The all-electric Candela Seven has thrown down the gauntlet to competitors still reliant on combustion engines – and may well have the performance chops to back up this challenge.

Profiled at boot Düsseldorf in January, the head-turning craft deploys retractable, wing-shaped foils and an advanced control system to fly above the water, while utilising a network of sensors and an aero-style flight controller to enhance its seakeeping capabilities. Most impressively, perhaps, the boat can achieve a range of 50nm on a single battery charge – a feat that, along with the other aspects of its design, has earned it the nickname of the ‘Tesla boat’.

Under development since 2015, the Candela Seven was conceived and built by Candela Speedboat, and the first unit launched in September 2019. Since then, an additional 11 boats in the series have been launched from the company’s production facility in Lidingö, Sweden – and, Candela tells Ship & Boat International, the company expects to make a further 30-40 boats before the end of 2020.

“So, the only way to go electric is with foils, which give you other benefits such as no slamming, overall better seakeeping and a quiet ride. Foiling boats may look exotic today but, if you think about how boats have evolved in just 60 years, you will find that variation is the norm in shipping.”

Hasselskog is opinionated on the green revolution. “Planing, fossil fuel craft have been the standard for 50 years,” he continues, “so people are used to their high fuel consumption. But for how long will the boaters – and society in general – accept recreational craft that spew out CO2 and pollutants at nearly the same rate as a main battle tank? Brand new outboards would never make it into a car: they are far too polluting.”

The commuter market

The enhanced seakeeping and quiet performance – not to mention the lack of emissions – means that the Candela Seven is a truly green commuter boat. The 22-foot vessel can achieve speeds of up to 30 knots on a single battery charge, and its top speed is limited only by the boat’s water speed, not by the speed of the boat. This means that the boat can still reach speeds of up to 30 knots, even in rough conditions.

“The Candela Seven uses a combination of low friction and low weight to produce colossal energy savings compared to fibre glass-built, petrol-fed boats.”

Sea trials showed the Candela Seven capable of hitting a top speed of 30 knots. The green revolution is inevitable, in Hasselskog’s opinion. “Planing, fossil fuel craft have been the standard for 50 years,” he continues, “so people are used to their high fuel consumption. But for how long will the boaters – and society in general – accept recreational craft that spew out CO2 and pollutants at nearly the same rate as a main battle tank? Brand new outboards would never make it into a car: they are far too polluting.”

Sea trials showed the Candela Seven capable of hitting a top speed of 30 knots.
of smoke and harmful emissions – are welcome bonuses, particularly given one of Candela’s key target markets.

“With Candela, it was a case of saving every kg they could to get the range and performance they wanted. By providing these properties in an infusion system using SR1710, the builders can get a resin content of about 35%, which is hard to achieve with a wet laminating system. Any more resin than that becomes excess weight – it doesn’t make the structure any stronger.”

**Cleaner, more consistent**

SR1710 was developed to offer a cleaner and more consistent process than is the case with traditional wet lamination techniques. For wet lamination of composites, an applicator wets out the cloth with resin using a brush or a roller. This tends to be a messy process. Sicomin says: “As the mould is open, there are more fumes and more chances for workers to make contact with the resin – but, on the positive side, it’s a process that works and has been used for decades, and for boats of all sizes.”

In terms of consistency, lamination is very operator-dependent. Skilled guys can do a great job but, if care is not taken, the resin-to-fibre ratio can vary a lot and can easily be 50:50, whereas a good infusion produces a more consistent result, and could be 35:65 with less resin than fibre – producing a lighter structure, which was key for Candela.”

SR1710 has a post-cure glass transition temperature (Tg) of 100°C. Sicomin
Micro-cracking resistance

The final assembly was performed by Candela using Sicomin’s Isobond SR7100TH epoxy adhesive, which has been formulated for both thick and thin bond lines, and which comes with several different hardener speeds.

Sicomin adds that SR1710 is deemed ideal for “hot and wet conditions”, with regards to where it is used aboard the boat. “The Tg of 100°C is a laboratory-tested figure, but it is a value that can be significantly reduced by exposure to hot, wet and humid conditions when the composite is in use,” Sicomin says. “For this reason, engineers are more interested in the knockdown on the Tg value after prolonged exposure to these aggressive conditions – perhaps in engine bays, near battery boxes and electric motors, or in the bilges. SR1710 has very little Tg loss in these conditions: it maintains its mechanical performance so engineers don’t have to make allowances.”

Smart controls

Ultrasonic sensors were installed in the boat’s bow. These measure wave height during the boat’s journey, and relay this info in real time to the onboard flight controller, which was manufactured purely in-house by Candela – right down to the printed circuit boards. The software code was also written internally by Candela’s technical team.

The flight controller responds to this data by autonomously adjusting the foils’ positions and angles in reaction to the sensor-captured wave conditions and speed. Hasselskog elaborates: “Mechanically, the foil struts move independently back and forth to twist the flexible carbon fibre hydrofoil wings, which then act much like the ailerons on an aeroplane. The principle is the same as that of the Wright Brothers’ first aircraft.”

The coxswain has access to a 12” touchscreen on the helm, which displays the sensor data and can be updated over the cloud, using a 4G connection. Recharging
the battery, meanwhile, can be done using an electric car-style charger and charge port, connected to an in-harbour power source.

**Trial observations**
The final stage – and undoubtedly the most fun part – was to commence the Candela Seven’s international sea trials. “We tested the boat extensively in the Swedish archipelago and the Baltic Sea, in just about every condition,” Hasselskog recounts. This included biting winds of 20 metres per second (m/s). It’s here that the team learned a lot about the boat’s capabilities.

“We can foil in up to 1.2m-high waves without the waves hitting the boat,” says Hasselskog. “The waves here are very choppy, and can be high, and we managed to hit our top speed of 30knots in 24m/s gusts. In these sheltered waters with choppy seas, there is no other 7.5m boat that can compete with the Candela Seven in terms of seakeeping.”

The strength of the composite foils was also put to the test, and passed admirably. “We even broke some ice with the foils,” Hasselskog says.

The payload restriction of 410kg was imposed as this is the maximum the boat can handle when taking off with a 70kW motor. “More power is needed for take-off with heavy loads,” Hasselskog says, adding: “Once up and flying, though, we only use 18-20kW with six persons on board.”

Follow-up trials were then hosted in the Caribbean earlier this year. “The boat performed very well, even though we found that long, high waves can be a problem,” he says. “But that is true for any other boat of the same size. At open sea, in stormy conditions, we cannot go foilborne – then we have to slow down to about 5knots, just as any other small boat must in rough conditions.” Of course, this should not be a major consideration when the boats are used in urban or coastal environments.

The Candela Seven certainly has the stylish looks and the ‘wow’ factor to appeal to operators; the fact that it’s also managed to eliminate emissions, smoke and excessive noise without sacrificing speed or power could see it becoming a useful and desirable alternative to taxis and trains in the not-so-distant future. Candela confirms that it plans to scale up the vessel in size, which would not only suit the carriage of greater numbers of commuters, but could also appeal to the leisure boat sector and those seeking an eye-catching, flying craft to stand out from the pack – for now, at least. 

---

Remote and autonomous ships have the potential to redefine the maritime industry and the roles of the players in it with implications for shipping companies, shipbuilders and maritime systems providers, as well as technology companies from other (especially the automotive) sectors.

The operation of remote and autonomous ships will need to be at least as safe as existing vessels if they are to secure regulatory approval, the support of ship owners, operators, seafarers and wider public acceptance.

RINA invites papers from ship designers, builders, operators, classification societies, legislative government bodies and organisations/companies with experience in other related autonomous domains, on topics including:

- Maritime remote-control technology
- Automated onboard systems
- Autonomous technology
- E-navigation
- Impact on maritime workforce and human factors
- Legal implications and maritime regulations
- Case studies and research projects

Register your Interest | Sponsorship Opportunities
conference@rina.org.uk  Tel: +44(0)20 7235 4622
www.rina.org.uk/Autonomous_Ships