

NOISE & VIBRATION DESIGN GUIDANCE
GENERAL ACOUSIC DESIGN YACHT
(Prepared by Noise Control Engineering, Billerica, MA)

This memo outlines those items of concern in the design of a quiet yacht.

Cavitation & Propeller Induced Vibration: The propeller tip clearance should be a minimum of 20% of the propeller diameter; for very quiet vessels - a wake survey should be taken and wake adapted propeller should be designed; tip velocity should be held to less than 105 fps; preferred that propeller induced pressure pulses not exceed 1.1 psi at blade freq. & 0.5 psi at twice blade freq.

Foundations: Foundations are to be designed with due regard for noise and vibration; dynamic stiffness should be ten times the stiffness of isolation mounted equipment; cantilever foundations should be avoided; foundations should not be placed on bulkheads adjacent to noise sensitive compartments.

Shaft Struts: Struts are to be V form and airfoil shaped or faired to minimize resistance and cavitation.

Acoustic Insulation: (see separate design guidance)

HVAC: Particular attention should be directed toward designing and installing an HVAC system with minimal airborne and structureborne sound transmission (see separate design guidance). High velocity systems (above 1500 fpm) should be avoided.

Vibration and Noise Control Features: All diesel generator sets, air compressors, air conditioning and refrigeration compressors, fans and blowers should be installed on resilient mounts; select rotating equipment in lieu of reciprocating equipment; utilize equipment that vendors certify as having low noise and vibration source levels.

Combustion Air Systems: Each diesel engine is to be fitted with an air filter/silencer. Ducts to weather are to have either silencers or sound traps. Louvers in hull sides are not to be adjacent to noise sensitive compartments.

Combustion Exhaust Systems: Each diesel engine is to be fitted with a high attenuation (high Dynamic Insertion Loss - DIL) silencer. Resilient mounting of the exhaust system may be necessary to meet the noise requirements. Particular attention shall be given to the arrangement of the ship service generator resilient mounting system when selecting expansion joints.

Piping Systems: Gate/butterfly valves shall not be used for throttling service. Velocity limits are provided in a separate design document. Flexible piping connections should be used to connect machinery and equipment mounted on resilient isolators. These shall consist of an assembly of flexible elements designed to absorb the maximum excursions of the mounted equipment without over stressing the attached piping or components to which the flex connections are attached. Minimum pipe bend radii are provided in this section. Design of piping support hangers is also addressed. Piping to resiliently mounted equipment shall be supported by means of resiliently mounted pipe hangers. There shall be at least two resilient mounts in a "V" configuration with suspension such that each mount will be loaded along its axis and will provide total pipe support. Flexible connections shall not be used to compensate for misaligned piping or carry the weight of attached piping. Documentation should be required of the piping hanger calculations.

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Navigation Equipment: Navigation equipment located within the Pilothouse and Radio Room — particularly transformers, gyro repeaters — should be purchased to a noise criteria that is 10 dB below the compartment criterion. If possible, locate transformers and gyro repeaters outside pilothouse. Cooling fans for racks should be back mounted.

Refrigeration, dishwasher, ice makers, and other noisy equipment located within galley/scullery areas should be purchased to a noise criteria that is 10 dB below the compartment criterion. If make and model is specified by the owner, he should provide acoustic data. Small food processing appliances are exempted from noise limits.

Windows: The window panes should always be mounted in rubber lined channels. The rubber should be a minimum of ½” thick of 30 to 40 durometer. To meet stringent noise requirements, double pane windows may be required.

High Transmission Loss Constructions: Penetrations of bulkheads between machinery spaces and noise sensitive spaces should be minimized and grouped. A gaps at penetrations should be sealed to be gas tight.