

## System VIII Hydraulic Panel Installation and Operation Manual • Model #C-8

### **Thank you for purchasing the Navtec System VIII hydraulic panel.**

It is made of the highest quality Marine materials available. Used with Navtec Backstay Cylinders, Boom Vangs, Cunningham Cylinders, etc. it will add to your sailing pleasure for years to come. System VIII panels use Navtec cam-operated fast-acting valves.

All system VIII "L00" panels include a Navtec 2-speed auto-shift pump mounted on the same face plate as the valves. VGM panels require an independent pump and reservoir (A360-PO-02) or other pumping system. The Navtec auto-shift 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 (while 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.



**www.NavtecHydraulics.com**  
Info@NavtecHydraulics.com

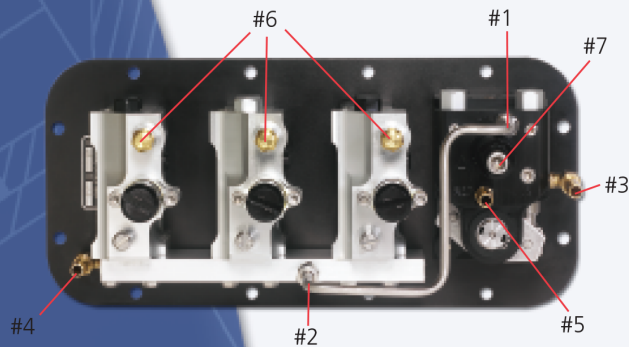
800 Flanders Road • Building 10, #5 • Mystic, CT 06355 • Tel (860) 245-4616 • Fax (860) 245-4351

## 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.

## Panel and Reservoir

System VIII 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 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 ensure 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 supplied cap is vented). If replacing the cap or making your own reservoir, be sure that a vent is included.



## Plumbing

The connections between pump and valve manifold have already been completed on "LOO" systems. Omit step 1 below with these systems. 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.

### VGM systems with Navtec auto-shift pumps

- Step 1.** Connect pump output (labeled "out" #1) to valve manifold input (stainless steel fitting on end of manifold #2) with 5000 psi hose or tubing. Valve manifold input and return connections may be made at either end of the manifold block.
- Step 2.** Connect either hose barb at the bottom of the reservoir to pump intake hose barb (#3) 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.
- Step 3.** Connect the other hose barb on the reservoir to the return from the manifold (#4). Tee in the return from the auto-shift pump (#5) to this line.
- Step 4.** Run high pressure hose from each valve port (#6) to the cylinder/function it operates.

### LOO systems

Skip step one and complete steps 2-4

## Relief Valve Adjustment

The relief valve 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 each valve. Maximum relief setting is 5000 psi. Turning the cap counter-clockwise will lower the relief pressure point. Turning 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 out 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. All CAM valves have a 5% reduction restrictor in them as standard to keep the cylinders from jumping when the valve is turned to release. For maximum flow remove restrictor. In some cases, such as the backstay or out-haul, it may be desirable to restrict the flow more to allow the cylinder to return slowly. For this reason, other flow regulators may be easily exchanged in each valve block when a lower rate of release is desired. Call your Navtec representative to order the correct flow restrictors. To change the rate of release, simply unscrew the output oil fitting on the back of the valve block (#6, above) and replace the standard restrictor with the new one purchased from your Navtec agent.

## The 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 connected 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 the formula: Pressure (lbs/inch<sup>2</sup>) x Cylinder area (inch<sup>2</sup>) = Force (lbs) or see table below. Gauge faces have a special backing card that is specially treated to provide night illumination. If luminescence is not adequate, recharge by directing a flashlight beam at the gauge.



GENERATED FORCE AT APPLIED PRESSURE									
SIZE		ROD DIA	PRESS AREA	PRESSURE (psi)					
		in	in^2	500	1,000	2,000	3,000	4,000	5,000
		FORCE (lbs)							
-6	CYLINDER	0.437	0.639	320	640	1,280	1,920	2,550	3,200
	VANG	0.625	0.482	240	480	960	1,450	1,930	2,410
-10	CYLINDER	0.500	1.160	580	1,160	2,320	3,500	4,600	5,800
	VANG	0.750	0.914	460	910	1,830	2,740	3,700	4,600
-12	CYLINDER	0.625	1.525	760	1,520	3,000	4,600	6,100	7,600
	VANG	0.875	1.230	620	1,230	2,460	3,700	4,900	6,200
-17	CYLINDER	0.625	2.173	1,090	2,170	4,300	6,500	8,700	10,900
	VANG	1.000	1.695	850	1,690	3,400	5,100	6,800	8,500
-22	CYLINDER	0.750	2.785	1,390	2,790	5,600	8,400	11,100	13,900
	VANG	1.000	2.442	1,220	2,440	4,900	7,300	9,800	12,200
-30	CYLINDER	0.875	4.414	2,210	4,400	8,800	13,200	17,700	22,100
	VANG	1.250	3.788	1,890	3,800	7,600	11,400	15,200	18,900
-40 & -48	CYLINDER	1.000	6.435	3,200	6,400	12,900	19,300	25,700	32,200
	VANG	1.250	5.993	3,000	6,000	12,000	18,000	24,000	30,000
-60 & -76	CYLINDER	1.250	8.571	4,300	8,600	17,100	25,700	34,300	42,900
	VANG	1.500	8.031	4,000	8,000	16,100	24,100	32,100	40,200
-90	CYLINDER	1.250	11.541	5,800	11,500	23,100	34,600	46,200	57,700
	VANG	1.875	10.007	5,000	10,000	20,000	30,000	40,000	50,000
-110	CYLINDER	1.375	14.646	7,300	14,600	29,300	43,900	58,600	73,200
	VANG	2.125	12.585	6,300	12,600	25,200	37,800	50,300	62,900
-150	CYLINDER	1.500	18.120	9,100	18,100	36,200	54,400	72,500	90,600
	VANG	2.375	15.457	7,700	15,500	30,900	46,400	61,800	77,300

## Operating Instructions

**For the 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 (between 1000-1200 psi). The shift pressure may be increased by turning the socket head cap screw in the black cylinder on the rear of the pump (#7, above) clockwise, and reduced by turning it counter-clockwise. A 5/16" allen wrench will be needed.

**For the valves:** System VIII panels use the CAM valve which has contoured asymmetric handles. The CAM valve is a non-interconnected valve, meaning that one function can be released while a second is being pumped. To pressurize a cylinder, rotate the handle 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 counter-clockwise from vertical.

**Four-way Valves:** System VIII 4-way CAM valves are designed to operate double-acting (push-pull) cylinders and vangs. When one side of the valve is pressurized, the pressure on the other side is released back to the reservoir. With the handle centered (vertical), load holding is accomplished for either side of the valve. Note that while there are 2 separate relief valves, the gauge is only active for one side of the valve, and thus one side of the cylinder. A Navtec Remote Gauge Assembly (A060-02-00) can be installed in-line to monitor the pressure on the other side of the cylinder, if desired.

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## Oil and Filter

Use Navtec hydraulic oil or Shell Tellus 15 hydraulic oil. Never use brake fluid or transmission fluid as it will attack the seals. Oil should be checked periodically for cleanliness. Any particulate matter or water in the oil will decrease the life of the moving parts and may also cause immediate malfunctions. The oil filter should be changed every 2 years or if there is any indication of pump skipping due to oil starvation. Call your local Navtec agent for oil or filter part numbers.

## Oil Level

All "L00" systems are supplied with a standard Navtec 4 quart reservoir. The 4 quart reservoir should be enough capacity for most 2-4 function systems. Please check with the Navtec agent when purchasing your system to make sure a larger reservoir is not needed. When increasing either the number or size of cylinders installed, reservoir capacity may also need to increase. To determine reservoir size, sum the volume of each installed cylinder or vang as provided in the table below or visit the Navtec web site [www.navtec.net](http://www.navtec.net) and use the reservoir calculator in the support section. For custom stroke cylinders, the volume is calculated by multiplying the pressure area by the stroke. 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 ensure adequate supply. Check to be sure cap is a special breather cap. Custom size reservoirs are available from Navtec.

CYLINDER AND VANG VOLUMES											
		ROD DIA	PRESS AREA	STROKE	VOLUME			ROD DIA	PRESS AREA	STROKE	VOLUME
		in	in^2	in	in^3			in	in^2	in	in^3
SIZE						SIZE					
-6	SE	0.437	0.639	9	5.75	-30	SE	0.875	4.414	11	48.51
	LE	0.437	0.639	13.5	8.62		LE	0.875	4.414	16.5	72.83
	FE	0.437	0.639	20.2	12.89		FE	0.875	4.414	40	176.56
	VANG	0.625	0.482	9	4.34		VANG	1.25	3.788	11	41.67
-10	SE	0.5	1.16	9	10.44	-40-48	SE	1	6.435	12	77.22
	LE	0.5	1.16	13.5	15.66		LE	1	6.435	18	115.83
	FE	0.5	1.16	20	23.24		-40 ONLY VANG	1.25	5.993	12	71.92
	VANG	0.75	0.914	9	8.23		-60	SE	1.25	8.571	13.9
-12	SE	0.625	1.525	9.5	14.48	-76	LE	1.25	8.571	21	179.98
	LE	0.625	1.525	14.2	21.66		VANG	1.5	8.031	14	112.43
	FE	0.625	1.525	24.1	36.67		SE	1.25	8.571	15	128.56
	VANG	0.875	1.23	9.5	11.69		LE	1.25	8.571	22.5	192.84
-17	SE	0.625	2.173	9.5	20.65	-90	SE	1.25	11.541	16	184.43
	LE	0.625	2.173	14.2	30.86		LE	1.25	11.541	24	276.75
	FE	0.625	2.173	30	65.29		VANG	1.875	10.007	16	160.11
	VANG	1	1.695	9.5	16.1		-110	SE	1.375	14.646	18
-22	SE	0.75	2.785	10	27.85	-150	LE	1.375	14.646	27	395.45
	LE	0.75	2.785	15	41.78		VANG	2.125	12.585	18	226.53
	FE	0.75	2.785	35	97.59		SE	1.5	18.12	18	325.98
	VANG	1	2.442	10	24.42		LE	1.5	18.12	27	489.24
							VANG	2.375	15.457	18	278.23

## 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.** Pick one function and turn the valve counter-clockwise to release.
- 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 carefully to allow any remaining pressure to decrease slowly. Be prepared for possible oil drips.
- Step 4.** Set valve to pump position and begin pumping, holding the hose end in a can to collect oil. When oil stream is bubble-free, reconnect hose to cylinder.
- Step 5.** Pump cylinder all the way down (with cylinder detached from rigging). Then turn valve to release and allow cylinder to return fully.
- Step 6.** Repeat above procedure for each cylinder and line.

## Cylinders

Standard Navtec cylinders are equipped with an air-pressure return. This return is pressurized through the Schrader 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. (Normal pressure needed is 40-60 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's Dealer or at Navtec Hydraulics.**

**Vangs: Standard (single-acting) Navtec vangs have a factory set inert (nitrogen) gas charge for return force. Warning: this pressure is quite large- usually between 500-900 psi. Only a Navtec agent should change the return force in Navtec vangs.**