
# ÈTA 6700

## An extremely energy efficient vessel

**ÈTA has launched a project which is to result in an energy efficient vessel. The name ÈTA has been selected due to the fact that the Greek letter "η" (eta) is used as a symbol for efficiency. The objective is to reduce emissions as much as possible. This is to be accomplished by implementing a number of measures.**

ÈTA Shipping in Leeuwarden, the Netherlands, was founded in 2019 and is active in dry cargo short sea shipping. ÈTA Transitions followed in 2021 and is focused on in-house product innovation and acts as a consultant to third party energy transitions.

The type of vessel selected for the project is a coaster intended to sail between the Baltic and the Mediterranean with mainly forest products like lumber, pulp and paper products. The intention is to build a series of ships of the same type and size for this trade. A total of six ships are planned to be built. ÈTA Shipping claims that the charter (the cargo) is available once the ships have been built and are commissioned. ÈTA Shipping is at present negotiating the finance conditions with eventual investors, but so far, pre-financing is still pending. Negotiations are also in progress with a number of preferred building yards.

### Market

The present age of "short sea" ships is rather high with the oldest ships built in 1993. Out of a total of 533 vessels, registered in the European Union, mainly Dutch and German register, 3.4 per cent or eighteen ships are less than six years old. Nineteen per cent are over twenty years old (normally the useful lifetime for this type of vessel). ÈTA seeks to participate in the fleet renewal and sees opportunity to introduce ships with very low harmful emissions. The high energy efficiency and low emissions are achieved by drasticallly reducing crew size (as the crew is part of the harmful emission situation), optimising all systems for maximum efficiency and introducing new techniques such as alternative fuels for the diesel engines (like ammonia or methanol), wind power and fuel cells.

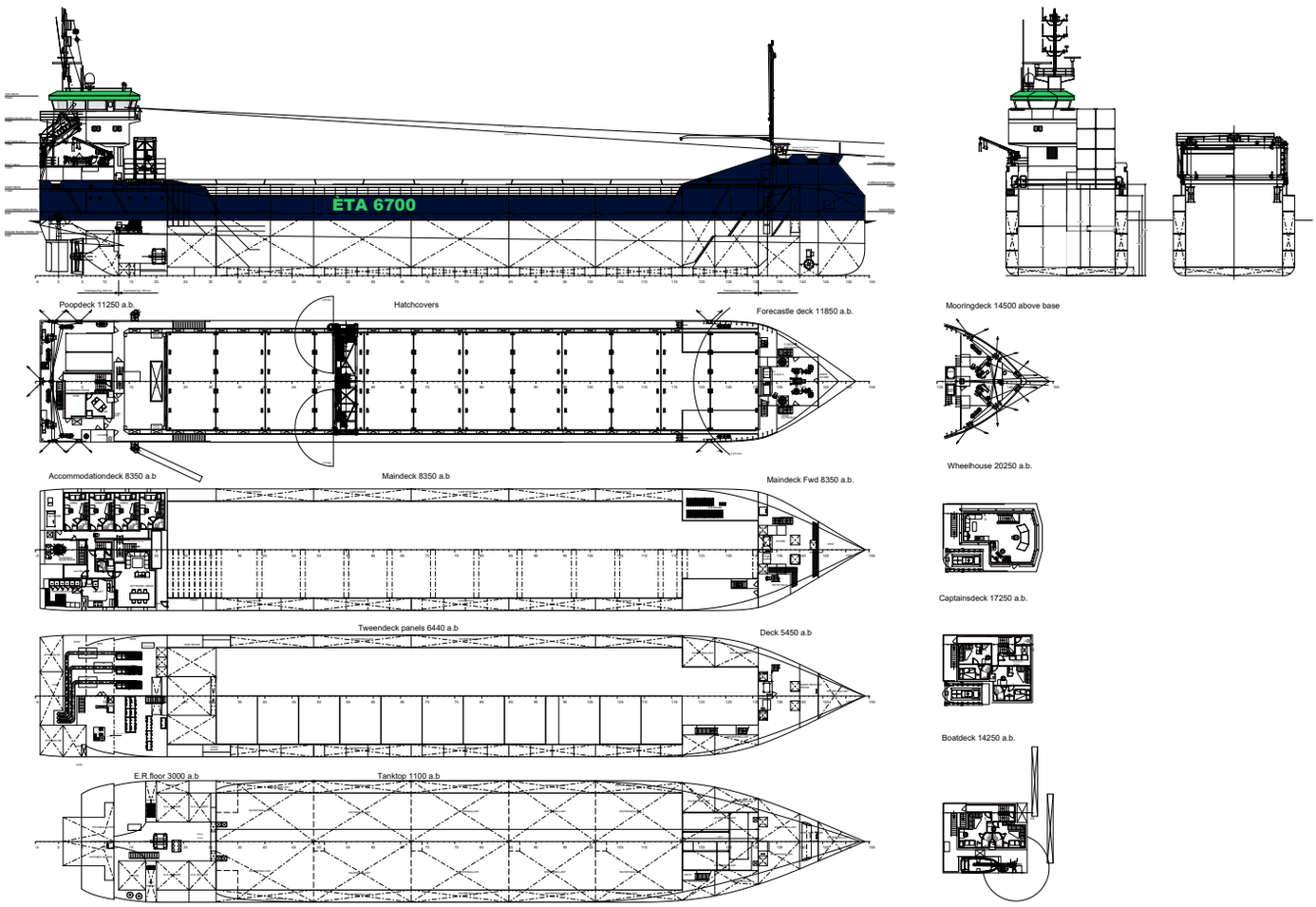
### Hull form and arrangements

The bow has no flare and this means that the ship will not ride with the waves, but will pass right through them. The waterline forward has an angle of about 25° to the centreline. Seakeeping tests as well as performance tests in ice have been carried out at the testing tanks in Hamburg (HSVA). Based on these model tests, ÈTA claims that in head seas, the forecastle deck is dry and there will not be any "green water" on top of the hatches. The mooring deck forward is 7.3 metres above the deep load line.

The aft ship is of the pram type with full width at the transom and a U-shaped skeg encompassing the propeller shaft.

The hold has double skin with a depth of about 1.5 metres. The total

*Photo: Artist's impression of the ÈTA 6700 project. Please note the hatches under the gantry belong to the tweendeck (courtesy ÈTA Transitions).*




*General arrangement of the ÈTA 6700 (courtesy ÈTA Transitions).*

length of the hold is 70.5 metres. There is a tween-deck at 5.45 metres above base line. The tween-deck hatches can be removed and stored on deck as depicted in the artist's impression. Equipment access to the machinery spaces is through a hatch on poop-deck just forward of the accommodation. The size of the hatch is 6 x 1.5 metres. The travelling gantry on deck for handling hatch covers has a safe working load of 21.5 tonnes. The deck hatches are "self-cleating" with a special locking system requiring no manual interference and no hydraulics.

The deckhouse aft is located off-centre with the purpose of allowing a number of twenty foot containers to be stored athwartships on portside. Two side by side and up to three high. These containers will contain fuel cells, batteries, or possibly fuel for fuel cells and/or diesel generators as required for the operation. This enables a very flexible power plant arrangement.

Fouling can increase fuel consumption by ten to twenty per cent within a two-year period if left unchecked. The intention is for the ÈTA 6700 to receive a hard glossy epoxy coat on the underwater hull. This antifouling is non-toxic and will form a hard surface making it difficult for marine organisms to settle and is easy to clean. The "In Water Survey" (IWS) notation permits one drydocking in a five-year period. This type of coating is also beneficial to the ship's ice-breaking characteristics.

## MAIN PARTICULARS

The ÈTA 6700 project has the following main particulars:

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|---|---|
| Length over all | 107.25 metres |
| Length waterline | 105.15 metres |
| Breadth moulded | 15.80 metres |
| Depth to maindeck | 8.35 metres |
| Maximum draught | 7.20 metres |
| Deadweight | 6,700 tonnes |
| Total cargo hold volume | 9450 $m^3$ (333,700 cubic feet) |
| Maximum speed | 12 knots |
| Operational speed | 10.5 knots |
| Class | Lloyd's Register |
| | ✠ 100A1, strengthened for heavy cargo 15 $t/m^2$ |
| | Container cargoes in holds and on upper deck hatch-covers |
| | Ice class 1A Finnish-Swedish ice class |
| | NAV 1, IBS, |
| | ✠IWS, ✠LMC, UMS |

### Accommodation

Accommodation is provided for a total of eight people. All cabins are one-person cabins and are en suite. Two cabins have separate

bedrooms. There are also a change room, a gymnasium, an office and a dayroom/messroom.

## Machinery and propulsion arrangements

The basic power generation is diesel electric with three diesel generators on the tween-deck level, three switchboards and below the propulsion room with an electric motor. The reason for selecting diesel electric is the reliability of the modern diesel generators as well as a low fuel consumption compared to a diesel engine direct on the propeller-shaft via a gearbox and a controllable pitch propeller. By selecting a "DC bus" configuration, it is possible to optimise the diesels' fuel consumption by varying the speed (rpm) with respect to the load.

DC bus means that the alternating current (AC) generators are fitted with a rectifier and feeding the main busbar with direct current (DC). The advantage is that the AC consumers can be fed via a frequency converter with the frequency (speed) as required. With an AC distribution system, the frequency converter consists of a rectifier and a frequency converter to produce the correct frequency for the AC consumer. The frequency converter with a DC bus system is simpler and cheaper due to the fact that the rectifying part is not required. The disadvantage is that the main busbar must be split in two (SOLAS requirement for all main power generation and distribution systems). In order to run an energy efficient system, it is preferable to have the bus-tie breaker closed during normal operation. In case of failure, the bus-tie breaker will open. The DC is difficult to break, compared to AC where the current is passing through zero about 120 times per second (60 Hz). Certain companies like Siemens have found a solution for operating the DC bus-tie breaker (Siemens Blue Drive). DC Bus also makes it very easy to connect battery packs and fuel cell applications as both deliver DC.

ÈTA is studying various fuel cell applications like hydrogen fuel cells and is also looking into the possibility of applying wind assisted propulsion like Econowind Ventifoils.

*Aft deck with place for machinery/power plant containers and the propeller with nozzle and rudder (courtesy ÈTA Transitions).*

ÈTA Shipping has opted to utilise an electro motor with a diameter of about 2.0 metres, making about 100 rpm at full speed, directly on the shaft. A conventional single propeller with fixed pitch and with a nozzle is fitted aft in front of the rudder. The rudder is of the "flap type" with no ice knife, which may not be so good when manoeuvring in ice.

The conventional gearbox has been eliminated, saving some three to five per cent in energy or fuel. The propeller diameter is about 4.0 metres rotating at 100 rpm and is consequently more efficient than a more conventional size propeller. The propulsion power required is about 1500 kW in operational condition. The Ice 1A minimum power requirement has been tested at the Hamburg testing facility and came out at about 1150 kW. Please note that the Finnish-Swedish ice class has a minimum power requirement that can either be calculated or verified by model tests, to be confirmed with actual ice trials. The 1A ice class requires a minimum speed of 5 knots in a broken brash ice channel with a thickness of 1.0 metre.

ÈTA 6700 can accommodate eight people, but the objective is to sail with a crew of only four

Each diesel generator has its own cooling water pump circulating the cooling water through a box cooler. The other cooling water consumers, like air-conditioning, switchgear, electro motor, frequency converters, etc., will have their own box coolers. The cooling water pumps will be frequency controlled for energy efficient operation, depending on seawater temperature and cooling demand.

The modular design and flexibility of the machinery systems makes it easy to change the conventional diesel oil driven diesel generators to diesels that can use ammonia or methanol as fuel.

GRE (glass reinforced epoxy) piping will be used for all cold-water systems. This in order to save on weight and maintenance cost. Below the bridge, there is an instrument room, which makes modification of electronic equipment or change out of complete units easy.

## Reduced manning

ÈTA 6700 can accommodate eight people, but the objective is to sail with a crew of only four. Yet, certain tasks on board require more hours than others like:

- Mooring operations;
- Hatch cover handling;
- Ballast operations;
- Cleaning;
- Maintenance.

To reduce the time and effort required for such tasks, various innovations will be implemented on board the ship. Constant tension winches will be fitted in order to make mooring operations easy. The hatch cover operations are autonomously controlled and re-


*Flatrack Ventifoil unit from Econowind (courtesy Econowind).*

quire no operator. Ballast operations will be autonomous and synchronised with the cargo handling operation, in order to reduce manhours.

The intention is also to have only one person as watchkeeper at sea. The ship will be fitted out with various sensors giving the watchkeeper a supervisory position. The generators require a minimum amount of maintenance and there will be a planned maintenance system with spare part control, giving detailed instructions for the various tasks to be carried out.

The ÈTA 6700 will be equipped with ÈTA HOMP (Holistic Operational Management Platform). ÈTA HOMP is an intuitive digital platform where all systems of the ship are integrated. Through applications assisted by artificial intelligence (AI) and augmented reality (AR), ÈTA HOMP enables semi-autonomous ship operations by junior seafarers. Besides two junior seafarers, ÈTA's crew consists of two senior seafarers. Through ÈTA HOMP, ÈTA is able to increase cost efficiency, which allows ÈTA to sail with an all-Dutch crew.

The objective of the crew reduction is an all-Dutch crew sourced from local vocational education (MBO), which increases team cohesion and ownership of the crew on board the vessel, resulting in less incidents, a smaller footprint and better economy. Wage costs will be similar to a conventional foreign crew of eight seafarers. However, travel costs, accommodation, lodging costs, insurance and consumables will be significantly lower.

## Weather routing

Weather routing is a way to save fuel and time by avoiding bad weather and eventual delays and in the worst-case weather damage. Weather routing can be performed by an outside meteorological service company. The problem with weather routing, at least in the past, is that the captain does not always rely on the advice given and will run at full speed to gain time and then slows down at the end in order to be in port just in time. This is not beneficial to fuel consumption. Another aspect of re-routing the ship is water depth. If the bottom clearance below the keel is too small and/or the speed too high, resistance will increase due to the bottom effect, which will result in a higher fuel consumption or a lower speed than anticipated.

ÈTA's approach to weather routing is also a holistic one. ÈTA is developing a predictive voyage planning system with partners, where besides weather, sea state and current, traffic, just-in-time delivery in cooperation with the receiver, costs and emissions during the voyage will also be taken into account. The receiver and the shipper are able to decide beforehand on the optimal voyage planning with regard to time of arrival, cost of the voyage and emissions during the voyage.

The mooring deck forward is 7.3 metres above the deep load line. The lack of flare will result in the vessel passing through the waves instead of on top of them. For the route Baltic Sea to the Mediterranean, Sea Global Wave Statistics reports that the maximum significant wave height is ($H_s$) is 10 to 11 metres ($H_s$ = average wave height of the upper 1/3 of all observations) and the maximum wave height of a particular wave can be twice that much. For about 2.3 per cent of the time or on average eight days per year, an $H_s$ above 7 metres can be expected. The distance between Helsinki (Helsingfors) and for example Barcelona is 2790 nautical miles and at 10 knots, this will take about twelve days in good weather. The strength and securing of the forward part of the deck hatches is well worth a consideration as "green water" may be encountered on top of the hatches forward.

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