Engine top bracing

General

When the piston in a cylinder is not exactly in the top or bottom position (dead cntre), the gas force from the combustion transferred through the connecting rod has a component acting on the crosshead and the crankshaft. This component acts perpendicular to the axis of the cylinder. Its resultant acts on the guide shoe and together they form a guide force moment. In short, guide force moments are caused by transverse reaction forces acting on the crossheads due to the connecting rod and crankshaft mechanism.

The moments may excite engine vibrations, moving the engine top athwartships and causing a rocking (excited by H-moment) or twisting (excited by X-moment) movement of the engine. For engines with fewer than seven cylinders, this guide force moment tends to rock the engine in the transverse direction, and for engines with seven cylinders or more, it tends to twist the engine.

The guide force moments are harmless to the engine, except when resonance vibrations occur in the engine/double-bottom system. If proper countermeasures are not taken, the guide force moments may, however, cause annoying vibrations in the superstructure and/or engine room.

As a detailed calculation of this system is normally not available, Everllence recommends installing a top bracing between the upper platform brackets of the engine and the casing side.

However, a top bracing is not always needed, sometimes the vibration level is lower without the top bracing. Normally, this has to be checked by measurements, i.e., with and without top bracing.

If a vibration measurement on the first vessel in a series shows that the vibration level is acceptable without the top bracing, we have no objection to the top bracing being removed, and the rest of the series produced without top bracing. In our experience the seven cylinder engine will often have a lower vibration level without top bracing.

Without top bracing, the natural frequency of the vibrating system (engine, ship bottom and side structures) is often so low that resonance with the excitation source (the guide force moment) can occur close to the normal speed range. This may increase the risk of vibration.

With top bracing, resonance with the excitation source shifts above the normal speed range, as the natural frequencies of the double-bottom/main engine system will increase. As a result, the impact of vibration is lowered.

The top bracing system is installed either as a mechanical top bracing (typically on smaller engine types), or a hydraulic top bracing (typically on larger engine types). Both systems are described in the following.

Normally, the top bracing is installed on the exhaust side of the engine, but as an alternative, the hydraulic top bracing can be installed on the manoeuvring side. It is also possible to combine exhaust side and manoeuvring side installation of the hydraulic top bracing.

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Mechanical top bracing

The mechanical top bracing comprises stiff connections between the engine and the hull.

The top bracing stiffener in Fig. 5.13.01 consists of a double bar tightened with friction shims at each end of the mounting positions. The friction shims allow the top bracing stiffener to move during displacements caused by thermal expansion of the engine, or different loading conditions of the vessel. Furthermore, to prevent overloading of the system during excessive vibration levels, tightening is made with a well-defined force on the friction shims using disc springs.

The shipyards makes the mechanical top bracing according to Everllence instructions.

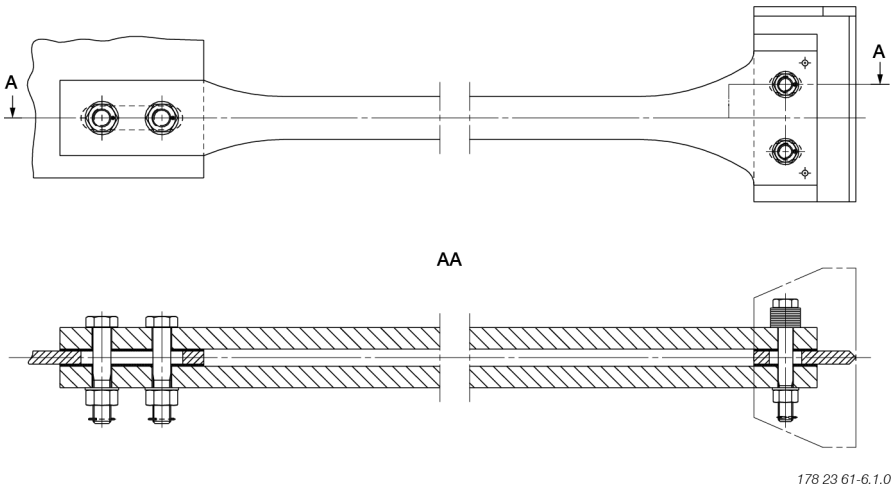

Fig. 5.13.01: Mechanical top bracing stiffener

Hydraulic top bracing

As an alternative to the mechanical top bracing, a hydraulic top bracing can be used, mainly on engines with a cylinder bore of 50 or more. The installation normally features two, four, or six independently working top bracing units.

The top bracing unit consists of a single-acting hydraulic cylinder with a hydraulic control unit and an accumulator mounted directly on the cylinder unit.

The top bracing is controlled by an automatic switch in a control panel, which activates the top bracing when the engine is running. The switch can be programmed to activate the top bracing in a specific RPM range. For service purposes, manual control from the control panel is also possible. The top bracing unit is designed to allow displacements between the hull and engine caused by thermal expansion of the engine, or different loading conditions of the vessel.

When active, the hydraulic cylinder provides a pressure on the engine in proportion to the vibration level. When the distance between the hull and engine increases, oil pressurised by the accumulator flows into the cylinder. When the distance decreases, a non-return valve prevents the oil from flowing back to the accumulator, and the pressure rises. When the pressure reaches a preset maximum value, a relief valve allows the oil to flow back to the accumulator, hereby maintaining the force on the engine below a specified value.

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By using different pre-settings of the relief valve, the top bracing becomes available in a low-pressure version (26 bar) and a high-pressure version (40 bar).

Fig. 5.13.02 shows the outline of a hydraulic top bracing unit.

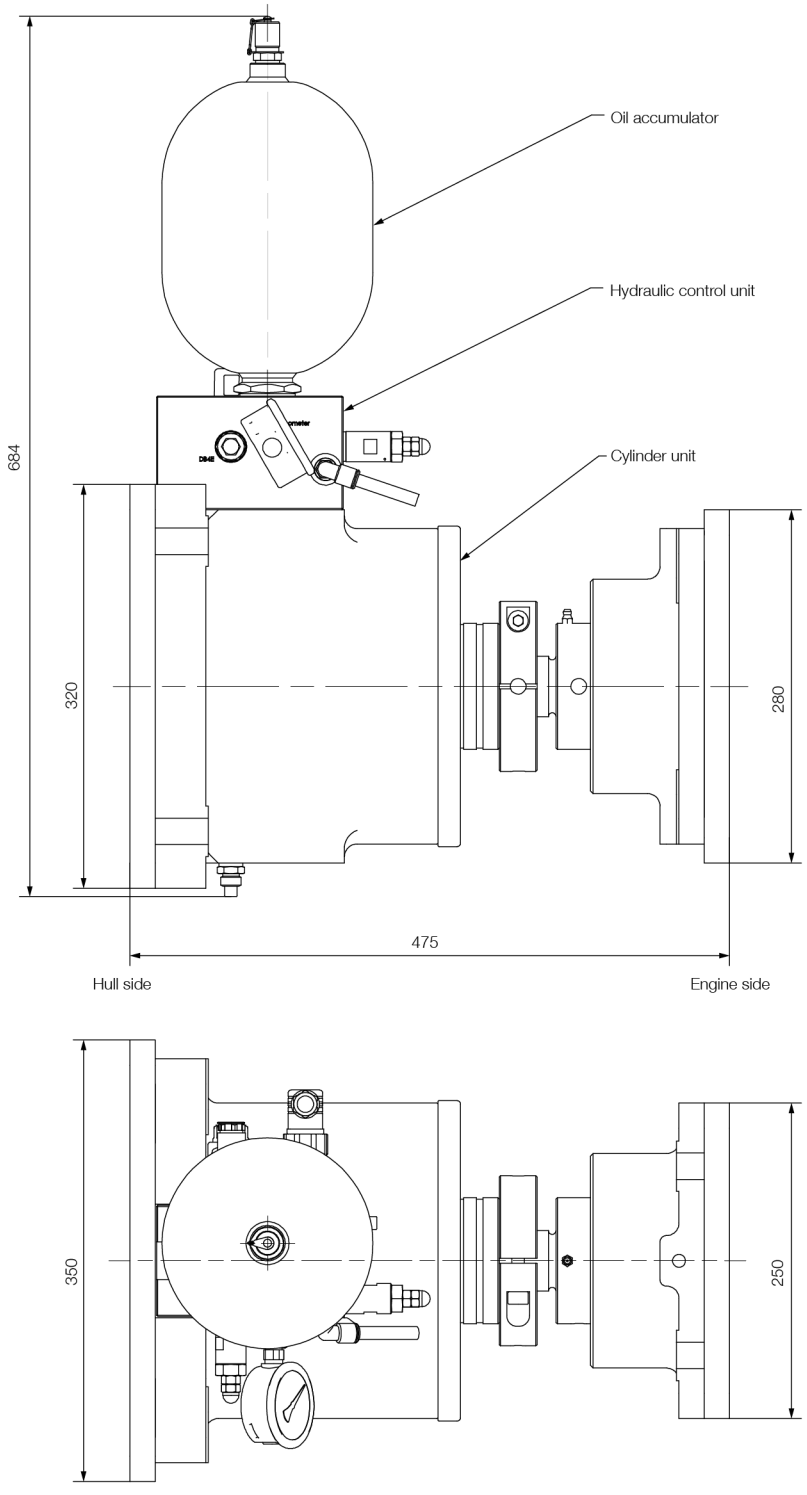

Fig. 5.13.02: Outline of a hydraulic top bracing unit, which can be installed with the oil accumulator pointing either up or down

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