

• CAMARC DESIGN •

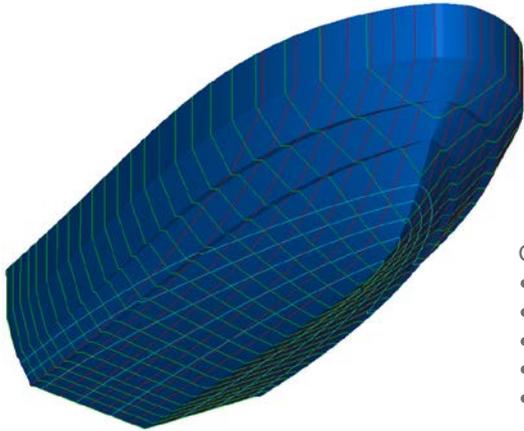


REFINED HULL DESIGN



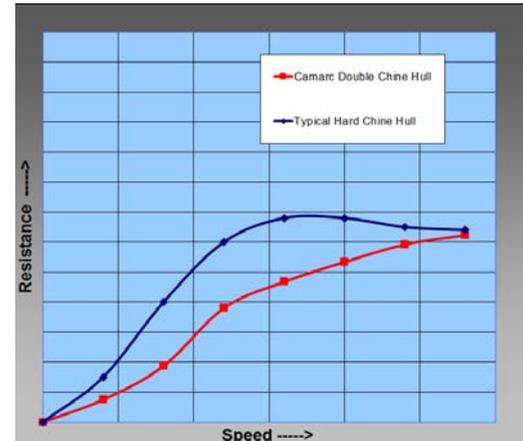
Camarc Hull Design - Overview

The Camarc double chine hull exhibits an excellent resistance profile resulting in improved efficiencies for medium speed applications over that of conventional hard chine hulls. The Camarc resistance profile avoids the significant hump typically found on conventional vessels reducing load at medium speed. The results are well proven with over 500 craft in service exhibiting an efficient, dry & stable platform with excellent all-round seakeeping capability. The Camarc double chine hull form is the choice of experienced operators Worldwide including Government Navies, Coast Guards, Police Forces, Port & Pilotage Authorities.



Camarc Double Chine Hull Design;

- Efficient
- Supreme seakeeping
- Dry running
- Load tolerant
- Excellent resistance profile



As well as a comprehensive database of built vessel trials, the Camarc hull range has been extensively tank tested over the years to continue to improve and optimise the hull efficiency and characteristics for Operators.



Pilot Hulls & Boarding



The Camarc Pilot specific hull design promotes the following;

- Balanced all-round seakeeping
- Curved forefoot to assist boarding & breaking away
- Deck Plan to assist boarding & breaking away
- Hull & Fender shape to protect from damage



The Camarc hull shape allows for the boarding position outlined above with maximum beam at the shoulders forward. The increasing gap between ship and pilot boat provides an additional measure of safety should there be a man overboard incident from the boarding area.





Carmac pilot boat hulls are well proven in service and offer specific features unique to those required by this type of craft and pilot boarding operations. Used by Port Authorities and Pilotage organisations worldwide including Loodswezen Dutch Pilots, Columbia River Bar Pilots, Port of Harwich and Port of Tees, Sydney Ports, Rosmorport Russia, Milford Haven Port Authority, Canadian Pacific Pilots, Suez Canal Authority and many others.

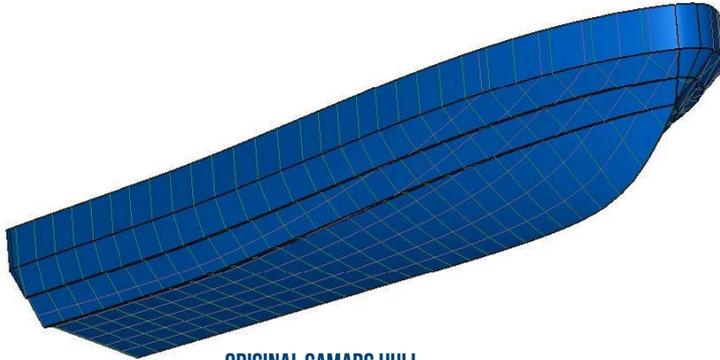


Hull Design - The Next Step

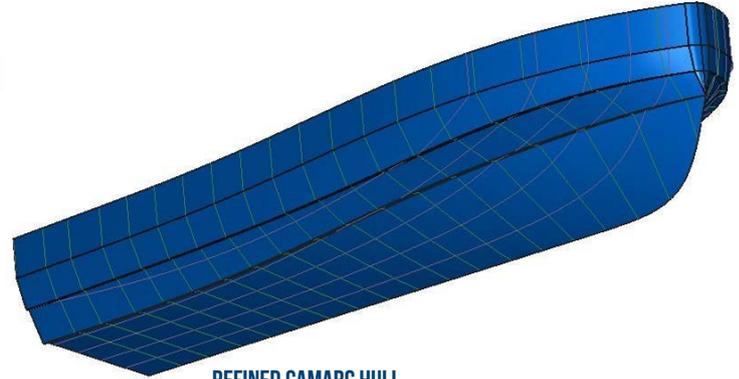
Loodswezen, The Dutch Pilots Association and largest single user of Camarc Pilot Boats which started in 1993 with a test 18m high speed tender from which a series of 21m craft followed with 10 boats. The next series of slightly larger 22m vessels then began in 2010 with another 10 craft, the final of that series entering service in 2019. They also operate two 21m steel ICE Camarc pilot boats and a fleet of Camarc 8m davit launched craft. As part of future planning Loodswezen asked Camarc in 2015 "What's next for future pilot boat design and innovation? Prior to this Camarc had been working on a refinement and enhancement to the well proven hull with an R&D programme, including tank testing, targeted at further optimising efficiency and comfort. Ensuring these gains did not compromise on the all-round seakeeping and performance for the specific role of pilotage then became the new focus for the next step in pilot hull design.



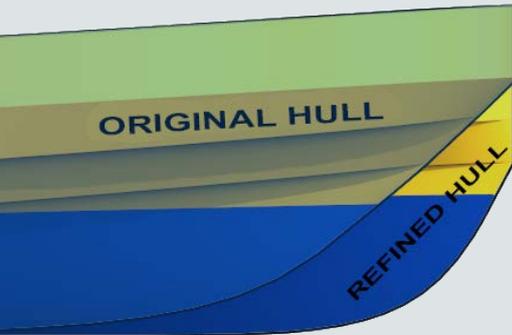
Hull Design



ORIGINAL CAMARC HULL



REFINED CAMARC HULL



The Camarc refined hull is a development of the original and well proven hull form. The refinement has taken place in the forward third of the hull, with the most notable change observed in the extended waterline length. This improves efficiency and seakeeping in itself, but has also allowed for finer sections forward to further enhance efficiency and reduce slamming vertical accelerations. The resulting vertical stem at the bow is importantly above water only and the hull retains a curved forefoot at entry for all-round seakeeping. This curved forefoot is also relevant to pilotage, to assist in boarding & breaking-away operations.

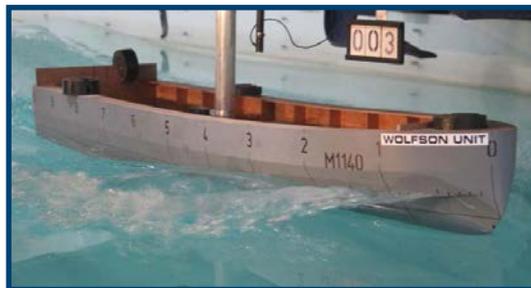




Project Innovation - The Refined Hull

Project Innovation was born. Loodswezen commissioned Camarc to complete an extensive testing programme to prove the gains in efficiency & comfort alongside confirming the suitability of the new refined hull for pilotage. One of the existing vessels from the original Camarc series, 'Enterprise', was put forward as the test boat for Project Innovation. 'Enterprise' was instrumented and tested as-is, then modified to include the new refined hull and re-tested in the same conditions to have a direct comparison.

ORIGINAL CAMARC TEST HULL



REFINED CAMARC TEST HULL



Trials Programme



- 6 month extensive trials programme
- Trials on both original & refined hulls
- Efficiency trials; speed, acceleration, fuel consumption
- Seakeeping trials; vertical accelerations, course keeping
- Pilotage trials; boarding & in-service use



To achieve comparative tests between the original hull and the refined hull it was necessary to change the hull shape of the Enterprise test vessel. Given the shape of the new hull is a development of the original shape with refined sections forward it was possible to add this new shape on to the original hull. It was therefore decided to construct a bow module that would be added on to the original structure to achieve the refined hull test vessel.



Original Hull being modified to refined shape for full scale trials.



Trials Results - Efficiency

Speed, Acceleration & Efficiency

From the results the Camarc refined hull has shown a 2.3 Knot speed increase at full power when compared to the Camarc original hull, both being tested in the same condition. This amounts to an increase in efficiency of 9%. It is therefore possible to achieve higher speeds for a given power with the refined hull or achieve a set operational speed with reduced power.

The increase in hull efficiency also leads to improved acceleration, with the refined hull achieving set speeds in reduced time. Very clean water separation at the bow of the refined hull was observed (as can be seen from the images below), offering further improvements in spray reduction and dry running over the original hull tested.

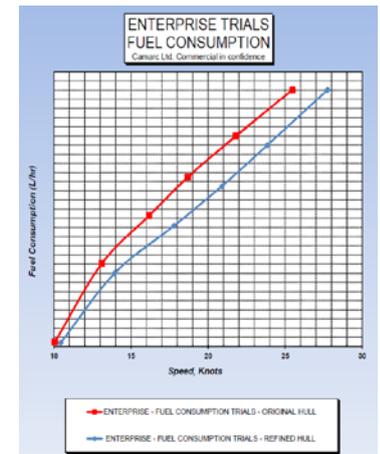
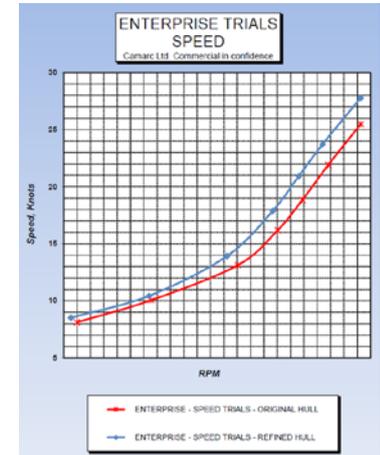
For a given operational speed the refined hull was found to reduce fuel consumption by around 9% on average when compared to the original hull.

Turning & Manoeuvrability

Trials data shows that there is not a compromise in turning circles at speed for the refined hull, in fact reduced turning circle final diameters were measured. All turning trials for both hulls were observed to be smooth.

Trials programme Results

- + 2.3 Knots
- + 9% Efficiency
- 9% Fuel Saving
- 20% Improvement in acceleration



Trials Results - Seakeeping

Vertical Accelerations

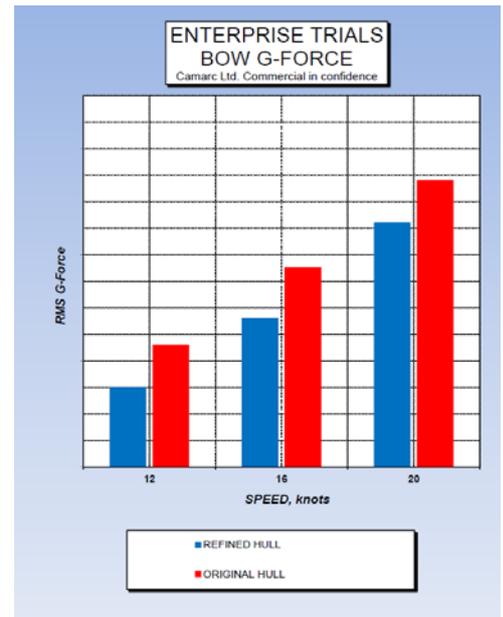
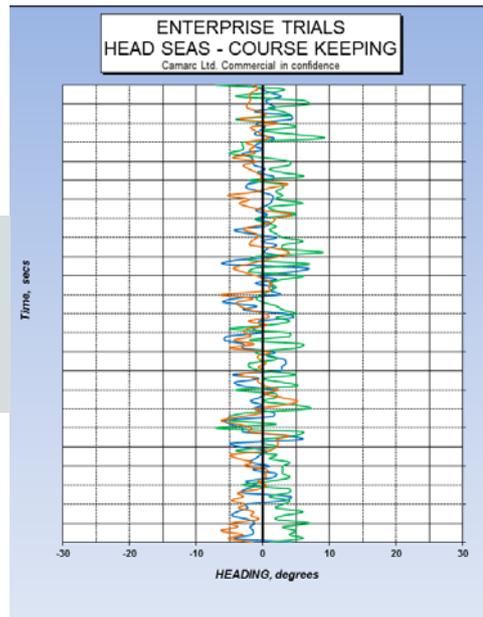
The refined hull shows a significant ~10% reduction in vertical accelerations in a head sea for the vessel condition and sea conditions tested. This % reduction is applicable to the bow area for structure slamming, the boarding area for pilotage operations and the wheelhouse location for crew/pilot comfort.

Course Keeping

Trials results shows no notable change or compromise in course keeping ability with the refined hull in to head seas and following seas when compared to the original hull.

Trials programme Results

- -10% vertical accelerations
- No compromise in course keeping



Trials Results - In Service

Following successful trials confirming the efficiency and seakeeping improvements with the refined hull, the test vessel 'Enterprise' went in to service conducting pilotage alongside the remainder of the fleet.

Having been tested and trialed by different crews at the various sites across the Netherlands the refined hull received positive feedback on all fronts; seakeeping, comfort and pilotage (coming alongside, boarding & breaking away). As a result of the success of the Refined Hull and Project Innovation, the operator Loodswezen has since commissioned Camarc to design their next generation Pilot boat series featuring the refined hull. The first vessel of the new series is currently building and will be in operation in 2020.



Loodswezen 21m test boat 'Enterprise' continues to operate in service

Refined Hull – In Service

18m Pilot Boats for Dalian Port – 2 boats



Refined Hull – In Service

23m Pilot Boats for Kuwait Oil Company – 6 boats



Refined Hull – Building



First of the next generation 22m Pilot Boats for Loodswezen following the success of Project Innovation



Refined Hull – Building

A further 18m Pilot Boat, this one for Rizhao Port



16m Pilot Boat fleet for MED Marine – 4 boats





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