Wärtsilä enhances the business of its customers by providing them with complete lifecycle power solutions. When creating better and environmentally compatible technologies, Wärtsilä focuses on the marine and energy markets with products and solutions as well as services. Through innovative products and services, Wärtsilä sets out to be the most valued business partner of all its customers. This is achieved by the dedication of more than 18,000 professionals manning 160 Wärtsilä locations in 70 countries around the world. Wärtsilä is listed on the Nordic Exchange in Helsinki, Finland.
**Tripping bracket** – A bracket used to strengthen a structural member under compression, against torsional forces.

**Brake power** of engine – The observed power measured at the crankshaft or its equivalent, the engine being equipped only with the standard auxiliaries, necessary for its operation on the test bed.

**Brass** – An alloy of copper and zinc usually with higher percentage of copper.

**Breadth** of the ship – Depending on the purpose, the following definitions of breadth (B) are used:

1. The maximum breadth of the ship, measured **amidships** to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material, (MARPOL).

2. The extreme width from outside of the frame to outside of the frame at, or below, the **deepest subdivision load line**, (SOLAS).

**Extreme breadth** – The maximum breadth over the extreme points between port side and starboard of the ship.

**Moulded breadth** -The greatest breadth of the ship measured between the inside edges of the shell plating.

**Break-bulk cargo** – Loose cargo, such as cartons, drums, bags etc., stowed directly in the ship holds contrary to unitised, containerized, ro-ro cargo or **bulk cargo**.

**Breakwater** – A vertical **bulwark**-like structure on a **forecastle** deck intended to deflect and disperse head seas shipped over the bow in order to protect deck cargo from damage.

**Breast hook** – A triangular plate bracket joining structural members of the port and starboard sides at the **stem**.

**Breathing apparatus** – Equipment that enables a person to get a supply of oxygen in an environment where little or no air exists, e.g. a smoke-filled compartment.
BRIDGE VISIBILITY

Designed by BAOBAB NAVAL CONSULTANCY www.betterships.com
BULK HANDLING

Screw-type unloader

Traditional grab handling

Photos courtesy of MacGREGOR

Rail-mouted Siwertell unloader can travel freely along the quay during operation
Cold work

Cold work – Any work which cannot create a source of ignition.

Collapsible mast – A mast hinged near the deck so it can lie horizontally.

Collar, collar plate – A welded plate used to, partly or completely, close a hole cut for a longitudinal stiffener passing through a transverse web.

Collision – The act of ships striking each other.

Collision bulkhead – see bulkheads.

Collision damage – Damage caused by physical contact between two or more ships.

Collision Regulations (COLREG 1972) – The Convention on International Regulations for Preventing Collision at Sea adopted in 1972 by IMO.

Combined cycle technology – The use of two different power generation processes, e.g. fuel engines and steam turbines, in the same power plant. The second process utilizes the heat recovered from the first.

Illustrations courtesy of Wärtsilä Corporation

Combined diesel-electric and diesel-mechanical (CODED) propulsion – A novel propulsion and machinery concept developed by Wärtsilä Corporation. The concept features a diesel-mechanical part driving a conventional propeller and a diesel-electric power plant powering one or more electric pods.
Wärtsilä has proposed to adopt the CODED machinery consisting of two azimuthing pods and one mechanically driven feathering CP propeller for the next generation of cruise ships (Wärtsilä Marine News N°2/2003). This arrangement offers very high propulsion efficiency. The possibility to split the load between three propellers instead of two yields better propeller open water efficiency. Furthermore, the single-skeg hull form without any open shaft lines has lower resistance than a twin shaft line arrangement. At low speeds, the vessel is driven by the pods alone. The centerline propeller is only used at high speeds and feathered at low and medium speeds. The feathered mode (pitch changed to align the blades with water flow) results in significantly less resistance than for a windmilling propeller. Other version of CODED machinery with one pod installed in a contra-rotating mode aft of the main propeller has been proposed for RoPax vessels (Wärtsilä Marine News N°3/2001). This configuration offers better hydrodynamic efficiency, compared with twin screws on long open shafts supported by brackets. The aft propeller takes advantage of the rotative energy left in the slipstream of the forward propeller improving the rotative efficiency. In addition, the resistance of the single skeg hull form with a single pod is lower than of a twin-screw hull with two open shaft lines, two rudders and many appendages. Such configuration has been used for ferries AKASHIA and HAMANASU; see CRP-Azipod propulsion of the ferries AKASHIA and HAMANASU.

**Combined diesel-electric and gas turbine (CODAG) propulsion** – A hybrid machinery system with a gas turbine and diesel engines driving generators to create electric power for both propulsion and the hotel side. See also CODAG propulsion system of CORAL PRINCESS.

*Photo courtesy of Wärtsilä Corporation*

**QUEEN MARY 2**

*The vessel is driven by four Mermaid pods. The 117,200kW CODAG installation is supplied from four 16,800kW Wärtsilä/ABB diesel alternator sets, supplemented by the output from two alternators with 25,000kW General Electric gas turbine drive. The diesel installation produces some 57% of power requirements, with 43% derived from the gas turbine sets.*
MacPILER

Bulkhead hoister units

Auxiliary JIB units

Auxiliary JIB:
- JIB SWL: 999 kg
- JIB hoisting speed: 18 m/min
- JIB hoisting height: 12.5 m
- Turning angle: 180 deg
- Out reach: 4.1 m

All movements are soft and controlled

Fixed side / Driving side
- Controlled and adjusted by fixed side structure stiffness

Slave side

Illustration courtesy of MacGREGOR
Earthing – The electric connection of equipment to the main body of the earth to ensure that it is at earth potential. On board of the ship, the connection is made to the main metallic structure of the ship, which is at earth potential because of the conductivity of the sea.

EC directive on marine equipment (European Union Marine Equipment Directive) – The directive of European Commission about marine equipment for which international conventions require the approval of the national administrations as well as mandatory carriage on board. That means items like live-saving appliances, evacuation systems, fire fighting and prevention, navigation equipment, communications, but also some pollution prevention equipment like oily-water systems, sewage and incinerators. Only equipment proven to comply with the requirements of relevant international instruments is allowed on board of an EU ship.

ECDIS – see electronic chart display and information system.

Echo sounder – An instrument located on the keel of a ship to record the depth of water underneath. Echo sounders work on the sonar principle of emitting a vertical pulse on high frequency sound waves. The waves bounce off the seabed and are picked up by a receiver on the hull that measures the time interval between transmission and return. A scale converts the interval to a water depth.

EcoStream – Bilge water treatment module developed by Alfa Laval. The EcoStream is a centrifugal separation system. It operates at flow rates of between 1500 and 5000 liters per hour and cleans bilge water to less than 5 ppm.
PLATE TYPE FRESHWATER GENERATOR

ALFA LAVAL Freshwater generator JWP-26

1. Front cover
2. Separator
3. Bed frame
4. Evaporator
5. Demister
6. Condenser
7. Brine pipe
8. Combined brine/air ejector
9. Seawater pipe from condenser
10. Pipe for feed water
11. Freshwater pipe to pump
12. Freshwater pump
13. Motor for freshwater pump
FOLDING HATCH COVERS

1. Intermediate hinge
2. Leading pair
3. Trailing pair
4. Lifting wheel for trailing pair
5. Bell crank
6. External hydraulic cylinder for bell crank
7. External hydraulic cylinder for leading pair
8. Link for end hinge
9. Longitudinal stopper

Multi-folding hatch cover
Propeller open water test – Although in reality, the propeller operates in the highly non-uniform ship wake, a standard propeller test is performed in uniform flow yielding the so-called open-water characteristics, namely thrust, torque and propeller efficiency.

Further reading: ITTC Recommended Procedure 7.5-03-02-01

The model resistance has to be converted for a prediction of the full-scale ship. Full-scale predictions are prepared usually according to the modified “1978 ITTC Performance Prediction Method”.

Standard Model Test Programme for ordinary cargo vessels

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Model tests of the 57,300 DWT bulk carrier at HSVA

HSVA was contracted by a Chinese consortium to optimize the hull lines for a new 57,300 DWT Super-Handymax Bulk Carrier. Prior to performing calm water model tests, HSVA’s experts analysed and improved the hull lines using computational fluid dynamics calculations. The calculations were done with the CFD-software Comet which takes into account viscous effects as well as the free surface, i.e. the wave pattern of the vessel. According to HSVA’s experience, for high block vessels with very blunt waterlines the application of a viscous flow code is to be preferred in comparison with a potential flow code. Longer computing time must be accepted, but the advantages of using this code are clear: not only the bulbous bow design can be optimized but also the wake field at the location of the propeller.

The model test program started with resistance and self-propulsion tests with a stock-propeller at four draughts. A 3-dimensional wake field measurement, a paint test and manoeuvring tests were the next step. All the tests were performed in HSVA’s 300m-long towing tank. The tests were continued with self-propulsion tests with a final propeller and cavitation tests in the HYKAT.

Modified atmosphere – Fruit and vegetables can be transported in a nitrogen reach atmosphere in order to slow down the ripening process. For this purpose nitrogen generating plants are installed on board. If the bananas are transported in containers, nitrogen is distributed to the cargo holds through piping system, which must ensure that a precise and pre-determined amount of nitrogen reaches each container.

Molten sulphur tanker SULPHUR ENTERPRISE

According to the Significant Ships of 1994

Built in 1994 by McDermott Shipyards, USA, a single-skin chemical tanker designed to transport molten sulphur in bulk. The ship has four holds fitted with self-supporting, insulated sulphur tanks able to carry cargo at temperatures between 127°C and 138°C and at a specific gravity of 1.79t/m$^3$.

Each tank is approximately 21.33m long, 20.72m wide and 9.14m deep and sits in its own hold on 14 pedestals above the double-bottom ballast tanks. At the interface of each pedestal there is a special Scan-Pac high-density Teflon-coated insulating pad capable of supporting the tank, as well as insulating the hull from the heated cargo and allowing for expansion. Non-load-bearing anti-roll and anti-pitch chocks prevent movement of the tanks in heavy seas or during collision. Anti-roll chocks are located on the centerline top and bottom while the anti-pitch chocks are at the aft end of each tank, port and starboard, top and bottom. By locating them at the aft
OFFSHORE CONSTRUCTION VESSEL NORMAND INSTALLED

- Heave compensated 250t offshore crane
- 50t cargo crane
- ROV
- Helideck
- 350t A-frame
- Bollard pull 308t
- Stern roller

Illustration courtesy of Wärtsilä Corporation
OFFSHORE CONSTRUCTION VESSEL NORMAND INSTALLER

$L_{OA} = 123.65\, m$, $L_{BP} = 110.00\, m$, $B = 28.00\, m$, $D_{mld} = 11.00\, m$
Pump room – A space, located in the cargo area, containing pumps and their accessories for the handling of ballast and fuel oil.

Pumpman – The unlicensed member of the engine department. He is trained in all skills necessary to engine maintenance. Usually watchstander, but on some ships a day worker. On tankers, a pumpman operates pumps and discharges petroleum products. He maintains and repairs all cargo handling equipment.

PureBallast – Ballast water treatment system developed by Alfa Laval. PureBallast incorporates patented Wallenius Advanced Oxidation Technology. AOT units contain titanium dioxide catalysts, which generate radicals when hit by light. The radicals, whose lifetime is only a few milliseconds, break down the cell membrane of microorganisms without the use of chemicals or the creation of harmful residuals. During ballasting, water passes through a 50 um prefilter to remove larger particles and organisms and to prevent sediment build-up in the ballast tanks. The water then continues to the AOT units where smaller organisms that pass the filter are broken down by the radicals produced here. During deballasting, water again passes the AOT units to destroy any organisms that might have regrown in the tanks during the voyage.

Pure car/truck carrier (PCTC) – The PCTC is a purpose-built vessel for the transportation of different types of rolling cargo, such as new private cars and trucks, heavy construction equipment, and other heavy loads. The vessels are usually configured with 10-13 decks for the loading of different vehicle types; axle loads varying between 1.2 tonnes and over 22 tonnes.

PureVent system – Alfa Laval’s compact air separator designed to remove oil mist from crankcase gases with a cleaning efficiency of 99%. Occupying 30 litres of space in handling any engine size, the system reportedly has low power consumption and is maintenance-free. The oil is returned to the sump via a drainpipe, thereby reducing losses and releasing only clean air to the atmosphere.

Purging of cargo tanks with inert gas – The introduction of inert gas into a tank already in the inert condition, with the purpose of further reducing the existing oxygen content; and/or reducing the existing hydrocarbon gas content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

Purification – Separation of two intermixed and mutually insoluble liquid phases of different densities. Solids having a higher density than the liquids can be removed at the same time. The lighter liquid phase (oil), which is the major part of the mixture, shall be purified as far as possible.

Purifier – A separator that cleans the oil from water and solid particles with continuous removal of separated water.

Purse seiner – A fishing vessel catching pelagic species by surrounding the shoals with purse seines. Since purse seiners must be able to manoeuvre close to the net without fouling the propeller, most of them require the assistance of a powered skiff or of a small towboat.

Purse seiner/trawler LIBAS
According to Ship and Boat International May/June 2004
Norwegian shipyard Fitjar Mek Verksted AS completed the 94m fishing vessel LIBAS according to the design from Vik-Sandvik AS, who developed a new hull form for
Thrusters

**Thrust power** – The product of the propeller thrust and speed of vessel advance.

**Thrust shaft** – A short length of shaft with flanges at either end and a thrust collar in the centre. It may be manufactured as an integral part in some engines.

**Thruster system** of dynamic positioning system – All components and systems necessary to supply the DP system with thrust force and thruster direction. The thruster system includes:
- thrusters with prime movers and necessary auxiliary systems including piping,
- main propellers and rudders if they are under control of the DP-system,
- thruster control electronics,
- manual thruster controls,
- associated cabling and cable routing.

**Thrusters** – Manoeuvering devices designed to deliver side thrust or thrust through 360°. Thrusters are used to allow ships to be more independent from tugs, give them more manoeuvrability for special tasks, and in some cases give them a “take home” capability. There are three general types of thrust devices: the **lateral thruster** or tunnel thruster, which consists of a propeller installed in an athwartship tunnel; a **jet thruster** which consists of a pump taking suction from the keel and discharge to either side; and azimuthal thruster, which can be rotated through 360°. A **cycloidal propulsor** can be considered a type of azimuthal thruster.

*Thrusters can enhance the manoeuvrability of existing vessels, particularly at low speeds, and provide a high level of redundancy. The main propulsion system based on thrusters can also provide increased speed, or lower installed power and reduction in fuel consumption. The general arrangement and hull form of new buildings incorporating thrusters can be modified significantly in order to increase hydrodynamic efficiency. The other key advantage of thrusters is that they tend to suffer less from vibration and noise and are therefore well suited for use on passenger vessels. Since thrusters are steerable, using them may also eliminate the ship rudder.*

**Azimuthing thruster** – A propeller that can be rotated through 360° in the horizontal plane, thus allowing the thrust to be generated in any desired direction.

See also **Azipod, Azipull, Contaz**.

*Twin main engines with independent fuel systems, and twin propulsors with independent steering offer the redundancy and very good manoeuvrability, which are important features of the shortsea tankers navigating in crowded and littoral waters. These were key factors in decision to use twin 3240kW Ulstein Aquamaster thrusters for the main propulsion of tanker PULI built in 2005 by Turkish shipyard Cicek.*

**Continuous duty thruster** – A thruster designed for continuous operation, such as dynamic positioning thrusters, propulsion assistance, or main propulsion units.

**CRP thruster** – An azimuthing thruster equipped with twin contra-rotating propellers.

**Intermittent duty thruster** – A thruster which is designed for the operation at the peak power or rpm levels, or both, for periods not exceeding 1 hour followed by periods at the continuous rating of less, with total running time not exceeding 8
AZIMUTHING THRUSTERS

Photos courtesy of Wärtsilä Corporation

2000kW Lips Modular thruster FS250

Lips pulling thruster
WATERJET

1. Shaft
2. Thrust bearing block
3. Duct
4. Impeller
5. Impeller housing
6. Stator housing
7. Discharge nozzle
8. Steering nozzle
9. Hydraulic actuators
10. Reversing bucket

Illustrations courtesy of Wärtsilä Corporation
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