



ENGINE ROOMS

While modern propulsion, electrical and other auxiliary marine installations become increasingly powerful and sophisticated, some things never change. It makes no difference—small boat, medium size or megayacht, all marine mechanical, electrical, hydraulic and other engineering systems still require three essentials for long life and safe operation of mechanical and electrical systems: Regular maintenance, Periodic service, Timely repair.

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A few other general rules apply. The engine room's arrangement and layout should follow basic principles to allow for optimal access and performance. Procedures in the event of minor or major malfunction should be studied and rehearsed so that if and when the worst happens, response is swift and effective. Nobody wants to be looking at a pump manual for answers when there's a foot of water over the batteries.

Along with the engine or engines, a typical engine room will contain equipment related to fuel supply, lubrication, starting, cooling, exhaust, transmission, propeller shafts, stern glands and seals. Also the batteries, chargers, generators, inverters, transformers, electrical switchboards, refrigeration and air conditioning; compressors, watermakers, hydraulic



Onboard most large yachts, the layout of the engine room is often completed by adjacent technical work-rooms. These angles demonstrate a perfectly designed room. The captain and the engineer can oftentimes provide excellent input into the design.

pumps, pressurized water systems, stabilizers, hydraulic power units. In short, a wide variety of machines and installations that perform a range of functions and which usually rely on an onboard power supply for effective operation.

A larger vessel will generally have its own pump room even though some pumps, such as fuel and hydraulic power carriers, are necessarily installed in the engine room.

Obviously, all installations needing regular maintenance must be as accessible as possible, which is generally one of the greatest challenges facing builders: how to provide maximum space in the yacht's living areas without encroaching too much on the space required for the engineer to service, repair or replace essential equipment in the engine room.

Engine rooms should be well-lit, the flooring must provide non-slip protection and there must be ample hand holds for crew when working in the area in severe weather conditions. This minimizes risk of burns from hot surfaces or collisions with heavy metal projections.

LAYOUT

This will be determined by type of engine/engines which in turn determine actual placement of engine room. A yacht equipped with direct drives will have a centrally-located engine room, which divides the space longitudinally. V-drives allow aft installation of the engines while providing acceptable angles for the shafts and propellers. In yachts driven by surface drives or jets the engine room will normally be right aft. If generators are fitted in the engine room rather than housed in separate compartments, the engine room is generally found to be around 15% of hull length.

Bulkheads and doors must be water- and

gas-tight to prevent flooding and propagation of fire caused by leaking gas. The coamings of engine room hatches or doors located on the main or weather decks should have minimum sill heights of between 12" and 24" depending on the size of the vessel and its applicable regulations. Ideally, all such doors should be kept shut when underway.

SOUND

An increasingly important and expanding field in the marine industry, acoustical engineering brings new materials and technology to the construction of large motor yachts. Clearly, the less vibration and noise, the more comfort for guests and crew, also, longer life for parts protected by insulation.

Consultant acoustical engineers, the recommended authorities, will advise on insulation of engine and gearbox mountings that reduce vibration as well as on sound-deadening carpet underlays, thermal and sound insulation for ducting and ventilation systems. Fire retardant or "self-extinguishing" materials must be employed for protection against impregnation by or absorption of combustibles. Many materials including foams are unacceptable.

VENTILATION

Another essential in an area that generates excessive heat and may often require the extended presence of crew employed on service and repairs. Maximum possible ventilation is crucial because of this and also to allow for optimal engine and machinery performance.

It is useful to remember that the internal combustion engines used for propulsion or the production of electricity need a large amount of air to operate efficiently, especially turbocharged engines. The





average quantity of air necessary to run these engines satisfactorily is of approximately 0.65 cubic feet/minute/hp. As an example, on board a yacht driven by diesel engines each rated at 1400 bhp, running at the same time as two 20 kW generators driven by one 30 bhp engine each, the air circulation in the engine room must be of approximately 1870 cubic feet per minute!

Such a level of airflow can only be achieved by powerful electrical blowers and extractors which are connected to air ducts. The fresh air inlet must be positioned as low as possible forward of the compartment and the extractors are located higher up aft of the compartment. The air grills and ducts must be designed to limit the air speed between 26 and 40 feet per second in order to limit the noise level. It is generally recommended for the flow of the extractors to be 10 to 20 % superior to the flow of the blowers, thus creating a slight depression inside the compartment. This will, among other things, confine the heat and odors to the engine room and stop its diffusion to other compartments. Air intakes should always be located above the main deck level and be equipped with water traps to stop seawater ingress in the engine compartment. Unfortunately, this is not the case aboard yachts on which vents are fitted in the hull topsides. In the event of a fire, one must be able to stop the ventila-

tion immediately and shut the flaps on the air vent using commands located outside the engine room.

FIRE

An engine room must be fitted with two doors/escape hatches widely separated in order to allow fast evacuation in the case of fire. Fire is one of the main risks in this compartment. It is therefore important that it is equipped with a fire alarm system and efficient fire fighting equipment, especially on board yachts on which an engineer is not permanently present. The smoke and heat detectors are generally connected to a centralized system with repeaters in the wheelhouse and the crew mess.

The fire fighting protection begins with the installation of portable fire extinguishers capable of quickly putting out a localized fire at its onset. The next step is the activation of the fixed extinguishing system. Fixed systems use either carbon dioxide (CO₂) or bromochlorodifluoromethane (Halon 1301). The use of this gas is now banned for new installations but remains acceptable for existing systems where is available. In any case, these fixed fire-fighting systems must be installed according to precise standards insuring the efficiency of the system and the safety of the crew. The CO₂ cylinders must be stored in a dedicated locker.

Finally, the majority of engine rooms are

An engine room is not the place for the weak-at-heart, especially when the boat is underway. Unprotected sterndrives can be very dangerous indeed. Solutions such as this piece of transparent tubing enables one to read the fuel line very quickly.





From the very first stages of construction the engine room must be perfectly laid-out. Easy access to the filters and the different engine parts is a necessity.

equipped with an electrical pump for the fire hydrants, which are fitted with hoses usually installed in the compartment itself, in the fore and aft peak or on the fore and aft deck. This pump can also be connected to the bilge manifold through a three-way valve and be used as a back up bilge pump.

The flooding of the engine room is also a major risk. Severe water ingress can rapidly deprive the yacht of all its vital systems. Once more, as in the case of the fire fighting system, a bilge water level alarm system with centralized alarm is imperative. This alarm must allow the crew to immediately activate one or several bilge pumps. The bilge system generally includes a main bilge pump connected to a manifold fitted with valves for the selection of the compartments to be drained.

PUMPS

In numerous cases, the main electrical pump uses 24 VDC and the motor of the secondary pump (fire pump) runs on 230 VAC, which offers extra safety in case of a failure of one of the yacht's electrical systems. Furthermore, a manual pump is generally fitted and sometimes an engine driven pump is installed on one of the main engines. It is recommended—and in many cases it is mandatory—to install outside the engine room an emergency electric pump with its own power source or a diesel engine driven pump for bilge pumping and fire-fighting.

Lastly, many yachts, notably those constructed by Italian shipyards, are equipped with three ways valves mounted on the raw water suction lines of the main engines cooling systems, which allows the raw water circulation pump to be used as a high output bilge pump. On a 1400 hp engine, this pump has an output of around 12,700 US gallons per hour whilst

the maximum output of an electric pump is 6,300 US gallons per hour. This efficient arrangement has enabled many vessels victim of severe water ingress in the engine compartment to be saved.

THROUGH HULLS

Seacocks and strainers must obviously be easily accessible through inspection hatches fitted in the compartment floors. Valves must be made of bronze and of ball type. During yacht surveys we notice only too often the presence of gate valves. This type of valve is to be proscribed because it is impossible to tell at a glance whether it is open or closed. Furthermore, galvanic corrosion can deteriorate and even destroy the valve stem, often made of brass, and thus makes the valve totally inoperative even though its apparent condition appears satisfactory. The raw water supply must be through two interconnected seacocks equipped with strainers that supply the manifolds fitted with shut-off valves on which are connected the various systems using sea water (fridge and air conditioning compressors, watermaker, etc). This arrangement allows the use of one of the inlets to supply the various systems while the other is being cleaned or serviced.

PIPING

It is strongly recommended that all piping carrying seawater be made with cupronickel pipes. The various systems and pipes must be marked with standard color schemes and all valves must be identified with solidly mounted engraved plates.

FUEL

The fuel systems installed in engine rooms must also be made of metal pipes with short sections of flexible hoses to a recognized standard (USCG Type A1, SAE





On super yachts such as the 80m Constellation by Oceanco, there is an exterior system that enables one to quickly access the fuel system. An important detail when seeing the size of the fuel pump between the two Mtu engines. Generally the compressors and other auxiliary motors can also be found inside the engine room.

J 1527, ISO 7840 Type A1 or equivalent) and fitted with screw down fastenings. These systems generally include a centrifugal fuel cleaning plant (Alfa Laval or equivalent) and fuel filters/water separators (Racor, Separ, etc.). It is recommended that these filters be fitted in pairs so that they can be cleaned without stopping the engines or the generators. Obviously, the fuel system must be fitted with shut-off valves which can be operated from outside the engine room allowing the fuel supply to be cut in the event of a fire.

BATTERIES

Generally there are two kinds of batteries aboard a yacht—domestic or house batteries and engine batteries. It is important that these latter be installed close to the engines starter motors in order to reduce the length of the cables and the associated voltage drops. All batteries must be securely installed in acid proof and gastight boxes, fitted with lids to protect the terminals and to avoid accidental short circuits. These boxes must be correctly ventilated with ignition protected extractors and air ducts discharging directly overboard. Indeed, the discharge of hydrogen during the charging of the batteries represents a real danger of explosion.

The electrical switchboard panels must obviously be wired and installed according to customary practices but also fitted with various meters for the AC and DC systems. All meters, switches, circuit breakers and others must be clearly identified and permanently marked.

EXHAUST

To conclude this summary of engine room basic, we should mention the exhaust system, whose size and complexity usually impresses those who visit the engine room of a large yacht for the first time. As a preamble, let us note that on a 1400

bhp diesel engine, the discharge flow of exhaust gases is of approximately 8100 CFM (cubic feet per minute) and the gas temperature of 650 F.

These two figures explain the choice of diameter for the exhaust piping. Two 10" diameter pipes are necessary for the above mentioned engine, as well as complex lagging and thermal insulation.

In theory there are two main types of exhaust systems: one called "dry" and the other "wet", but in reality the two principles are often combined in the same installation. In this case the gas emissions are discharged into insulated vertical piping and it is the dry part that ends in an elbow, at which point water from the cooling-system is injected to cool down the gases. This is the wet exhaust. The mixture of gas/water is then discharged by flexible hoses at the transom or sometimes under the hull.

In all cases the assembly must respect the maximum backpressures laid down by the engine manufacturer. The flexible hoses must be of a recognized standard type (SAE J2006 or equivalent) in order to be resistant to high temperatures and must be firmly fixed with double stainless steel hose clamps. All piping and waterlocks used must be able to withstand the aggression of acidic solutions created by the mixture of sulfur residues and seawater associated with high temperatures. All these components should be solidly supported by hangers or brackets which absorb the vibrations created by the flow of exhaust gases at high speed.

In conclusion, the engine room on a modern yacht is a complex inter-connected group of numerous systems vital to the vessel's operation and safety. It must be designed, installed and used with logic and clarity in order to simplify its operation while observing the highest level of safety for all aboard.

