Navy 44 Tank Test Update
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Summary: This report provides an update to the ongoing Navy 44 tank test program. This report includes results from tests of the models heeled 20 degrees and with bow down trim caused by sail forces. These tests also included the use of improved Hama strips and a new keel on the Midshipmen 44.

Expansion of the test data to full size indicated the Midshipmen design will now have lower or equal resistance to the M&R design at all powering speeds. It also showed lower resistance with bow down sailing moments and showed a reduced tendency to pitch.

McCurdy & Rhodes *Audacious* class 44

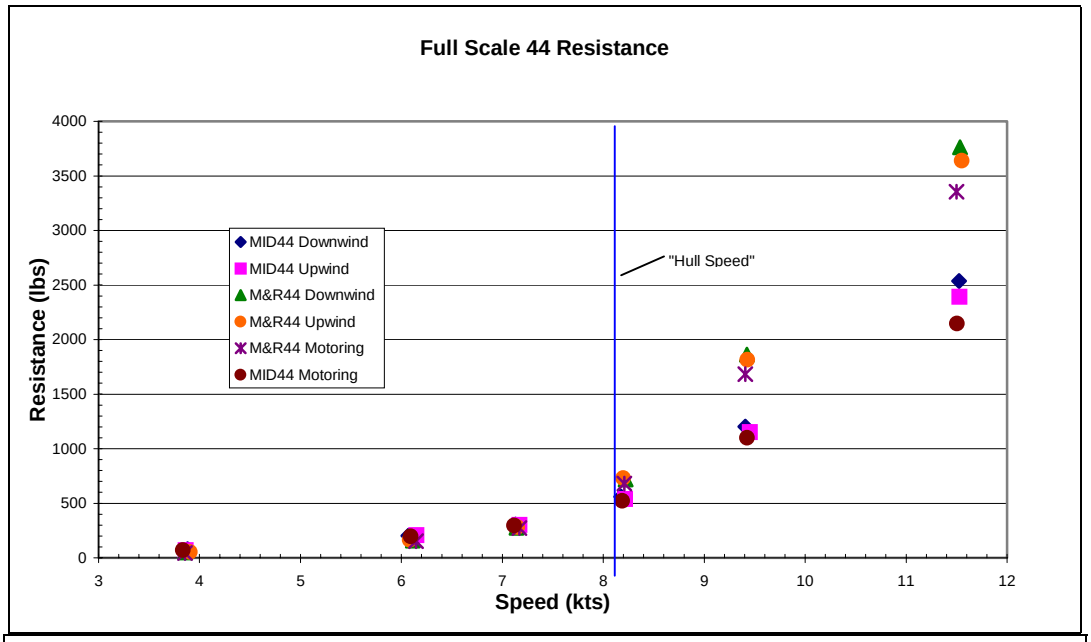
Midshipmen *Defiance* class 44 (note the scale painted waterline is 6” lower on this model)

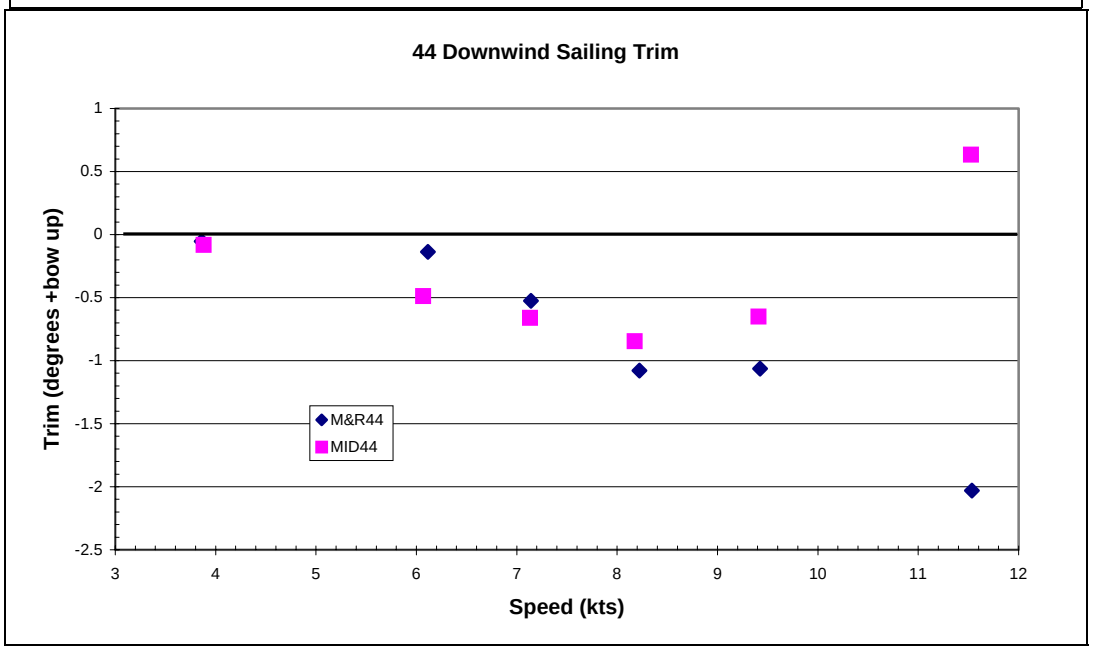
Background: After the *Defiance* class sloop was model tested for simulated motoring resistance in April, a new keel was designed and fitted to the *Defiance* model and both 44 models were tested for sailing performance. With input from researchers at Stanford and the Naval Academy, new Hama strips were installed. The new strips are designed to reduce 3-D effects, which could incorrectly delay hull flow separation.

The new keel, designed by Prof. Miller, attempted to reduce drag by reducing the “frontal area” of the *Defiance* class keel by using a thinner section shape over the whole keel. The planform area of the new keel was increased by 15 percent, and the deadwood at the top of the original Midshipmen keel was eliminated. The bulb was also reduced slightly. The new keel uses a J5014 section shape with a NACA 0018 bulb section, as apposed to the old keel’s NACA 0018 section shape with a NACA 0027 bulb section. The new keel’s volume is therefore 12 percent less than the old keel, the center of gravity is slightly higher and the weight remains constant. In

terms of stability, this will mean that the new LPS will fall between the M&R 44's 128 and the Midshipmen's 142 degrees.

The *Defiance* class and *Audacious* class Navy 44 models were then tested for upright motoring resistance and simulated downwind and upwind resistance sailing resistance. To get the sailing trim moment the models were first run with zero simulated bow-down moment to find the base resistance. The hull resistance, combined with the IMS-generated sail plan center of effort, was used to calculate how far forward to move the weights in the hull to simulate the bow-down moment caused by the sails. After the weights were moved, the models were run to find the resistance and trim of the hull while sailing. The pictures above were taken of the models run at full-scale 7 knots with 20 degrees heel. The plots below show the results of the May, 2001, testing. Note that no yaw was included as the dynamometer is not configured to measure yaw moment or side force. The next planned tests, which will evaluate rudder efficiency, will address this issue. A qualitative grounding experiment is also under development.





Results: Within the experimental precision, the *Defiance* class model fitted with the new keel showed equal or lower resistance throughout the simulated motoring test. With the proposed higher horsepower, the *Defiance* design may be as much as half a knot faster than the current design. This would help solve the current time constraints and allow for more sailing before resorting to the motor. Conversely, if the engine were throttled back the new design would show increased range.

The *Defiance* class model also showed reduced or equal resistance across the full speed range with bow down sailing trim. When heeled 20 degrees, the rudder of the new design remained fully submerged. There was initially a concern in that given the increase in beam at stern, the rudder would break the surface, causing ventilation and reducing the rudder effectiveness when heeled. Complaints from CSNTS and VOST about rudder ventilation and reduced steering ability of the current design drove this concern. This was proven not to be the case however, as the new design's rudder remained well submerged when heeled. In the pictures shown above, the exposed aft end of the current design's rudder is clear, while the proposed design's rudder is fully submerged. Note also the difference in trim, although the two model's paint lines are in different locations. On the *Audacious* class the bottom of the white boot top is located 8" above the static waterline. On the *Defiance* class the bottom of the boot top is located 2" above the static waterline. One other beneficial attribute of the new design is that at high speeds it tends to trim bow up, while the old design trims bow down. This can have a dramatic impact on high-speed maneuverability and broach resistance.

In terms of overall sailing performance, the VPP shows the new design will now have greater speed in all conditions. This too will allow for lower dependence on the engine and greater opportunity for sail training. As the new design includes aspects that rate more favorably under the IMS Rule than the old design, it will also be easier for VOST to sail the boats to their IMS rating. Local racing under PHRF will depend on the committee that assigns ratings.