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The new 75ft Lazzara LSX express yacht is the world's first boat to install four Volvo Penta IPS drive units

New Sea Friendly Diesels

Latest engine technology minimises noise, vibration and emissions and improves efficiency.

By Guy Waddilove

Marine engine manufacturers are accounting for modern thinking when it comes to new product development. Once the design and development of marine engines was driven by customers' desire for speed and acceleration; now other criteria are given priority.

Cleaner exhaust emissions have been developed to satisfy environmental regulations. The International Maritime Organisation, the European Union (EU) and US are introducing strict requirements for emissions from diesel engines in leisure craft. Engine manufacturers have been obliged to develop engines to produce less noxious gases to comply with the various regulations. Additionally, the closely related criteria of fuel efficiency and economy are now priority factors in the minds of customers.

Customers are also demanding quieter engines with less vibration than before. One of the major developments in diesel engines that addresses these points is the common rail direct fuel injection. With this system, fuel is fed by a single rail at high pressure to individual electronically controlled solenoid or piezoelectronic injection valves. Older types of diesel engines relied on mechanically-controlled, low pressure pumps supplying fuel to spray nozzles. Common rail systems permit very accurate control over the timing and amount of fuel supplied to the cylinder. The solenoids can be set to inject a small amount of fuel prior to the main injection to reduce explosiveness, vibration and noise. As the fuel is at much higher pressure, better atomisation occurs giving a more efficient and cleaner burn.

Another factor driving engine development is physical size. With engines becoming more efficient, smaller sizes can now be specified, freeing space for other equipment. Overall weight is also decreased, further improving economy.

As engines become more sophisticated so too have control and monitoring systems. With engines controlled electronically, associated monitoring systems can be integrated to give accurate digital displays of performance and safety overrides and alarms. Electronic throttle and gear operation is more precise than traditional push-pull Morse cables.

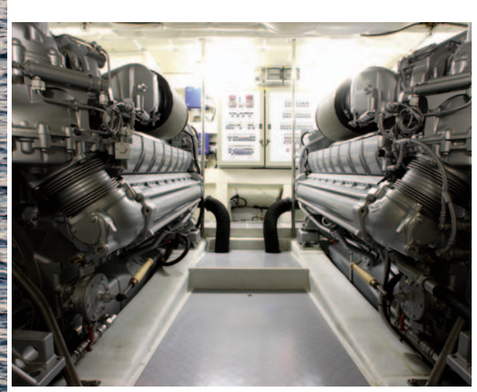
With electronic "brains" at the centre of engine systems, manufacturers can combine steering, trim and thruster commands into propulsion plants to fully integrate systems. For example, Volvo Penta has integrated throttle and leg steering systems to allow two engines and steering functions to be controlled with one lever. MTU has developed a system integrating throttle control with trim for its surface-piercing propeller legs optimising performance throughout the speed range.

Bow and stern thruster development is keeping up with technology with composite units in place of metal housings. The benefits of research on propeller blade shaping and positioning is also reflected in recent products.

ENGINES

MTU

MTU Friedrichshafen has introduced Maritune, a system for surface drive propellers that automatically adjust for optimum depth. Engine speed and trim settings are pre-selected for each control lever position. Software continuously adjusts trim settings whilst the vessel is underway. The electronically controlled system allows speed and trim to be controlled with a



single lever optimising acceleration, manoeuvring, banking and astern operation. Thus, negotiating heavy seas is easier for the skipper. An integrated steering function further enhances the auto-trim facility, thereby eliminating hydraulic lines. Trimming and steering is via a single hydraulic unit with an independent pump for each function. All systems are displayed on a single monitor screen.

MTU demonstrated Maritune's capabilities during practical trials on a Mangusta 80 powered by two MTU 16V 2000 common rail engines; the automatic trimming system reduced acceleration times up to 30 percent.

As a systems provider, MTU supplies complete propulsion plants with all hardware from propulsion control lever to propeller, including software. The Maritune system is compatible with all plants equipped with MTU Series 2000 or Series 4000 engines.

Volvo Penta

Volvo Penta's new propulsion system, the Inboard Performance System (IPS), features propellers that pull rather than push. The propellers are on forward facing drives

through the bottom of the hull and counter rotate giving greater efficiency over shaft driven hulls. According to Volvo Penta's calculations, the IPS will produce 20 per cent more speed, give 15 per cent better acceleration and cut noise and vibration by 50 per cent. These improvements are achieved with propellers rotating in undisturbed water. Backwash runs parallel with the boat's bottom so all power developed drives the boat. Rotational inefficiencies are eliminated via twin counter rotating propellers.

Manoeuvring is simplified by turning the drives like rudders. Because the units turn, the entire thrust is correctly aimed.

Volvo Penta has four versions: IPS350, IPS400, IPS500 and IPS600. The range is appropriate for boats from 35-50 feet.

At the top of the range the new Volvo Penta IPS600 represents state-of-the-art diesel technology with electronically-controlled common-rail fuel injection, double overhead camshafts, four valves per cylinder, turbocharger, intercooler and compressor. The compressor operates immediately during acceleration at low revs, creating powerful torque. At higher revs, the compressor disengages and the turbo takes over, resulting in improved acceleration and higher torque throughout the entire range.

All of the engines feature common-rail fuel injection. To further reduce vibration, the engine blocks are reinforced with a special "ladder frame" and cylinder head cast as a single unit.

The engines' exhaust emissions are extremely low and will likely meet the requirements planned for the EU and US in 2006-2007.

The entire system - from steering wheel to propulsion units - is electronically controlled and integrated via Volvo Penta's EVC (Electronic Vessel Control) system. Each unit is linked to a steering gear powered by an electric motor. The system processes the skipper's wheel input and converts it into movements of the propulsion units. EVC is a sophisticated system that takes into account water flow along the bottom of the boat at different speeds. The steering is progressive, making it easier to turn the wheel at low speeds.

Cummins MerCruiser

Cummins MerCruiser Diesel (CMD) will add a new series of engines to its range at the Sanctuary Cove International Boat Show in May. The new QSD series, designed for stern drive and inboard applications, is based on the successful, high pressure common rail fuel system design introduced on its larger recreational and commercial engines. Each are designed as drop-in replacements for petrol-engined applications; the 4.2 litre engine, for example, has been shortened by over 100mm to simplify retrofitting.

The engines' common rail fuel system is designed to reduce smoke, noise and vibration and to provide rapid power delivery. Turbocharger and seawater aftercooler are redesigned for improved throttle response and performance while newly-designed torsional couplers are used for a smoother ride in inboard applications. Modernised components like integrated heat exchangers and exhaust manifolds enhance the QSD design strategy of reducing engine weight and size.

The QSD range features an advanced ECM (Electronic Control Module) with SmartCraft compatibility. This system constantly monitors engine performance parameters providing instant diagnostics and operations data at the helm via a digital display.

The QSD series is a development of CMD's four- and six-cylinder diesels and includes 2.0, 2.8 and 4.2 litre engines with ratings spanning 85 to 257 kW (115 to 350 hp). The engines meet US EPA Tier 2 emissions regulations.

Cummins MerCruiser Diesel is a 50/50 joint venture between Cummins and Mercury Marine.

Caterpillar

Caterpillar developed strategies to make engines cleaner and more environmentally friendly. ACERT (Advanced Combustion Emissions Reduction Technology) represents Caterpillar's US$500m investment in the technology and is based on models which map

the combustion process in the cylinder during all phases of operation including full and part load, acceleration, deceleration and idle. Working with these models, engineering staff varied airflow, fuel injection timing and multiple fuel injections per revolution with the results used by Caterpillar engineers to improve the combustion process.

One of the results was the refinement of the ADEM electronic engine management system. The ADEM module was upgraded to control multiple injections of fuel into each cylinder, revised fuel mapping and valve timing, combustion control and improved engine monitoring.
It became evident that the efficiencies gained delivered other benefits including lighter engines and power increases of 10 per cent.

THRUSTERS

Maxpower

Maxpower has incorporated composite technology adopted from the automotive industry in its latest line of electric thrusters. Composite moulded legs are now used in place of aluminium or steel housings to give a maintenance free drive leg. Assembling the unit from composite avoids electrolysis and corrosion without anodes.
The composite thruster has electronic control in line with all recent Maxpower electric thrusters. The more usual thermal overload trip is replaced by an audible alarm allowing the skipper to continue running the thruster. This overrides the overheat alarm allowing escape from dangerous situations.

Side-power

Side-power has introduced a radio-controlled remote control for use with its bow and stern thrusters. The waterproof unit is boat-shaped to avoid confusion with port and starboard and possible misuse when the operator is absent. Accidental activation is avoided with an on/off button and a cut out switch.

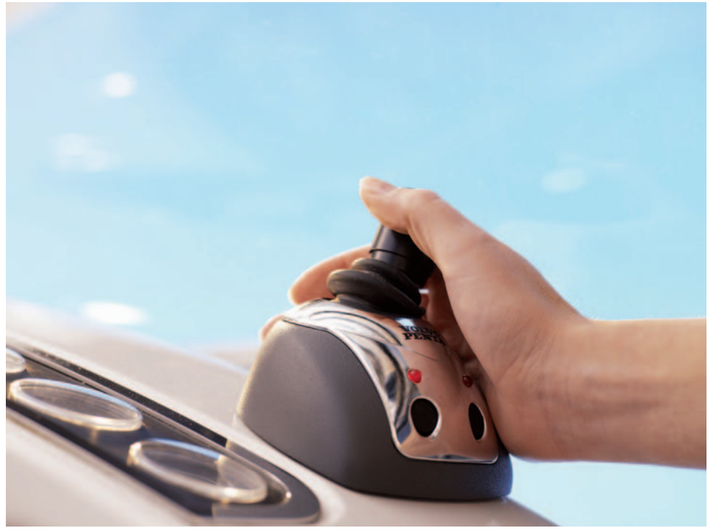
VETUS

VETUS's new six-bladed thruster will be inroduced at the Sanctuary Cove International Boat Show. Developed in collaboration with the Maritime Research Institute Netherlands, the six blades are specifically shaped to reduce cavitation and noise whilst increasing power by 9 per cent. As there is only one propeller, the thruster works with small tunnel length applications, and the blades' shaping allows it to produce equal power to port or starboard.

CONTROL SYSTEMS

Volvo Penta

Volvo Penta has introduced joystick control to further aid manoeuvrability for boats with its IPS engines. The joystick can be retrofitted and allows single-handed manoeuvring in all directions at engine speeds up to 1,500rpm. Software translates the joystick's movement into specific throttle, gear and steering instructions. Using the joystick with the steerable drive units allow the boat to move directly sideways, rotate within its own length or move forward or astern at an angle. The joystick function is cancelled by pressing the connection button or by turning the steering wheel or touching the throttle or gear levers.



Micro Device

Micro Device of Italy has produced the Yacht Controller, a wireless remote control about the size of a mobile phone. The Yacht Controller integrates controls for two engines, bow and stern thrusters and anchor windlass to enable full control when manoeuvring and docking from any part of the boat. The controller runs on two AAA batteries and, should a malfunction occur, the unit reverts to safe mode making the helm station controls active. Each unit is coded to avoid interference from similar equipment.
One advantage with the yacht controller is the unit will operate from anywhere on the boat, saving installation of extra steering/control stations only used for docking and manoeuvring. It may also save on repairs to scratches and bumps!

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