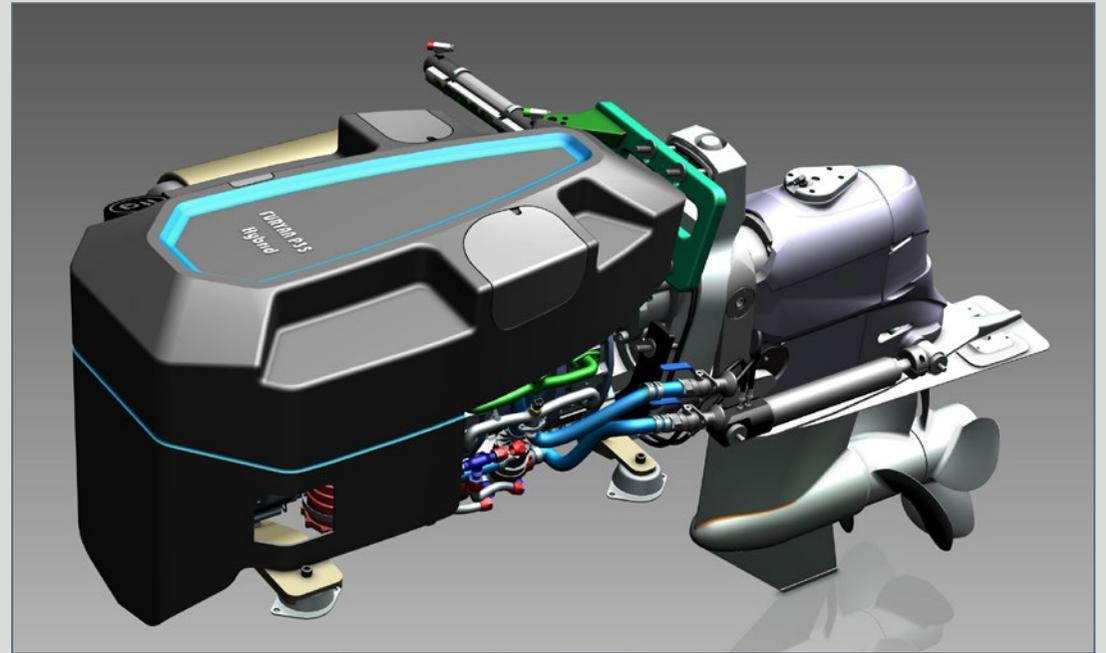


Marine Hybrid Propulsion Systems

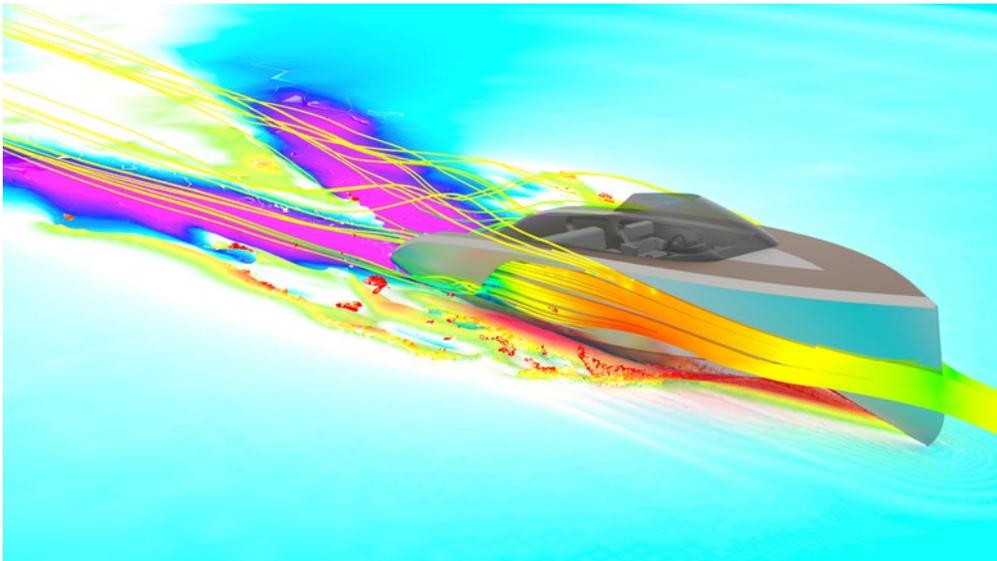


New Serial Hybrid Propulsion Systems
featuring mono unit construction

FURYANTM

The Benefits of *FURYAN* Propulsion

- Instant torque and a smooth consistent drive
- Harmful emissions reduced
- Safe at sea
- Reduced service maintenance and running costs
- No worry with recharging
- Class leading battery technology
- Intelligent battery management



Contents

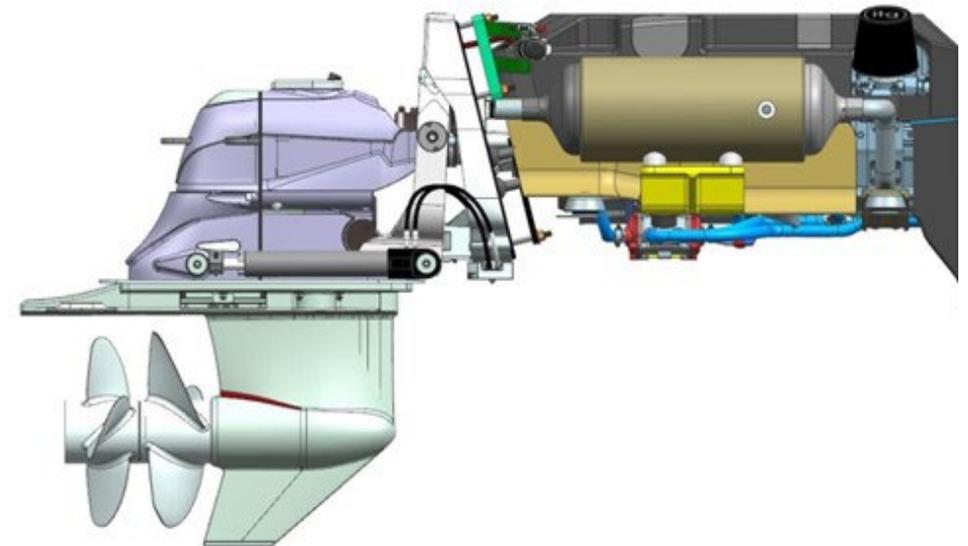
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Technical Data

- **E-motor type** 2 High efficiency power density Electric Axial Flux Motors
- **Voltage** 800V
- **Coolant** Shell Dielectric fluid / sea water heat exchangers
- **Output shaft peak power @ 700V** 200kW x 2 (268hp) x 2
- **Output shaft peak torque @ 450Arms** 790Nm x 2
- **Propeller shaft peak power** 190kW x 2 (255hp) x 2
- **Overall system efficiency** 89% (E-motors and sterndrive only)
- **E-motor speed rpm** 0 to 3,250 rpm
- **E-motor configuration** Mono Unit Construction* (MUC) Serial Hybrid Cascade Propulsion System
- **Dry weight, E-motor / IC range extender generator backup** 187kg without sterndrive and 374kg with sterndrive
- **Sterndrive** Konrad 680A Twin Prop System with Power Trim with Optimus EPS
- **Ratio** 1.52:1
- **Propeller** 18"/16" dual propellers / pitch 27" (pitch TBD as per hull design)

Range Extender Backup Generator

- **Engine type** Single rotary
- **Fuel type** Gasoline
- **Fuel consumption** 340 grams/kWh
- **Power output** 90kW (120hp) max @ 8,000rpm
- **Coolant** Glycol / sea water heat exchangers
- **Generator type** High efficiency power density Axial Flux
- **Generator output** 30kW to 70kW 3,000 to 6,000rpm
- **Coolant** Shell Dielectric fluid / sea water heat exchangers



Serial Hybrid System

Features a variable power integrated range-extending bank-up generator 30kWh to 90kWh.

Two high efficiency power density Electric Axial Flux Motors 200 kW 790Nm torque @ 700volts DC max power (268hp each) 70kW 400Nm torque @ 300volts DC (93hp each) at constant running, motor cooling through Shell Dielectric fluid to sea water heat exchangers. Power limitation is due to the duty cycle of marine application with performance boat max speed limited to 38 knots and constant running 25 knots (based on simulations using a 35ft boat).

Transmission & Sterndrives

The two electric motors will run in series in what we call a Cascade system. The motors run as separate motors or linked as the power is required to match the propeller load curve to the linear power line of the electric motor. The motor link is through a seamless dog-clutch engagement system, so each motor runs at maximum efficiency. The electric motors then power a single Konrad 680A sterndrives with 18"/16" dual propellers, max motor speed 3,250rpm with the capability of a 1:52 reductions ratio. *The range extender can act as the safety backup, to get back to port any time even with depleted batteries.*

The compact range extender only runs when power requirements exceed the renewable sources and available battery capacity, using the battery management system and software it does this autonomously. The Wankel Rotary Engine 120BHP range extenders IC engine powers a high efficiency power density Axial Flux generator and acts as the starter for the range extender generator. There is no direct connection to the Cascade E-motors system, and no link from the IC engine to the sterndrive. This is a true serial hybrid system with an integrated range-extending generator, running at optimum operating point feeding the 800V systems directly.

Exhaust is water cooled Shell-and-Tube Heat Exchanger and catalytic converter, before the exhaust gases are exhausted under the water line they are cooled with the heat exchangers prior to discharge through the transom. The exhaust coolant heat can be used to pre-heat the batteries on cold days and heat the domestic water heating via the heat pump.

Note: In relation to the EU Recreational Craft Directive, RCD or the Directive.

The exhaust emission requirements apply only to engines installed for propulsion of the recreational craft or personal watercraft. For example, an engine installed to be used exclusively as an on-board generator, is therefore outside of the scope of this Directive. See also comments on Article 1.3(c) concerning the definition of 'propulsion engines', and on Article 1.1(d) regarding the date of application of the exhaust emission requirements.

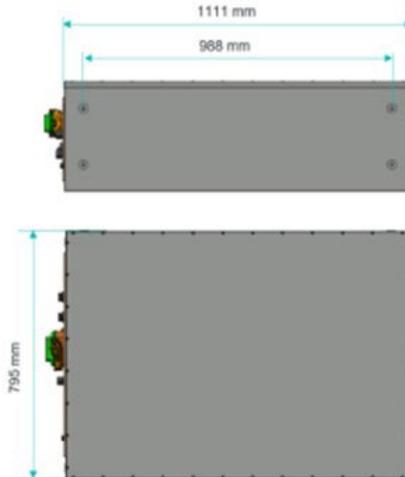
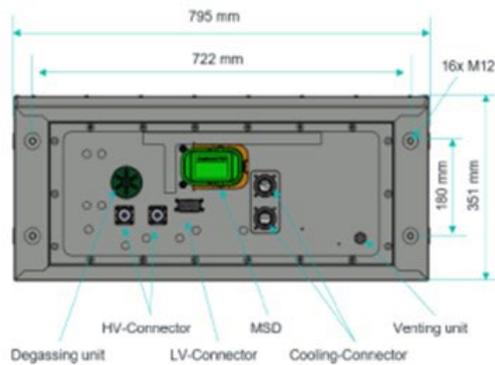
Energy Control

This is the heart of the drive management system, all the connections and system management functions from the battery power to the (Cascade E-motors) vessel management and mapping.

As a vessel transitions from displacement mode, through transient mode into planning mode the propeller torque varies. Propeller slippage in the transient mode can result in up to 30% wasted energy. **FURYAN** Energy Management Control System (EMCS), along with Propeller Slip Power Control (PSPC) these systems will electronic control efficiently to manage the deployment of energy to the propeller using mapping technology to minimise propeller slippage. The **FURYAN** electronic control system also makes energy usage calculations using Navionics and Dock to Dock Autorouting that take account of such variables as head wind/tail wind, sea conditions and tidal currents, so the system calculates energy density required for a pre-entered passage plans.

Battery Packs

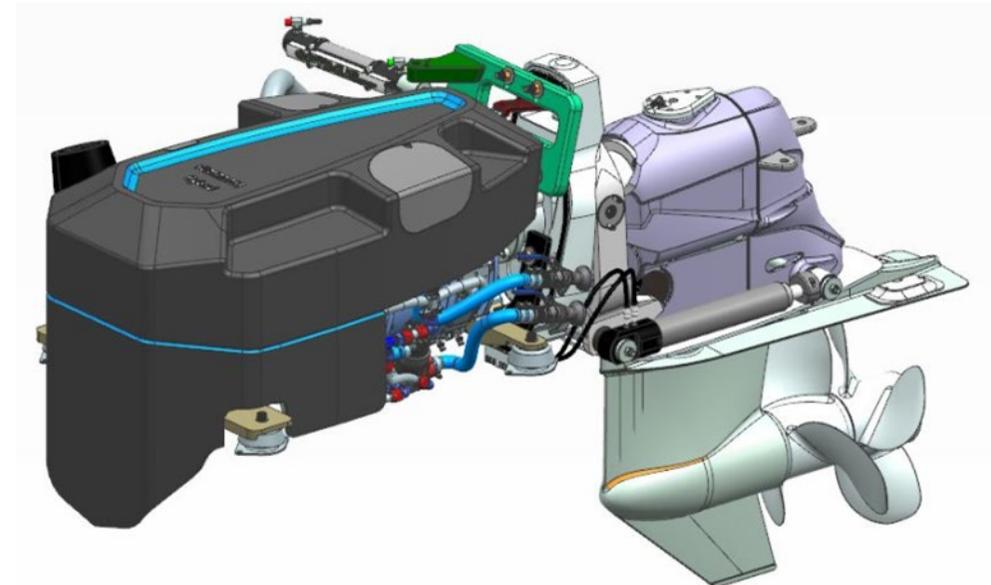
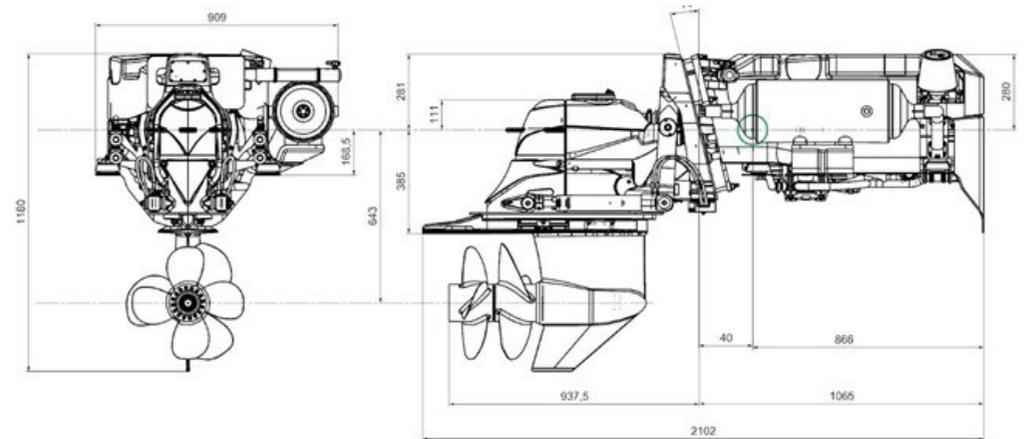
The 63kWh battery packs are shock-resistant a performance needed for boating applications, IP protection class IP6K9K & IP67 waterproof, ISO certification 26262, RSV1216 Norwegian Maritime Authority (Marine), GTR20, ISO6469-1, IEC TR 62660-4 (Automotive) certification and include a pressure release safety disc for releasing built-up gases while maintaining waterproof integrity. The batteries have a BMS (Battery Management System) this prevents thermal run away and the battery packs are PCM Immersion liquid cooled using Shell Dielectric fluid. This fluid is also a Fire Protection Fluid and helps give you the peace of mind from cell fires, the fluid is then cool via sea water heat exchangers. Battery capacity of 63kWh per pack, 400 volts per pack with cell mass 0.2kWh/kg and pack mass 0.16kWh/kg and 380kg per pack without coolant. Parallel and series connection possible 400V or 800V. Shore-power charging times 19.8min/kWh @ 3kW AC charge and 8.5min/kWh @ 7kWh AC charge and using CHAdeMO (DC) @ 60kW charging 1.0min/kWh and 33sec/kWh @ 180kW.



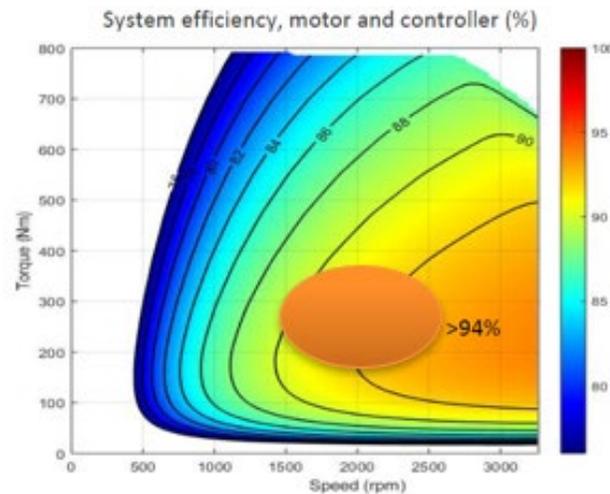
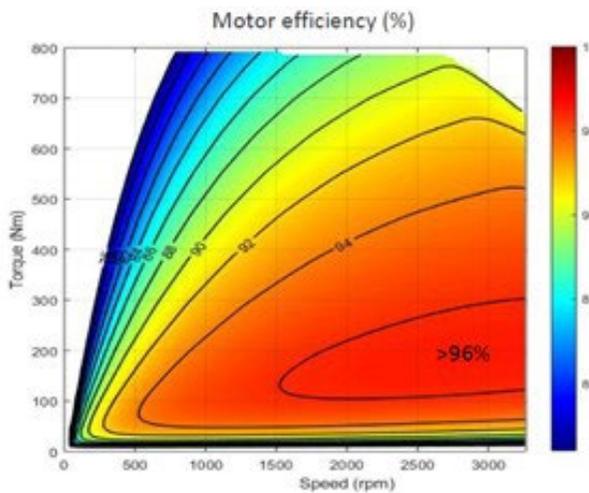
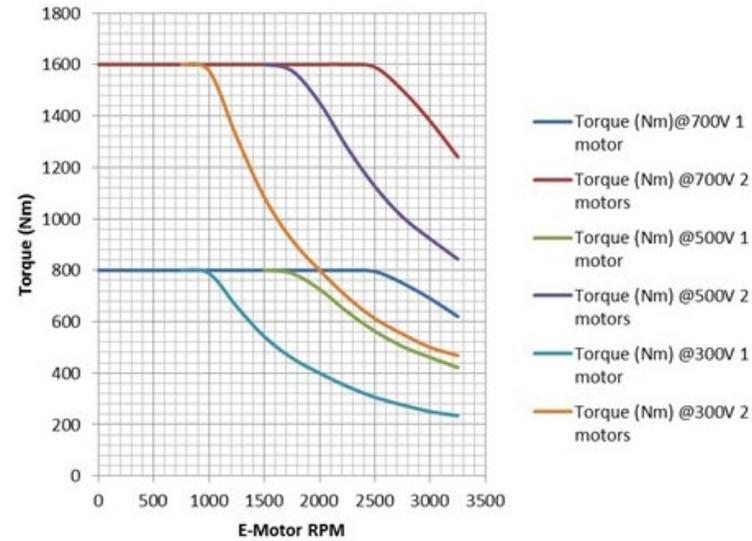
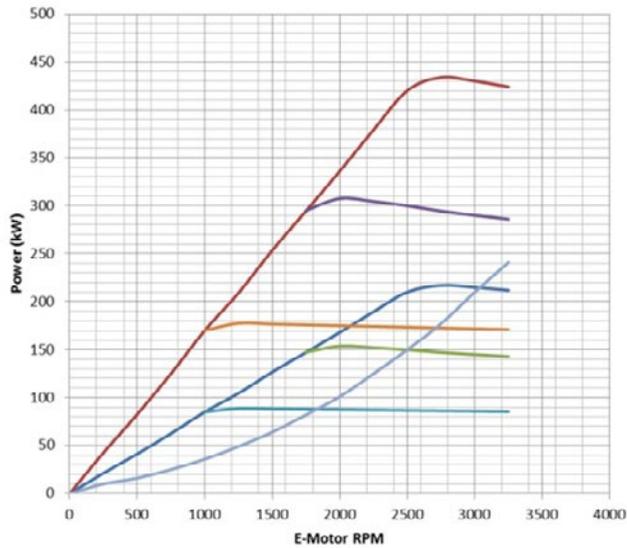
Overall Battery Pack Dimensions:
(LxWxH) 1,111mm x 795mm x 350mm

Dimensions

Not for installation



Example Electrical Performance with 800V Controller @ 450ARMS



The orange ellipse shows the target area for constant running for each motor using the Cascade system and software. The key to the Cascade system is power management, managing to power for the duty cycle of the marine application, this is very different to the requirement of the automotive EV application.

About Us

The Furyan Marine Technology Propulsion Team have worked with some of the world's leading engineering companies and in motorsport at the highest level of F1, Le Mans and Hypercars.

We have successfully led and delivered projects on both electric and hybrid technology and vehicles, working across continents and in multi-disciplinary teams.

Your project is in safe hands.

For further details of *FURYAN* Marine Technology or to discuss your confidential project:

Visit our website www.furyanmarinetechology.com

Send us an email enquiries@furyanmarinetechology.com

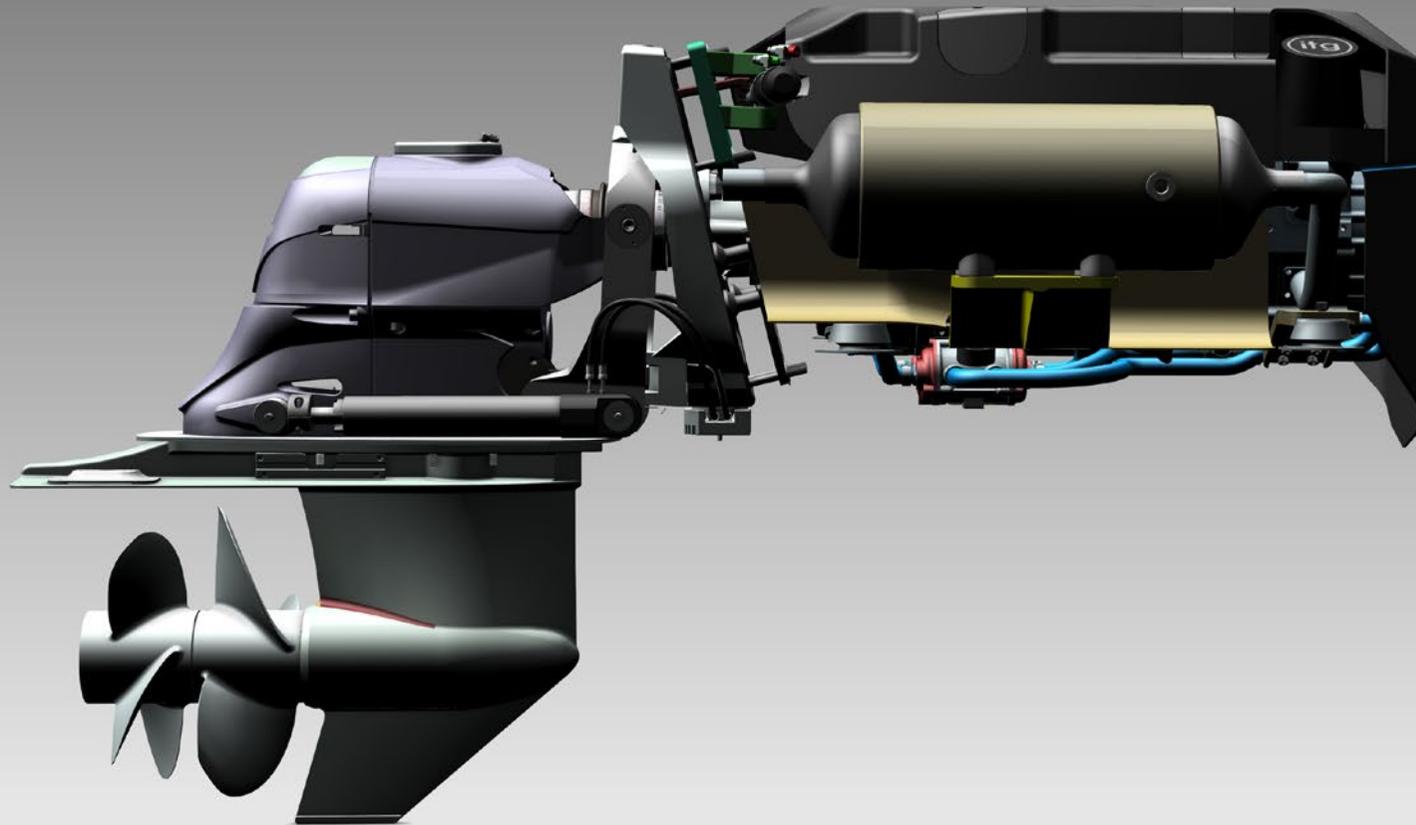
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MARINE TECHNOLOGY

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