

Sinking of Nordhavn 75 – hull #2

The details of the sinking accident in Cabo San Lucas are pretty clear at this stage and the problem was completely associated with the installation of a Tuna Tube bait system which was conceived, designed and installed by contractors in Mexico.

PAE had no involvement whatsoever. The boat had been delivered two years earlier and the present owner purchased it from the first owner about ten months ago and shipped it from Ft. Lauderdale to Cabo San Lucas.



The boat sunk at about 10:00 pm on Thursday the 3rd of February 2011.



By Sunday the 6th of February at about 6:00 pm she was refloated.

On Sunday morning prior to the refloating a diver entered the engine room and reported that a large PVC fitting has popped off of a large pump and that was the source of the leaking.



When access was possible photos were taken. The photo above shows the PVC fitting with a Sealand sanitation hose attached. The fitting was loose and laying in the bilge below the engine room floor. The diver had noted the through hull was open and he closed it before they attempted to raise the boat. The diver also noted that the water tight door between the engine room and the lazarette was open.



The photo above shows the fitting lifted and the detail can be seen.



The photo above shows the incoming water when the thru hull was temporarily opened to observe the water flow. Water is flowing out of the pump which is mounted under the engine room floor - in the upper right of the photo. The pump is plumbed directly to the thru hull and is approximately three to four feet below the static waterline. The fitting shown is attached to a Sealand hose and runs up to the Tuna Tube bait system located in the cockpit. The pump is hard plumbed to the two inch thru hull and valve with no inline strainer.

The flooding took place entirely within the engine room which is separated from the Lazarette by a water tight bulkhead with a large water tight ships door. Each compartment had an AC positive displacement pump and a DC centrifugal pump with float switches. After calculating the reduction in capacity of the centrifugal pump due to head pressure it is estimated that the combined pumping capacity was about 1,300 gallons per hour. The boat is also fitted with an emergency hydraulic driven pump capable of 10,000 gallons per hour with suction lines at each compartment along with a 240 volt AC centrifugal back of the same capacity - however these pumps must be manually activated and an engine or generator has to be running to develop the hydraulic pressure required.

It appears that the engine room flooded and then water spilled over the sill of the open lazarette door. At that point the lazarette pumps should have operated but the combined capacity of all four pumps running was not sufficient to deal with the amount of water entering.

The calculation below shows that a two inch hole with a four foot head of pressure - will allow water to flow at 9,200 gallons per hour. As the vessel sank lower the flow would have increased.

Flow thru a Hole			
h	4	ft	Head in ft
Hole dia	2	in	Diameter in inches
Velocity	16.04344	ft	
Hole area	3.14		
g	32.174	ft/sec ²	Acceleration due to gravity
Volume	592.73	in ³ /sec	
	2.57	gal/sec	
	153.96	gal/min	
	9237.30	gal/hr	
$V = C_v \sqrt{2gH} \quad \text{and} \quad V = X \sqrt{\frac{g}{2Y}} \quad \text{and} \quad A = \frac{\pi}{4} B^2 \quad \text{or} \quad A = B^2$			
$Q = C_c AV \quad \text{and} \quad Q = C_o A \sqrt{2gH}$			
Assumes Cv = 0.98 for a sharp or rounded edge hole			



The above photo shows the PVC fitting with the threaded collar that screws over the male threads of the pump outlet. This fitting is similar to what's commonly seen on the bottom of a kitchen sink drain.

The photo below shows the male threads of the centrifugal pool pump that the above fitting was attached to.



A few comments about some of the questions and comments posed on the Yacht Forums discussions:

The standard “nuisance water pumps” installed aboard the 75 are a positive displacement pump which is mounted fairly high in the bilge with a suction line running down to an intake strainer. These pumps are 120 volt AC so they can be run via the batteries and inverter as well as from dockside or generator supplied electricity. An AC pump is far more robust than a DC pump and normally specified on larger yachts.

Centrifugal DC pumps commonly used on smaller boats and installed within the bilge are very limited on their ability to lift water. On the 75 the draft is in excess of seven feet so the engine room pumps will have to lift bilge water upward seven feet to the water line and approximately three feet more over a vented loop. The capacities are greatly diminished with this kind of lift. PAE uses a virtually identical bilge pumping system aboard our 86 and have received ABS certification. Additionally 120, hull #1 is being built to ABS classification with existing plan approval, engineered by Applied Marine Design of Mobile Alabama (one of the most respected marine engineering firms in the country) and has essentially the same system but with slightly greater capacity.

In this case the “Unattended Bilge Pumping” capacity could have been doubled or tripled and the results would likely have been the same. Had people been aboard the pumping capacity of the large hydraulic and 240 volt electric pumps could have kept up however if the hole was four inches instead of two, they could not have. Ultimately the best safeguard against this type of accident is the use of watertight bulkheads which in some cases of serious flooding is the only thing that will prevent the loss of a vessel until much larger pumps can be brought aboard. Unfortunately the Pacific Coast Marine, ABS approved water tight door aboard the 75 from the engine room to the lazarette was not closed when the crew left the boat for the night.