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## Vessels highlighted

Aegir  
Galactica Star

## The vision of

Frank Verhagen  
Director Verhagen IT Group

## Special

Europort 2013





At the Monaco Yacht Show 2013, one of the yachts gathering the most attention was Heesen's new flagship, called *Galactica Star*. It is the Dutch superyacht builder's largest yacht to date, and also the first all-aluminium yacht with the patented Fast Displacement Hull Form (FDHF). The sleekness of her underwater lines is matched by a unique helmet-shaped superstructure, giving the yacht a sporty look, a far cry of many of the wedding-cake-styled yachts in this size range.

It was while tank testing a 43.5 metre motor yacht (*Latitude*) in 2007 that the Naval Architects of Van Oossanen noticed that - contrary to popular opinion - a properly designed bulbous bow can reduce the wave-making resistance at speeds well above the 'hull speed'. They decided to research this further and design a bulb optimised for high speeds and an integral lines plan to work with it. Up until then, semi-displacement hulls were either adapted hard-chine hulls (with some curvature in the buttocks) or modified round-bilge hulls (with flatter aft sections to create a planing surface).

The FDHF design takes a different route: forget about dynamic lift, and instead minimise the

bow wave and stern wave with sleek waterlines and the proper appendages at the bow and stern. Armed with their CFD software, Van Oossanen Naval Architects started with a blank piece of paper and designed a round bilge hull with bulbous bow and started tweaking it, so it would perform well at speeds in the semi-displacement range (which corresponds with Froude numbers from 0.5 to 1).

They succeeded well, and only at Froude numbers over 0.95 (fully planing regime) will hard chine hulls start to show a lower resistance than the FDHF. For a 65 metre motor yacht like *Galactica Star*, that would mean a speed in the region of 45 knots. At her top speed of 28.8

# GALACTICA STAR

HEESEN YACHT'S FLAGSHIP MARRIES SPEED WITH EFFICIENCY IN 65 METRE FDHF

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## Builder

Heesen Yachts, Oss, the Netherlands

## Principal particulars

Length o.a.	65.00 m
Length waterline	57.50 m
Beam max.	11.30 m
Draught	3.10 m
Displacement (50% load)	560 ton
Gross tonnage	985 GT

Main engines	2 x MTU 20V4000 M93L/4300 kW @ 2100 rpm
Auxiliary generators	2 x Kilo-Pak 175 kW + 1 x Kilo-Pak 99 kW harbour
Emergency generator	1 x Kilo-Pak 80 kW
Top speed (50% load)	28.8 knots
Range at 14 knots	4,200 Nm

Crew	12 (7 cabins)
Guests	12 (6 cabins)

## Tanks

Fuel tanks	90,000 l
Fresh water tanks	30,000 l
Grey water tank	12,500 l
Black water tank	2,800 l



At every speed, the running trim is minimal

knots, *Galactica Star* has a 15% lower resistance than a hard-chine hull, which increases to 30% at cruising speeds around 15 knots.

The result of the FDHF study is a patented combination of four design features:

- A slender foreship, visible in a sharp entry on the waterline;
- A considerable bulbous bow, relatively wide and with V-shaped bottom to avoid slamming;
- A substantial sprayrail in the bow above the waterline;
- A device to control the trim at the stern (such as trimtabs or an interceptor).

On *Galactica Star*, all of these features are

indeed combined, with a fixed interceptor plate at the stern used for trim control.

## Collateral benefits

Seatrials on *Galactica Star* have now proven the concept, which was known to insiders from tank testing and CFD calculations for a few years already. But the actual build and usage of the yacht has shown quite a few side benefits when comparing the FDHF to conventional semi-displacement or planing hulls. Because of the absence of dynamic lift (apart from a tiny bit produced by the sprayrail and the trim control), acceleration from zero to top speed is smooth, without a hump speed or any noticeable changes in running trim. Besides the obvious

comfort for guests, who could possibly be having dinner, this improves the visibility from the wheelhouse.

Another benefit is that the yacht slices through the water, rather than riding on top like a hard-chine planing yacht. Therefore, waves have much less effect on ship motions. At low speeds and at anchor, the soft rolling motions of a round-bilge hull provoke much less seasickness than the hard 'floating-cork' motions of a hard-chine hull.

Finally, the weight is slightly less critical than for a planing yacht, and therefore a yacht can be built quieter and more luxurious. Evidence



The long and wide bulbous bow was designed for high speed

can be found on *Galactica Star* in the extensive use of natural stone in the interior, which is not limited to the bathrooms, but also used in the guest corridors throughout. To save weight, the marble consists of thin (five to ten millimetres) slabs bonded to aluminium honeycomb plates, which give strength.

### Beachclub

The innovation on *Galactica Star* does not stop at her hull form and her progressive angular looks. Perhaps the most striking feature is the spacious 77 square metre beach club on the lower deck aft, which can be opened up to sea with a stern door and a side door, adding another 32 square metres of prime relaxation area. The beach club features a bar, a seating area and an adjoining shower room, day head and sauna. Daylight enters from above, filtered through the glass bottom and the water of the splash pool on the main deck. The walls are covered with back-lit Perspex covered with bamboo, creating the feel of a tropical forest.

All this was made possible by relocating the tender garage to the main deck forward. Gull-wing doors open on either side and cranes can launch either the rescue boat on portside, the guest tender on starboard, or the jet skis to either side. Because of the rescue boat, the doors have to be openable with emergency power, and the whole launching process of the boat takes less than five minutes. Above the tender garage is a touch-and-go helipad covered with teak decking, where usually sun loungers are placed. The area can be covered with square sun awnings, suspended from removable poles.

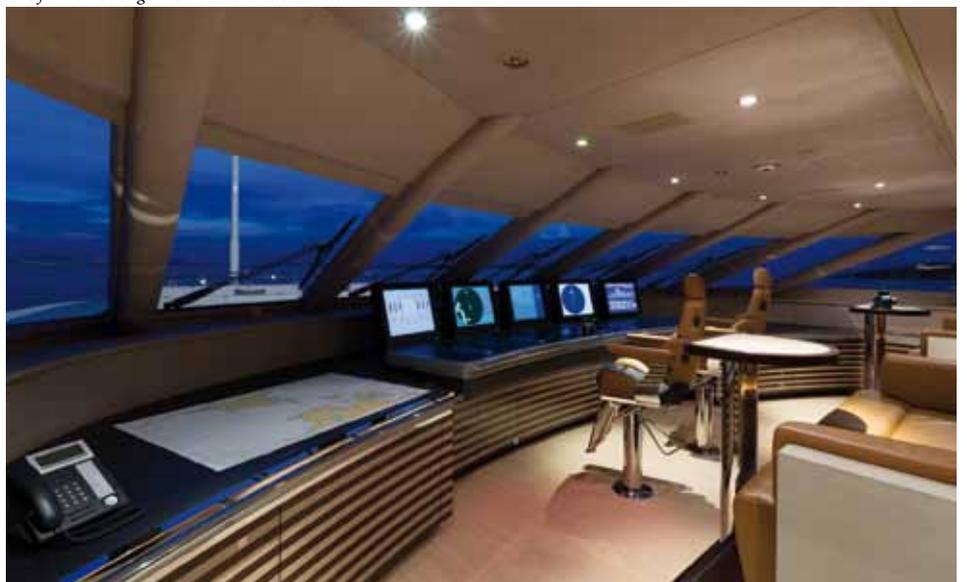
### Design

The exterior design was done by Frank Laupman of Omega Architects and is a very balanced combination of bold curved lines and angular profiles. The positioning of windows, black surfaces and recesses in the superstructure is spot-on, resulting in a yacht which looks sporty and light from any angle. The angular exterior lines are carried on in the interior by Bannenberg and Rowell, for example in the stainless steel inlays in the marble floors which are found in all the corridors. Inspiration was clearly drawn from science fiction movies, and this theme is carried on throughout the yacht, but perhaps most evident in the wheelhouse, which could be mistaken for the bridge of a

spaceship. Bannenberg and Rowell were also given a free hand in selecting the artwork on board.

The main lounge is divided in three areas: a lounging area aft, a bar and seating area with bio-ethanol fireplace in the narrower part between the engine room ventilation trunks, and a formal dining area further forward, conveniently located near the galley. Inside the galley, a set of bar stools and a granite countertop allow for the guests with an interest in cooking to interact with the chef and follow the proceedings in the galley, an idea inspired by some of the best restaurants. The galley is equipped with professional cooking equipment.

The futuristic design theme is continued in the wheelhouse



*"The FDHF design is optimised over a wide range of speeds, and not just the top speed"*



*The master cabin has a private balcony on starboard side*

The lower deck features four double guest cabins around the central hall. The oval staircase leads all the way from the lower deck to the sundeck is an attention grabber with its multitude of high-gloss wooden surfaces, polished stainless steel inlays and leather-clad curved surfaces. The entrance to the master cabin on main deck is through the owner's office. A small owner's balcony, accessible through a pair of sliding weathertight doors, is located on starboard. This is a unique feature which will certainly be appreciated by the owner for a private morning coffee. Forward of the master cabin is a dressing room and a bathroom with bath, shower and separate toilet room. For the construction of the interior, Heesen's own interior construction division worked together with Sinnex as an external contractor.

An extra guest cabin is located on the upper deck, on starboard side. What this cabin lacks in floor space is more than compensated by the large

windows and excellent views, and direct access to the media lounge further aft, and the exterior dining room on the upper aft deck. Opposite, on port side, is a seating room with adjoining day head and shower. During private use, free from the twelve-passenger maximum limit, the sofa in this seating room can be converted to a double bed to create an extra cabin.

The sundeck has all one could wish for: a seating area forward, a dining area and bar area in the middle and a sunbathing area aft, next to the whirlpool. The most unique exterior space is on the main deck aft, which has a sheltered feel because of the curved arches in the corner and the semi-glass ceiling overhead. Plants on the backside of the lounge sofas give a feel of freshness.

#### **Propulsion**

*Galactica Star* reaches a top speed of 28.8 knots at half load with all 8,600 kilowatts of

main engine power engaged. In this case, the fuel consumption accrues to about 2,500 litres per hour. When there is less haste, and the captain throttles down to 15 knots, the fuel consumption is reduced to less than 400 litres per hour. The exhausts go overboard under the waterline after injection of the cooling water. During manoeuvring in port, the exhausts go through a bypass above the waterline. Two 2,000 millimetre fixed-pitch propellers from Schaffran convert the engine power into forward thrust. An electrically powered 165 kW bow thruster from HRP is used for manoeuvring. The two main generators, rated at 175 kW each, are equipped with Hugs soot filters to eliminate smell, fouling on the hull and a sheen of soot on the water.

As bringing in all the cooling air for the powerful main engines (the largest in MTU's range) from outside would require disproportionate ventilation ducting, the yard opted for a seawater cooling system in the engine room. Only combustion air is brought in with the engine room fans, and the local air is circulated through a heat exchanger with seawater running through it. An added benefit of this, according to the engineer on board, is that the engine room air is constantly driven through a filter, which can be easily washed.

*The spacious beach club opens to the aft and to portside*



## "Heesen Yachts currently has another three FDHF motoryachts in build"

### Gyro-stabilizers

*Galactica Star* is equipped with five M21000 gyro-stabilizers from Seakeeper. Unlike conventional fin stabilizers, a significant source of drag at high speeds, these are located inboard and therefore only carry a weight penalty. Each of them consists of a spinning gyro disc in a vacuum chamber, on gimballed bearings. The vessel's resonant roll (which occurs when the encountered wave period resembles the vessel's own natural rolling frequency) is eliminated by applying torque at the right moments to the bottom girders. The control system actively regulates the braking system with hydraulic cylinders, thus matching the roll motion of the gyros to the vessels roll motion for maximum performance. The stabilizers are less effective under way, but are mainly intended for zero-speed stabilization at anchor. Their performance will be further enhanced by increasing the spinning velocity of the gyros.



A lot of stainless steel accents were used the interior

### Conclusion

The beauty of *Galactica Star* is perhaps not that she has such a high top speed, but that when sailing at ten to 15 knots, which most yachts do most of the time, the fuel consumption and emissions are lower than that of both a hard-chine hull and a traditional full-displacement

hull. The fact that the main engines are modern common-rail diesel engines, means that even at low loads, the combustion and fuel efficiency are excellent. The efficiency of the yacht is clearly visible when the yacht is sailing at low speed: the minimal bow and stern waves indicate that less propulsion energy is wasted. The emission of exhaust particles is further reduced by the soot filters on both of the generators, which typically clock ten times as much running hours as the propulsion engines.



As a testament to the success of the yacht's design and construction, it is noted that she was sold on the day of delivery. Amongst the first charter guests were Beyoncé and her husband Jay-Z, celebrating Beyoncé's 32<sup>nd</sup> birthday with a seven-day cruise in the Balearic Islands. The success of Van Oossanen's Fast Displacement Hull Form is demonstrated by the fact that Heesen currently has three other FDHFs in build: a 42 metre, a 50 metre and a 55 metre motor yacht.

Instead of resorting to complex propulsion power plants with debatable fuel savings, this project has demonstrated that real fuel savings can be obtained with a traditional direct-diesel driven propeller by optimising the ship's hull through extensive CFD analysis, something which was not possible 20 years ago, and hardly affordable ten years ago. The technology is now at such a level that Van Oossanen Naval Architects have as much faith in CFD (computational flow dynamics) simulations as in model testing, with the added benefit that many more variations can be tested in a short timeframe.