

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF MARINE SAFETY

Washington, D.C. 20594

**Sinking of the Passenger Carrying Amphibious Stalwart M/V Minnow on 18
September 2000 in Milwaukee Harbor (Lake Michigan)**

DCA00MM042

Engineering Factual Report

By Ash Chatterjee, IIC

10/17/00

ENGINEERING FACTUALS

Vessel Particulars:

Name: M/V Minnow

Length (overall) = 20 ft 10 in

Beam = 8 ft 7 in

Wheelbase = 10 ft

Freeboard = 30 inches approx (bow and stern with full load of passengers)

Draft = 6' 3"

Height = 11'8" to top of canopy

Passengers: 28

Crew: 1 Licensed Master + 1 deckhand

Gross Tons: 4

Route: Milwaukee river & tributaries, Milwaukee's outer harbor, not to exceed 1000 ft from shore

Max. road speed: 40 mph

Max. water speed: 5 knots

Fuel type : gasolene

6 wheel drive

Unladen Weight = 18,000 lbs

Owner/ Operator: Minnow Tours LLC
3775 South Packard Ave
St. Francis, WI 53235

On-scene Disassembly/ Damage Survey

The Minnow was salvaged about 6 pm on 9/18/00 by a floating crane, placed on a barge which was then towed to the Coast Guard base 200 yards away. The Minnow was then placed on a flat bed and taken to a boat shed on the base where it was kept in Coast Guard custody. Parts of the Minnow were disassembled for examination on 9/21/00 by the Safety Board Investigator and Coast Guard investigators with the aid of the owner and the technical representative from the company. The owner was assisted by the technical representative of the company that had performed repair work on the Minnow prior to the owner's purchase of the vessel. (see Company Background). The technical representative was Mr Frank Serrafine from Land & Sea Tours Inc., Apopka, Florida.

Waterjet Disassembly:

After salvaging the Minnow, water from inside the hull was found to drain for 10-15 minutes out of the intake for the port (left) waterjet tunnel. The waterjet pipe tunnel is normally watertight relative to the hull and could not drain the interior of the hull, unless the pipe tunnel's watertightness was breached. The tunnel is about 12 inches in diameter.

The intake and discharges for the port and starboard waterjets were examined and there was no evidence of blockage from debris. The intake gratings were undamaged. Viewing through the intake gratings it was found that the left waterjet impeller blades had severely scoured the tunnel interior and there was fresh rust in the scoured region (photo). The starboard waterjet impeller blades had maintained their clearance with the tunnel interior and there was no scouring of the tunnel or other abnormalities. Viewing through the waterjet tunnel exit the Safety Board investigator noted that a sacrificial anode at the end of the impeller shaft was missing on the left waterjet while it was intact on the right waterjet. (photo)

The port waterjet was then examined from the vessel interior after removing some of the floorboards. The tunnel was found to be cut, leaving an 1/8 inch opening around its full circumference, at the flanged joint between the section of the housing containing the impeller and the forward (intake) section of the waterjet (photo, drawing). The bolts connecting the flanged joint were intact and tight. The 1/8 th inch opening allowed water to enter the hull through the waterjet tunnel.

The port waterjet was unbolted from the vessel, laid on the shop floor and disassembled. The (undamaged) starboard waterjet was similarly disassembled to provide a reference for comparing the damaged parts on the port jet.

The impeller blades on the port waterjet showed that metal had been scraped off the blade tips when it cut through its tunnel housing. The starboard impeller blades showed no scraping damage with its housing. The retaining nut for the left impeller was severely corroded while the nut for the right impeller showed no corrosion (photo). (The retaining nut was magnetic when tested with a magnet. Other parts, including the tunnel (housing), the stator, the impeller appeared to be non-magnetic. The materials list on the drawing does not specify the materials used, and will need to be tested at the NTSB laboratory for materials identification)

The left impeller shaft in way of the stator bearing was severely out of round (flattened appearance), with metal having been ground unevenly off the shaft surface, resulting in a smaller cross-sectional diameter over an angular range of 180 degrees. The circular lip of the impeller hub that overlaps and rotates over the stator hub (normally with a fine clearance between lip and hub) showed a corresponding uneven metal-to-metal wear pattern over approximately 270 degrees of the circumference of the lip (photo). The right impeller shaft showed no unevenness or metal being ground off.

The stator hub (which the lip of the impeller hub overlaps and rotates over with a fine clearance) was found to have a depth of 1/4" of metal ground off all around its circumference, where the overlapping impeller hub had rubbed against it while rotating (photo). No such damage was found on the right impeller/ stator.

The needle bearing inside the left impeller was dismantled and it was discovered that there was no lubrication in the bearing or in the conical hub at the aft end of the stator. Remnants of needle rollers inside the left stator bearing, which had been pounded into

1/16 – 1/8 inch reddish brown colored particles remained, along with metal shavings from bushings etc, - most of these remnants appeared to have been washed away. Remnants of the bushing in the bearing, now appearing brownish colored, appeared to have “welded” itself on to part of the impeller shaft surface. Only a small portion of the O ring seal retaining spring remained. Examination of the right bearing and conical hub showed that they contained lubricant, and the needle rollers in the bearing were of a stainless steel color. The O ring seal and retaining spring were intact.

On the left impeller a tubular lubricating filler plug within the anode had broken off at the stator cone, and the fitting was missing along with the anode (photo). (Both the lubrication fitting and the anode was intact on the right waterjet). The surface of the break appeared to be a fresh brittle fracture by naked eye along with a speck of rust – it was planned to send it to the NTSB Laboratory for examination. The tubular fitting appeared to have been TIG welded from the inside of the stator cone.

Bilge Pumping System:

Electric Bilge Pumps: Two 12 volt, battery operated, positive displacement bilge pumps were installed aboard the vessel. One of the pumps had its overboard discharge via a 1 inch blue-colored PVC pipe located at the portside stern corner just above the bulwark, and below the vehicle’s license tag (photo). This discharge point would not be visible to the operator from his driving position – this was confirmed by the driver.

The discharge from the second bilge pump – a white PVC 1 inch pipe - was located at the starboard forward corner of the passenger area just above the bulwark. This discharge was visible from the driver’s position. (photo).

One of the bilge pumps had a label plate that was not fully legible; however the following information was distinguishable on that pump:

Brand: WaterPuppy
Capacity: Not legible
Manufacturer: ITT Jabsco, Costa Mesa, CA
Manufacturing Date: March 8, 2000
Model No: (Not legible) ?0?003
Color of pump Casing: Black

The cover plate for this pump was unscrewed and its interior examined. It was found that 2 of its 6 rubber (neoprene) impeller vanes had completely broken. One of the broken vanes had completely blocked the pump’s discharge opening within the casing; the second broken vane had partially blocked the suction opening inside the casing. Further, the pump shaft was jammed and could not be rotated by hand; the pump was inoperable.

The second electric bilge pump appeared identical in size and configuration; however its label plate and body had been completely painted over with grey paint and none of its specifications could be read. The cover plate was taken off and its interior was identical

to that of the previous pump, except that all its 6 rubber vanes were intact and its shaft rotated freely by hand.

Because the pump capacity could not be read from the label plate, I referenced a ITT Jabsco pump catalog in presence of the owner, tech rep and the Coast Guard inspector. It was agreed that the subject pump matched a catalog description (Model # 16360-1003) and photograph for a Water Puppy Flexible Impeller Pump rated at 6.3 GPM @ 0 feet, with garden hose sized (1") suction and discharges, drawing 6.8 - 9 Amps. According to the catalog, self-priming water puppy pumps can be located above the fluid source, and can lift it up to 4 feet. Pump price: \$167.00

Bilge Pump Controls: The drivers dashboard had two toggle white switches with blue label plates marked "Bilge Pump 1" and "Bilge Pump 2" respectively. After salvaging the vessel, the switch for pump 2 was found in the ON position while that for Pump 1 was OFF. The Captain of the vessel stated that he had left both pumps turned on at the time of the accident. There was a bilge pump running light on the right hand side of the dashboard.

In addition, the Minnow was equipped with a hand operated "Guzzler" pump rated at 15 GPM. This pump was stowed at the forward starboard corner of the passenger compartment.

The Minnow was also equipped with a high level bilge alarm located about amidships. There was an alarm light on the right hand side of the dashboard. The alarm sensor was mounted such that the alarm would come on when 5 – 6 inches of water had accumulated in the flat bottom of the vessel.

Hull Integrity:

The underwater hull of the Minnow was examined and showed no leaks or breach of its integrity. The hull was in good condition, without corrosion and without any obvious signs of temporary or patchwork hull repairs. The hull is constructed of ¼ inch steel plate.

All through hull fittings were found to be intact. All three drain/ maintenance plugs each about 2 inches in diameter were found to be tightly secured in place. Among the possible sources of hull leakage the plugs are the most significant; however no leakage occurred through the plugs. The microscopic clearances around the seals and bushings of the transverse driveshafts to the wheels would, at worst, only allow miniscule amounts of leakage

Canopy:

At the vessel owner's request, the passenger canopy atop the Minnow was removed by divers just prior to lifting the Minnow from the bottom of the Lake. This was done to

avoid destruction of the tarpaulin canopy from crushing by the lifting slings. The canopy is normally bolted on at the base of each supporting stanchion.

Life Preservers:

There were child size PFDs on board and adult size PFDs stowed in the overhead of the passenger canopy of the Minnow. The PFDs were supported in the overhead by a criss-cross network of elastic cords (photo). At the center of the overhead of the passenger area was a pull tab. Pulling down on the tab was effortless and caused the elastic cords to snap back to the sides of the vessel, releasing the PFDs through the opening in the network created in its center. It was also relatively effortless to reach up and simply pull out PFDs vertically through the gaps between the network of elastic cords.

Placards were attached to the overhead network of cords, indicating procedures for donning PFDs and showing the separate location for stowing children's PFDs. These placards are required by Coast Guard regulations (46 CFR Subchapter T).