

Basic Detail Report



Spirit of Australia

Vessel number

HV000018

Date

1974

Description

On 8 October 1978, Australian Ken Warby stunned the speedboating world by breaking both the 300 mph and

500 km/h barriers, claiming the outright world water speed record for a second time. His record endures, despite several challenges which have ended in tragedy. Warby was the first person to design, build and drive a boat to a new world water speed record-and on a shoestring budget. He first claimed the world record in 1977, taking his home-made hydroplane to a speed of 464.44 km/h and breaking American Lee Taylor's ten-year-old record of 458.98 km/h. But where Lee Taylor's record had cost close to \$1 million in 1967, Warby built his boat in a suburban backyard-with a military-surplus jet engine that cost \$65! In 1978 he returned to Blowering Dam in the southern highlands of New South Wales and pushed his record to 511.11 km/h (317.68 mph), where it still stands. The remarkable thing about Spirit of Australia is that almost anyone with reasonable building skills could put it together. It is a home-built wooden boat, using stringers, brackets, stock bits of timber, plywood, screws and epoxy. What stands out is the builder's logical approach to the project. He did not know the answers to many of the problems he expected to meet along the way, so he followed a path on which he could learn as he progressed. He started with a shape based on his knowledge of hull design, built the basic hull and tested it, then went on gradually to explore the problem areas and search for the solutions. Ken Warby is a genial, confident and easily approachable character whose casual manner doesn't entirely hide his extraordinary genius: an intuitive, seat-of-the-pants understanding of forces and structures. At 500 km/h you are travelling 139 metres per second, and one kilometre goes by in seven seconds. These are speeds that rip a boat to shreds if something goes amiss. Instinct is needed not just to survive but to learn-video footage at those speeds is a blur lost in spray, so no-one knows exactly how much of the boat is in contact with the water. Ken Warby sums it up by saying 'You don't drive the boat, you wear it.' An experienced amateur designer/builder at the time he started out on what he called Project 300, to break the 300 mph barrier, Warby was inspired by the water speed record holders of the 50s and 60s when record breaking was fashionable. As a kid he made a model of the great British land and water record breaker Sir Donald Campbell's last Bluebird and ran it on the local pond with a tiny 'Jetex' engine. He designed, built and raced his own power craft before he was old enough to visit the speedboat club bar, and later won races and state championships. A mechanical engineering qualification and practical workshop experience at the local steelworks added a solid grounding, but what he knew about hydrodynamics and aerodynamics came mostly from practical experience. His philosophy was 'KISS' (keep it simple, stupid), and Spirit of Australia's design and structure

reflects this 100%. Spirit is a three-point hydroplane, well established as the type for high speed racing and speed records. The concept of the planing hull with widely separated sponsons forward of midships was patented in 1938 by Adolph Apel and his son Arno in the USA. At speed the hull lifts and planes on the two sponsons and the aft end of the hull. The wetted surface of these three points of support is minimal, and the shape lets air under the hull to create additional lift. At record-breaking speeds there is very, very little boat in contact with the water, making directional control and stability a problem. Most dangerous of all, lift under the nose can lead to a catastrophic somersault-the thing that killed Sir Donald Campbell and many other record seekers. Warby describes Spirit in an offhand, affectionate manner as 'a box around the engine with skis, (shaped) to go through the wind right'-and indeed it evolved from a simple hull, sponsons and uncovered engine into a refined, streamlined record breaker. Its proportions initially came from the size of the engine, the length of the cockpit, and 'enough nose out front to line it up on the course'. Why did he choose wood as his material? Warby had built his previous boats of wood so he had the skills, and he knew a timber structure could be robust and sturdy. Aluminium, fibreglass or composite structures can have a strength to weight advantage over wood but Warby wanted a bit of weight in the hull to keep it from taking off. Wood also suited his budget, and would be easy to modify as the project went on. When Ken Warby put his thoughts on paper in 1970, working on the kitchen table at night, he drew a minimal pencil lines plan, enough to lift offsets for the hull and sponsons. As designer and builder the structure was in his head; he did not need to draw it, just do it. Later he sketched over the plan with outlines for a tailplane, air inlets and a windshield that would eventually be added. His 'box' took shape first around two main longitudinal members of solid timber girders, surrounded by transverse bulkheads with a floor, side frames and deck beams. On the centreline at the bottom is a flat keel. Chine logs, stringers and a solid wood transom complete the framework of Oregon and spruce which is covered with marine-grade plywood, laminated with Dynel cloth. The sponsons are built onto the hull and their structure is similar. Just forward of the cockpit are the airspeed fitting and a cleat-even the world's fastest boat needs to be towed or tied up! But how do you support a powerful jet engine and keep it from parting company with the boat? The twin girders became engine beds supporting a framework of welded mild steel pipe in which the engine is slung. For steering, a mild steel rudder blade and quadrant was securely bolted to the transom, linked by heavy cables to a wheel in the cockpit. Behind the sponsons were stainless steel fins acting like skegs to give the rudder something to push against. Spirit of Australia was launched for trials in 1974, looking rather agricultural with neither tailplane nor windshield. Warby sat in front of the uncovered engine in an open cockpit, wearing a crash helmet, goggles and a big smile as he set an Australian record of 267 km/h. He deduced that the centre of gravity should be further forward at higher speeds and he moved the engine forward. He also knew that the time had come to seek technical advice about the things he needed to push the boat much faster. Air intakes, a windscreen and engine cowlings would reduce drag from the engine and pilot, while a tailplane and a planing shoe-the third planing surface at the aft end of the hull-were critical to lift the stern and correct any tendency for the bow to lift. Warby's self-taught confidence mixed with trepidation when, in 1975, he sought out Professor Tom Fink and his assistant, Dr Laurie Doctors, at the engineering faculty of the University of New South Wales. Professor Fink had done wind tunnel testing in London for the designers of the last Bluebird, and asked Warby to make a test model for the university wind tunnel. To the Professor's surprise, Spirit's apparently crude design was more aerodynamically stable than Bluebird, and was theoretically capable of achieving the desired speed. The

less stable Bluebird had lifted off and looped the loop, killing Sir Donald Campbell in 1967. Fink showed Warby how to design his intakes and what area was needed for the tailplane, and continued to advise as the project went on. Warby made his tailplane by riveting an aluminium skin around the ribs and tips of a Cessna 172 aircraft. It was mounted on a steel framework, the whole tailplane pivoting fore and aft so the angle of incidence of the horizontal 'wings' could be adjusted between test runs. It was the first speed record boat to fit such a stabiliser. Professor Fink would have preferred a wider span and narrower chord for the tailplane, but the Cessna parts were all Warby could get at the time. Not only that, they were within the maximum 2.44-m width legally towed on the roads in the state of New South Wales, a very practical consideration! The shoe under the hull, the aft planing point, was a long, narrow wedge of wood finished with fibreglass. Warby felt that the tailplane was 'too mushy' as a control surface, and that the shoe would be a much more positive influence in raising the stern and pushing the bow down. Further trials confirmed this, as he gradually increased his Australian record while working up to his first successful attempt on the world record, in 1977. The attention this first record brought him helped him secure a \$60,000 sponsorship from the swimsuit manufacturer Speedo, and more help from the source of his engine, the Royal Australian Air Force. Other local sponsors assisted too. So what was it like to drive Spirit of Australia at such speeds? Only Ken Warby really knows, as no one else has ever driven the boat. Warby says he always felt comfortable and unthreatened, able to drive with two fingers on the wheel. He says 300 mph is much the same as 200 mph, except that the end of the dam comes up much faster. Exactly what is in contact with the water is uncertain. Undoubtedly the rudder and fins are, and probably the extreme aft ends of the sponsons and shoe should be providing planing support. Unfortunately the spray thrown up under the boat hides the truth! Film footage shows no hint of pitching. This rock-steady profile comes from a delicate balance of factors countering any lift up forward. The boat has weight, and its centre of gravity is a short distance aft of the sponsons. The sponsons are angled to lift gradually and to straddle any ripples or small waves on the water. The nose is shaped so the airflow across the deck pushes it downwards, and the thrust of the jet above the centre of gravity also gives the nose a slight downward push. So does drag from the wedge-shaped rudder, pulling backwards below the centre of gravity. The shoe also lifts the stern. The fixed tailplane increases its angle of attack if the nose rises and this increases lift at the stern, pushing the nose back down. In fact the combination of forces acts like a see saw around the centre of gravity. What really disconcerts observers is the slow sideways oscillation at top speed that Warby calls 'sponson walking'. Rolling through about three degrees from side to side over two seconds, this is another delicate balance of forces whose significance was only learned through many trials. The rolling motion releases air pressure which builds up under the hull and could flip the boat. The roll is induced by torque from the engine and subtle shaping of the shoe, and it can be adjusted by positioning the fuel load to reduce it to what Warby calls a 'gentle' motion. But to someone watching from the shore it's terrifying. Warby is adamant that the search for mirror-smooth water is wrong. Rippled water-75 to 100 mm ripples running down the course-is ideal. The ripples aerate the contact surfaces and reduce drag. Warby says he lost 50 km/h in mirror smooth water, and the increased drag on the sponsons as they 'walk' from side to side induces an uncomfortable yawing motion not evident on rippled water. The emphasis is on ripples-at 500 km/h you don't want to hit a wave, and between runs you have to wait for the wash to dissipate. For official records, Spirit's speed was measured over one kilometre of a 13-km course. There is an accelerating run up and acceleration continues through the measured kilometre. The speed is measured as

an average of two runs over the same course, one in either direction, taken within a period of one hour. Beforehand volunteers go out and pick up any debris on the course. Spirit once collided with a soft drink can during early trials, the boat sank as it came ashore and the salt water ruined the engine.

Westinghouse J34 WE 34 Turbojets were booster jets from the RAAF's Lockheed Neptune anti-submarine aircraft. In 1970 a friend told Warby about an Air Force disposal sale and he bid for two jets at \$100 each. To his surprise he got them, so he incorporated them in the final design. Later he bid for a third at another sale and this one only cost \$65. Declared unserviceable, it was put aside for spares. During his first world record attempt in 1977 a screwdriver which had probably been left in an intake went through the turbines, ruining his good engine and the screwdriver. Warby was forced to use the sick \$65 engine in that first record-breaking run, even though it had much less thrust than the original. The only way to get greater speed from this less powerful engine was to reduce drag. Professor Tom Fink calculated that a 50 mm reduction in rudder depth would be enough, but Warby realised that it would also reduce his margin of safety because that drag was a factor helping to keep the bow down. He took the risk, and in a farmer's shed in the rural countryside where the record attempt was taking place he took an oxy torch to the rudder. Just to be sure he took off 65 mm. It was a rough cut which visitors to the Museum can still see today. The boat handled well despite the shorter rudder, and he had his first world record. Sadly this did not make much impact in the Australian media even though the event was recognised internationally.

Warby describes the second attempt in 1978 describes as a 'cakewalk', just a matter of 'running the numbers'. He had managed to swap his sick engine for a better one at the nearby Air Force apprenticeship training base, and they also gave him technical support. His jet ran smoothly with plenty of power and gave him his 300-mph and 500 km/h prizes-but not without some drama. On 7 October the weather was deteriorating. He had started in relatively calm water but part way down the course when he was up to about 400 km/h (250 mph) he ran into waves. Leaping off one, Spirit landed badly. Warby was tossed around in the cockpit and the tail mounts broke. That night while others were partying in anticipation of a record the next day, Ken was back in a farmer's barn fixing his tail mounts until late at night. On 8 October he went out and broke the record. And this time he made the news locally and internationally, winning the title MBE (Member of the British Empire). Ken Warby is immensely proud of his boat, but a little protective about its details. He realises that his simple approach could easily be copied, and he does not want to give away too much too easily. After his record he did some more trials out of curiosity, to test an afterburner that had been installed before the record attempts but failed to work. When it was put into action it gave the boat a significant jolt but Warby kept in control, and even today he is a little coy about the success of the trials. Rather than push Spirit any further he has preferred to wait and see if his record might be broken by someone else before trying again. Lee Taylor and then Craig Arfons, both from the USA, tried separately in tragic attempts. Both drivers died when their boats went out of control at speeds below his existing record. The Australian National Maritime Museum acquired Spirit of Australia ten years after the record, buying it from Warby with financial assistance from the 1978 record sponsor, Speedo. These days Warby is happily established as a resident in Cincinnati Ohio, the intervening years filled with racing jet cars, jet trucks and a jet hydroplane, 'having fun and getting paid for it'. He has also just built another boat. Twenty years down the track Ken Warby says he'll attempt to break his own record, with a new wooden boat. Instead of an open backyard and garage to build in, he now has a well-equipped shed as a workshop. What did the neighbours think back in the 1970s, when he started Project 300 in the backyard

over their fences, with some used jet engines stored under tarpaulins? They thought he was nuts, while many of his boating contemporaries called it an impossible dream. But Ken Warby had the mark of someone with a good feel for what is right, separating him from the average person the way a sporting champion has that gift of timing or co-ordination that puts him in the elite level. Warby knew that by following a well thought out, logical and cautious approach, he would meet and overcome the various obstacles ahead and put his name up with Gar Wood, first through 100 mph, and Sir Donald Campbell, first through 200 mph. And so he became Ken Warby MBE, first to break 300 mph on water in the Spirit of Australia, a simple wooden boat with performance like no other. First published in 1998, written by D Fletcher and D Payne (ANMM)

Dimensions

Vessel Dimensions: 8.22 m x 2.37 m (27 ft x 7.8 ft)