemplated by the buyer is the sole responsibility of the buyer, and Navtec shall have no responsibility in connection with such suitability. D. Navtec shall not be liable for any harm resulting from: (1) failure due to use of products in applications for which they are not intended. (2) failure due to corrosion, wear and tear, or improper installation. In the case of rod rigging products, improper installation includes, but is not limited to, the use of rod rigging end fittings other than those manufactured by Navtec or meeting Navtec's specifications. Improper installation also includes, but is not limited to, the use of dies other than those leased by Navtec to Authorized Navtec Representatives, to form the head which is part of the patented Navtec Headed Rod Rigging System. E. Navtec shall not be responsible for shipping charges or installation labor associated with any warranty claims. F. Service by anyone other than Authorized Representatives shall void this warranty unless in accordance with Navtec guidelines and standards of workmanship.

2. **DISCLAIMER OF IMPLIED WARRANTIES.** There are no warranties of merchantability, fitness for purpose, or any other kind, expressed or implied, and none shall be implied by law. The duration of any such warranties that are nonetheless implied by law for the benefit of a consumer shall be limited to a period of one year from original purchase by the user. Some states do not allow limitations on how long an implied warranty lasts so the above may not apply to you.

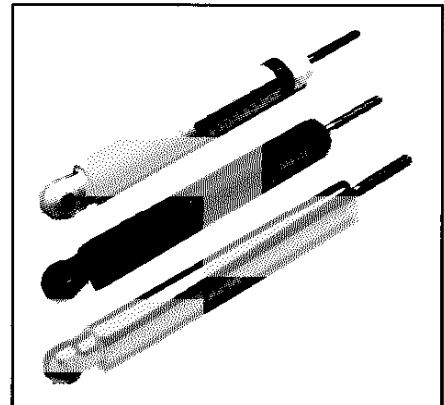
3. **LIMITATIONS OF CONSEQUENTIAL DAMAGES.** Navtec shall not be liable for consequential damages to yachts, equipment or other property, or persons due to any failure of Navtec equipment. Some states do not allow the exclusion of limitation of incidental or consequential damages, so the above limitation or inclusion may not apply to you.

4. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

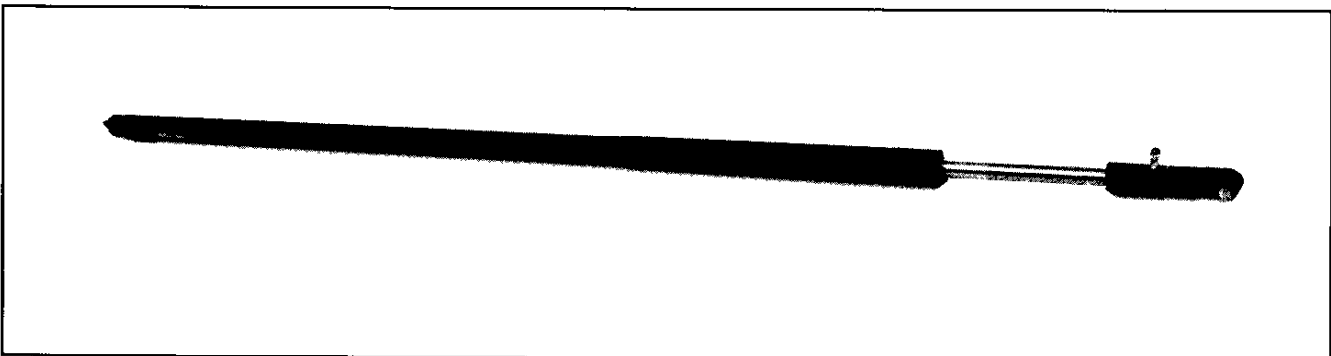
## OTHER NAVTEC PRODUCTS



**CYLINDER TERMINALS**



**CYLINDERS**



**BOOM VANGS**