SEA KNIFE EVALUATION TRIALS

By G H Vick

1. INTRODUCTION

SEA KNIFE is an unorthodox design of high speed craft designed by Peter Payne of Blade Hulls Inc of Maryland, USA. The designer claims that SEA KNIFE is able to maintain high speed in sea states which would cause conventional planing craft to reduce speed. This capability is attributed to the heavily loaded, flat planing bottom which is fully submerged and thus unaffected by wave action (Reference 1).

To investigate these claims action was taken to hire a British built version to test and evaluate its performance. The trials were conducted in the Solent during the period 23 September to 3 October 1974.

2. ARRANGEMENTS FOR TRIALS

SEA KNIFE was evaluated by comparing her performance with that of a conventional high speed planing craft, AVENGER 19. Sandrock Marine of Rye, Sussex, builders of SEA KNIFE, supplied both craft for these series of tests. Table 1 gives details of both craft.

To ensure a fair comparison, the two boats were tested side by side, for speed, handling and seakeeping. Speed trials were carried out over a measured distance for a range of speeds covering displacement and planing conditions.

Seakeeping performance and handling were tested in head, oblique, quartering, following and beam seas and assessed by drivers drawn from IHU HMS DAEDALUS, Royal Naval School of Seamanship, DNE and AEW. Each driver completed questionnaires comparing handling, wetness and motion of the two hulls. Typical comments are given in Appendix I.

RAE Fatigue Meters Mk 13 fitted in both hulls recorded accelerations whilst the craft were driven on identical headings and speeds. This gave a direct comparison of vertical loadings.

3. RESULTS

3.1. Speed Trials

These trials were conducted in moderate conditions with wave heights of 6 inches to 1 foot and wind speeds up to 12 knots. Figure 1 shows speed/rpm curves and Figure 2 measured speed/ships speed plots for SEA KNIFE and AVENGER. SEA KNIFE was 0.5 knot faster than AVENGER at 1,000 rpm, roughly equal at 2,500 rpm and 5 knots slower at 4,250 rpm, the optimum rpm for 188 Mercruiser engines. Differences in pitch of the two propellers accounted for some of this variation in speed. Face cavitation on SEA KNIFE's propeller indicated that a coarser pitch would have improved performance.

Figures 3, 4, 5, 6, 7 and 8 show SEA KNIFE and AVENGER running

attitudes at 4-28 knots and in calm conditions. Figures 5 and 6 show the spray sheets which stabilise SEA KNIFE at higher speed (Reference 2).

Trim and loading affected SEA KNIFE's performance. A 5 per cent increase in displacement reduced her speed at 3,900 rpm from 26 knots to 24.5 knots. Excess stern trim increased SEA KNIFE's speed at 3,800 rpm from 25 knots to 28 knots, but at this trim she was difficult to steer, see Appendix II.

Power could not be measured in terms of propeller thrust and torque, and fuel consumption was used as an approximate comparison. On this basis SEA KNIFE needed 35 per cent more fuel than AVENGER over the range of trials and speeds.

3.2. Turning Trials

Comparison of turning circles showed AVENGER as the faster turning craft at displacement and planing speeds. At 28 knots and above AVENGER's lack of lateral resistance caused her to skid broadside on the turn so that SEA KNIFE turned faster at these speeds.

3.3. Seakeeping and Handling Trials

3.3.1. Drivers Comments

Sea conditions varied from 6 inches waves and wind speeds of 8 knots to 3.5 feet crested waves 30-40 feet long and mean wind speeds of 30 knots gusting to 42 knots. The boats were driven by 11 drivers in all, who commented on the boats' behaviour. A selection of their comments are listed in Appendix I.

Squadron Leader D A Lethem of IHU, HMS DAEDALUS, drove both craft in all sea conditions. His impressions of their performances are given in Appendix II.

3.3.2. Handling

SEA KNIFE was difficult to control at 4 knots, due to her bow trim. At 7 knots and above she trimmed by the stern which gave directional stability, and from then on she was easy to steer. AVENGER's steering was steady and predictable at all speeds. The drivers agreed that AVENGER was easier to handle at slow speed, but preferred SEA KNIFE's performance, at planing speeds, in moderate seas.

3.3.3. Wetness

No clear assessment could be made in 1 foot wave heights or less, and only on 4 occasions were these wave heights exceeded.

SEA KNIFE's bow down attitude at slow speed made her wetter than AVENGER, but she was noticeably drier at planing speeds. SEA KNIFE generated more spray than AVENGER, though this was thrown clear by her flared sides. Occasionally solid water was shipped by SEA KNIFE in following seas: Her fine bows lacked sufficient buoyancy to lift her out of the trough and she ploughed into the back of the next wave.

3.3.4. Motion

a. Pitching

SEA KNIFE pitched far less than AVENGER in all sea states and headings. Figure 9 shows a comparison of accelerometer readings recorded in SEA KNIFE and AVENGER, which clearly demonstrates this behaviour. In 3 feet head seas AVENGER slammed continuously at planing speed, whereas SEA KNIFE experienced only an occasional "thump".

b. Rolling

SEA KNIFE lacked static stability and lolled to 10 degrees when laden, see Figure 10. At speeds up to 4 knots SEA KNIFE was tender and rolled heavily, but above this speed she trimmed by stern and became quite stiff. AVENGER's roll characteristics were quite conventional for this type of craft and exhibited no unusual features.

In a seaway SEA KNIFE showed a tendency to small jerky roll expecially in beam seas.

c. Yawing

In beam and quartering seas SEA KNIFE occasionally lurched off course in an unpredictable manner when a wave struck one wing of her wide transom. In 3 feet seas this movement was sufficiently violent to throw the crew across the width of the cockpit.

Sea conditions were never severe enough at any time during these trials to conclusively prove SEA KNIFE's claimed superiority in rough water.

SEA KNIFE and AVENGER were filmed in 3 feet waves to record and compare their respective motions and shots from this film are shown in Figure 11.

4. DISCUSSION

4.1. SEA KNIFE UK is not fitted with the spray reversers of later American models, which are claimed to increase speed and limit "lift forces when passing into the flank of a wave" (Reference 4).

The following comments therefore, only apply to the British built version of SEA KNIFE.

4.2. The object of these trials was to obtain a comparative assessment of the SEA KNIFE design and its potential in larger versions. The short trials period seldom allowed drivers more than one day's handling of either craft, on which to base their judgements. Consequently, it was not unexpected that the majority preferred AVENGER, a craft prone to slamming but handling in a predictable fashion. SEA KNIFE undoubtedly gave a much smoother ride in waves though her steering was unpredictable occasionally.

4.3. Further operational experience would be needed to develop new control techniques for SEA KNIFE in heavy weather high speed operation. Alternatively, it should be possible to modify SEA KNIFE's hull to minimise her odd behaviour in beam seas without loosing that well damped pitching motion.

Reduction of topside flare at the transom, would be beneficial when encountering beam seas and model experiments could be used to determine the optimum shape.

4.4. SEA KNIFE at 28 knots using 188 hp, could be extrapolated to 61 knots for a 100 feet craft using 40,000 hp and able to operate in 14 feet wave heights.

4.5. Her very easy pitching motion, especially in head seas, merits further investigation and development as a weapons platform. No absolute evidence of either hull's superiority to maintain speed in rough water was obtained from these trials. It was evident from vertical accelerations comparison in Figure 9 that SEA KNIFE was most likely to be the better.

4.6. Static stability in SEA KNIFE is poor and can be improved by modifications; eg i. lower the CG, ii. widen the waterplane, ie increase bow entry angle, iii. adopt a swing wing trimaran configuration with wing floats housed in the bustle at speed.

4.7. The planing attitude of SEA KNIFE is dependent upon a variable angle propeller thrust and for this reason the outboard drive should be retained in larger versions.

5. SUMMARY AND CONCLUSIONS

SEA KNIFE was a most interesting and unusual hull form having the following advantages and disadvantages when compared with conventional hulls.

5.1. Advantages

5.1.1. Very much easier motion, especially in ahead seas, at planing speed and above which would enable work to be performed in more severe sea states.

5.1.2. Handled well and turned positively at planing speeds and above.

5.1.3. Much drier craft, except at low speeds and in following seas.

5.2. Disadvantages

5.2.1. Lacked static stability, see Figure 10.

5.2.2. Difficult to bring alongside and manoeuvre at slow speed, see Appendix I for drivers' comments.

5.2.3. More power required to attain comparable speeds.

5.2.4. Subject to unpredictable changes in course in beam and quartering seas.